

Microsoft® Excel® 2010

Power Programming with VBA

John Walkenbach



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Excel[®] 2010 Power Programming with VBA

by John Walkenbach



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INTRODUCTION

Welcome to *Excel 2010 Power Programming with VBA*. If your job involves developing Excel workbooks that others will use — or if you simply want to get the most out of Excel — you’ve come to the right place.

Topics Covered

This book focuses on Visual Basic for Applications (VBA), the programming language built into Excel (and other applications that make up Microsoft Office). More specifically, it will show you how to write programs that automate various tasks in Excel. This book covers everything from recording simple macros through creating sophisticated user-oriented applications and utilities.

This book does *not* cover Microsoft Visual Studio Tools for Office (VSTO). VSTO is a relatively new technology that uses Visual Basic .NET and Microsoft Visual C#. VSTO can also be used to control Excel and other Microsoft Office applications.

What You Need to Know

This is not a book for beginning Excel users. If you have no experience with Excel, a better choice might be my *Excel 2010 Bible*, which provides comprehensive coverage of all the features of Excel. That book is meant for users of all levels.

To get the most out of this book, you should be a relatively experienced Excel user. I didn’t spend much time writing basic how-to information. In fact, I assume that you know the following:

- How to create workbooks, insert sheets, save files, and so on
- How to navigate through a workbook
- How to use the Excel Ribbon user interface
- How to enter formulas
- How to use Excel’s worksheet functions
- How to name cells and ranges
- How to use basic Windows features, such as file management techniques and the Clipboard

If you don't know how to perform the preceding tasks, you could find some of this material over your head, so consider yourself warned. If you're an experienced spreadsheet user who hasn't used Excel 2010, Chapter 2 presents a brief overview of what this product offers.

What You Need to Have

To make the best use of this book, you need a copy of Excel 2010. Although most of the material also applies to Excel 2003 and later versions, I assume that you're using Excel 2010. Although Excel 2007 and Excel 2010 are radically different from their predecessors, the VBA environment hasn't changed at all. If you plan to develop applications that will be used in earlier versions of Excel, I strongly suggest that you *don't* use Excel 2010 for your development work. Rather, use the earliest version of Excel that the target audience will be using.

This book isn't intended for any version of Excel for Macintosh. Any computer system that can run Windows will suffice, but you'll be much better off with a fast machine with plenty of memory. Excel is a large program, and using it on a slower system or a system with minimal memory can be extremely frustrating.

I recommend using a high-resolution video driver (1280 × 1024 is adequate, and 1600 × 1200 is even better). For optimal results, try a dual-monitor system and place Excel on one screen and the Visual Basic Editor on the other. You'll soon become spoiled.

To use the examples on the companion CD, you also need a CD-ROM drive.

Conventions in This Book

Take a minute to skim this section and learn some of the typographic conventions used throughout this book.

Excel commands

Beginning with Excel 2007, the product features a brand-new “menu-less” user interface. In place of a menu system, Excel uses a context-sensitive Ribbon system. The words along the top (such as Insert, View, and so on) are known as *tabs*. Click a tab, and the Ribbon of icons displays the commands that are most suited to the task at hand. Each icon has a name that is (usually) displayed next to or below the icon. The icons are arranged in groups, and the group name appears below the icons.

The convention I use in this book is to indicate the tab name, followed by the group name, followed by the icon name. So, for example, the command used to toggle word wrap within a cell is indicated as:

Home→Alignment→Wrap Text

Clicking the first tab, labeled File, takes you to a new screen called Backstage. The Backstage window has commands along the left side of the window. To indicate Backstage commands, I use the word *File*, followed by the command. For example, the following command displays the Excel Options dialog box:

```
File→Excel Options
```

Visual Basic Editor commands

The Visual Basic Editor is the window in which you work with your VBA code. The VB Editor uses the traditional menu-and-toolbar interface. A command like the following means to click the Tools menu and select the References menu item:

```
Tools→References
```

Keyboard conventions

You need to use the keyboard to enter data. In addition, you can work with menus and dialog boxes directly from the keyboard — a method that you might find easier if your hands are already positioned over the keys.

Input

Input that you are supposed to type from the keyboard appears in boldface — for example, enter **=SUM(B2: B50)** into cell B51.

More lengthy input usually appears on a separate line in a monospace font. For example, I might instruct you to enter the following formula:

```
=VLOOKUP(StockNumber,PriceList,2)
```

VBA code

This book contains many snippets of VBA code, as well as complete procedure listings. Each listing appears in a monospace font; each line of code occupies a separate line. (I copied these listings directly from the VBA module and pasted them into my word processor.) To make the code easier to read, I often use one or more tabs to create indentations. Indentation is optional, but it does help to delineate statements that go together.

If a line of code doesn't fit on a single line in this book, I use the standard VBA line continuation sequence: At the end of a line, a space followed by an underscore character indicates that the line of code extends to the next line. For example, the following two lines are a single code statement:

```
If Right(ActiveCell, 1) = "!" Then ActiveCell _  
    = Left(ActiveCell, Len(ActiveCell) - 1)
```

You can enter this code either on two lines, exactly as shown, or on a single line without the underscore character.

Functions, filenames, and named ranges

Excel's worksheet functions appear in uppercase font, like so: "Enter a SUM formula in cell C20." VBA procedure names, properties, methods, and objects appear in monospace font: "Execute the `GetTotals` procedure." I often use mixed uppercase and lowercase letters to make these names easier to read.

I also use the monospace font for filenames and named ranges in a worksheet — for example: Open `myfile.xls` and select the range named `data`.

Mouse conventions

If you're reading this book, you're well versed in mouse usage. The mouse terminology I use is all standard fare: pointing, clicking, right-clicking, dragging, and so on.

What the Icons Mean

Throughout the book, I use icons to call your attention to points that are particularly important:



New Feature

I use this icon to indicate that the material discussed is new to Excel 2010.



Note

I use Note icons to tell you that something is important — perhaps a concept that could help you master the task at hand or something fundamental for understanding subsequent material.



Tip

Tip icons indicate a more efficient way of doing something or a technique that might not be obvious.



On the CD

These icons indicate that an example file is on the companion CD-ROM. (See "About the Companion CD-ROM," later in this Preface.) This CD holds many of the examples that I show in the book.

**Caution**

I use Caution icons when the operation that I'm describing can cause problems if you're not careful.

**Cross-Ref**

I use the Cross-Reference icon to refer you to other chapters that have more to say on a subject.

How This Book Is Organized

The chapters of this book are grouped into eight main parts.

Part I: Some Essential Background

In this part, I set the stage for the rest of the book. Chapter 1 presents a brief history of spreadsheets so that you can see how Excel fits into the big picture. In Chapter 2, I offer a conceptual overview of Excel 2010 — quite useful for experienced spreadsheet users who are switching to Excel. In Chapter 3, I cover the essentials of formulas, including some clever techniques that might be new to you. Chapter 4 covers the ins and outs of the various files used and generated by Excel.

Part II: Excel Application Development

This part consists of just two chapters. In Chapter 5, I broadly discuss the concept of a spreadsheet application. Chapter 6 goes into more detail and covers the steps typically involved in a spreadsheet application development project.

Part III: Understanding Visual Basic for Applications

Chapters 7 through 11 make up Part III, and these chapters include everything that you need to know to learn VBA. In this part, I introduce you to VBA, provide programming fundamentals, and detail how to develop VBA subroutines and functions. Chapter 11 contains many useful VBA examples.

Part IV: Working with UserForms

The four chapters in this part cover custom dialog boxes (also known as *UserForms*). Chapter 12 presents some built-in alternatives to creating custom UserForms. Chapter 13 provides an introduction to UserForms and the various controls that you can use. Chapters 14 and 15 present many examples of custom dialog boxes, ranging from basic to advanced.

Part V: Advanced Programming Techniques

Part V covers additional techniques that are often considered advanced. The first three chapters discuss how to develop utilities and how to use VBA to work with pivot tables and charts (including the new Sparkline graphics). Chapter 19 covers *event handling*, which enables you to execute procedures automatically when certain events occur. Chapter 20 discusses various techniques that you can use to interact with other applications (such as Word). Chapter 21 concludes Part V with an in-depth discussion of creating add-ins.

Part VI: Developing Applications

The chapters in Part VI deal with important elements of creating user-oriented applications. Chapter 22 discusses how to modify the new Ribbon interface. Chapter 23 describes how to modify Excel's shortcut menus. Chapter 24 presents several different ways to provide online help for your applications. In Chapter 25, I present some basic information about developing user-oriented applications, and I describe such an application in detail.

Part VII: Other Topics

The six chapters in Part VII cover additional topics. Chapter 26 presents information regarding compatibility. In Chapter 27, I discuss various ways to use VBA to work with files. In Chapter 28, I explain how to use VBA to manipulate Visual Basic components such as UserForms and modules. Chapter 29 covers the topic of class modules. Chapter 30 explains how to work with color in Excel. I finish the part with a useful chapter that answers many common questions about Excel programming.

Part VIII: Appendixes

Four appendixes round out the book. Appendix A contains useful information about Excel resources online. Appendix B is a reference guide to all VBA's keywords (statements and functions). I explain VBA error codes in Appendix C, and Appendix D describes the files available on the companion CD-ROM.

About the Companion CD-ROM

The inside back cover of this book contains a CD-ROM that holds many useful examples that I discuss in the text. When I write about computer-related material, I emphasize learning by example. I know that I learn more from a well-thought-out example than from reading a dozen pages in a book. I assume that this is true for many other people. Consequently, I spent more time developing the examples on the CD-ROM than I did writing chapters.

The files on the companion CD-ROM aren't compressed, so you can access them directly from the CD.



Cross-Ref

Refer to Appendix D for a description of each file on the CD-ROM.

About the Power Utility Pak Offer

Toward the back of the book, you'll find a coupon that you can redeem for a discounted copy of my popular Power Utility Pak software. PUP is an award-winning collection of useful Excel utilities and many new worksheet functions. I developed this package exclusively with VBA.

I think you'll find this product useful in your day-to-day work with Excel. You can also purchase the complete VBA source code for a nominal fee. Studying the code is an excellent way to pick up some useful programming techniques.

You can take Power Utility Pak for a test drive by installing the 30-day trial version available at my Web site:

<http://spreadsheetpage.com>

How to Use This Book

You can use this book any way that you please. If you choose to read it from cover to cover, be my guest. But because I'm dealing with intermediate-to-advanced subject matter, the chapter order is often immaterial. I suspect that most readers will skip around, picking up useful tidbits here and there. If you're faced with a challenging task, you might try the index first to see whether the book specifically addresses your problem.

Reach Out

The publisher and I want your feedback. After you've had a chance to use this book, please take a moment to visit the Wiley Publishing Web site to give us your comments. (Go to www.wiley.com and then click the Contact Us link.) Please be honest in your evaluation. If you thought a particular chapter didn't tell you enough, let us know. Of course, I would prefer to receive comments like, "This is the best book I've ever read," or "Thanks to this book, I was promoted and now make \$124,000 a year."

I get at least a half dozen questions every day, via e-mail, from people who have read my books. I appreciate the feedback. Unfortunately, I simply don't have the time to reply to specific questions. Appendix A provides a good list of sources that *can* answer your questions.

I also invite you to visit my Web site, which contains lots of Excel-related material. The URL is

<http://spreadsheetpage.com>

PART

I

Some Essential Background

CHAPTER 1

Excel 2010: Where It Came From

CHAPTER 2

Excel in a Nutshell

CHAPTER 3

Formula Tricks and Techniques

CHAPTER 4

Understanding Excel's Files

Excel 2010: Where It Came From

In This Chapter

- Exploring the history of spreadsheets
- Discussing Excel's evolution
- Analyzing why Excel is a good tool for developers

A Brief History of Spreadsheets

Most people tend to take spreadsheet software for granted. In fact, it may be hard to fathom, but there really was a time when electronic spreadsheets weren't available. Back then, people relied instead on clumsy mainframes or calculators and spent hours doing what now takes minutes.

It all started with VisiCalc

The world's first electronic spreadsheet, *VisiCalc*, was conjured up by Dan Bricklin and Bob Frankston back in 1978, when personal computers were pretty much unheard of in the office environment. VisiCalc was written for the Apple II computer, which was an interesting little machine that is something of a toy by today's standards. (But in its day, the Apple II kept me mesmerized for days at a time.) VisiCalc essentially laid the foundation for future spreadsheets, and you can still find its row-and-column-based layout and formula syntax in modern spreadsheet products. VisiCalc caught on quickly, and many forward-looking companies purchased the Apple II for the sole purpose of developing their budgets with VisiCalc. Consequently, VisiCalc is often credited for much of the Apple II's initial success.

In the meantime, another class of personal computers was evolving; these PCs ran the CP/M operating system. A company called Sorcim developed SuperCalc, which was a spreadsheet that also attracted a legion of followers.

When the IBM PC arrived on the scene in 1981, legitimizing personal computers, VisiCorp wasted no time porting VisiCalc to this new hardware environment, and Sorcim soon followed with a PC version of SuperCalc.

By current standards, both VisiCalc and SuperCalc were extremely crude. For example, text entered into a cell couldn't extend beyond the cell — a lengthy title had to be entered into multiple cells. Nevertheless, the ability to automate the budgeting tedium was enough to lure thousands of accountants from paper ledger sheets to floppy disks.



Tip

You can download a copy of the original VisiCalc from Dan Bricklin's Web site at www.bricklin.com. And yes, nearly 30 years later, this 27K program still runs on today's PCs (see Figure 1-1).

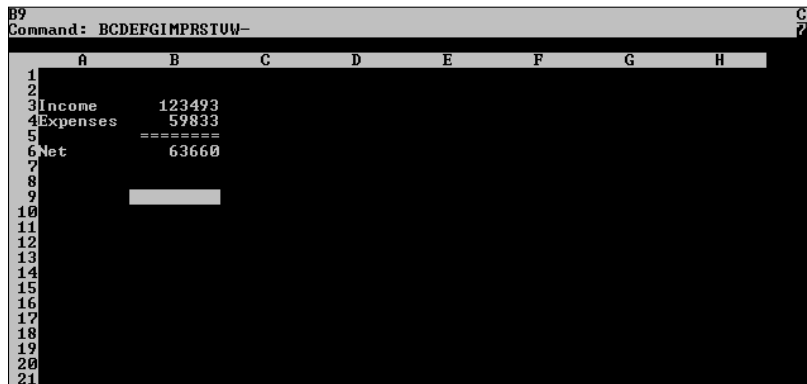


Figure 1-1: VisiCalc, running in a DOS window on a PC running Windows XP.

Lotus 1-2-3

Envious of VisiCalc's success, a small group of computer freaks at a start-up company in Cambridge, Massachusetts, refined the spreadsheet concept. Headed by Mitch Kapor and Jonathan Sachs, the company designed a new product and launched the software industry's first full-fledged marketing blitz. I remember seeing a large display ad for 1-2-3 in *The Wall Street Journal*. It was the first time that I'd ever seen software advertised in a general interest publication.

Released in January 1983, Lotus Development Corporation's 1-2-3 was an instant success. Despite its \$495 price tag (which is probably close to \$1,000 in today's dollars), it quickly outsold VisiCalc, rocketing to the top of the sales charts, where it remained for many years.

What Lotus did right

Lotus 1-2-3 improved on all the basics embodied in VisiCalc and SuperCalc and was also the first program to take advantage of the new and unique features found in the powerful 16-bit IBM PC AT. For example, 1-2-3 bypassed the slower DOS calls and wrote text directly to display memory,

giving it a snappy and responsive feel that was unusual for the time. The online help system was a breakthrough, and the ingenious “moving bar” menu style set the standard for many years.

One feature that really set 1-2-3 apart, though, was its *macro* capability — a powerful tool that enabled spreadsheet users to record their keystrokes to automate many procedures. When such a macro was “played back,” the original keystrokes were sent to the application, and it was like a super-fast typist was at the keyboard. Although a far cry from today’s macro capability, 1-2-3 macros were definitely a step in the right direction.

1-2-3 was not the first integrated package, but it was the first successful one. It combined (1) a powerful electronic spreadsheet with (2) elementary graphics and (3) some limited but handy database features. Easy as 1, 2, 3 — get it?

Lotus followed up the original 1-2-3 Release 1 with Release 1A in April 1983. This product enjoyed tremendous success and put Lotus in the enviable position of virtually owning the spreadsheet market. In September 1985, Release 1A was replaced by Release 2, which was a major upgrade that was superseded by the bug-fixed Release 2.01 the following July. Release 2 introduced *add-ins*, which are special-purpose programs that can be attached to give an application new features and extend the application’s useful life. Release 2 also had improved memory management, more functions, 8,192 rows (four times as many as its predecessor), and added support for a math coprocessor. Release 2 also included some significant enhancements to the macro language.

Not surprisingly, the success of 1-2-3 spawned many *clones* — work-alike products that usually offered a few additional features and sold at a much lower price. Among the more notable were Paperback Software’s VP Planner series and Mosaic Software’s Twin. Lotus eventually took legal action against Paperback Software for copyright infringement (for copying the “look and feel” of 1-2-3); the successful suit essentially put Paperback out of business.

In the summer of 1989, Lotus shipped DOS and OS/2 versions of the long-delayed 1-2-3 Release 3. This product literally added a dimension to the familiar row-and-column-based spreadsheet: It extended the paradigm by adding multiple spreadsheet pages. The idea wasn’t really new, however; a relatively obscure product called Boeing Calc originated the 3-D spreadsheet concept, and SuperCalc 5 and CubeCalc also incorporated it.

1-2-3 Release 3 offered features that users wanted — features that ultimately became standard fare: multilayered worksheets, the capability to work with multiple files simultaneously, file linking, improved graphics, and direct access to external database files. But it still lacked an important feature that users were begging for: a way to produce high-quality printed output.

Release 3 began life with a reduced market potential because it required an 80286-based PC and a minimum of 1MB of RAM — fairly hefty requirements in 1989. But Lotus had an ace up its corporate sleeve. Concurrent with the shipping of Release 3, the company surprised nearly everyone by announcing an upgrade of Release 2.01. (The product materialized a few months later as 1-2-3 Release 2.2.) Release 3 was *not* a replacement for Release 2, as most analysts had expected. Rather, Lotus made the brilliant move of splitting the spreadsheet market into two segments: those with high-end hardware and those with more mundane equipment.

Too little, too late

1-2-3 Release 2.2 wasn't a panacea for spreadsheet buffs, but it was a significant improvement. The most important Release 2.2 feature was *Allways*, an add-in that gave users the ability to churn out attractive reports, complete with multiple typefaces, borders, and shading. In addition, users could view the results on-screen in a WYSIWYG (What You See Is What You Get) manner. Allways didn't, however, let users issue any worksheet commands while they viewed and formatted their work in WYSIWYG mode. Despite this rather severe limitation, many 1-2-3 users were overjoyed with this new capability because they could finally produce near-typeset-quality output.

In May 1990, Microsoft released Windows 3.0. As you probably know, Windows changed the way that people used personal computers. Apparently, the decision-makers at Lotus weren't convinced that Windows was a significant product, and the company was slow getting out of the gate with its first Windows spreadsheet, 1-2-3 for Windows, which wasn't introduced until late 1991. Worse, this product was, in short, a dud. It didn't really capitalize on the Windows environment and disappointed many users. It also disappointed at least one book author. My very first book was titled *PC World 1-2-3 For Windows Complete Handbook* (Wiley). I think it sold fewer than 1,000 copies.

Serious competition from Lotus never materialized. Consequently, Excel, which had already established itself as the premier Windows spreadsheet, became the overwhelming Windows spreadsheet market leader and has never left that position. Lotus came back with 1-2-3 Release 4 for Windows in June 1993, which was a vast improvement over the original. Release 5 for Windows appeared in mid-1994.

Also in mid-1994, Lotus unveiled 1-2-3 Release 4.0 for DOS. Many analysts (including myself) expected a product more compatible with the Windows product. But we were wrong; DOS Release 4.0 was simply an upgraded version of Release 3.4. Because of the widespread acceptance of Windows, that was the last DOS version of 1-2-3 to see the light of day.

Over the years, spreadsheets became less important to Lotus. In mid-1995, IBM purchased Lotus Development Corporation. Additional versions of 1-2-3 became available, but it seems to be a case of too little, too late. The current version is Release 9.8. Excel clearly dominates the spreadsheet market, and 1-2-3 users are an increasingly rare breed.

Quattro Pro

The other significant player in the spreadsheet world is (or, I should say, *was*) Borland International. Borland started in spreadsheets in 1987 with a product called *Quattro*. Word has it that the internal code name was *Buddha* because the program was intended to "assume the Lotus position" in the market (that is, #1). Essentially a clone of 1-2-3, Quattro offered a few additional features and an arguably better menu system at a much lower price. Importantly, users could opt for a 1-2-3-like menu system that let them use familiar commands and also ensured compatibility with 1-2-3 macros.

In the fall of 1989, Borland began shipping Quattro Pro, which was a more powerful product that built upon the original Quattro and trumped 1-2-3 in just about every area. For example, the first Quattro Pro let you work with multiple worksheets in movable and resizable windows — although

it did *not* have a graphical user interface (GUI). More trivia: Quattro Pro was based on an obscure product called Surpass, which Borland acquired.

Released in late 1990, Quattro Pro Version 2.0 added 3-D graphs and a link to Borland's Paradox database. A mere six months later — much to the chagrin of Quattro Pro book authors — Version 3.0 appeared, featuring an optional graphical user interface and a slide show feature. In the spring of 1992, Version 4 appeared with customizable SpeedBars and an innovative analytical graphics feature. Version 5, which came out in 1994, had only one significant new feature: worksheet notebooks (that is, 3-D worksheets).

Like Lotus, Borland was slow to jump on the Windows bandwagon. When Quattro Pro for Windows finally shipped in the fall of 1992, however, it provided some tough competition for the other two Windows spreadsheets, Excel 4.0 and 1-2-3 Release 1.1 for Windows. Importantly, Quattro Pro for Windows had an innovative feature, known as the *UI Builder*, that let developers and advanced users easily create custom user interfaces.

Also worth noting was a lawsuit between Lotus and Borland. Lotus won the suit, forcing Borland to remove the 1-2-3 macro compatibility and 1-2-3 menu option from Quattro Pro. This ruling was eventually overturned in late 1994, however, and Quattro Pro can now include 1-2-3 compatibility features (as if anyone really cares). Both sides spent millions of dollars on this lengthy legal fight, and when the dust cleared, no real winner emerged.

Borland followed up the original Quattro Pro for Windows with Version 5. In 1994, Novell purchased WordPerfect International and Borland's entire spreadsheet business, and Version 6 was released.

In 1996, WordPerfect and Quattro Pro were both purchased by Corel Corporation. As I write, the current version of Quattro Pro is Version 14, which is part of WordPerfect Office X4.

There was a time when Quattro Pro seemed the ultimate solution for spreadsheet developers. But then Excel 5 arrived.

Microsoft Excel

And now on to the good stuff.

Most people don't realize that Microsoft's experience with spreadsheets extends back to the early '80s. Over the years, Microsoft's spreadsheet offerings have come a long way, from the barely adequate MultiPlan to the powerful Excel 2010.

It started with MultiPlan

In 1982, Microsoft released its first spreadsheet, *MultiPlan*. Designed for computers running the CP/M operating system, the product was subsequently ported to several other platforms, including Apple II, Apple III, XENIX, and MS-DOS.

MultiPlan essentially ignored existing software user-interface standards. Difficult to learn and use, it never earned much of a following in the United States. Not surprisingly, Lotus 1-2-3 pretty much left MultiPlan in the dust.

Excel arrives

Excel sort of evolved from MultiPlan, first surfacing in 1985 on the Macintosh. Like all Mac applications, Excel was a graphics-based program (unlike the character-based MultiPlan). In November 1987, Microsoft released the first version of Excel for Windows (labeled Excel 2.0 to correspond with the Macintosh version). Because Windows wasn't in widespread use at the time, this version included a runtime version of Windows — a special version that had just enough features to run Excel and nothing else. Less than a year later, Microsoft released Excel Version 2.1. In July 1990, Microsoft released a minor upgrade (2.1d) that was compatible with Windows 3.0. Although these 2.x versions were quite rudimentary by current standards (see Figure 1-2) and didn't have the attractive, sculpted look of later versions, they attracted a small but loyal group of supporters and provided an excellent foundation for future development.

Excel's first macro language also appeared in Version 2. The XLM macro language consisted of functions that were evaluated in sequence. It was quite powerful, but very difficult to learn and use. The XLM macro language was replaced by Visual Basic for Applications (VBA), which is the topic of this book. However, Excel 2010 still supports XLM macros.

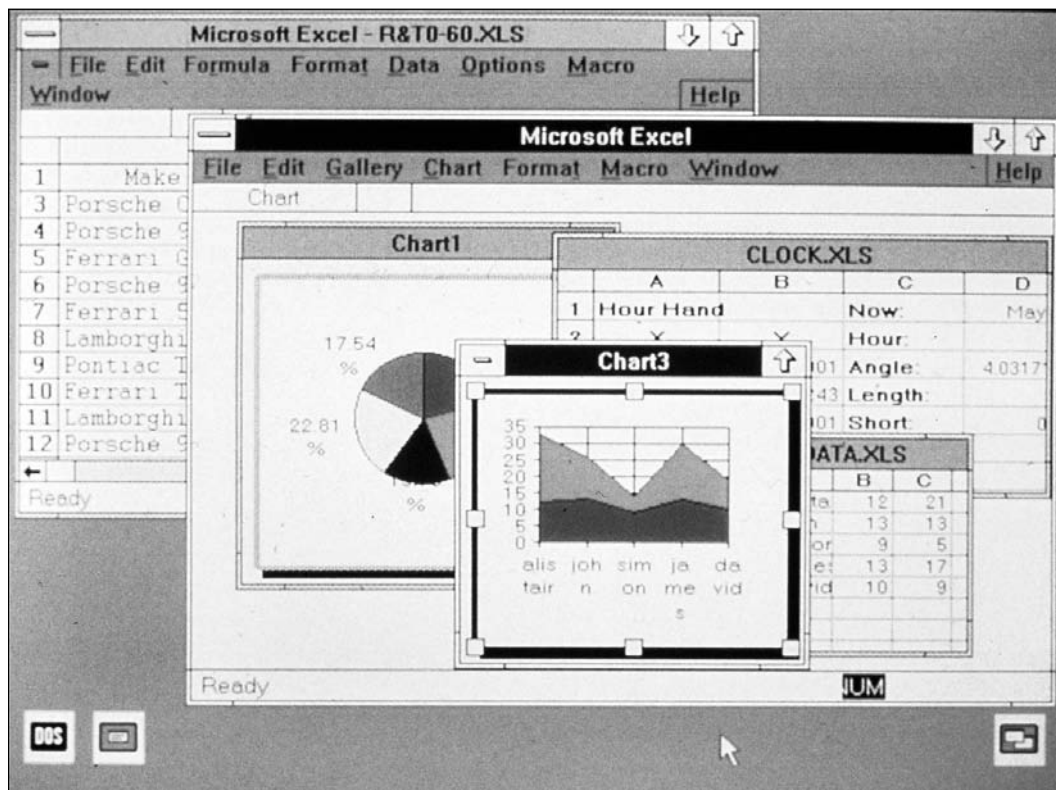
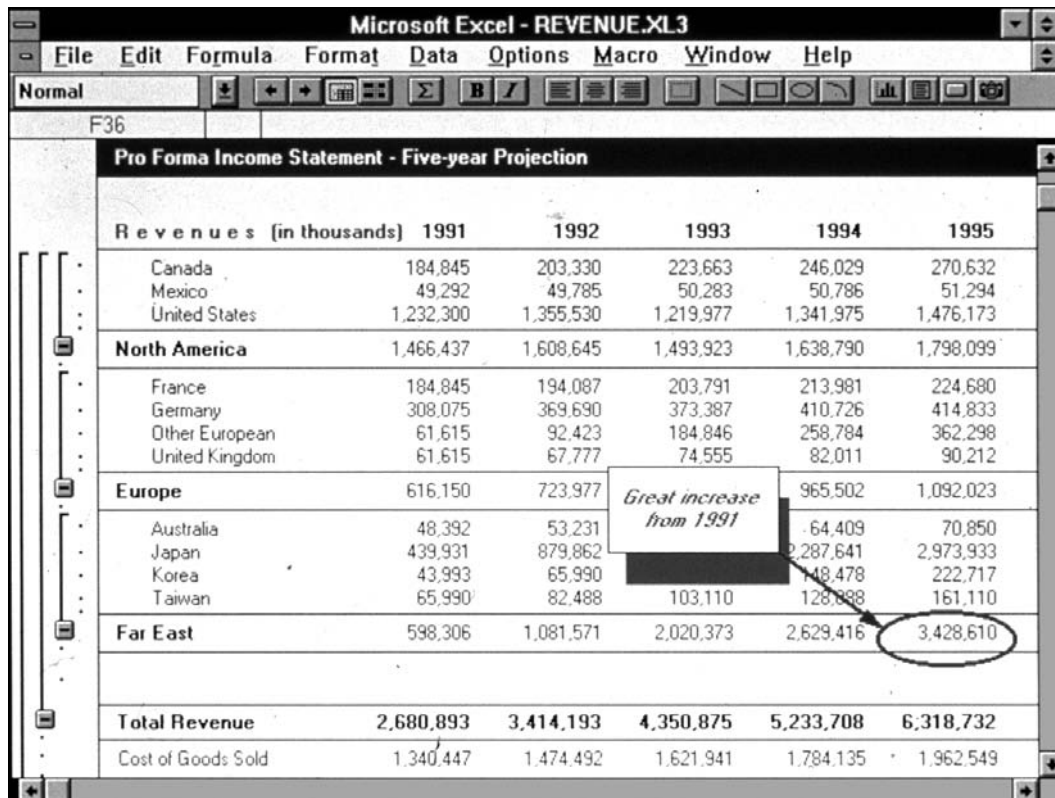


Figure 1-2: The original Excel 2.1 for Windows. This product has come a long way.
(Photo courtesy of Microsoft)

Meanwhile, Microsoft developed a version of Excel (numbered 2.20) for OS/2 Presentation Manager, released in September 1989 and upgraded to Version 2.21 about 10 months later. OS/2 never quite caught on, despite continued efforts by IBM.

In December 1990, Microsoft released Excel 3 for Windows, which boasted a significant improvement in both appearance and features (see Figure 1-3). The upgrade included a toolbar, drawing capabilities, a powerful optimization feature (Solver), add-in support, Object Linking and Embedding (OLE) support, 3-D charts, macro buttons, simplified file consolidation, workgroup editing, and the ability to wrap text in a cell. Excel 3 also had the capability to work with external databases (via the Q+E program). The OS/2 version upgrade appeared five months later.



Pro Forma Income Statement - Five-year Projection					
Revenues (in thousands)	1991	1992	1993	1994	1995
Canada	184,845	203,330	223,663	246,029	270,632
Mexico	49,292	49,785	50,283	50,786	51,294
United States	1,232,300	1,355,530	1,219,977	1,341,975	1,476,173
North America	1,466,437	1,608,645	1,493,923	1,638,790	1,798,099
France	184,845	194,087	203,791	213,981	224,680
Germany	308,075	369,690	373,387	410,726	414,833
Other European	61,615	92,423	184,846	258,784	362,298
United Kingdom	61,615	67,777	74,555	82,011	90,212
Europe	616,150	723,977	<i>Great increase from 1991</i>	965,502	1,092,023
Australia	48,392	53,231		64,409	70,850
Japan	439,931	879,862		2,287,641	2,973,933
Korea	43,993	65,990		148,478	222,717
Taiwan	65,990	82,488	103,110	128,888	161,110
Far East	598,306	1,081,571	2,020,373	2,629,416	3,428,610
Total Revenue	2,680,893	3,414,193	4,350,875	5,233,708	6,318,732
Cost of Goods Sold	1,340,447	1,474,492	1,621,941	1,784,135	1,962,549

Figure 1-3: Excel 3 was a vast improvement over the original release.

(Photo courtesy of Microsoft)

Version 4, released in the spring of 1992, not only was easier to use but also had more power and sophistication for advanced users (see Figure 1-4). Excel 4 took top honors in virtually every spreadsheet product comparison published in the trade magazines. In the meantime, the relationship between Microsoft and IBM became increasingly strained, and Microsoft stopped making versions of Excel for OS/2.

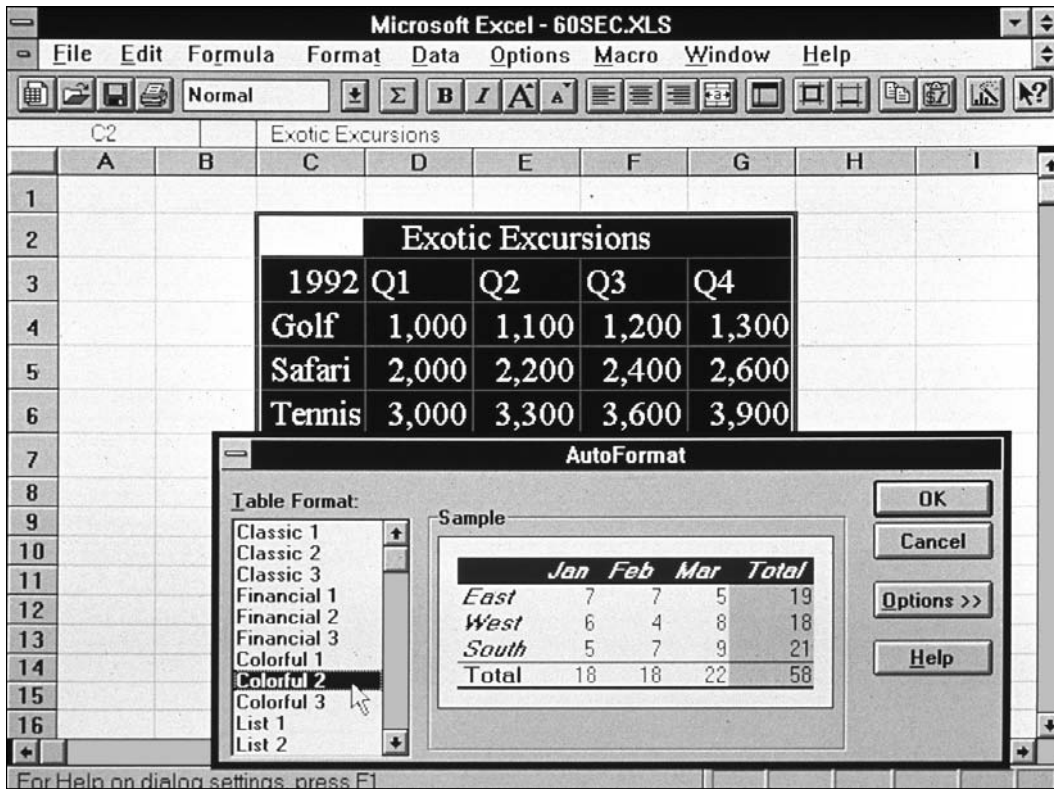


Figure 1-4: Excel 4 was another significant step forward, although still far from Excel 5.

(Photo courtesy of Microsoft)

VBA is born

Excel 5 hit the streets in early 1994 and immediately earned rave reviews. Like its predecessor, it finished at the top of every spreadsheet comparison published in the leading trade magazines. Despite stiff competition from 1-2-3 Release 5 for Windows and Quattro Pro for Windows 5 — both were fine products that could handle just about any spreadsheet task thrown their way — Excel 5 continued to rule the roost. This version, by the way, was the first to feature VBA.

Excel 95 (also known as Excel 7) was released concurrently with Microsoft Windows 95. (Microsoft skipped over Version 6 to make the version numbers consistent across its Office products.) On the surface, Excel 95 didn't appear to be much different from Excel 5. Much of the core code was rewritten, however, and speed improvements were apparent in many areas. Importantly, Excel 95 used the same file format as Excel 5, which is the first time that an Excel upgrade didn't use a new file format. This compatibility wasn't perfect, however, because Excel 95 included a few enhancements in the VBA language. Consequently, it was possible to develop an application using Excel 95 that would load but not run properly in Excel 5.

In early 1997, Microsoft released Office 97, which included Excel 97. Excel 97 is also known as Excel 8. This version included dozens of general enhancements plus a completely new interface for developing VBA-based applications. In addition, the product offered a new way of developing custom dialog boxes (called UserForms rather than dialog sheets). Microsoft tried to make Excel 97 compatible with previous versions, but the compatibility was far from perfect. Many applications that were developed using Excel 5 or Excel 95 required some tweaking before they would work with Excel 97 or later versions.



Cross-Ref

I discuss compatibility issues in Chapter 26.

Excel 2000 was released in early 1999 and was also sold as part of Office 2000. The enhancements in Excel 2000 dealt primarily with Internet capabilities, although a few significant changes were apparent in the area of programming.

Excel 2002 (sometimes known as Excel XP) hit the market in mid-2001. Like its predecessor, it didn't offer many significant new features. Rather, it incorporated a number of minor new features and several refinements of existing features. Perhaps the most compelling new feature was the ability to repair damaged files and save your work when Excel crashed.

Excel 2003 (released in fall 2003) was perhaps the most disappointing upgrade ever. This version had very few new features. Microsoft touted the ability to import and export eXtensible Markup Language (XML) files and map the data to specific cells in a worksheet — but very few users actually needed such a feature. In addition, Microsoft introduced some “rights management” features that let you place restrictions on various parts of a workbook (for example, allow only certain users to view a particular worksheet). In addition, Excel 2003 had a new Help system (which put the Help contents in the task pane) and a new “research” feature that lets you look up a variety of information in the task pane. (Some of these required a fee-based account.)



Note

For some reason, Microsoft chose to offer two sub-versions of Excel 2003. The XML and rights management features are available only in the stand-alone version of Excel and in the version of Excel that's included with the Professional version of Office 2003.

Because of this, Excel developers may now need to deal with compatibility issues within a particular version!

A new user interface

Excel 2007 (Version 12) became available in late 2006 and was part of the Microsoft 2007 Office System. In terms of user interface, this upgrade was clearly the most significant ever. A new Ribbon UI replaced menus and toolbars. In addition, the Excel 2007 grid size is 1,000 times larger than in previous versions, and the product uses a new open XML file format. Other improvements include improved tables, conditional formatting enhancements, major cosmetic enhancements for charts, and document themes.

Reaction to the new UI was mixed. Some users loved it, others hated it. Several companies even created add-ins that allowed Excel 2007 users to revert to the old menu system. Clearly, Excel 2007 is easier for beginners, but long-time users may spend a lot of time wondering where to find their old commands.

The current version, Excel 2010, is part of Microsoft 2010 Office System. Apparently, the decision-makers at Microsoft are a bit superstitious. They skipped Version 13, and went straight to Version 14.

Excel 2010 features enhancements in pivot tables, conditional formatting, and image editing. The product now supports in-cell charts called *sparklines* and the ability to preview pasting before committing to it. A new *backstage* feature is devoted to document-related tasks, such as saving and printing. In addition, end users can now customize the Ribbon. And finally, dozens of new worksheet functions are available — mostly highly specialized functions that replace old functions that had some accuracy problems.

Current Competition

So there you have it: More than three decades of spreadsheet history condensed into a few pages. It has been an interesting ride, and I've been fortunate enough to have been involved with spreadsheets the entire time.

Things have changed. Microsoft not only dominates the spreadsheet market, it virtually owns it. What little competition exists is primarily in the form of free open-source products, such as OpenOffice and StarOffice. Increasingly, you hear about Web-based spreadsheets, such as Google Spreadsheets (see Figure 1-5). Microsoft has responded, and now has its own Web-based version of Excel and other Office 2010 applications.

In the final analysis, Microsoft's biggest competitor is probably itself. Users tend to settle on a particular version of Excel, and if things are working well, they have very little motivation to upgrade. Convincing users to upgrade to a new version that provides only a few advantages is one of Microsoft's biggest challenges.

Why Excel Is Great for Developers

Excel is a highly programmable product, and it's easily the best choice for developing spreadsheet-based applications.

holidays - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://spreadsheets.google.com/ccc?key=0AkLjKiDT3DUdHRI

Google Docs - All items

holidays

File Edit View Insert Format Tools Form (0) Help

\$ % 123 11pt B Abc

	A	B	C	D	E	F
1	2010	<-- Enter the year				
2						
3			Holiday Calculations			
4						
5		Holiday	Description	Date	Weekday	
6		New Year's Day	1st Day in January	January 1, 2010	Friday	
7		Martin Luther King Jr. Day	3rd Monday in January	January 18, 2010	Monday	
8		Presidents' Day	3rd Monday in February	February 15, 2010	Monday	
9		Easter	Complicated	April 4, 2010	Sunday	
10		Memorial Day	Last Monday in May	May 31, 2010	Monday	
11		Independence Day	4th Day of July	July 4, 2010	Sunday	
12		Labor Day	1st Monday in September	September 6, 2010	Monday	
13		Veterans Day	11th Day of November	November 11, 2010	Thursday	
14		Columbus Day	2nd Monday in October	October 11, 2010	Monday	
15		Thanksgiving Day	4th Thursday in November	November 25, 2010	Thursday	
16		Christmas Day	25th Day of December	December 25, 2010	Saturday	
17						
18						
19						

Add Sheet Sheet1 Sheet2

=DATE(A1,9,0,1,0)+IF(WEEKDAY(DATE(A1,9,0,1,0),1),1,0)

Figure 1-5: A Web-based spreadsheet from Google.

For developers, Excel's key features include the following:

- **File structure:** The multisheet orientation makes it easy to organize an application's elements and store them in a single file. For example, a single workbook file can hold any number of worksheets and chart sheets. UserForms and VBA modules are stored with a workbook but are invisible to the end user.
- **Visual Basic for Applications:** This macro language lets you create structured programs directly in Excel. This book focuses on using VBA, which, as you'll discover, is extremely powerful and relatively easy to learn.

- **Easy access to controls:** Excel makes it very easy to add controls, such as buttons, list boxes, and option buttons, to a worksheet. Implementing these controls often requires little or no macro programming.
- **Custom dialog boxes:** You can easily create professional-looking dialog boxes by creating UserForms.
- **Custom worksheet functions:** With VBA, you can create custom worksheet functions to simplify formulas and calculations.
- **Customizable user interface:** Developers have lots of control over the user interface. In previous versions, changing the interface involved creating custom menus and toolbars. Beginning with Excel 2007, it involves modifying the Ribbon. Changing the Ribbon interface is not as easy as it was in previous versions, but you can still do it.
- **Customizable shortcut menus:** Using VBA, you can customize the right-click, context-sensitive shortcut menus.
- **Powerful data analysis options:** Excel's PivotTable feature makes it easy to summarize large amounts of data with very little effort. The data can reside in a worksheet or in an external database.
- **Microsoft Query:** You can access important data directly from the spreadsheet environment. Data sources include standard database file formats, text files, and Web pages.
- **Extensive protection options:** Your applications can be kept confidential and protected from changes by casual users.
- **Ability to create add-ins:** With a single command, you can create add-in files that bring new features to Excel.
- **Support for automation:** With VBA, you can control other applications that support automation. For example, your VBA macro can generate a report in Microsoft Word.
- **Ability to create Web pages:** You can easily create a HyperText Markup Language (HTML) document from an Excel workbook. The HTML is very bloated, but it's readable by Web browsers.

Excel's Role in Microsoft's Strategy

Currently, most copies of Excel are sold as part of Microsoft Office — a suite of products that includes a variety of other programs. (The exact programs that you get depend on which version of Office you buy.) Obviously, it helps if the programs can communicate well with each other. Microsoft is at the forefront of this trend. All the Office products have extremely similar user interfaces, and all support VBA.

Therefore, after you hone your VBA skills in Excel, you'll be able to put them to good use in other applications — you just need to learn the object model for the other applications.

Excel in a Nutshell

In This Chapter

- Introducing Excel's object orientation
- Gaining a conceptual overview of Excel, including a description of its major features
- Discovering the new features in Excel 2010
- Taking advantage of helpful tips and techniques

Thinking in Terms of Objects

When you're developing applications with Excel (especially when you're dabbling with Visual Basic for Applications — VBA), it's helpful to think in terms of *objects*, or Excel elements that you can manipulate manually or via a macro. Here are some examples of Excel objects:

- The Excel application
- An Excel workbook
- A worksheet in a workbook
- A range or a table in a worksheet
- A ListBox control on a UserForm (a custom dialog box)
- A chart embedded in a worksheet
- A chart series in a chart
- A particular data point in a chart

You may notice that an *object hierarchy* exists here: The Excel object contains workbook objects, which contain worksheet objects, which contain range objects. This hierarchy comprises Excel's *object model*. Excel has more than 200 classes of objects that you can control directly or by using VBA. Other Microsoft Office products have their own object models.



Note

Controlling objects is fundamental to developing applications. Throughout this book, you find out how to automate tasks by controlling Excel's objects, and you do so by using VBA. This concept becomes clearer in subsequent chapters.

Workbooks

The most common Excel object is a *workbook*. Everything that you do in Excel takes place in a workbook, which is stored in a file that, by default, has an XLSX extension. An Excel workbook can hold any number of sheets (limited only by memory). There are four types of sheets:

- Worksheets
- Chart sheets
- Excel 4.0 XLM macro sheets (obsolete, but still supported)
- Excel 5.0 dialog sheets (obsolete, but still supported)

You can open or create as many workbooks as you like (each in its own window), but at any given time, only one workbook is the *active workbook*. Similarly, only one sheet in a workbook is the *active sheet*. To activate a sheet, click its sheet tab at the bottom of the screen. To change a sheet's name, double-click the tab and enter the new text. Right-clicking a tab brings up a short-cut menu with additional options for the sheet, including changing its tab color, hiding the sheet, and so on.

You can also hide the window that contains a workbook by using the View→Window→Hide command. A hidden workbook window remains open, but it isn't visible to the user. Use the View→Window→Unhide command to make the window visible again. A single workbook can display in multiple windows (choose View→Window→New Window). Each window can display a different sheet or a different area of the same sheet.

Worksheets

The most common type of sheet is a worksheet, which is what people normally think of when they think of a spreadsheet. Worksheets contain cells, and the cells store data and formulas.

Excel 2010 worksheets have 16,384 columns and 1,048,576 rows. You can hide unneeded rows and columns to keep them out of view, but you can't increase or decrease the number of rows or columns.



Note

Versions prior to Excel 2007 used the XLS binary format, and worksheets had only 65,536 rows and 256 columns. If you open such a file, Excel 2010 automatically enters *compatibility mode* in order to work with the smaller worksheet grid. To convert such a file to the new format, save it as an XLSX or XLSM file. Then close the workbook and re-open it.

How big is a worksheet?

It's interesting to stop and think about the actual size of a worksheet. Do the arithmetic ($16,384 \times 1,048,576$), and you'll see that a worksheet has 17,179,869,184 cells. Remember that this is in just one worksheet. A single workbook can hold more than one worksheet.

If you're using a 1600 x 1200 video mode with the default row heights and column widths, you can see 24 columns and 49 rows (or 1,176 cells) at a time — which is about .0000068 percent of the entire worksheet. In other words, more than 14.6 million screens of information reside within a single worksheet.

If you entered a single digit into each cell at the relatively rapid clip of one cell per second, it would take you over 500 years, nonstop, to fill up a worksheet. To print the results of your efforts would require more than 36 million sheets of paper — a stack about 12,000 feet high. (That's ten Empire State Buildings stacked on top of each other.)

As you might suspect, filling an entire workbook with values is impossible. It's not even close to being possible. Even if you use the 64-bit version of Excel, you'd soon run out of memory, and Excel would probably crash.

The real value of using multiple worksheets in a workbook isn't access to more cells. Rather, multiple worksheets enable you to organize your work better. Back in the old days, when a file comprised a single worksheet, developers wasted a lot of time trying to organize the worksheet to hold their information efficiently. Now you can store information on any number of worksheets and still access it instantly by clicking a sheet tab.



Note

By default, every new workbook starts out with three worksheets. You can easily add a new sheet when necessary, so you really don't need to start with three sheets. You may want to change this default to a single sheet. To change this option, use the Office→Excel Options command, click the General tab, and change the setting for the option labeled Include This Many Sheets.

As you know, a worksheet cell can hold a constant value or the result of a formula. The value may be a number, a date, a Boolean value (True or False), or text. Every worksheet also has an invisible drawing layer, which lets you insert graphic objects, such as charts, shapes, SmartArt, UserForm controls, pictures, and other embedded objects.

You have complete control over the column widths and row heights — in fact, you can even hide rows and columns (as well as entire worksheets). You can specify any font size, and you have complete control over colors. You can display text in a cell vertically (or at an angle) and even wrap it around to occupy multiple lines. In addition, you can merge a group of cells to create a single larger cell.



Note

In the past, Excel was limited to a palette of 56 colors. Beginning with Excel 2007, the number of colors has been virtually unlimited. In addition, Excel 2007 introduced *document themes*. A single click lets you apply a new theme to a workbook, which can give it an entirely different look.

Chart sheets

A chart sheet normally holds a single chart. Many users ignore chart sheets, preferring to store charts on the worksheet's drawing layer. Using chart sheets is optional, but they make it a bit easier to print a chart on a page by itself, and they're especially useful for presentations. Figure 2-1 shows a pie chart on a chart sheet.

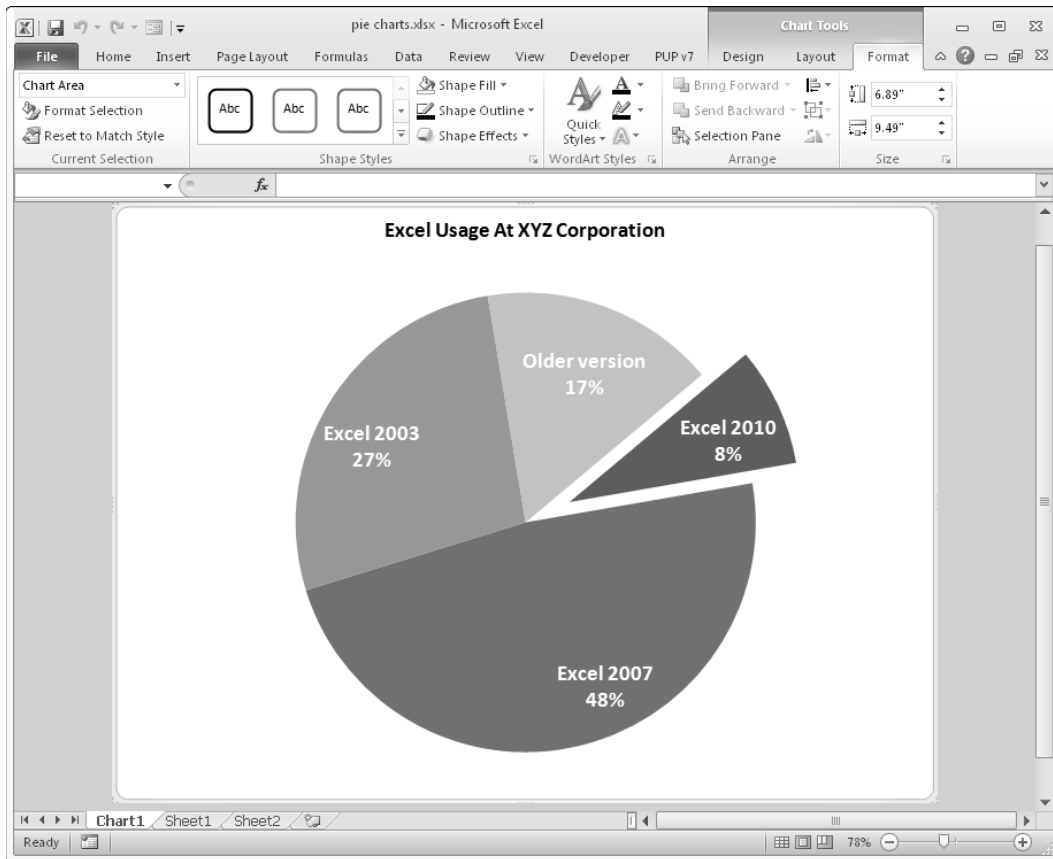


Figure 2-1: A pie chart on a chart sheet.

XLM macro sheets

An XLM macro sheet (also known as an *MS Excel 4 macro sheet*) is essentially a worksheet, but it has some different defaults. More specifically, an XLM macro sheet displays formulas rather than the results of formulas. In addition, the default column width is larger than in a normal worksheet.

As the name suggests, an XLM macro sheet is designed to hold XLM macros. As you may know, the XLM macro system is a holdover from previous versions of Excel (Version 4.0 and earlier). Excel 2010 continues to support XLM macros for compatibility reasons — although it no longer provides the option of recording an XLM macro. This book doesn't cover the XLM macro system; instead, it focuses on the more powerful VBA macro system.



What's new in Excel 2010?

Here's a quick overview of the new features in Excel 2010:

- **64-bit version:** If your hardware and Windows version supports it, you can install the 64-bit version, which lets you create larger workbooks. You might experience some incompatible macros and add-ins. Specifically, macros that use 32-bit Windows API calls won't work in 64-bit Excel 2010. In most cases, however, you can modify the code so that the API calls work with both versions of Excel.
- **Sparkline charts:** Create small in-cell charts to summarize a range of data graphically.
- **Slicers:** A slicer is a new way to filter and display data in pivot tables.
- **New pivot table formatting options:** You have more control over the appearance of pivot table reports.
- **Office button changes:** The big round Office button in Excel 2007 has been replaced by a File button, displayed to the left of the tabs. Clicking it displays Office Backstage, a screen that lets you perform various operations on your workbook. This view essentially replaces the traditional File and Print menus — plus quite a bit more.
- **Conditional formatting enhancements:** Data bar conditional formatting can display in a solid color, and the bars provide a more accurate display and support negative values.
- **Function enhancements:** Some of Excel's worksheet financial and statistical functions have been improved in terms of numerical accuracy. These functions have new names, and the old versions are still available for compatibility.
- **Image-editing enhancements:** You have much more control over graphic images inserted into a workbook, including the ability to remove non-essential parts from the background of an image.
- **Screen capture tool:** You can easily capture a window from a different program and insert the image on a worksheet.
- **Paste preview:** When you copy a range, the Paste command displays various options with a live preview so that you can see how the paste operation will look.
- **Ribbon customization:** End users can customize the Ribbon by adding new tabs and groups. Unfortunately, it's still not possible to customize the Ribbon using VBA.
- **Equation editor:** You can create and display (noncalculating) mathematical equations and embed them on a worksheet.
- **Faster:** Microsoft made some improvements to the calculation engine, and files load a bit faster.
- **New security features:** Workbooks downloaded from the Internet or from e-mail attachments are opened in Protected View mode. You can designate workbooks as trusted, and they don't need to reside in special trusted folders.
- **Solver:** Excel 2010 includes a new version of the Solver add-in.
- **Enhancements to VBA:** You can now perform operations that used to require old XLM macros directly using VBA macro commands. In addition, macro recording now works for operations such as chart and shape formatting.

Excel 5/95 dialog sheets

In Excel 5 and Excel 95, you created a custom dialog box by inserting a special dialog sheet. Excel 97 and later versions still support these dialog sheets, but a much better alternative is available: UserForms. You work with UserForms in the Visual Basic Editor (VBE).

If you open a workbook that contains an Excel 5/95 dialog sheet, you can access the dialog sheet by clicking its tab.

I don't discuss Excel 5/95 dialog sheets in this book.

Excel's User Interface

A *user interface* (UI) is the means by which an end user communicates with a computer program. Generally speaking, a UI includes elements such as menus, toolbars, dialog boxes, keystroke combinations, and so on.

The release of Office 2007 signaled the end of traditional menus and toolbars. The UI for Excel consists of the following elements:

- The Ribbon
- The Quick Access toolbar
- Right-click shortcut menus
- Dialog boxes
- Keyboard shortcuts
- Smart Tags
- Task pane

About the Ribbon

In Office 2007, Microsoft introduced an entirely new UI for its product. Menus and toolbars are gone, replaced with a *tab and Ribbon UI*. Click a tab along the top (that is, a word such as Home, Insert, or Page Layout), and the Ribbon displays the commands for that tab. Office 2007 was the first software in history to use this new interface, and a few other companies have incorporated this new UI style in their products.

The appearance of the commands on the Ribbon varies, depending on the width of the Excel window. When the window is too narrow to display everything, the commands adapt and may seem to be missing. But the commands are still available. Figure 2-2 shows the Home tab of the Ribbon with all controls fully visible. Figure 2-3 shows the Ribbon when Excel's window is

narrower. Notice that some of the descriptive text is gone, but the icons remain. Figure 2-4 shows the extreme case, in which the window is very narrow. Some of the groups display a single icon. However, if you click the icon, all the group commands are available to you.



Figure 2-2: The Home tab of the Ribbon.

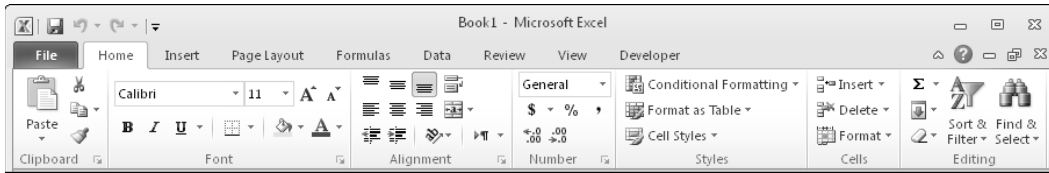


Figure 2-3: The Home tab when Excel's window is narrower.

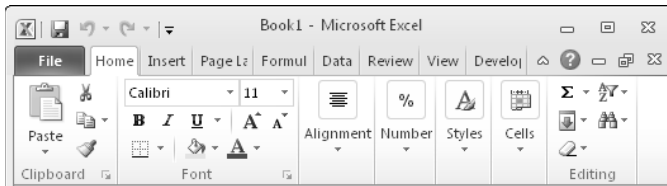


Figure 2-4: The Home tab when Excel's window is very narrow.



Tip

If you'd like to hide the Ribbon to increase your worksheet view, just double-click any of the tabs. The Ribbon goes away, and you'll be able to see about four additional rows of your worksheet. When you need to use the Ribbon again, just click any tab, and it comes back. You can also press **Ctrl+F1** to toggle the Ribbon display or use the **^** control, to the left of the Help icon in the tab bar.

Contextual tabs

In addition to the standard tabs, Excel includes *contextual tabs*. Whenever an object (such as a chart, a table, a picture, or SmartArt) is selected, tools for working with that specific object are made available in the Ribbon.

Figure 2-5 shows the contextual tabs that appear when an embedded equation is selected. In this case, Excel displays two contextual tabs: **Format** (for working with object) and **Design** (for working with the equation). Notice that the contextual tabs contain a description (Drawing Tools and Equation Tools) in Excel's title bar. When contextual tabs are displayed, you can, of course, continue to use all the other tabs.

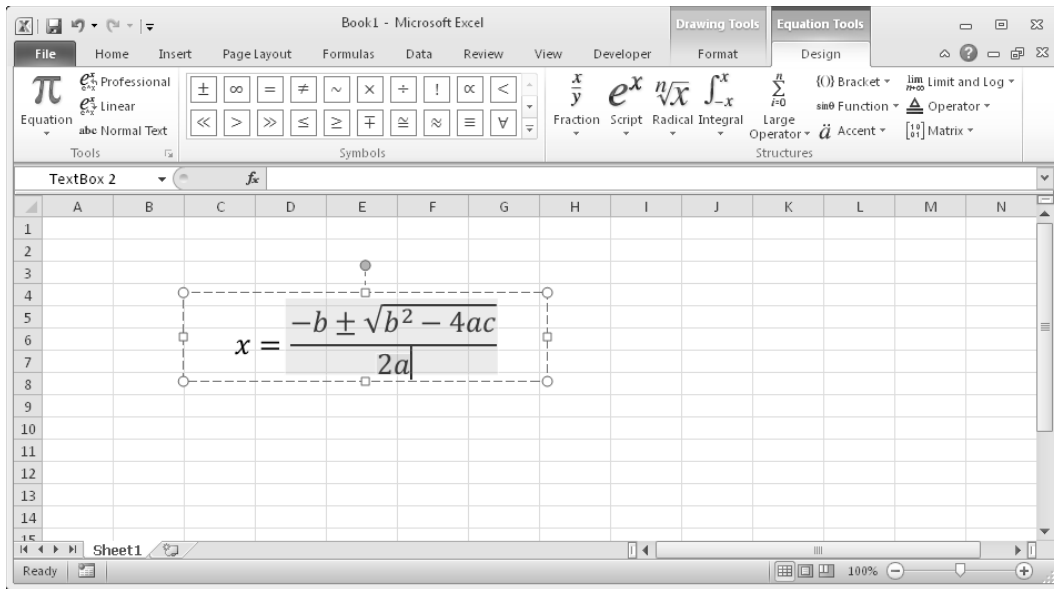


Figure 2-5: When you select an object, contextual tabs contain tools for working with that object.

Types of commands on the Ribbon

For the most part, the commands in the Ribbon work just as you'd expect them to. You'll encounter several different styles of commands on the Ribbon:

- **Simple buttons:** Click the button, and it does its thing. An example of a simple button is the Increase Font Size button in the Font group of the Home tab. Some buttons perform the action immediately; others display a dialog box so that you can enter additional information. Button controls may or may not be accompanied by text.
- **Toggle buttons:** A toggle button is clickable and also conveys some type of information by displaying two different colors. An example is the Bold button in the Font group of the Home tab. If the active cell isn't bold, the Bold button displays in its normal color. But if the active cell is already bold, the Bold button displays a different background color. If you click this button, it toggles the Bold attribute for the selection.
- **Simple drop-downs:** If the Ribbon command has a small downward-pointing arrow, then the command is a drop-down list. Click it, and additional commands appear below it. An example of a simple drop-down is the Merge and Center command in the Alignment group of the Home Tab. When you click this control, you see four options related to merging and centering information.

- **Split buttons:** A split button control combines a one-click button (on the top) with a drop-down (on the bottom). If you click the button part, the command is executed. If you click the drop-down part, you choose from a list of related commands. You can identify a split button because it displays in two colors when you hover the mouse over it. An example of a split button is the Paste command in the Clipboard group of the Home tab. Clicking the top part of this control pastes the information from the Clipboard. If you click the bottom part of the control, you get a list of paste-related commands (see Figure 2-6).
- **Check boxes:** A check box control turns something on or off. An example is the Gridlines control in the Show/Hide group of the View tab. When the Gridlines check box is checked, the sheet displays gridlines. When the control isn't checked, the sheet gridlines aren't displayed.
- **Spinners:** An example of a spinner control is in the Scale to Fit group of the Page Layout tab. Click the top part of the spinner to increase the value; click the bottom part of the spinner to decrease the value.

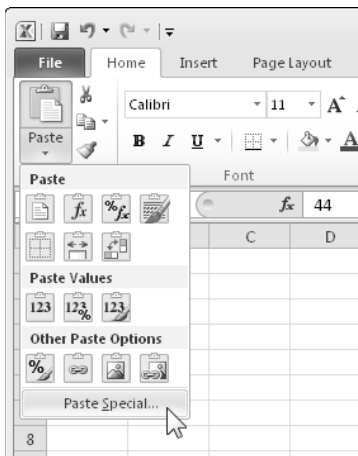


Figure 2-6: The Paste command is a split button control.



Cross-Ref

Refer to Chapter 22 for information about customizing Excel's Ribbon.

Some of the Ribbon groups contain a small icon in the lower-right corner, known as a dialog launcher. For example, if you examine the Home→Alignment group, you'll see this icon (refer to Figure 2-7). Click it, and it displays the Format Cells dialog box, with the Number tab preselected. This dialog box provides options that aren't available in the Ribbon.

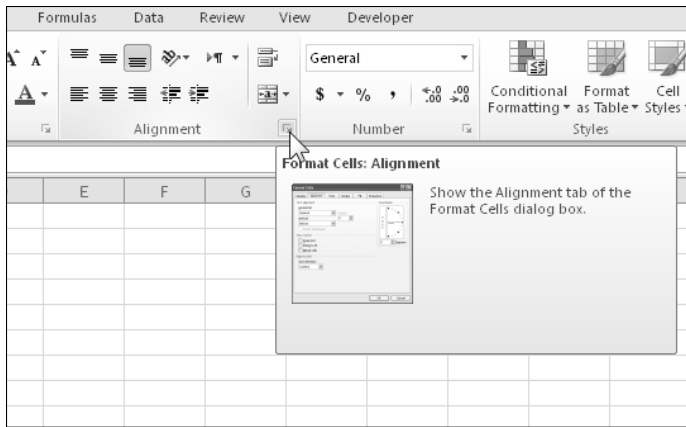


Figure 2-7: This small dialog launcher icon, when clicked, displays a dialog box that has additional options.



In Excel 2007, end users couldn't modify the Ribbon. In Excel 2010, users can easily add or remove commands. See Chapter 22 for information about customizing the Ribbon.

The Quick Access toolbar

The Quick Access toolbar is a place to store commonly used commands. The Quick Access toolbar is always visible, regardless of which Ribbon tab you select. Normally, the Quick Access toolbar appears on the left side of the title bar. Alternatively, you can display the Quick Access toolbar below the Ribbon by right-clicking the Quick Access toolbar and selecting Show Quick Access Toolbar Below the Ribbon.

By default, the Quick Access toolbar contains three tools: Save, Undo, and Redo. You can, of course, customize the Quick Access toolbar by adding other commands that you use often. To add a command from the Ribbon to your Quick Access toolbar, right-click the command and choose Add To Quick Access toolbar.

Excel has quite a few commands that aren't available in the Ribbon. In most cases, the only way to access these commands is to add them to your Ribbon or Quick Access toolbar. Figure 2-8 shows the Quick Access toolbar section of the Excel Options dialog box. This area is your one-stop shop for Quick Access toolbar customization. A quick way to display this dialog box is to right-click the Quick Access toolbar and choose Customize Quick Access toolbar.

Accessing the Ribbon by using your keyboard

At first glance, you may think that the Ribbon is completely mouse-centric. After all, none of the commands has the traditional underlined letter to indicate the Alt+keystrokes. But, in fact, the Ribbon is *very* keyboard friendly. The trick is to press the Alt key to display the pop-up *keytips*. Each Ribbon control has a letter (or series of letters) that you type to issue the command.

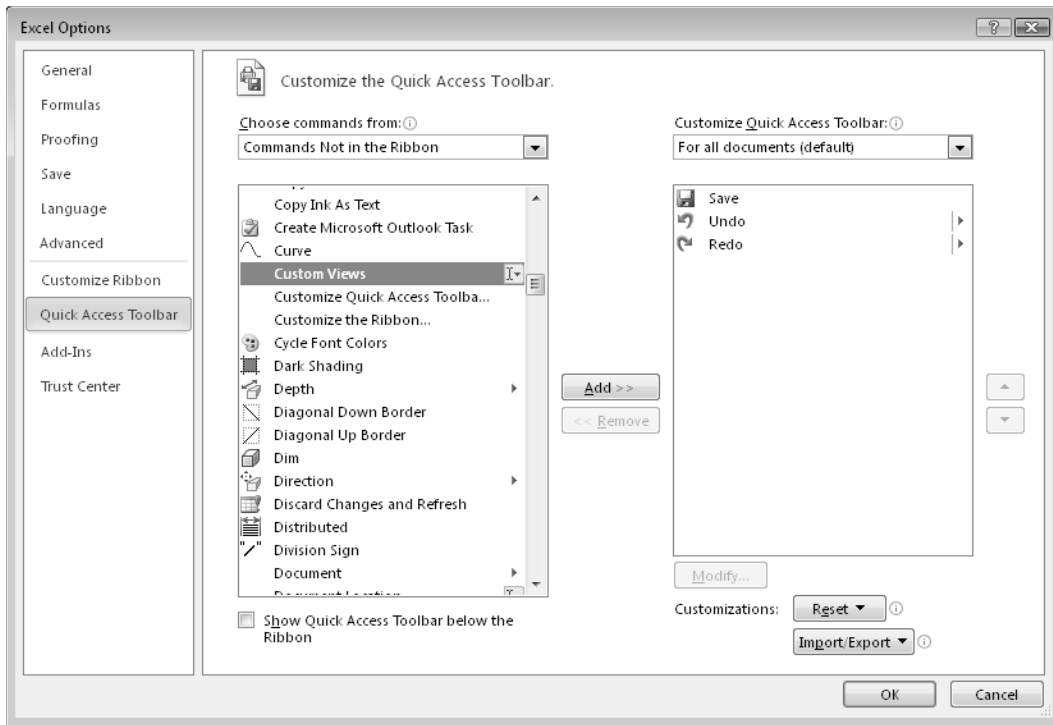


Figure 2-8: Add new icons to your Quick Access toolbar by using the Quick Access toolbar section of the Excel Options dialog box.



Tip

You don't need to hold down the Alt key as you type the keytip letters.

Figure 2-9 shows how the Home tab looks after I press the Alt key to display the keytips. If you press one of the keytips, the screen then displays more keytips. For example, to use the keyboard to align the cell contents to the left, press Alt, followed by H (for Home) and then AL (for Align Left). If you're a keyboard fan (like me), it will just take a few times before you memorize the keystrokes required for common commands.

After you press Alt, you can also use the left and right arrow keys to scroll through the tabs. When you reach the proper tab, press the down-arrow key to enter the Ribbon. Then use the left- and right-arrow keys to scroll through the Ribbon commands. When you reach the command you need, press Enter to execute it. This method isn't as efficient as using the keytips, but it's a quick way to take a look at the choices on the Ribbon.

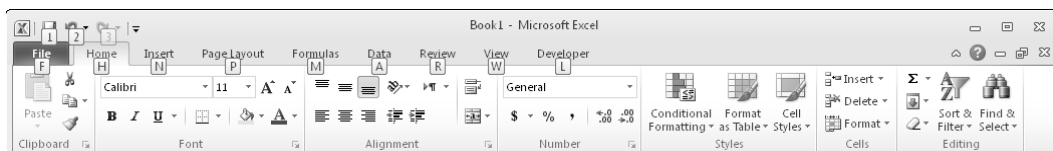


Figure 2-9: Pressing Alt displays the keytips.



Note

Excel 2010 still supports the menu-oriented keyboard shortcuts from Excel 2003. So if you've memorized key sequences, such as Alt+ES (to display the Paste Special dialog box), you can still use those shortcuts.

Shortcut menus and the Mini Toolbar

The only menus that remain in Excel are shortcut menus. These menus appear when you right-click your mouse. The shortcut menus are context-sensitive. In other words, the menu that appears depends on the location of the mouse pointer when you right-click. You can right-click just about anything — a cell, a row or column border, a workbook title bar, a toolbar, and so on.

Right-clicking some objects displays a Mini Toolbar above the shortcut menu. This toolbar provides quick access to commonly used formatting commands. Figure 2-10 shows the Mini Toolbar when a cell is selected.

Although you can't customize the Ribbon by using VBA, you can use VBA to customize any of the shortcut menus. You can't, however, modify the Mini Toolbar.

Refer to Chapter 23 for more information about customizing shortcut menus.

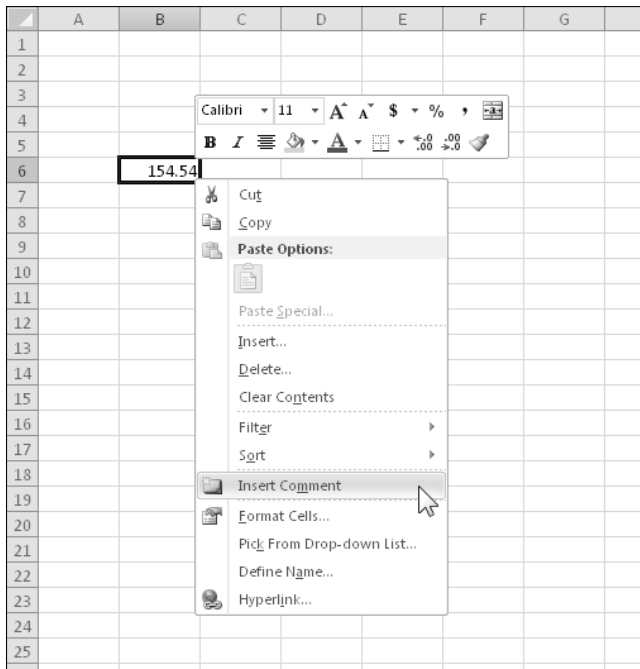


Figure 2-10: Right-clicking some objects displays a Mini Toolbar in addition to a shortcut menu.

Dialog boxes

Some Ribbon commands display a dialog box. In many cases, these dialog boxes contain additional controls that aren't available in the Ribbon.

You'll find two general classes of dialog boxes in Excel:

- **Modal dialog boxes:** When a modal dialog box is displayed, it must be closed in order to execute the commands. An example is the Format Cells dialog box. None of the options you specify are executed until you click OK. Use the Cancel button to close the dialog box without making any changes.
- **Modeless dialog boxes:** These are stay-on-top dialog boxes. For example, if you're working with a chart using the Format dialog box, your changes are reflected immediately in the chart. Modeless dialog boxes usually have a Close button rather than OK and Cancel buttons.

Many of Excel's dialog boxes use a notebook tab metaphor, which makes a single dialog box function as several different dialog boxes. In older dialog boxes, the tabs are usually along the top. But in newer dialog boxes (such as the one shown in Figure 2-11), the tabs are along the left side.

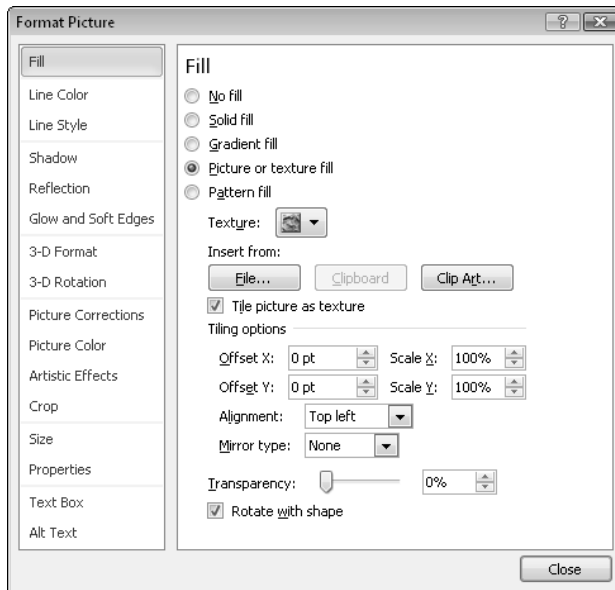


Figure 2-11: Tabbed dialog boxes make many options accessible without overwhelming the user.

Developers can create custom dialog boxes by using the UserForm feature. As you'll see, you can create a wide variety of dialog boxes, including tabbed dialog boxes.



Cross-Ref

Refer to Part IV for information about creating and working with UserForms.

Keyboard shortcuts

Excel has *many* useful keyboard shortcuts. For example, you can press Ctrl+D to copy a cell to selected cells below it. If you're a newcomer to Excel — or you just want to improve your efficiency — I urge you to check out the Help system (access the Accessibility main topic and go from there). Learning these shortcuts is key to becoming proficient in Excel. The Help file has tables that summarize useful keyboard commands and shortcuts.

And, as I note previously, you can access the Ribbon commands by using the keyboard.

Smart Tags

A *Smart Tag* is a small icon that appears automatically in your worksheet after you perform certain actions. Clicking a Smart Tag reveals several options. For example, if you copy and paste a range of cells, Excel generates a Smart Tag that appears below the pasted range (see Figure 2-12) and provides you with several options regarding the formatting of the pasted data.

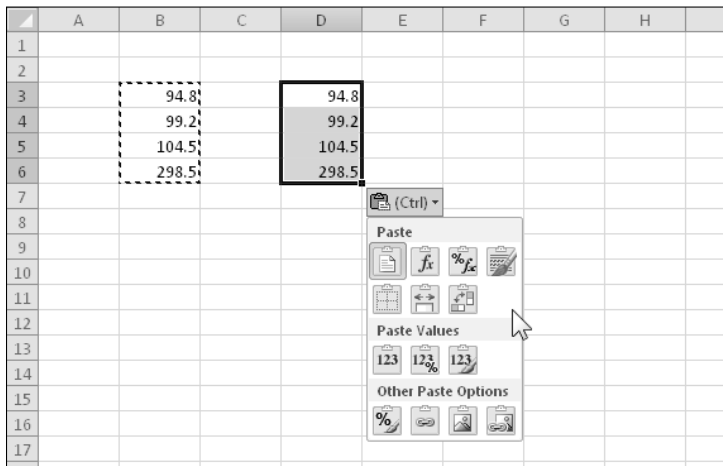


Figure 2-12: This Smart Tag appears when you paste a copied range.

Task pane

Excel 2002 introduced a new UI element known as the *task pane*. This multipurpose user interface element is normally docked on the right side of Excel's window (but you can drag it anywhere). The task pane is used for a variety of purposes, including displaying the Office Clipboard, displaying a pivot table field list, inserting clipart, providing research assistance, and mapping eXtensible Markup Language (XML) data. Figure 2-13 shows the Clip Art task pane.



What's new in the Visual Basic Editor?

Nothing.

Most of Excel 2010's updated object model is accessible in your VBA code, but the VB Editor hasn't changed in many versions. The Microsoft Office applications all use the new Ribbon UI, but the VB Editor still uses menus and toolbars. By comparison, most would agree that the VB Editor is starting to look very old-fashioned. Maybe we'll see an updated UI in the *next* release. But I'm not holding my breath.

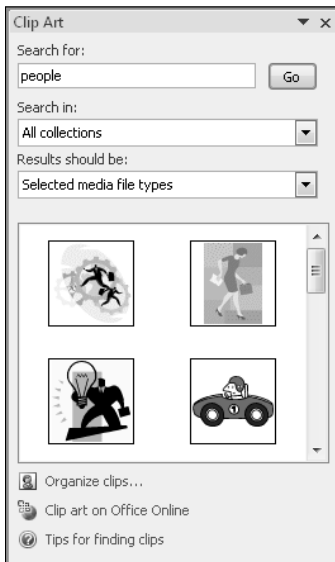


Figure 2-13: Locating clipart is one of several uses for the task pane.

Customizing the Display

Excel offers a great deal of flexibility regarding what is displayed on-screen (formula bar, grid-lines, row and column headings, and so on). These commands are located in the View tab.

In fact, Excel makes it possible to develop an application that doesn't even look like a spreadsheet. For example, by choosing View→Workbook Views→Full Screen, you can get rid of everything except the title bar, thereby maximizing the amount of information visible. To exit full-screen mode, right-click any cell and choose Close Full Screen from the shortcut menu.

Notice the zoom control in the right side of the status bar. This control makes zooming in or out very easy. In addition, you can right-click the status bar and specify the type of information you'd like to see.

Data Entry

Data entry in Excel is quite straightforward. Excel interprets each cell entry as one of the following:

- A numeric value (including date and time values)
- Text
- A Boolean value (True or False)
- A formula

Formulas always begin with an equal sign (=). Excel accommodates habitual 1-2-3 users, however, and accepts an each-at symbol (@), a plus sign (+), or a minus sign (-) as the first character in a formula. Excel automatically adjusts the entry after you press Enter.

Formulas, Functions, and Names

Formulas are what make a spreadsheet a spreadsheet. Excel has some advanced formula-related features that are worth knowing. They enable you to write array formulas, use an intersection operator, include links, and create *megaformulas* (my term for a lengthy and incomprehensible — but very efficient — formula).



Cross-Ref

Chapter 3 covers formulas and presents lots of tricks and tips.

Excel also has some useful auditing capabilities that help you identify errors or track the logic in an unfamiliar spreadsheet. To access these features, use the commands in the Formulas→Formula Auditing group.

You may find the Formulas→Formula Auditing→Error Checking command useful. This command scans your worksheet and identifies possibly erroneous formulas. In Figure 2-14, Excel identifies a possibly inconsistent formula and provides some options.

Worksheet functions enable you to perform calculations or operations that would otherwise be impossible. Excel provides a huge number of built-in functions.

The easiest way to locate the function that you need is to use the Insert Function dialog box, as shown in Figure 2-15. Access this dialog box by clicking the Insert Function button on the formula bar (or by pressing Shift+F3). After you select a function, Excel displays its Function Arguments dialog box, which assists with specifying the function's arguments.



Note

Beginning with Excel 2007, the Analysis ToolPak functions became part of Excel. In other words, you can use these function even if the Analysis ToolPak add-in isn't installed.

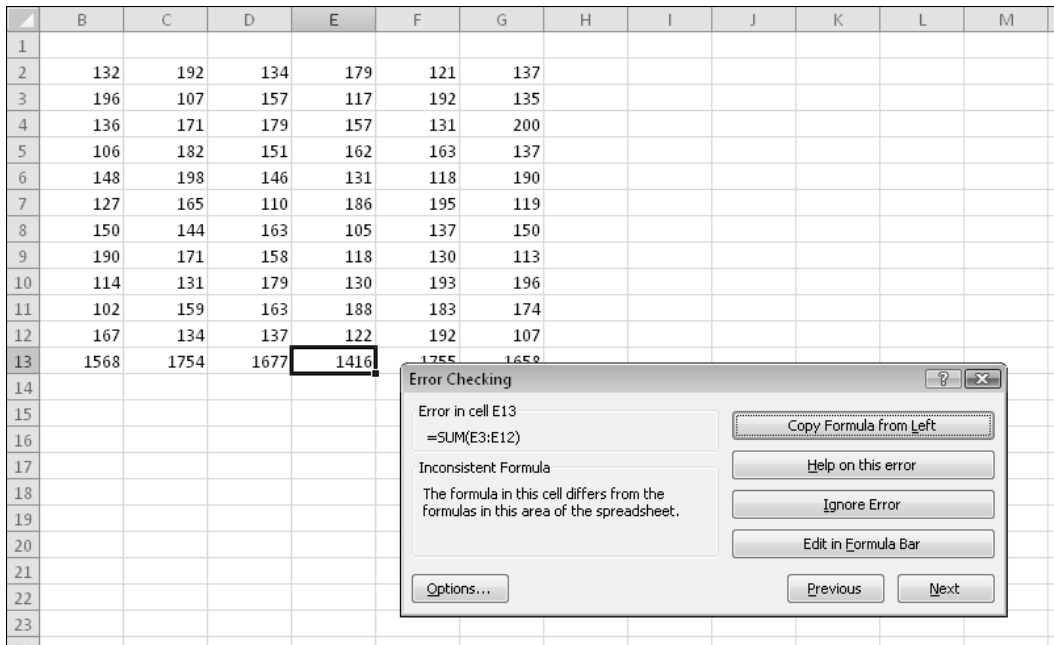


Figure 2-14: Excel can monitor your formulas for possible errors.

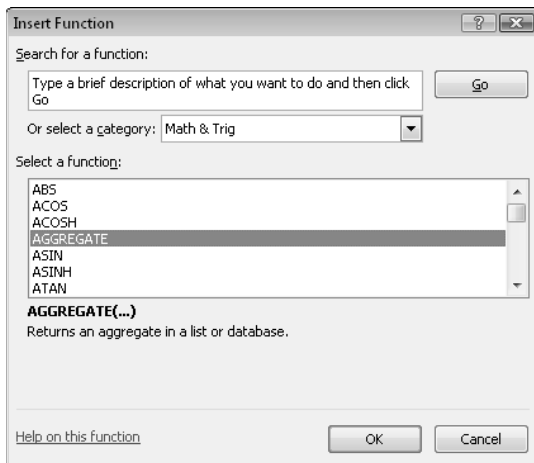


Figure 2-15: The Insert Function dialog box is the best way to insert a function into a formula.



Cross-Ref

Excel also lets you create your own worksheet functions by using VBA. For details about this powerful feature, see Chapter 10.

A *name* is an identifier that enables you to refer to a cell, range, value, formula, or graphic object. Formulas that use names are much easier to read than formulas that use cell references, and creating formulas that use named references is much easier.



Cross-Ref

I discuss names in Chapter 3. As you can see there, Excel handles names in some unique ways.

Selecting Objects

Selecting objects in Excel conforms to standard Windows practices. You can select a range of cells by clicking and dragging. (Learning the keyboard shortcuts is more efficient, however.) Clicking an object that has been placed on the drawing layer selects the object. To select multiple objects or noncontiguous cells, press Ctrl while you select the objects or cells.



Note

Clicking a chart selects a specific object within the chart. To select the chart object itself, press Ctrl while you click the chart.

If an object has a macro assigned to it, clicking the object executes the macro. To actually select such an object, right-click it and press Esc to hide the shortcut menu. Or press Ctrl while you click the object.

Formatting

Excel provides two types of formatting: numeric formatting and stylistic formatting.

Numeric formatting refers to how a number appears in the cell. In addition to choosing from an extensive list of predefined formats, you can create your own formats (see Figure 2-16). The procedure is thoroughly explained in the Help system.

Excel applies some numeric formatting automatically, based on the entry. For example, if you precede a number with a currency symbol (a dollar sign in the United States), Excel applies Currency number formatting. You can also use the conditional formatting feature to apply number formatting conditionally, based on the magnitude of the number.

Stylistic formatting refers to the formatting that you apply to make your work look good. Many Ribbon buttons offer direct access to common formatting options, but you'll want to access the object's Format dialog box for the full range of formatting options.

The easiest way to get to the correct dialog box and format an object is to select the object and press Ctrl+1. You can also right-click the object and choose Format xxx (where xxx is the selected object) from the shortcut menu. Either of these actions brings up a tabbed dialog box that holds all the formatting options for the selected object.

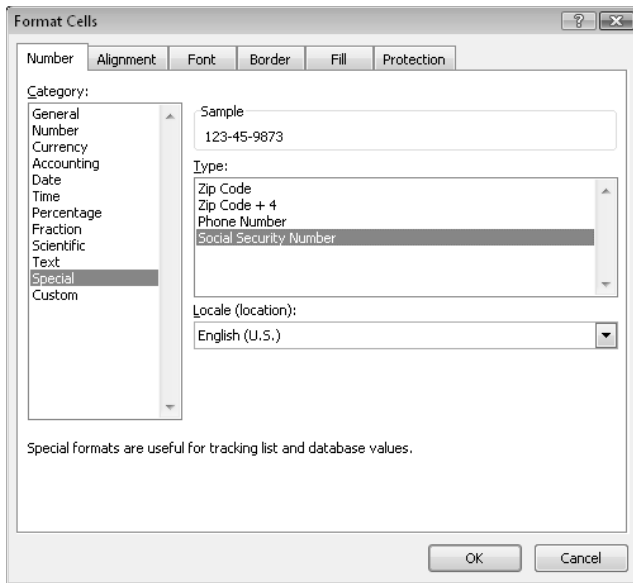


Figure 2-16: Excel's numeric formatting options are very flexible.

Excel's conditional formatting feature is particularly useful. This feature, accessed by choosing Home→Styles→Conditional Formatting, allows you to specify formatting that will be applied only if certain conditions are met. For example, you can make cells that exceed a specified value appear in a different color.

Excel 2007 introduced several conditional formatting options, including data bars, color scales, and icon sets. These features have been enhanced in Excel 2010. Figure 2-17 shows the data bars conditional formatting option that displays a histogram directly in the cells.

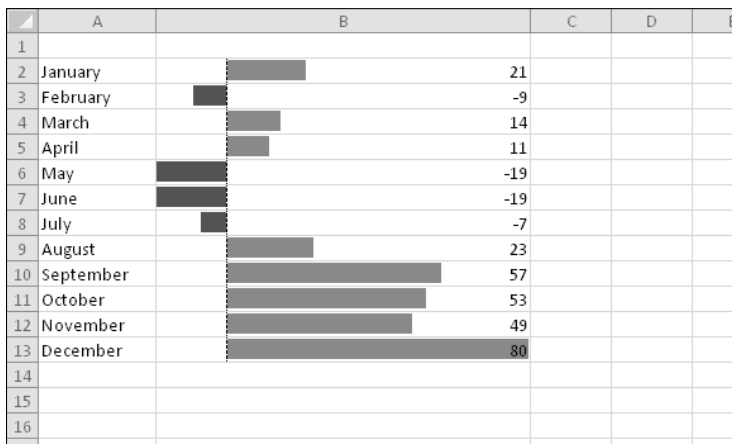


Figure 2-17: The data bars option is one of the conditional formatting features.

Protection Options

Excel offers a number of different protection options. For example, you can protect formulas from being overwritten or modified, protect a workbook's structure, password-protect a workbook, and protect your VBA code.

Protecting formulas from being overwritten

In many cases, you might want to protect your formulas from being overwritten or modified. To do so, perform the following steps:

1. Select the cells that *may* be overwritten.
2. Right-click and choose Format Cells from the shortcut menu.
3. In the Format Cells dialog box, click the Protection tab.
4. In the Protection tab, clear the Locked check box.
5. Click OK to close the Format Cells dialog box.
6. Choose Review→Changes→Protect Sheet to display the Protect Sheet dialog box, as shown in Figure 2-18.
7. In the Protect Sheet dialog box, select the options that correspond to the actions to allow, specify a password if desired, and then click OK.



Note

By default, all cells are locked. The locked status of a cell has no effect, however, unless you have a protected worksheet.

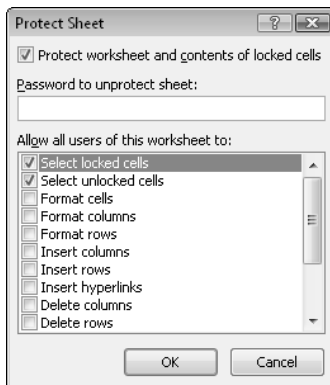


Figure 2-18: The Protect Sheet dialog box.

You can also hide your formulas so that they won't appear in Excel's formula bar when the cell is activated. To do so, select the formula cells and make sure that the Hidden check box is marked in the Protection tab of the Format Cells dialog box.

Protecting a workbook's structure

When you protect a workbook's structure, you can't add or delete sheets. Choose the Review→Changes→Protect Workbook command to display the Protect Structure and Windows dialog box, as shown in Figure 2-19. Make sure that you enable the Structure check box. If you also mark the Windows check box, you can't move or resize the window.

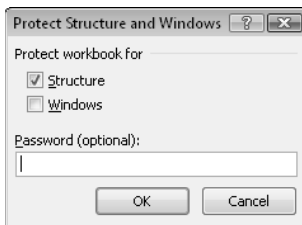


Figure 2-19: The Protect Structure and Windows dialog box.

Applying password protection to a workbook

In some cases, you may want to limit access to a workbook to only those who know the password.

To save a workbook file with a password, choose File→Info→Protect Workbook→Encrypt With Password to display the Encrypt Document dialog box (see Figure 2-20). In this dialog box, you can specify a password that's required to open the workbook.



Figure 2-20: Use the Encrypt Document dialog box to save a workbook with a password.

Protecting VBA code with a password

If your workbook contains VBA code, you may wish to use a password to prevent others from viewing or modifying your macros. To apply a password to the VBA code in a workbook, activate the VBE (Alt+F11) and select your project in the Projects window. Then choose Tools→xxxx Properties (where xxxx corresponds to your Project name) to display the Project Properties dialog box.

In the Project Properties dialog box, click the Protection tab (see Figure 2-21). Enable the Lock Project for Viewing check box and enter a password (twice). Click OK and then save your file. When the file is closed and then reopened, a password will be required to view or modify the code.

**Caution**

Keep in mind that Excel isn't really a secure application. The protection features, even when used with a password, are intended to prevent casual users from accessing various components of your workbook. Anyone who really wants to defeat your protection can probably do so by using readily available password-cracking utilities (or by knowing a few "secrets").

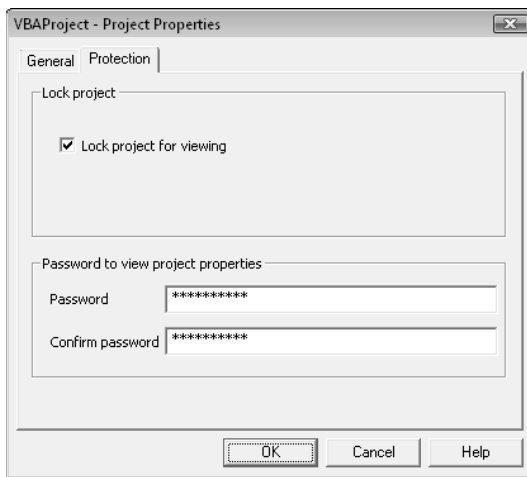


Figure 2-21: Protecting a VBA project with the Project Properties dialog box.

Charts

Excel is perhaps the most commonly used application in the world for creating charts. As I mention earlier in this chapter, you can store charts on a chart sheet or float them on a worksheet. You can also create pivot charts. A *pivot chart* is linked to a pivot table, and you can view various graphical summaries of your data by using the same techniques used in a pivot table.

A new feature in Excel 2010 is Sparkline charts. These small charts fit inside a cell. This type of chart is completely separate from Excel's standard chart feature. Figure 2-22 shows a worksheet with some Sparkline charts added.

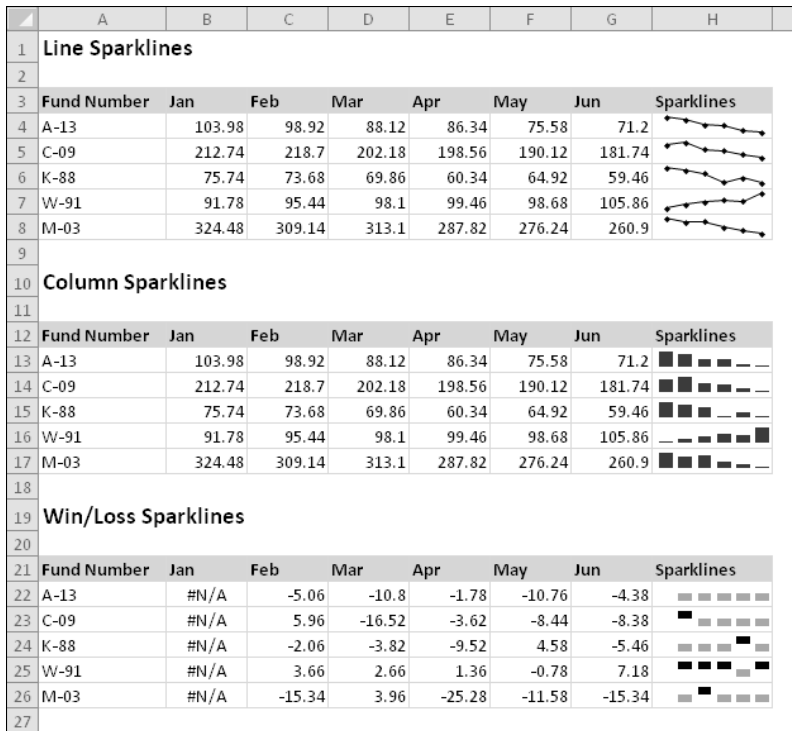


Figure 2-22: Sparkline charts in a worksheet.

Shapes and SmartArt

As I mention earlier in this chapter, each worksheet has an invisible drawing layer that holds charts, pictures, controls (such as buttons and list boxes), and shapes.

Excel enables you to easily draw a wide variety of geometric shapes directly on your worksheet. To access the Shape gallery, choose **Insert**→**Illustrations**→**Shapes**. The shapes are highly customizable, and you can even add text. You can also group objects into a single object, which is easier to size or position.

A feature introduced in Office 2007 is SmartArt, which you use to create a wide variety of customizable diagrams. Figure 2-23 shows an example of a SmartArt diagram on a worksheet.

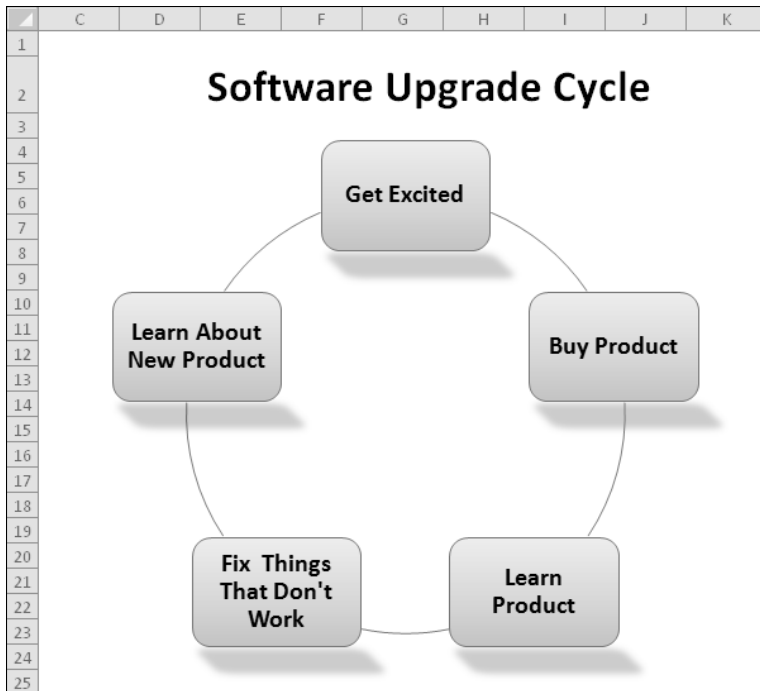


Figure 2-23: A SmartArt diagram.

Database Access

Over the years, most spreadsheets have enabled users to work with simple flat database tables. Excel has some slick tools.

Databases fall into two categories:

- **Worksheet databases:** The entire database is stored in a worksheet, limiting the size of the database.
- **External databases:** The data is stored in one or more files and is accessed as needed.

Worksheet databases

Generally, a rectangular range of data that contains column headers can be considered a worksheet database.

Excel 2007 was the first version that enabled you to specifically designate a range as a *table*. Select any cell in your rectangular range of data and choose **Insert**→**Tables**→**Table**. Using a table offers many advantages: an automatic summary row at the bottom, easy filtering and sorting, auto-fill formulas in columns, and simplified formatting. In addition, if you create a chart from a table, the chart expands automatically as you add rows to the table.

Tables are particularly useful when working with columns of data. Each column header is actually a drop-down list that contains easy access for filtering or sorting (see Figure 2-24). Table rows that don't meet the filter criteria are temporarily hidden.

County	State Name	Region	Census 2000	Census 1990	Land Area	WaterArea
Los Angeles	California	Region I	9,519,338	8,863,164	4,060.87	691.45
Cook	Illinois	Region I	5,376,741	5,105,067	945.68	689.36
Harris	Texas	Region VI	3,400,578	2,818,199	1,728.83	48.87
San Diego	California	Region IX	2,813,833	2,498,016	4,199.89	325.62
Orange	California	Region IX	2,846,289	2,410,556	789.40	158.57
Kings	New York	Region VI	2,465,326	2,300,664	70.61	26.29
Maricopa	Arizona	Region IX	3,072,149	2,122,101	9,203.14	21.13
Wayne	Michigan	Region IX	2,061,162	2,111,687	614.15	58.05
Queens	New York	Region VI	2,229,379	1,951,598	109.24	69.04
Dade	Florida	Region IX	2,253,362	1,937,094	1,946.21	77.85
Dallas	Texas	Region VI	2,218,899	1,852,810	879.60	28.96
Philadelphia	Pennsylvania	Region IX	1,517,550	1,585,577	135.09	7.55
King	Washington	Region IX	1,737,034	1,507,319	2,126.04	180.48
Santa Clara	California	Region IX	1,682,585	1,497,577	1,290.69	13.32
New York	New York	Region VI	1,537,195	1,487,536	22.96	10.81
San Bernardino	California	Region IX	1,709,434	1,418,380	20,052.50	52.82
Cuyahoga	Ohio	Region IX	1,393,978	1,412,140	458.49	787.07
Middlesex	Massachusetts	Region IX	1,465,396	1,398,468	823.46	24.08
Allegheny	Pennsylvania	Region IX	1,281,666	1,336,449	730.17	14.54
Suffolk	Massachusetts	Region IX	1,419,369	1,321,864	912.20	1,460.87
Nassau	Florida	Region IX	1,334,544	1,287,348	286.69	166.39
Alameda	California	Region IX	1,443,741	1,279,182	737.57	83.57
Broward	Florida	Region IX	1,623,018	1,255,488	1,205.40	114.24
Bronx	New York	Region VI	1,332,650	1,203,789	42.03	15.40
Bexar	Texas	Region VI	1,392,931	1,185,394	1,246.82	9.84
Riverside	California	Region IX	1,545,387	1,170,413	7,207.37	95.76
Tarrant	Texas	Region VI	1,446,219	1,170,103	863.42	34.06

Figure 2-24: Excel's table feature makes it easy to sort and filter rows.

External databases

To work with external database tables, use the commands in the Data→Get External Data group. Excel 2010 can work with a wide variety of external databases.

Internet Features

Excel includes a number of features that relate to the Internet. For example, you can save a worksheet or an entire workbook in HyperText Markup Language (HTML) format, accessible in a Web browser. In addition, you can insert clickable hyperlinks (including e-mail addresses) directly in cells.



Caution

In versions prior to Excel 2007, HTML was a *round-trip file format*. In other words, you could save a workbook in HTML format and then reopen it in Excel, and nothing would be lost. That's no longer the case. HTML is now considered an export-only format.

You can also create Web queries to bring in data stored in a corporate intranet or on the Internet. Such a query can be refreshed, so the data updates as new information is posted. Figure 2-25 shows an example of a Web query.

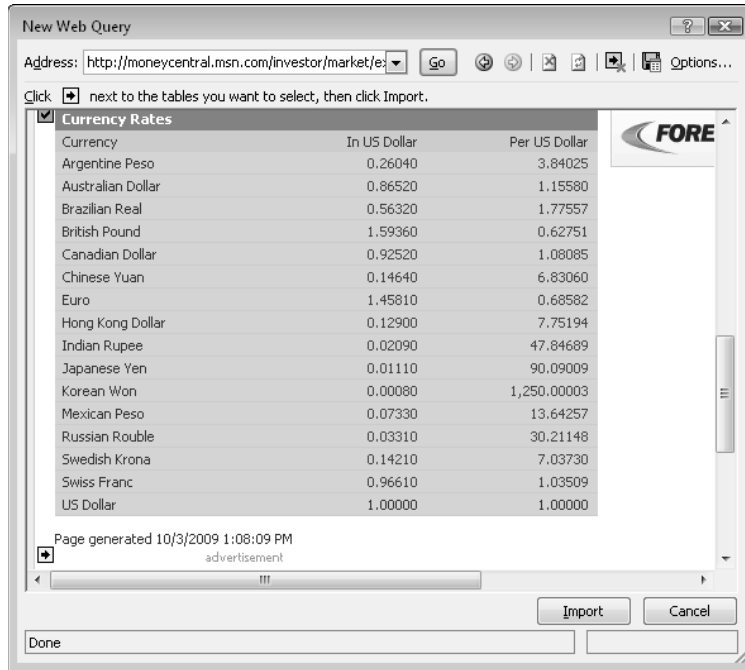


Figure 2-25: Create a Web query to import data into a worksheet.

Analysis Tools

Excel is certainly no slouch when it comes to analysis. After all, that's what most people use a spreadsheet for. You can handle most analysis tasks with formulas, but Excel offers many other options:

- **Outlines:** A worksheet outline is often an excellent way to work with hierarchical data such as budgets. Excel can create an outline (horizontal, vertical, or both) automatically, or you can do so manually. After you create the outline, you can collapse or expand it to display various levels of detail.
- **Analysis ToolPak:** In previous versions of Excel, the Analysis ToolPak add-in provided additional special-purpose analysis tools and worksheet functions, primarily statistical in nature. Beginning with Excel 2007, these features are built in. These tools make Excel suitable for casual statistical analysis.

- **Pivot tables:** Pivot tables are among Excel's most powerful tools. A pivot table is capable of summarizing data in a handy table, and you can arrange this table in many ways. In addition, you can manipulate a pivot table entirely by VBA. Data for a pivot table comes from a worksheet database or an external database and is stored in a special cache, which enables Excel to recalculate rapidly after a pivot table is altered. Figure 2-26 shows a pivot table.

	A	B	C	D	E
1	Bank Account Information				
2					
3	OpenedBy	New Accts			
4					
5	Sum of Amount		Customer		
6	Branch	AcctType	Existing	New	Grand Total
7	Central	CD	757,644	248,830	1,006,474
8		Checking	295,279	122,751	418,030
9		IRA	59,285		59,285
10		Savings	352,921	210,322	563,243
11	Central Total		1,465,129	581,903	2,047,032
12					
13	North County	CD	693,664	233,552	927,216
14		Checking	113,270	93,575	206,845
15		IRA	35,554	7,000	42,554
16		Savings	203,774	107,127	310,901
17	North County Total		1,046,262	441,254	1,487,516
18					
19	Westside	CD	251,276	200,335	451,611
20		Checking	62,122	75,616	137,738
21		IRA	10,000		10,000
22		Savings	228,568	33,594	262,162
23	Westside Total		551,966	309,545	861,511
24					
25	Grand Total		3,063,357	1,332,702	4,396,059
26					

Figure 2-26: Excel's pivot table feature has many applications.



Cross-Ref

See Chapter 17 for information about manipulating pivot tables with VBA.

- **Solver:** For specialized linear and nonlinear problems, Excel's Solver add-in calculates solutions to what-if scenarios based on adjustable cells, constraint cells, and, optionally, cells that must be maximized or minimized.



New Feature

The Solver add-in has finally been updated in Excel 2010. It has a new look as well as some performance improvements.

Add-Ins

An *add-in* is a program that's attached to an application to give it additional functionality. To attach an Excel add-in, use the Add-Ins tab in the Excel Options dialog box.

In addition to the add-ins that ship with Excel, you can download additional add-ins from Microsoft's Web site (<http://office.microsoft.com>), and you can purchase or download many third-party add-ins from online services. You can use the coupon in the back of the book to acquire a discounted copy of the Power Utility Pak add-in. And, as I detail in Chapter 21, creating your own add-ins is *very* easy.

Macros and Programming

Excel has two built-in macro programming languages: XLM and VBA. The original XLM macro language is obsolete and has been replaced by VBA. Excel 2010 can still execute most XLM macros, and you can even create new ones. However, you can't record XLM macros. You'll want to use VBA to develop new macros.



Cross-Ref

Part III of this book is devoted to the VBA language.

File Format

A key consideration is file compatibility. Excel 97 through Excel 2003 all use the same file format, so file compatibility isn't a problem for these four versions. Microsoft introduced a new file format with Excel 2007, and it's also used in Excel 2010. Fortunately, Microsoft has made a *compatibility pack* available for Excel XP and Excel 2003. This compatibility pack enables these older versions of Excel to read and write the new file format.

It's important to understand the difference between file compatibility and feature compatibility. For example, even though the compatibility pack enables Excel 2003 to open files created by Excel 2010, it can't handle features that were introduced in later versions.



Cross-Ref

Refer to Chapter 4 for more information about Excel's file format and read Chapter 26 for more information about compatibility issues for developers.

Excel's Help System

One of Excel's most important features is its Help system. When you get stuck, simply click the question mark below the title bar (or press F1). Excel's Help window appears, and you can search or use the Table of Contents.



The Search button in the Help window is actually a drop-down control. Use the options to help narrow your search or to specify the source to search (see Figure 2-27).

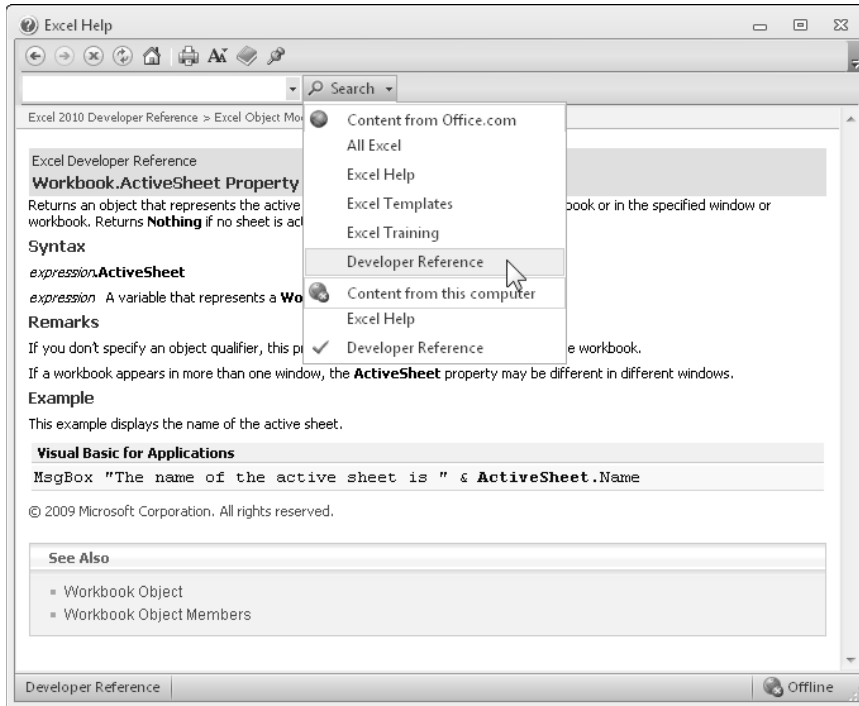


Figure 2-27: Excel's Help window.

Formula Tricks and Techniques

In This Chapter

- Getting an overview of Excel formulas
- Differentiating between absolute and relative references in formulas
- Understanding and using names
- Introducing array formulas
- Counting and summing cells
- Working with dates and times
- Creating megaformulas

About Formulas

Virtually every successful spreadsheet application uses formulas. In fact, constructing formulas can certainly be construed as a type of programming.



Note

For a much more comprehensive treatment of Excel formulas and functions, refer to my book, *Excel 2010 Formulas* (Wiley).

Formulas, of course, are what make a spreadsheet a spreadsheet. If it weren't for formulas, your worksheet would just be a static document — something that a word processor that has great support for tables could produce.

A formula entered into a cell can consist of any of the following elements:

- Operators such as + (for addition) and * (for multiplication)
- Cell references (including named cells and ranges)

- Numbers or text strings
- Worksheet functions (such as SUM or AVERAGE)

A formula in Excel 2010 can consist of up to 8,192 characters. After you enter a formula into a cell, the cell displays the result of the formula. The formula itself appears in the formula bar when the cell is activated. For a better view of a lengthy formula, click and drag the thick border of the formula bar to expand it vertically.

Calculating Formulas

You've probably noticed that the formulas in your worksheet get calculated immediately. If you change a cell that a formula uses, the formula displays a new result with no effort on your part. This is what happens when the Excel Calculation mode is set to Automatic. In this mode (which is the default mode), Excel uses the following rules when calculating your worksheet:

- When you make a change — enter or edit data or formulas, for example — Excel immediately calculates those formulas that depend on the new or edited data.
- If it's in the middle of a lengthy calculation, Excel temporarily suspends calculation when you need to perform other worksheet tasks; it resumes when you're finished.
- Formulas are evaluated in a natural sequence. In other words, if a formula in cell D12 depends on the result of a formula in cell D11, cell D11 is calculated before D12.

Sometimes, however, you might want to control when Excel calculates formulas. For example, if you create a worksheet with thousands of complex formulas, calculation might slow things down. In such a case, you should set Excel's calculation mode to Manual. Use the Calculation Options control in the Formulas→Calculation group.

When you're working in Manual Calculation mode, Excel displays *Calculate* in the status bar when you have any uncalculated formulas. You can press the following shortcut keys to recalculate the formulas:

- **F9** calculates the formulas in all open workbooks.
- **Shift+F9** calculates the formulas in the active worksheet only. Other worksheets in the same workbook won't be calculated.
- **Ctrl+Alt+F9** forces a recalculation of everything in all workbooks. Use it if Excel (for some reason) doesn't seem to be calculating correctly, or if you want to force a recalculation of formulas that use custom functions created with Visual Basic for Applications (VBA).
- **Ctrl+Alt+Shift+F9** rechecks all dependent formulas and calculates all cells in all workbooks (including cells not marked as needing to be calculated).



Note

Excel's Calculation mode isn't specific to a particular worksheet. When you change Excel's Calculation mode, it affects all open workbooks, not just the active workbook.

Cell and Range References

Most formulas refer to one or more cells. You can make cell references by using the cell's or range's address or name (if it has one). Cell references come in four styles:

- **Relative:** The reference is fully relative. When the formula is copied, the cell reference adjusts to its new location. Example: A1.
- **Absolute:** The reference is fully absolute. When the formula is copied, the cell reference doesn't change. Example: \$A\$1.
- **Row Absolute:** The reference is partially absolute. When the formula is copied, the column part adjusts, but the row part doesn't change. Example: A\$1.
- **Column Absolute:** The reference is partially absolute. When the formula is copied, the row part adjusts, but the column part doesn't change. Example: \$A1.

By default, all cell and range references are relative. To change a reference, you must manually add the dollar signs. Or, when editing a cell in the formula bar, move the cursor to a cell address and press F4 repeatedly to cycle through all four types of cell referencing.

Why use references that aren't relative?

If you think about it, you'll realize that the only reason why you would ever need to change a reference is if you plan to copy the formula. Figure 3-1 demonstrates why this is so. The formula in cell C3 is

=B3*C\$2

	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							
7							
8							
9							

Figure 3-1: An example of using nonrelative references in a formula.

This formula calculates the area for various lengths (listed in column B) and widths (listed in row 3). After the formula is entered, you can then copy it down to C7 and across to F7. Because the formula uses absolute references to row 2 and column B and relative references for other rows and columns, each copied formula produces the correct result. If the formula used only relative references, copying the formula would cause all the references to adjust and thus produce incorrect results.

About R1C1 notation

Normally, Excel uses what's known as *A1 notation*: Each cell address consists of a column letter and a row number. However, Excel also supports *R1C1 notation*. In this system, cell A1 is referred to as cell R1C1, cell A2 as R2C1, and so on.

To change to R1C1 notation, access the Formulas tab of the Excel Options dialog box. Place a check mark next to R1C1 Reference Style. After you do so, you'll notice that the column letters all change to numbers. All the cell and range references in your formulas are also adjusted.

Table 3-1 presents some examples of formulas that use standard notation and R1C1 notation. The formula is assumed to be in cell B1 (also known as R1C2).

Table 3-1: Comparing Simple Formulas In Two Notations

Standard	R1C1
=A1+1	=RC[-1]+1
=\$A\$1+1	=R1C1+1
=\$A1+1	=RC1+1
=A\$1+1	=R1C[-1]+1
=SUM(A1:A10)	=SUM(RC[-1]:R[9]C[-1])
=SUM(\$A\$1:\$A\$10)	=SUM(R1C1:R10C1)

If you find R1C1 notation confusing, you're not alone. R1C1 notation isn't too bad when you're dealing with absolute references. But when relative references are involved, the brackets can be very confusing.

The numbers in brackets refer to the relative position of the references. For example, R[-5]C[-3] specifies the cell that's five rows above and three columns to the left. On the other hand, R[5]C[3] references the cell that's five rows below and three columns to the right. If the brackets are omitted, the notation specifies the same row or column. For example, R[5]C refers to the cell five rows below in the same column.

Although you probably won't use R1C1 notation as your standard system, it *does* have at least one good use. Using R1C1 notation makes spotting an erroneous formula easy. When you copy a formula, every copied formula is exactly the same in R1C1 notation. This is true regardless of the types of cell references that you use (relative, absolute, or mixed). Therefore, you can switch to R1C1 notation and check your copied formulas. If one looks different from its surrounding formulas, there's a good chance that it might be incorrect.

In addition, if you write VBA code to create worksheet formulas, you might find it easier to create the formulas by using R1C1 notation.

Referencing other sheets or workbooks

When a formula refers to other cells, the references don't need to be on the same sheet as the formula. To refer to a cell in a different worksheet, precede the cell reference with the sheet name followed by an exclamation point. Here's an example of a formula that uses a cell reference in a different worksheet (Sheet2):

```
=Sheet2!A1+1
```

You can also create link formulas that refer to a cell in a different workbook. To do so, precede the cell reference with the workbook name (in square brackets), the worksheet name, and an exclamation point. Here's an example:

```
=[Budget.xlsx]Sheet1!A1
```

If the workbook name in the reference includes one or more spaces, you must enclose it (and the sheet name) in single quotation marks. For example:

```
='[Budget For 2010.xlsx]Sheet1'!A1
```

If the linked workbook is closed, you must add the complete path to the workbook reference. Here's an example:

```
= 'C:\Budgeting\Excel Files\[Budget For 2010.xlsx]Sheet1'!A1
```

Although you can enter link formulas directly, you can also create the reference by using normal pointing methods. To do so, the source file must be open. When you do so, Excel creates absolute cell references. If you plan to copy the formula to other cells, make the references relative.



Caution

Working with links can be tricky. For example, if you choose the File→Save As command to make a backup copy of the source workbook, you automatically change the link formulas to refer to the new file (not usually what you want to do). Another way to mess up your links is to rename the source workbook when the dependent workbook is not open.



Referencing Data in a Table

Beginning with Excel 2007, you can designate a range to be a table by using the Insert→Tables→Table command. Tables add a few new twists to formulas.

When you enter a formula into a cell in a table, Excel automatically copies the formula to all the other cells in the column — but only if the column was empty. This is known as a calculated column. If you add a new row to the table, the calculated column formula is entered automatically for the new row. Most of the time, this is exactly what you want. If you don't like the idea of Excel entering formulas for you, use the SmartTag to turn off this feature. The SmartTag appears after Excel enters the calculated column formula.

Excel also supports “structured referencing” for referring to cells within a table. The table in the accompanying figure is named Table1.

	A	B	C	D	E
1	Month	State	Income	Expenses	
2	Jan	Washington	983	462	
3	Feb	Washington	1,022	549	
4	Mar	Washington	861	503	
5	Jan	Oregon	764	398	
6	Feb	Oregon	993	425	
7	Mar	Oregon	882	387	
8	Total		5505	2724	
9					
10					

You can create formulas that refer to cells within the table by using the column headers. In some cases, using column headers may make your formulas easier to understand. But the real advantage is that your formulas will continue to be valid if rows are added or removed from the table. For example, these are all valid formulas that use table references:

```
=Table1[ [#Totals] , [Income] ]
=SUM( Table1 [Income] )
=Table1[ [#Totals] , [Income] ] - Table1[ [#Totals] , [Expenses] ]
=SUM( Table1 [Income] ) - SUM( Table1 [Expenses] )
=SUMIF( Table1 [State] , "Oregon" , Table1 [Income] )
=Table1 [ @Expenses ]
```

The last formula uses an each-at symbol (@), which means “this row.” This formula is valid only if it's in a cell in one of the rows occupied by the table.

Using Names

One of the most useful features in Excel is its ability to provide meaningful names for various items. For example, you can name cells, ranges, rows, columns, charts, and other objects. You can even name values or formulas that don't appear in cells in your worksheet. (See the “Naming constants” section, later in this chapter.)

Naming cells and ranges

Excel provides several ways to name a cell or range:

- Choose Formulas→Defined Names→Define Name to display the New Name dialog box.
- Use the Name Manager dialog box (Formulas→Defined Names→Name Manager or press Ctrl+F3). This method isn't the most efficient because it requires clicking the New button in the Name Manager dialog box, which displays the New Name dialog box.
- Select the cell or range and then type a name in the Name box and press Enter. The Name box is the drop-down control displayed to the left of the formula bar.
- If your worksheet contains text that you'd like to use for names of adjacent cells or ranges, select the text and the cells to be named and choose Formulas→Defined Names→Create from Selection. In Figure 3-2, for example, B3:E3 is named *North*, B4:E4 is named *South*, and so on. Vertically, B3:B6 is named *Qtr_1*, C3:C6 is named *Qtr_2*, and so on. Note that Excel changes the names to make them valid. (A hyphen isn't a valid character in a name.)

Using names is especially important if you write VBA code that uses cell or range references. The reason? VBA does not automatically update its references if you move a cell or range that's referred to in a VBA statement. For example, if your VBA code writes a value to `Range("C4")`, the data will be written to the wrong cell if the user inserts a new row above or a new column to the left of cell C4. Using a reference to a named cell, such as `Range("InterestRate")`, avoids these potential problems.

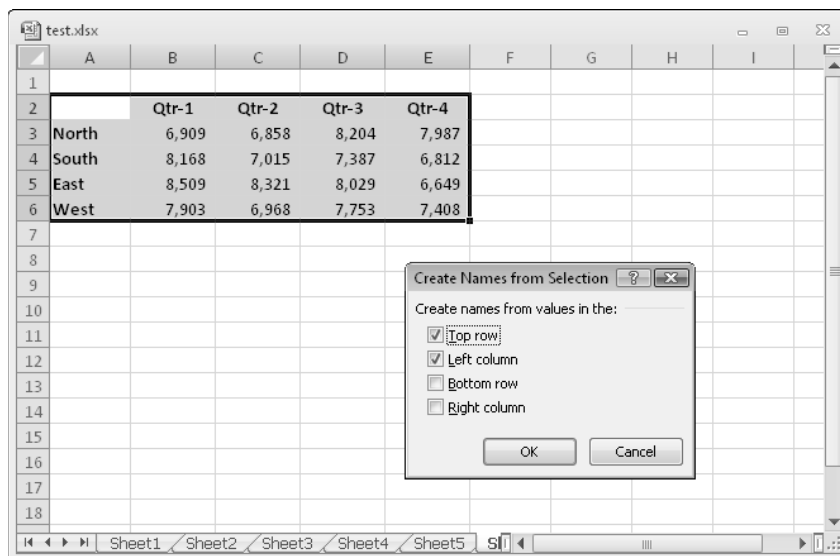


Figure 3-2: Excel makes it easy to create names that use descriptive text in your worksheet.

Applying names to existing references

When you create a name for a cell or a range, Excel doesn't automatically use the name in place of existing references in your formulas. For example, assume that you have the following formula in cell F10:

```
=A1-A2
```

If you define the names *Income* for A1 and *Expenses* for A2, Excel doesn't automatically change your formula to

```
=Income-Expenses
```

However, replacing cell or range references with their corresponding names is fairly easy. Start by selecting the range that contains the formulas that you want to modify. Then choose **Formulas**→**Defined Names**→**Define Name**→**Apply Names**. In the **Apply Names** dialog box, select the names that you want to apply and then click **OK**. Excel replaces the range references with the names in the selected cells.



Hidden names

Some Excel macros and add-ins create *hidden names*. Hidden names exist in a workbook but don't appear in the Name Manager dialog box. For example, the Solver add-in creates a number of hidden names. Normally, you can just ignore these hidden names. However, sometimes these hidden names create a problem. If you copy a sheet to another workbook, the hidden names are also copied, and they might create a link that is very difficult to track down.

You can use the following VBA procedure to delete all hidden names in the workbook:

```
Sub DeleteHiddenNames()  
    Dim n As Name  
    Dim Count As Integer  
    For Each n In ActiveWorkbook.Names  
        If Not n.Visible Then  
            n.Delete  
            Count = Count + 1  
        End If  
    Next n  
    MsgBox Count & " hidden names were deleted."  
End Sub
```

**Note**

Unfortunately, you can't automatically unapply names. In other words, if a formula uses a name, you can't convert the name to an actual cell or range reference. Even worse, if you delete a name that a formula uses, the formula doesn't revert to the cell or range address — it simply returns a `#NAME?` error.

My Power Utility Pak add-in (available by using the coupon in the back of the book) includes a utility that scans all formulas in a selection and automatically replaces names with their cell addresses.

Intersecting names

Excel has a special operator called the *intersection operator* that comes into play when you're dealing with ranges. This operator is a space character. Using names with the intersection operator makes creating meaningful formulas very easy. For this example, refer to Figure 3-2. If you enter the following formula into a cell

```
=Qtr_2 South
```

the result is 7,015 — the intersection of the *Qtr_2* range and the *South* range.

Naming columns and rows

Excel lets you name complete rows and columns. In the preceding figure, the name *Qtr_1* is assigned to the range B3:B6. Alternatively, *Qtr_1* could be assigned to all of column B, *Qtr_2* to column C, and so on. You also can do the same horizontally so that *North* refers to row 3, *South* to row 4, and so on.

The intersection operator works exactly as before, but now you can add more regions or quarters without having to change the existing names.

When naming columns and rows, make sure that you don't store any extraneous information in named rows or columns. For example, remember that if you insert a value in cell C7, it is included in the *Qtr_1* range.

Scoping names

A named cell or range normally has a workbook-level *scope*. In other words, you can use the name in any worksheet in the workbook.

Another option is to create names that have a worksheet-level scope. To create a worksheet-level name, define the name by preceding it with the worksheet name followed by an exclamation point: for example, *Sheet1!Sales*. If the name is used on the sheet in which it is designed, you can omit the sheet qualifier when you reference the name. You can, however, reference a worksheet-level name on a different sheet if you precede the name with the sheet qualifier.

The Name Manager dialog box (Formulas→Defined Names→Name Manager) makes identifying names by their scope easy (see Figure 3-3). Note that the dialog box is resizable, and you can adjust the column widths. You can also sort the information within this dialog box. For example, click the Scope column header, and the names are sorted by scope.

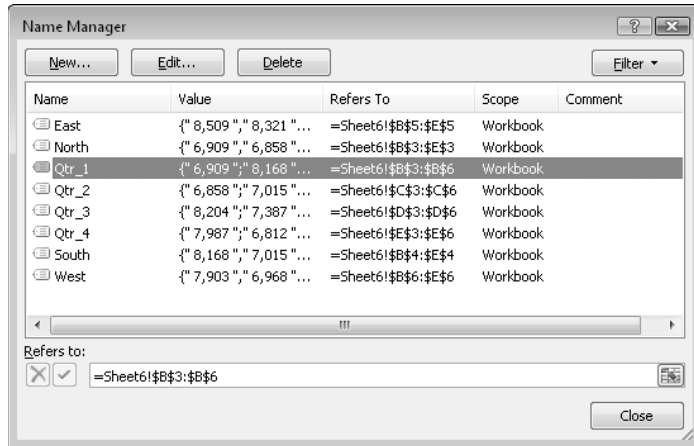


Figure 3-3: The Name Manager displays the scope for each defined name.

Naming constants

Virtually every experienced Excel user knows how to create cell and range names (although not all Excel users actually do so). But most Excel users don't know that you can use names to refer to values that don't appear in your worksheet — that is, *constants*.

Suppose that many formulas in your worksheet need to use a particular interest rate value. One approach is to type the interest rate into a cell and give that cell a name, such as *InterestRate*. After doing so, you can use that name in your formulas, like this:

```
=InterestRate*A3
```

An alternative is to call up the New Name dialog box (Formulas→Defined Names→Define Name) and enter the interest rate directly into the Refers To box (see Figure 3-4). Then you can use the name in your formulas just as if the value were stored in a cell. If the interest rate changes, just change the definition for *InterestRate*, and Excel updates all the cells that contain this name.



Tip

This technique also works for text. For example, you can define the name *IWC* to stand for *International Widget Corporation*. Then you can enter `=IWC` into a cell, and the cell displays the full name.

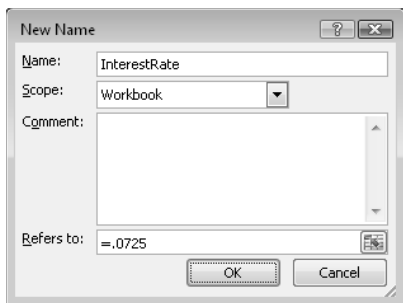


Figure 3-4: Excel lets you name constants that don't appear in worksheet cells.

Naming formulas

In addition to naming cells, ranges, and constants, you can also create named formulas. It's important to understand that a named formula, as described here, does not exist in a cell. A named formula exists only in memory. To create a named formula, enter a formula directly into the Refers To field in the New Name dialog box.



Note

This point is very important: The formula that you enter uses cell references relative to the active cell at the time that you create the named formula.

Figure 3-5 shows a formula ($=A1^B1$) entered directly in the Refers To box in the New Name dialog box. In this case, the active cell is C1, so the formula refers to the two cells to its left. (Notice that the cell references are relative.) After this name is defined, entering **=Power** into a cell raises the value two cells to the left to the power represented by the cell directly to the left. For example, if B10 contains 3 and C10 contains 4, entering the following formula into cell D10 returns a value of 81 (3 to the 4th power).

`=Power`

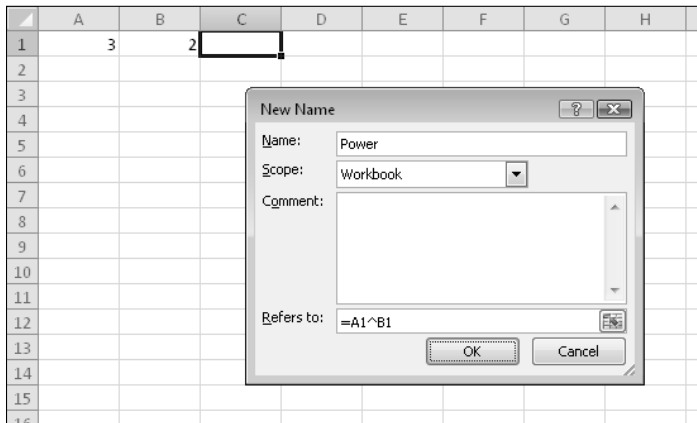


Figure 3-5: You can name a formula that doesn't appear in any worksheet cell.

When you display the Name Manager after creating the named formula, the Refers To column displays a formula that is relative to the current active cell. For example, if cell D32 is the active cell, the Refers To column displays

```
=Sheet1!B32^Sheet1!C32
```

Notice that Excel qualifies the cell references by adding the worksheet name to the cell references used in your formula. This, of course, will cause the named formula to produce incorrect results if you use it on a worksheet other than the one in which it was defined. If you'd like to use this named formula on a sheet other than Sheet1, you need to remove the sheet references from the formula (but keep the exclamation points). For example:

```
=!A1^!B1
```

After you understand the concept, you might discover some new uses for named formulas. One distinct advantage is apparent if you need to modify the formula. You can just change the formula one time rather than edit each occurrence of the formula.



On the CD

The companion CD-ROM contains a workbook with several examples of named formulas. The workbook is called `named formulas.xlsx`.



Tip

When you're working in the New Name dialog box, the Refers To field is normally in "point mode," which makes it easy to enter a range reference by clicking in the worksheet. Press F2 to toggle between point mode and normal editing mode, which allows you to use the arrow keys to edit the formula.



The secret to understanding cell and range names

Excel users often refer to *named ranges* and *named cells*. In fact, I use these terms frequently throughout this chapter. Actually, this terminology isn't quite accurate.

Here's the secret to understanding names:

When you create a name for a cell or a range in Excel, you're actually creating a named formula — a formula that doesn't exist in a cell. Rather, these named formulas exist in Excel's memory.

When you work with the New Name dialog box, the Refers To field contains the formula, and the Name field contains the formula's name. You'll find that the contents of the Refers To field always begin with an equal sign — which makes it a formula.

This isn't exactly an earthshaking revelation, but keeping this "secret" in mind could help you understand what's going on behind the scenes when you create and use names in your workbooks.

Naming objects

In addition to providing names for cells and ranges, you can give more meaningful names to objects such as pivot tables and shapes. Using meaningful names can make referring to such objects easier, especially when you refer to them in your VBA code.

To change the name of a nonrange object, use the Name box, which is located to the left of the formula bar. Just select the object, type the new name in the Name box, and then press Enter.



Note

If you simply click elsewhere in your workbook after typing the name in the Name box, the name won't stick. You *must* press Enter.

For some reason, Excel doesn't allow you to use the Name box to rename a chart. You must use Chart Tools→Layout→Properties→Chart Name.

Formula Errors

Entering a formula and receiving an error in return isn't uncommon. One possibility is that the formula you entered is the cause of the error. Another possibility is that the formula refers to a cell that has an error value. The latter scenario is known as the *ripple effect* — a single error value can make its way to lots of other cells that contain formulas that depend on the cell. The tools in the Formulas→Formula Auditing group can help you trace the source of formula errors.

Table 3-2 lists the types of error values that may appear in a cell that has a formula.

Table 3-2: Excel Error Values

Error Value	Explanation
#DIV/0!	The formula is trying to divide by 0 (zero), an operation that's not allowed on this planet. This error also occurs when the formula attempts to divide by a cell that is empty.
#N/A	The formula is referring (directly or indirectly) to a cell that uses the NA worksheet function to signal the fact that data isn't available. A LOOKUP function that can't locate a value also returns #N/A.
#NAME?	The formula uses a name that Excel doesn't recognize. This can happen if you delete a name that's used in the formula or if you have unmatched quotes when using text. A formula will also display this error if it uses a function defined in an add-in and that add-in isn't installed.
#NULL!	The formula uses an intersection of two ranges that don't intersect. (This concept is described in the section "Intersecting names," earlier in the chapter.
#NUM!	There is a problem with a function argument; for example, the SQRT function is attempting to calculate the square root of a negative number. This error also appears if a calculated value is too large or too small. Excel doesn't support nonzero values less than 1E-307 or greater than 1E+308 in absolute value.

continued

Table 3-2: Excel Error Values

#REF!	The formula refers to a cell that isn't valid. This can happen if that cell has been deleted from the worksheet.
#VALUE!	The formula includes an argument or operand of the wrong type. An operand is a value or cell reference that a formula uses to calculate a result. This error also occurs if your formula uses a custom VBA worksheet function that contains an error.
#####	A cell displays a series of hash marks under two conditions: The column isn't wide enough to display the result, or the formula returns a negative date or time value.

Array Formulas

In Excel terminology, an *array* is a collection of cells or values that is operated on as a group. An *array formula* is a special type of formula that works with arrays. An array formula can produce a single result, or it can produce multiple results — with each result displayed in a separate cell.

For example, when you multiply a 1 x 5 array by another 1 x 5 array, the result is a third 1 x 5 array. In other words, the result of this kind of operation occupies five cells; each element in the first array is multiplied by each corresponding element in the second array to create five new values, each getting its own cell. The array formula that follows multiplies the values in A1:A5 by the corresponding values in B1:B5. This array formula is entered into five cells simultaneously:

```
{=A1:A5*B1:B5}
```



Note

You enter an array formula by pressing Ctrl+Shift+Enter. To remind you that a formula is an array formula, Excel surrounds it with curly braces in the formula bar. When I present an array formula in this book, I enclose it in curly braces to distinguish it from a normal formula. Don't enter the braces yourself.

An array formula example

An array formula enables you to perform individual operations on each cell in a range in much the same way that a programming language's looping feature enables you to work with elements of an array. If you've never used array formulas before, this section will get your feet wet with a hands-on example.

Figure 3-6 shows a worksheet with text in A1:A5. The goal of this exercise is to create a *single formula* that returns the sum of the total number of characters in the range. Without the *single formula* requirement, you'd write a formula with the LEN function, copy it down the column, and then use the SUM function to add the results of the intermediate formulas.

	B1					
1	rabbit	29				
2	coyote					
3	quail					
4	deer					
5	javelina					

Figure 3-6: Cell B1 contains an array formula that returns the total number of characters contained in range A1:A5. Notice the brackets in the formula bar.

To demonstrate how an array formula can occupy more than one cell, create the worksheet shown in the figure and then try these steps:

1. Select the range B1:B5.
2. Type the following formula:

```
=LEN(A1:A5)
```

3. Press Ctrl+Shift+Enter.

The preceding steps enter a single array formula into five cells. Enter a SUM formula that adds the values in B1:B5, and you'll see that the total number of characters in A1:A5 is 29.

Here's the key point: It's not necessary to actually *display* those five array elements. Rather, Excel can store the array in memory. Knowing this, you can type the following single array formula in any blank cell (*Remember:* Don't type the curly brackets and make sure that you enter it by pressing Ctrl+Shift+Enter):

```
{=SUM(LEN(A1:A5))}
```

This formula essentially creates a five-element array (in memory) that consists of the length of each string in A1:A5. The SUM function uses this array as its argument, and the formula returns 29.

An array formula calendar

Figure 3-7 shows a worksheet set up to display a calendar for any month. (Change the month, and the calendar updates.) Believe it or not, the calendar is created with a single array formula that occupies 42 cells.

The array formula, entered in the range B5:H10, is

```
{=IF(MONTH(DATE(YEAR(B3),MONTH(B3),1))<>MONTH(DATE(YEAR(B3),
MONTH(B3),1)-(WEEKDAY(DATE(YEAR(B3),MONTH(B3),1))-1)
+{0;1;2;3;4;5}*7+{1,2,3,4,5,6,7}-1),"",
DATE(YEAR(B3),MONTH(B3),1)-(WEEKDAY(DATE(YEAR(B3),
MONTH(B3),1))-1)+{0;1;2;3;4;5}*7+{1,2,3,4,5,6,7}-1)}
```

The formula returns date serial numbers, and you need to format the cells to display the day number only by using a custom number format ("d").

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Figure 3-7: A single multicell array formula is all it takes to make a calendar for any month in any year.



On the CD

The companion CD-ROM contains a workbook with the calendar example, as well as several additional array formula examples. The file is named `array formula examples.xlsx`. In addition, you'll find a workbook named `yearly calendar.xlsx` that displays a calendar for a complete year.

Array formula pros and cons

The advantages of using array formulas rather than single-cell formulas include the following:

- They can sometimes use less memory.
- They can make your work much more efficient.
- They can eliminate the need for intermediate formulas.
- They can enable you to do things that would be difficult or impossible otherwise.

A few disadvantages of using array formulas are the following:

- Using many complex array formulas can sometimes slow your spreadsheet recalculation time to a crawl.
- They can make your worksheet more difficult for others to understand.
- You must remember to enter an array formula with a special key sequence (by pressing Ctrl+Shift+Enter).

Counting and Summing Techniques

A common task in Excel is conditional counting or summing. This section contains a number of formula examples that deal with counting various items on a worksheet, based on single or multiple criteria. You can adapt these formulas to your own needs.



Note

Excel 2007 introduced two new counting and summing functions that aren't available in previous versions (COUNTIFS and SUMIFS). Therefore, I present two versions of some formulas: an Excel 2007 and later version and an array formula that works with all recent versions of Excel.

Figure 3-8 shows a simple worksheet to demonstrate the formulas that follow. The following range names are defined:

	A	B	C	D	E	F	G	H
1	Month	Region	Sales			XL 2007+	All versions	Description
2	Jan	North	100				3	Count of Region
3	Jan	South	200				2	Count of Sales where Sales=300
4	Jan	West	300				2	Count of Sales where Sales>300
5	Feb	North	150				8	Count of Sales where Sales < 100
6	Feb	South	250				6	Count of Regions with five letters
7	Feb	West	350				6	Count of Regions that contain the letter "h"
8	Mar	North	200			1	1	Count of Sales where Month="Jan" and Sales >200
9	Mar	South	300			1	1	Count of Sales where Month="Jan" AND Region="North"
10	Mar	West	400			2	2	Count of Sales where Month="Jan" AND Region="North" or "South"
11						4	4	Count of Sales between 300 and 400
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								

XL 2007	All versions	Description
	1,600	Sum of Sales greater than 200
	600	Sum of Sales where Month="Jan"
	1,350	Sum of Sales where Month="Jan" or "Feb"
100	100	Sum of Sales where Month="Jan" AND Region="North"
500	500	Sum of Sales where Month="Jan" AND Region<"North"
500	500	Sum of Sales where Month="Jan" and Sales>= 200
1,350	1,350	Sum of Sales between 300 and 400

Figure 3-8: This worksheet demonstrates some useful formulas for counting and summing.

- **Month:** A2:A10
- **Region:** B2:B10
- **Sales:** C2:C10



On the CD

This workbook (including the formula examples) is available on the companion CD-ROM. The file is named `counting and summing examples.xlsx`.

Counting formula examples

Table 3-3 contains formulas that demonstrate a variety of counting techniques.

Table 3-3: Counting Formula Examples

Formula	Description
=COUNTIF(Region,"North")	Counts the number of rows in which Region = "North"
=COUNTIF(Sales,300)	Counts the number of rows in which Sales = 300
=COUNTIF(Sales,">300")	Counts the number of rows in which Sales > 300
=COUNTIF(Sales,"<>100")	Counts the number of rows in which Sales <> 100
=COUNTIF(Region,"?????")	Counts the number of rows in which Region contains five letters
=COUNTIF(Region,"*h*")	Counts the number of rows in which Region contains the letter H (not case-sensitive)
=COUNTIFS(Month,"Jan",Sales,">200")	Counts the number of rows in which Month = "Jan" and Sales > 200 (Excel 2007 and later)
{=SUM((Month="Jan")*(Sales>200))}	An array formula that counts the number of rows in which Month = "Jan" and Sales > 200
=COUNTIFS(Month,"Jan",Region,"North")	Counts the number of rows in which Month = "Jan" and Region = "North" (Excel 2007 and later)
{=SUM((Month="Jan")*(Region="North"))}	An array formula that counts the number of rows in which Month = "Jan" and Region = "North"
=COUNTIFS(Month,"Jan",Region,"North")+COUNTIFS(Month,"Jan",Region,"South")	Counts the number of rows in which Month = "Jan" and Region = "North" or "South" (Excel 2007 and later)
{=SUM((Month="Jan")*((Region="North")+(Region="South")))}	An array formula that counts the number of rows in which Month = "Jan" and Region = "North" or "South"
=COUNTIFS(Sales,">=300",Sales,"<=400")	Counts the number of rows in which Sales is between 300 and 400 (Excel 2007 and later)
{=SUM((Sales>=300)*(Sales<=400))}	An array formula that counts the number of rows in which Sales is between 300 and 400

Summing formula examples

Table 3-4 shows a number of formula examples that demonstrate a variety of summing techniques.

Table 3-4: Summing Formula Examples

Formula	Description
=SUMIF(Sales,">200")	Sum of all Sales over 200
=SUMIF(Month,"Jan",Sales)	Sum of Sales in which Month = "Jan"
=SUMIF(Month,"Jan",Sales)+SUMIF(Month,"Feb",Sales)	Sum of Sales in which Month = "Jan" or "Feb"

Formula	Description
<code>{=SUM((Month="Jan")*(Region="North")*Sales)}</code>	Sum of Sales in which Month="Jan" and Region="North"
<code>=SUMIFS(Sales,Month,"Jan",Region,"North")</code>	Sum of Sales in which Month="Jan" and Region="North" (Excel 2007 and later)
<code>{=SUM((Month="Jan")*(Region="North")*Sales)}</code>	An array formula that returns the sum of Sales in which Month="Jan" and Region="North"
<code>=SUMIFS(Sales,Month,"Jan",Region,"<>North")</code>	Sum of Sales in which Month="Jan" and Region <> "North" (Excel 2007 and later)
<code>{=SUM((Month="Jan")*(Region<>"North")*Sales)}</code>	An array formula that returns the sum of Sales in which Month="Jan" and Region <> "North"
<code>=SUMIFS(Sales,Month,"Jan",Sales,">=200")</code>	Sum of Sales in which Month="Jan" and Sales>=200 (Excel 2007 and later)
<code>{=SUM((Month="Jan")*(Sales>=200)*(Sales))}</code>	An array formula that returns the sum of Sales in which Month="Jan" and Sales>=200
<code>=SUMIFS(Sales,Sales,">=300",Sales,"<=400")</code>	Sum of Sales between 300 and 400 (Excel 2007 and later)
<code>{=SUM((Sales>=300)*(Sales<=400)*(Sales))}</code>	An array formula that returns the sum of Sales between 300 and 400

Other counting tools

Other ways to count or sum cells that meet certain criteria are:

- Filtering (using a table)
- Advanced filtering
- The DCOUNT and DSUM functions
- Pivot tables

For more information, consult the Help system.

Working with Dates and Times

Excel uses a serial number system to store dates. The earliest date that Excel can understand is January 1, 1900. This date has a serial number of 1. January 2, 1900, has a serial number of 2, and so on.

Most of the time, you don't have to be concerned with Excel's serial number date system. You simply enter a date in a familiar date format, and Excel takes care of the details behind the scenes. For example, if you need to enter August 15, 2010, you can simply enter the date by typing **August 15, 2010** (or use any of a number of different date formats). Excel interprets your entry and stores the value 40405, which is the serial number for that date.

**Note**

In this chapter, I assume the U.S. date system. If your computer uses a different date system, you'll need to adjust accordingly. For example, you might need to enter 15 August, 2010.

Entering dates and times

When working with times, you simply enter the time into a cell in a recognized format. Excel's system for representing dates as individual values is extended to include decimals that represent portions or fractions of days. In other words, Excel perceives all time with the same system whether that time is a particular day, a certain hour, or a specific second. For example, the date serial number for August 15, 2010, is 40405. Noon (halfway through the day) is represented internally as 40405.5. Again, you normally don't have to be concerned with these fractional serial numbers.

Because dates and times are stored as serial numbers, it stands to reason that you can add and subtract dates and times. For example, you can enter a formula to calculate the number of days between two dates. If cells A1 and A2 both contain dates, the following formula returns the number of intervening days:

```
=A2-A1
```

**Tip**

When performing calculations with time, things get a bit trickier. When you enter a time without an associated date, the date is assumed to be January 0, 1900 (date serial number 0). This is not a problem — unless your calculation produces a negative time value. When this happens, Excel displays an error (displayed as #####). The solution? Switch to the 1904 date system. Display the Excel Options dialog box, click the Advanced tab, and then enable the Use 1904 Date System check box. Be aware that switching to the 1904 date system can cause problems with dates already entered in your file or dates in workbooks that are linked to your file.

**Tip**

In some cases, you may need to use time values to represent duration, rather than a point in time. For example, you may need to sum the number of hours worked in a week. When you add time values, you can't display more than 24 hours. For each 24-hour period, Excel simply adds another day to the total. The solution is to change the number formatting to use square brackets around the hour part of the format. The following number format, for example, displays more than 24 hours:

```
[hh]:mm
```

Using pre-1900 dates

The world, of course, didn't begin on January 1, 1900. People who work with historical information when using Excel often need to work with dates before January 1, 1900. Unfortunately, the only way to work with pre-1900 dates is to enter the date into a cell as text. For example, you can enter the following into a cell, and Excel won't complain:

July 4, 1776

You can't, however, perform any manipulation on dates that are actually text. For example, you can't change its formatting, you can't determine which day of the week this date occurred on, and you can't calculate the date that occurs seven days later.

VBA, however, supports a much wider range of dates. I created a number of VBA worksheet functions that allow you to work with pre-1900 dates. Figure 3-9 shows a demonstration of these functions used in a worksheet. It's also an excellent example of how VBA can extend the features in Excel.

	A	B	C	D	E	F	G	H
4	Examples: President Birthdays							
5								
6	President	Year	Month	Day	XDATE	XDATEDIF	XDATEYEARDIF	XDATEDOW
7	George Washington	1732	2	22	February 22, 1732	101,398	277	Friday
8	John Adams	1735	10	30	October 30, 1735	100,052	273	Sunday
9	Thomas Jefferson	1743	4	13	April 13, 1743	97,330	266	Saturday
10	James Madison	1751	3	16	March 16, 1751	94,436	258	Tuesday
11	James Monroe	1758	4	28	April 28, 1758	91,836	251	Friday
12	John Quincy Adams	1767	7	11	July 11, 1767	88,475	242	Saturday
13	Andrew Jackson	1767	3	15	March 15, 1767	88,593	242	Sunday
14	Martin Van Buren	1782	12	5	December 5, 1782	82,849	226	Thursday
15	William Henry Harrison	1773	2	9	February 9, 1773	86,435	236	Tuesday
16	John Tyler	1790	3	29	March 29, 1790	80,178	219	Monday
17	James K. Polk	1795	11	2	November 2, 1795	78,134	213	Monday
18	Zachary Taylor	1784	11	24	November 24, 1784	82,129	224	Wednesday
19	Millard Fillmore	1800	1	7	January 7, 1800	76,607	209	Tuesday
20	Franklin Pierce	1804	11	23	November 23, 1804	74,826	204	Friday
21	James Buchanan	1791	4	23	April 23, 1791	79,788	218	Saturday
22	Abraham Lincoln	1809	2	12	February 12, 1809	73,284	200	Sunday
23	Andrew Johnson	1808	12	29	December 29, 1808	73,329	200	Thursday

Figure 3-9: The Extended Date Functions add-in lets you work with pre-1900 dates.



Cross-Ref

See Chapter 10 for more information about the Extended Date functions.

Creating Megaformulas

Often, a formula requires intermediate formulas to produce a desired result. In other words, a formula may depend on other formulas, which in turn depend on other formulas. After you get all these formulas working correctly, you can often eliminate the intermediate formulas and use what I refer to as a single *megaformula* instead. The advantages? You use fewer cells (less clutter), the file size is smaller, and recalculation may even be a bit faster. The main disadvantage is that the formula may be impossible to decipher or modify.

Here's an example: Imagine a worksheet that has a column with thousands of people's names. And suppose that you've been asked to remove all the middle names and middle initials from the names — but not all the names have a middle name or initial. Editing the cells manually would take hours, and even Excel's Data→Data Tools→Text To Columns command isn't much help. So you opt for a formula-based solution. Although this task isn't difficult, it normally involves several intermediate formulas.

Figure 3-10 shows the results of the more conventional solution, which requires six intermediate formulas shown in Table 3-5. The names are in column A; the end result goes in column H. Columns B through G hold the intermediate formulas.

	A	B	C	D	E	F	G	H
1	Name	Formula-1	Formula-2	Formula-3	Formula-4	Formula-5	Formula-6	Result
2	Bob Smith	Bob Smith	4	#VALUE!	4	Bob	Smith	Bob Smith
3	Mike A. Jones	Mike A. Jones	5	8	8	Mike	Jones	Mike Jones
4	Jim Ray Johnson	Jim Ray Johnson	4	8	8	Jim	Johnson	Jim Johnson
5	Tom Alvin Jacobs	Tom Alvin Jacobs	4	10	10	Tom	Jacobs	Tom Jacobs
6	John Q. Public	John Q. Public	5	8	8	John	Public	John Public
7	R.J Smith	R.J Smith	4	#VALUE!	4	R.J	Smith	R.J Smith
8	R. Jay Smith	R. Jay Smith	3	7	7	R.	Smith	R. Smith
9	Tim Jones	Tim Jones	4	#VALUE!	4	Tim	Jones	Tim Jones
10								

Figure 3-10: Removing the middle names and initials requires intermediate formulas.

Table 3-5: Intermediate Formulas Written In Row 2 in Figure 3-10

Column	Intermediate Formula	What It Does
B	=TRIM(A2)	Removes excess spaces.
C	=FIND(" ",B2,1)	Locates the first space.
D	=FIND(" ",B2,C2+1)	Locates the second space. Returns #VALUE! if there is no second space.
E	=IF(ISERROR(D2),C2,D2)	Uses the first space if no second space exists.
F	=LEFT(B2,C2)	Extracts the first name.
G	=RIGHT(B2,LEN(B2)-E2)	Extracts the last name.
H	=F2&G2	Concatenates the two names.

You can eliminate the intermediate formulas by creating a megaformula. You do so by creating all the intermediate formulas and then going back into the final result formula and replacing each cell reference with a copy of the formula in the cell referred to (without the equal sign). Fortunately, you can use the Clipboard to copy and paste. Keep repeating this process until cell H2 contains nothing but references to cell A2. You end up with the following megaformula in one cell:

```
=LEFT(TRIM(A2),FIND
(" ",TRIM(A2),1))&RIGHT(TRIM(A2),LEN(TRIM(A2))-
IF(ISERROR(FIND(" ",TRIM(A2),FIND(" ",TRIM(A2),1)+1)),
FIND(" ",TRIM(A2),1),FIND(" ",TRIM(A2),FIND
(" ",TRIM(A2),1)+1)))
```

When you're satisfied that the megaformula is working, you can delete the columns that hold the intermediate formulas because they're no longer used.

The megaformula performs exactly the same tasks as all the intermediate formulas — although it's virtually impossible for anyone to figure out, even the author. If you decide to use megaformulas, make sure that the intermediate formulas are performing correctly before you start building a megaformula. Even better, keep a single copy of the intermediate formulas somewhere in case you discover an error or need to make a change.

Another way to approach this problem is to create a custom worksheet function in VBA. Then you could replace the megaformula with a simple formula, such as

```
=NOMIDDLE(A1)
```

In fact, I wrote such a function to compare it with intermediate formulas and megaformulas. The listing follows.

```
Function NOMIDDLE(n) As String
    Dim FirstName As String, LastName As String
    n = Application.WorksheetFunction.Trim(n)
    FirstName = Left(n, InStr(1, n, " "))
    LastName = Right(n, Len(n) - InStrRev(n, " "))
    NOMIDDLE = FirstName & LastName
End Function
```



On the CD

A workbook that contains the intermediate formulas, the megaformula, and the NOMIDDLE VBA function is available on the companion CD-ROM. The workbook is named `megaformula.xlsm`.

Because a megaformula is so complex, you may think that using one slows down recalculation. Actually, that's not the case. As a test, I created a workbook that used the megaformula 175,000 times. Then I created another workbook that used six intermediate formulas to compute the 175,000 results. I compared the results in terms of calculation time and file size; see Table 3-6.

Table 3-6: Comparing Intermediate Formulas and Megaformula

Method	Recalculation Time (Seconds)	File Size
Intermediate formulas	5.8	12.60MB
Megaformula	3.9	2.95MB

The actual results will vary significantly, depending on system speed, amount of memory installed, and the actual formula.

The VBA function was much slower — I abandoned the timed test after five minutes. This is fairly typical of VBA functions; they are always slower than built-in Excel functions.

Understanding Excel Files

In This Chapter

- Starting Excel
- Opening and saving different types of files in Excel
- Introducing the XML file format in Excel 2007
- Figuring out how Excel uses the Windows Registry

Starting Excel

You can start Excel in various ways, depending on how it's installed. You can click an icon on the desktop, use the Windows Start button, or double-click a file associated with the Excel application. All methods ultimately launch the `excel.exe` executable file.

When Excel 2010 starts, it performs the following actions:

- It reads its settings stored in the Windows Registry.
- It reads and applies any Quick Access toolbar or Ribbon customizations defined in the `Excel.officeUI` file.
- It opens the `*.xlb` menu/toolbar customization file.
- It opens all add-ins that are installed (that is, those that are checked in the Add-Ins dialog box).
- It opens any workbooks that are in the XLStart directory.
- It opens any workbooks that are in the alternate start-up directory (specified in the Advanced tab of the Excel Options dialog box).
- It determines whether Excel ended with a crash the last time it was used. If so, it displays a list of autorecovered workbooks.
- It displays an empty workbook — unless the user specified a workbook to open or one or more files were found in the XLStart or alternate start-up directory.

You can install Excel in any location. But in most cases, the Excel executable file is located in the default installation directory:

```
C:\Program Files\Microsoft Office\Office14\EXCEL.EXE
```

You can create one or more shortcuts to this executable file and customize those shortcuts' various parameters, or command line switches. Table 4-1 lists these command line switches.

Table 4-1: Excel Command Line Switches

Switch	What It Does
filename	Opens the specified file. The filename is a parameter and does not require a switch.
/r filename	Opens the specified file in read-only mode.
/t filename	Opens the specified file as a template.
/n filename	Opens the specified file as a template (same as /t).
/e	Starts Excel without creating a new workbook and without displaying its splash screen.
/p directory	Sets the active path to a directory other than the default directory.
/s	Starts Excel in Safe mode and does not load any add-ins or files in the XLStart or alternate start-up file directories.
/m	Forces Excel to create a new workbook that contains a single Microsoft Excel 4.0 macro sheet (obsolete).

You can experiment with these command line switches by using the Windows Start→Run command (or use the Search box to start the Windows Run program). Put the path to Excel in quotes, followed by a space and the command line switch. Figure 4-1 shows an example.

One way to specify any of these switches is to edit the properties of the shortcut that starts Excel. For example, if there are times when you'd like Excel to start and use a folder named `c:\xlfiles` as its default folder, you can customize a Windows shortcut. In this case, you need to use the `/p` switch and specify the folder.

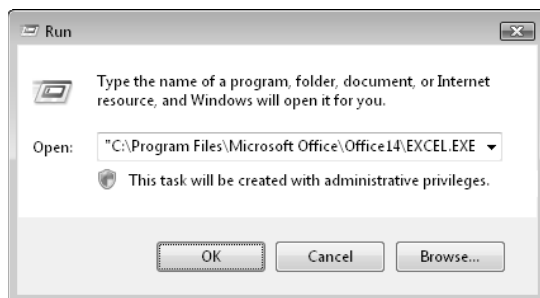


Figure 4-1: Starting Excel from the Windows Run dialog box.



The instructions that follow are for Windows Vista.

Start with an icon that launches Excel. Right-click the icon and choose Properties. In the Properties dialog box, click the Shortcut tab and enter the following in the Target field (see Figure 4-2):

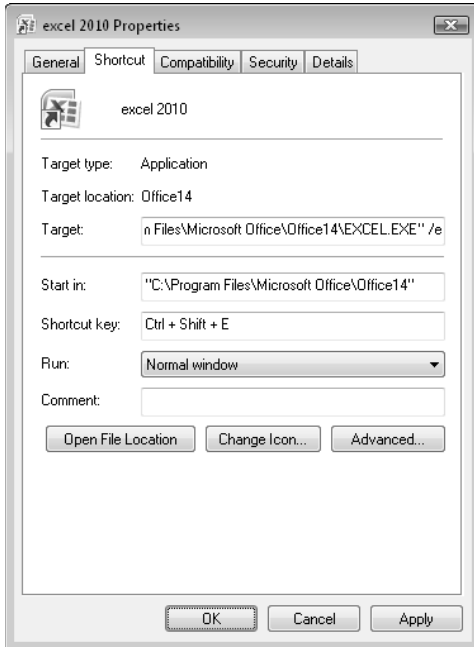


Figure 4-2: Customizing a shortcut to launch Excel.

```
"C:\Program Files\Microsoft Office\Office14\EXCEL.EXE" /p c:\xlfiles
```

Keep in mind that the path to `excel.exe` can vary for different installations and for different versions.

You can also assign a shortcut key to launch Excel, which can be useful. If Excel is already running, pressing the shortcut key activates Excel.



You can run multiple instances of Excel on a single system. Each instance is treated as a separate task. Most people have pretty good success running multiple *versions* of Excel on a single system. For best results, install the versions in the order of their release dates (earliest to newest).

File Types

Although the Excel 2010 default file format is an XLSX workbook file, the program can also open and save a wide variety of other file formats. This section provides an overview of the file types that Excel 2010 can handle.



Note

Beginning with Excel 2007, Microsoft removed support for Lotus and Quattro Pro spreadsheet file formats.

Excel file formats

Excel 2007 introduced a new default file format, and that format is also used in Excel 2010. However, these recent versions can still read and write older Excel file formats.



Tip

To change the default file save setting, choose File→Options and click the Save tab in the Excel Options dialog box. You'll find a drop-down list that lets you select the default file format.

Table 4-2 lists the Excel file types that Excel 2010 supports. Keep in mind that an Excel workbook or add-in file can have any extension that you like. In other words, these files don't need to be stored with the standard extensions shown in the table. However, Excel may display a warning if you try to open a file in which the content does not match the extension.

Table 4-2: Excel File Types

File Type	Extension	Read/Write	Notes
Excel Workbook	xlsx	Yes/Yes	The default Excel 2010 file format. It can't store VBA or XLM macro code.
Excel Macro-Enabled Workbook	xlsm	Yes/Yes	The Excel 2010 file format for workbooks that contain macros.
Excel Binary Workbook	xlsb	Yes/Yes	The Excel 2010 binary file format. It's an updated version of the previous XLS format.
Template	xltx	Yes/Yes	The Excel 2010 file format for a template. It can't store VBA or XLM macro code.
Macro-Enabled Template	xltm	Yes/Yes	The Excel 2010 file format for a template that contains macros.
Excel Add-In	xlam	Yes/Yes	The Excel 2010 file format for an add-in. It can store VBA and XLM macros.
Excel 97–Excel 2003 Workbook	xls	Yes/Yes	The Excel binary format (BIFF8) that's compatible with Excel 97 through Excel 2003.
Excel 97–Excel 2003 Template	xlt	Yes/Yes	The Excel binary template format (BIFF8) that's compatible with Excel 97 through Excel 2003.

File Type	Extension	Read/Write	Notes
Excel 97–Excel 2003 Add-In	xla	Yes/Yes	The Excel binary format (BIFF8) for add-ins that's compatible with Excel 97 through Excel 2003.
Microsoft Excel 5.0/95 Workbook	xls	Yes/Yes	The Excel binary format (BIFF5) that's compatible with Excel 5.0 and Excel 95.
XML Spreadsheet 2003	xml	Yes/Yes	Microsoft's XML Spreadsheet 2003 file format (XMLSS).



Note

Microsoft Office XP and Office 2003 users can install the **Microsoft Office Compatibility Pack**, which allows them to open and save documents in the Office 2010 and Office 2007 file formats. The Compatibility Pack is available at <http://office.microsoft.com>.

Text file formats

When you attempt to load a text file into Excel, the Text Import Wizard might kick in to help you specify how you want the file retrieved.



Tip

To bypass the Text Import Wizard, press the **Shift** key when you click **Open** in the **Open** dialog box.

Table 4-3 lists the text file types supported by Excel 2010. All text file formats are limited to a single worksheet.

Table 4-3: Text File Types

File Type	Extension	Read/Write	Notes
CSV (comma separated values)	csv	Yes/Yes	Columns are delimited with a comma, and rows are delimited with a carriage return. Excel supports subtypes for Macintosh and MS-DOS.
Formatted Text	prn	Yes/Yes	Columns are delimited with a space character, and rows are delimited with a carriage return.
Text	txt	Yes/Yes	Columns are delimited with a tab, and rows are delimited with a carriage return. Excel supports subtypes for Macintosh, MS-DOS, and Unicode.
Data Interchange Format (DIF)	dif	Yes/Yes	The file format originally used by VisiCalc.
Symbolic Link (SYLK)	slk	Yes/Yes	The file format originally used by Multiplan.

Database file formats

Table 4-4 lists the database file types supported by Excel 2010. All database file formats are limited to a single worksheet.

Table 4-4: Database File Types

File Type	Extension	Read/Write	Notes
Access	mdb, mde, accdb, accde	Yes/No	You can open one table from the database.
dBASE	dbf	Yes/No	The file format originally created by Ashton-Tate.
Others	Various	Yes/No	By using the commands in the Data→Get External Data group, you can import data from various data sources that have connections or queries defined on your system.

Other file formats

Table 4-5 lists the other file types supported by Excel 2010.

Table 4-5: Other File Types

File Type	Extension	Read/Write	Notes
Hypertext Markup Language (HTML)	htm, html	Yes/Yes	Beginning with Excel 2007, this file format no longer supports “round-tripping.” If you save a file and then re-open it, you may lose information.
Single File Web Page	mht, mhtml	Yes/Yes	Also known as Archived Web Page. The only browsers that can display these files are Microsoft Internet Explorer and Opera.
OpenDocument Spreadsheet	ods	Yes/Yes	A file format developed by Sun Microsystems and OASIS. Readable by open source spreadsheets, such as OpenOffice.
Portable Document Format (PDF)	pdf	No/Yes	The file format originated by Adobe.
XML Paper Specification	xps	No/Yes	Microsoft’s alternative to Adobe’s PDF.



Workspace files

A *workspace file* is a special file that contains information about an Excel workspace. For example, if you have a project that uses two workbooks and you like to have the workbook windows arranged in a particular way, you can save an XLW file to save this window configuration. Then, whenever you open the XLW file, Excel restores the desired workspace.

To save a workspace, choose View→Window→Save Workspace and provide a name when prompted.

To open a workspace file, use File→Open and select Workspaces (*.xlw) from the Files of Type drop-down list.

It's important to understand that a workspace file does *not* include the workbooks — only the configuration information that makes those workbooks visible in your Excel workspace. So if you need to distribute a workspace to someone else, make sure that you include the workbook files as well as the XLW file.

Working with Template Files

A *template* is essentially a model that serves as the basis for something else. An Excel template is a workbook that's used to create other workbooks. You can save any workbook as a template file (XLTX extension). Doing so is useful if you tend to create similar files on a regular basis. For example, you might need to generate a monthly sales report. You can save some time by creating a template that holds the necessary formulas and charts for your report. When you start new files based on the template, you need only to plug in the values.

Viewing templates

Excel gives you access to many templates. To explore the Excel templates, choose File→New to display the Available Templates screen.

The Office Online Templates section contains a number of categories. Click a category, and you'll see the available templates. To use a template, select it and click Download. Figure 4-3 shows some of templates available in the Invoices category.

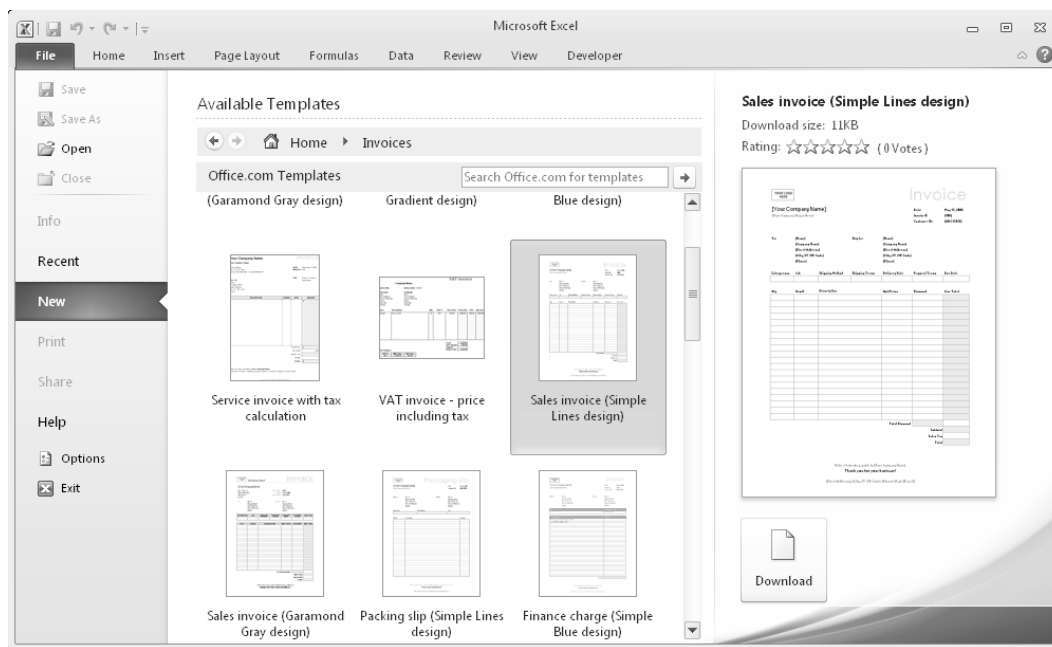


Figure 4-3: Templates that you can use for invoices.

Microsoft Office Online has a wide variety of templates, and some are better than others. If you download a few duds, don't give up. Even though a template may not be perfect, you can often modify a template to meet your needs. Modifying an existing template is often easier than creating a workbook from scratch.



Note

The location of the Templates folder varies, depending on the version of Excel. To find the location of your Templates folder, execute the following VBA statement:

```
MsgBox Application.TemplatesPath
```

Creating templates

Excel supports three types of templates:

- **The default workbook template:** Used as the basis for new workbooks. This file is named `book.xltx`.
- **The default worksheet template:** Used as the basis for new worksheets inserted into a workbook. This file is named `sheet.xltx`.
- **Custom workbook templates:** Usually, ready-to-run workbooks that include formulas. They can be as simple or as complex as you like. Typically, these templates are set up so that a user can simply plug in values and get immediate results.

Using the workbook template to change workbook defaults

Every new workbook that you create starts out with some default settings. For example, the workbook has three worksheets, the worksheets have gridlines, text appears in Calibri 11-point font, columns are 8.43 units wide, and so on. If you're not happy with any of the default workbook settings, you can change them.

Making changes to Excel's default workbook is fairly easy to do, and it can save you lots of time in the long run. Here's how you change Excel's workbook defaults:

1. Open a new workbook.
2. Add or delete sheets to give the workbook the number of worksheets that you want.
3. Make any other changes that you want to make, which can include column widths, named styles, page setup options, and many of the settings that are available in the two Display Options sections in the Advanced tab of the Excel Options dialog box.

To change the default formatting for cells, choose Home→Styles→Cell Styles and then modify the settings for the Normal style. For example, you can change the default font, size, or number format.

4. When your workbook is set up to your liking, choose File→Save As.
5. In the Save As dialog box, select Template (*.xltx) from the box labeled Save As Type.
6. Enter **book.xltx** for the filename.
7. Save the file in your \XLStart folder (*not* in your Templates folder).
8. Close the file.



Tip

To determine the location of \XLStart, execute this VBA statement:

```
MsgBox Application.StartupPath
```

After you perform the preceding steps, the new default workbook that appears when Excel is started is based on the `book.xltx` workbook template. You can also press Ctrl+N to create a workbook based on this template. If you ever want to revert back to the standard default workbook, just delete the `book.xltx` file.



Note

If you choose File→New and select Blank Workbook, the workbook will *not* be based on the `book.xltx` template. I don't know whether that's a bug or by design. In any case, it provides a way to override the custom `book.xltx` template if you need to.

Using the worksheet template to change worksheet defaults

When you insert a new worksheet into a workbook, Excel uses its built-in worksheet defaults for the worksheet. These defaults include items such as column width, row height, and so on. If you

don't like the default settings for a new worksheet, you can change them by following these steps:

1. Start with a new workbook and delete all the sheets except one.
2. Make any changes that you want to make, which can include column widths, named styles, page setup options, and many of the settings that are available in the Excel Options dialog box.
3. When your workbook is set up to your liking, choose File→Save As.
4. In the Save As dialog box, select Template (*.xltx) from the Save As Type box.
5. Enter **sheet.xltx** for the filename.
6. Save the file in your \XLStart folder (*not* in your Templates folder).
7. Close the file.
8. Close and restart Excel.

After performing this procedure, all new sheets that you insert by clicking the Insert Worksheet button (which is next to the last sheet tab) will be formatted like your `sheet.xltx` template. You can also press Shift+F11 to insert a new worksheet.

Creating workbook templates

The `book.xltx` and `sheet.xltx` templates discussed in the preceding section are two special types of templates that determine default settings for new workbooks and new worksheets. This section discusses other types of templates, referred to as *workbook templates*, which are simply workbooks that you set up as the basis for new workbooks or worksheets.

Why use a workbook template? The simple answer is that it saves you from repeating work. Assume that you create a monthly sales report that consists of your company's sales by region, plus several summary calculations and charts. You can create a template file that consists of everything except the input values. Then, when it's time to create your report, you can open a workbook based on the template, fill in the blanks, and be finished.



Note

You could, of course, just use the previous month's workbook and save it with a different name. This approach is prone to errors, however, because you easily can forget to use the Save As command and accidentally overwrite the previous month's file. Another option is to use the New From Existing icon in the New Workbook dialog box. This step creates a new workbook from an existing one, but gives a different name to ensure that the old file is not overwritten.

When you create a workbook that is based on a template, the default workbook name is the template name with a number appended. For example, if you create a new workbook based on a template named `Sales Report.xltx`, the workbook's default name is `Sales Report1`.

`xlsx`. The first time that you save a workbook that is created from a template, Excel displays its Save As dialog box so that you can give the template a new name if you want to.

A *custom template* is essentially a normal workbook, and it can use any Excel feature, such as charts, formulas, and macros. Usually, a template is set up so that the user can enter values and get immediate results. In other words, most templates include everything but the data, which is entered by the user.



Note

If your template contains macros, it must be saved as an Excel Macro-Enabled Template, with an XLTM extension.

Inside an Excel File

Excel 2010 uses an XML format for its workbooks, templates, and add-ins. These files are actually Zip compressed files. As such, they can be “unzipped” and examined.

Versions prior to Excel 2007 used a binary file format. Although the binary file format specifications are known, working with binary files is not easy. The Excel XML file format, on the other hand, is an *open format*. As such, these files can be created and manipulated using other software.

Dissecting a file

In this section, I describe the various parts within a typical Excel XLSM (macro-enabled) workbook file. The workbook, named `sample.xlsx`, is shown in Figure 4-4. It has one worksheet, one chart sheet, and a simple VBA macro. The worksheet contains a table, a button (from the Forms controls), a SmartArt diagram, and a photo of a flower.



On the CD

The `sample.xlsx` workbook is available on the companion CD-ROM.

To view the innards of an Excel 2010 file, you need to open an Explorer window and add a ZIP extension to the filename. So the `sample.xlsx` file is renamed to `sample.xlsx.zip`. You can then open the file by using any unzipping program. I use the Zip feature built into Windows Vista.



Note

If your system is set up to hide file extensions, I suggest that you turn off that option. In a Windows Explorer window, choose Tools→Folder Options and click the View tab. In the File and Folders section, remove the check mark from Hide Extensions For Known File Types.



Tip

You may prefer to extract the zipped files into an uncompressed directory. Doing so makes it easier to view the files. In Windows, right-click the filename and choose Extract All.

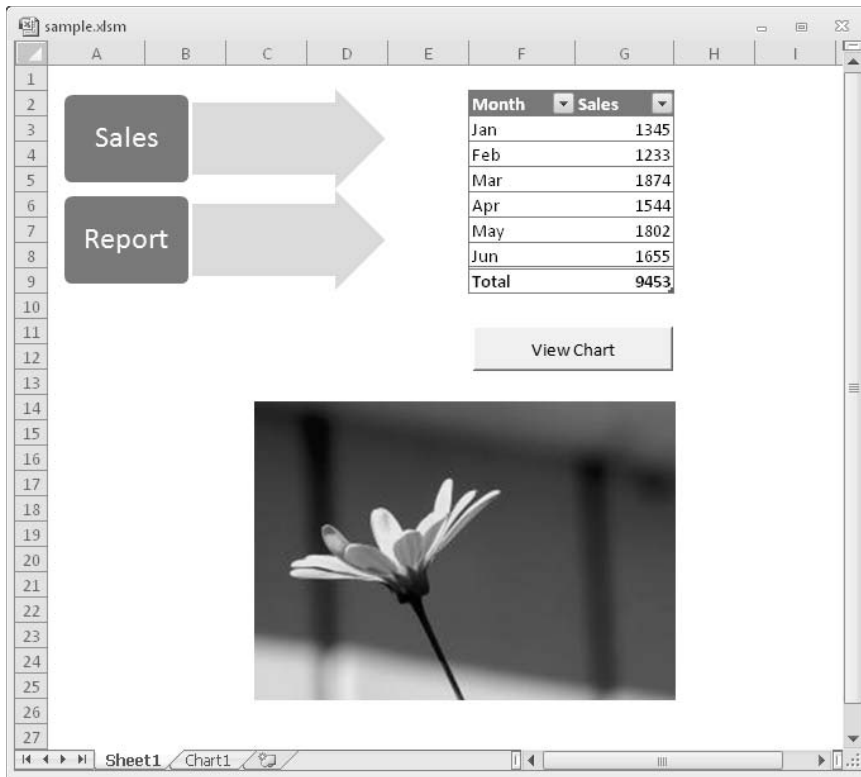


Figure 4-4: A simple workbook.

The first thing that you notice is that the file contains a directory structure. The left panel of Figure 4-5 shows the fully expanded directory structure for the workbook file. The actual directories will vary with the workbook.

With a few exceptions, all the files are text files. More specifically, they are XML files. You can view them in a text file editor, an XML editor, a Web browser, or even Excel. Figure 4-6 shows one of these files viewed in the Firefox browser. The non-XML files include graphic images and VBA projects (these are stored in binary format).

This XML file has four root-level folders, and some of these have subfolders. Many of the folders contain a `_rels` folder. These folders contain XML files that define the relationships to other parts within the package.

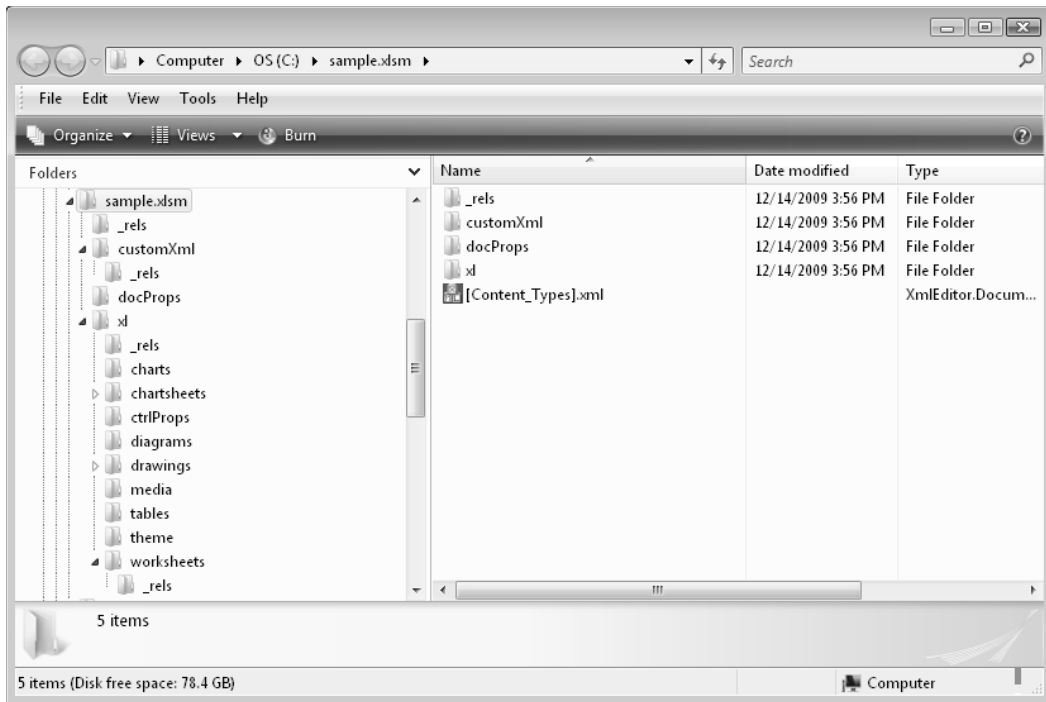


Figure 4-5: The directory structure of the workbook file.

Following is a list of the folders in the `sample.xlsm` workbook:

- *_rels*: Contains information about the package relationships.
- *customXml*: Contains information about Ribbon enhancements stored in the workbook.
- *docProps*: Contains XML files that describe the file properties and application settings.
- *xl*: Holds the meat of the file. The folder name varies with the Office document type (xl, ppt, word, and so on). You'll find several XML files that contain settings for the workbook. And if your workbook contains VBA code, it will be in a binary file with a BIN extension. The xl folder has several subfolders. (Some workbooks may have more or fewer subfolders, depending on the content.)
 - *charts*: Contains an XML file for each chart. This file contains the chart settings.
 - *chartsheets*: Contains an XML file with data for each chart sheet in the workbook.
 - *diagrams*: Contains XML files that describe the diagrams (SmartArt) in the workbook.
 - *drawings*: Contains an XML file with data for each *drawing*. Drawings include items such as buttons, charts, and images.

- *media*: Contains embedded media, such as GIF and JPG files.
- *tables*: Contains an XML file with data for each table.
- *theme*: Contains an XML file with data about the workbook's theme.
- *worksheets*: Contains an XML file for each worksheet in the workbook.

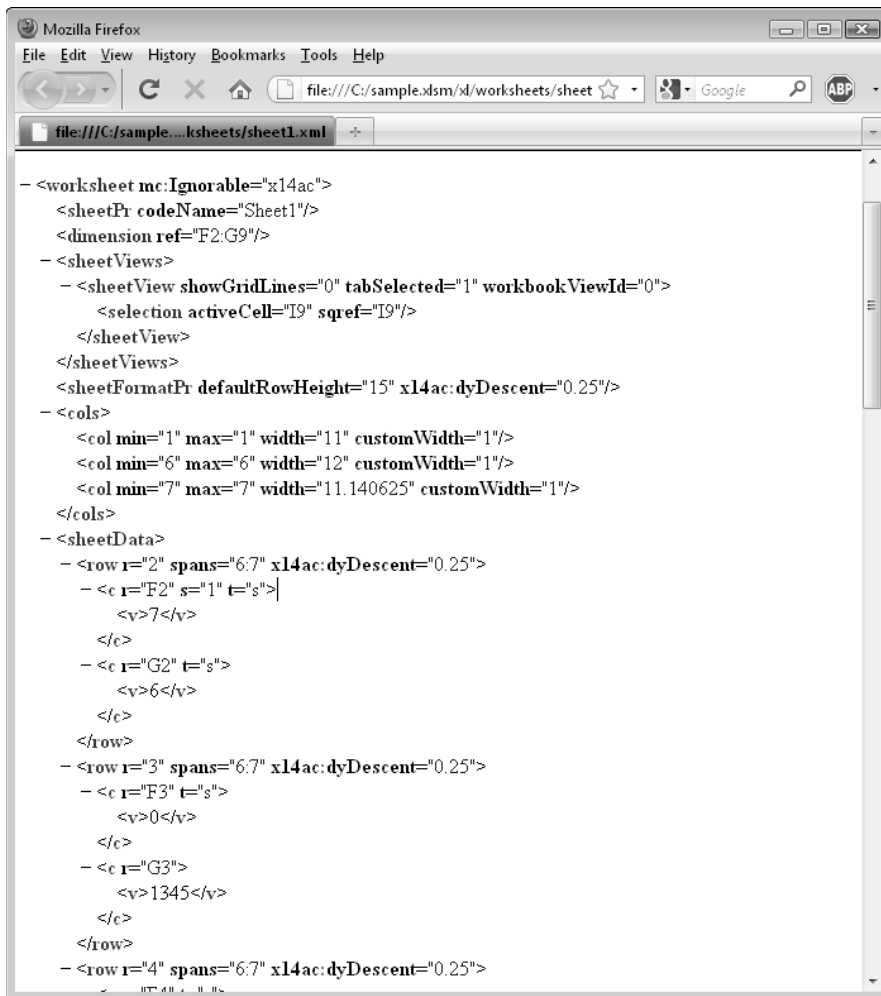


Figure 4-6: Viewing an XML file in a Web browser.



Tip

If you add a ZIP extension to an Excel file, you can still open it in Excel — although you'll get a warning message first. Also, you can save a workbook with a ZIP extension. In the Save As dialog box, add a ZIP extension and then place double quotation marks around the entire filename — for example, "Myworkbook.xlsx.zip".

Why is the file format important?

The open XML file formats introduced in Microsoft Office 2007 represent a significant step for the computing community. For the first time, it's relatively easy to read and write Excel workbooks using software other than Excel. For example, you can write a program to modify thousands of Excel workbook files without even opening Excel. Such a program could insert a new worksheet into every file. The programmer, of course, would need to have excellent knowledge of the XML file structures, but such a task is definitely doable.

Importantly, the new file formats are somewhat less prone to corruption (compared to the old binary formats). I saved a workbook file and then deleted one of the worksheet XML files. When I tried to reopen it in Excel, I got the message shown in Figure 4-7. Excel was able to tell that the file was damaged by comparing the information in the `.res` files with what's actually in the file. In this case, Excel was able to repair the file and open it. The deleted worksheet was re-inserted, but it was empty.

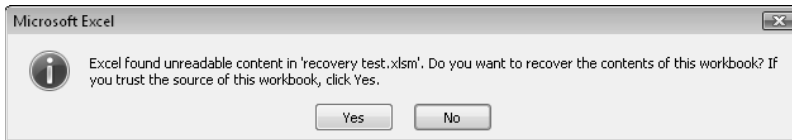


Figure 4-7: Excel can often repair a damaged workbook file.

In addition, the zipped XML files are usually smaller than comparable binary files. And, finally, the structured nature of the files makes extracting individual elements (for example, all graphic images) possible.

The typical Excel user won't need to examine or modify the XML components of a workbook file. But, as a developer, you may want to write code that changes Excel's Ribbon user interface. If that's the case, you *will* need to be at least somewhat familiar with the structure of a workbook XML file.



Cross-Ref

Refer to Chapter 22 for more information about modifying Excel's Ribbon.

The OfficeUI File

A file named `Excel.officeUI` stores changes made to the Quick Access toolbar and Ribbon. This XML file is located here:

```
C:\Users\\AppData\Local\Microsoft\Office
```

This file is updated whenever a change is made to the Quick Access toolbar or to the Ribbon. It's updated immediately, not when Excel is closed. This file doesn't exist unless you've made at least one change to the user interface.

You can view `Excel.officeUI` using an XML editor, a Web browser, or Excel. To view this file in Excel, follow these steps:

1. Make a copy of the `Excel.officeUI` file.
2. Add an XML extension to the copy of the file so that the name is `Excel.officeUI.XML`.
3. Choose **File**→**Open** to open the file or just drag it into Excel's window.
4. You'll see a dialog box with some options; choose **As an XML Table**.

Figure 4-8 shows an imported `Excel.officeUI` file (the file is displayed as a table). In this case, the Quick Access toolbar has two commands enabled (rows 12 and 13 in the table), and I added a new tab and group, with two commands (rows 14 and 15 in the table).

It's possible to share an `Excel.officeUI` file with other users. For example, you may have customized your Quick Access toolbar with some handy tools, and added a new Ribbon tab with lots of useful commands, nicely organized. If a colleague is impressed, just give him a copy of your `Excel.officeUI` file and tell him where to put it. Keep in mind that replacing an existing `Excel.officeUI` file will overwrite any changes your colleague has made.

Don't attempt to modify the `Excel.officeUI` file unless you know what you're doing. But feel free to experiment. If Excel reports an error in the `Excel.officeUI` file at start-up, you can just delete the file, and Excel will create a new one. Better yet, keep a backup copy of the original.

	A	B	C	D	E	F	G	H	I	J	
1	idQ	visible	insertBeforeQ	id	label	insertBefore	id3	label4	autoScale	idQ5	
2	mso:FileNewDefault	FALSE									
3	mso:FileOpen	FALSE									
4	mso:FileSave	TRUE									
5	mso:FileSendAsAttachmer	FALSE									
6	mso:Spelling	FALSE	mso:FilePrintQuick								
7	mso:Undo	TRUE	mso:FilePrintQuick								
8	mso:Redo	TRUE	mso:FilePrintQuick								
9	mso:SortAscendingExcel	FALSE	mso:FilePrintQuick								
10	mso:SortDescendingExcel	FALSE	mso:FilePrintQuick								
11	mso:FileOpenRecentFile	FALSE	mso:FilePrintQuick								
12	mso:FilePrintQuick	TRUE									
13	mso:FilePrintPreview	TRUE									
14				mso_c1.72439f My Tab	mso:TabInser	mso_c2.72439f My Group	TRUE	mso:About			G
15				mso_c1.72439f My Tab	mso:TabInser	mso_c2.72439f My Group	TRUE	mso:ApplicationOptionsDialog			
16											
17											

Figure 4-8: Viewing an `Excel.officeUI` data file in Excel.

The XLB File

Excel stores customized toolbar and menu bar configurations in an XLB file. Even though Excel 2010 doesn't officially support custom toolbars and menus in the way that it did in previous versions, it still uses an XLB file if you use any applications that create toolbars or custom menus. If you can't find an XLB file, it means that Excel isn't storing any custom toolbar or menu configurations.

When you exit Excel, the current toolbar configuration is saved in a file named `Excel12.xlb`. This file is (most likely) located here:

```
C:\Users\<username>\AppData\Roaming\Microsoft\Excel
```

This binary file contains information regarding the position and visibility of all custom toolbars and custom menu bars, plus modifications that you've made to built-in toolbars or menu bars.

Add-In Files

An *add-in* is essentially an Excel workbook file with a few important differences:

- The workbook's `IsAddin` property is `True` — which means that it can be loaded and unloaded by using the Add-Ins dialog box.
- The workbook is hidden and cannot be unhidden by the user. Consequently, an add-in is never the active workbook.
- When using VBA, the add-in workbook is not part of the `Workbooks` collection.



Tip

Access the Add-Ins dialog box by choosing `File→Excel Options`. Click the `Add-Ins` tab, select `Excel Add-Ins` from the `Manage` list, and click `Go`. If you've set up Excel to display the `Developer` tab, you can also use `Developer→Add-Ins→Addins`. Or (easiest of all), just press `Alt+TI`, a handy key combination leftover from Excel 2003.

Many add-ins provide new features or functions to Excel. You can access these new features as if they were built into the product.

You can create your own add-ins from workbook files. In fact, creating add-ins is the preferred method of distributing some types of Excel applications. Excel 2010 add-ins have an XLAM extension by default.



Note

Besides XLAM add-ins, Excel supports XLL add-ins and COM add-ins. These types of add-ins are created using software other than Excel. This book discusses only XLAM add-ins.



Cross-Ref

Chapter 21 covers the topic of add-ins in detail.

Excel Settings in the Registry

The Excel Options dialog box has dozens of user-specified options. Excel uses the Windows Registry to store these settings and retrieve them when Excel is started. In this section, I provide some background information about the Windows Registry and discuss how Excel uses the Registry to store its settings.

About the Registry

The *Windows Registry* is essentially a central hierarchical database that is used by the operating system and by application software. The Registry first appeared in Windows 95 and replaces the old INI files that stored Windows and application settings.



Cross-Ref

Your VBA macros can also read and write information to the Registry. Refer to Chapter 11 for details.

You can use the Registry Editor program (included with Windows) to browse the Registry — and even to edit its contents if you know what you’re doing. The Registry Editor is named `regedit.exe`. Before beginning your explorations, take a minute to read the sidebar “Before You Edit the Registry. . .” Figure 4-9 shows what the Registry Editor looks like.

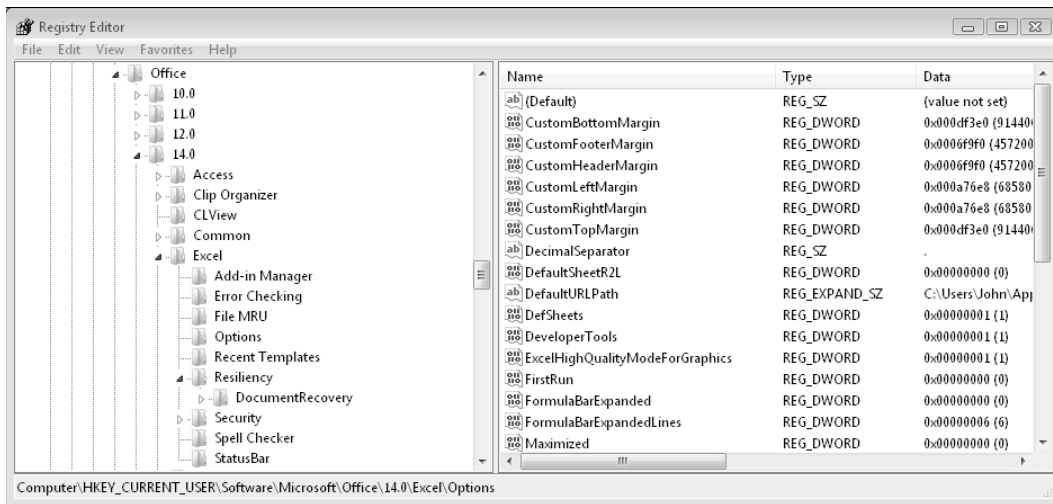


Figure 4-9: The Registry Editor lets you browse and make changes to the Registry.



Before you edit the Registry . . .

You can use the `regedit.exe` program to change anything in the Registry, including information that is critical to your system's operation. In other words, if you change the wrong piece of information, Windows may no longer work properly.

Get into the habit of choosing the File→Export command in Regedit. This command enables you to save an ASCII version of the entire Registry or just a specific branch of the Registry. If you find that you messed up something, you can always import the ASCII file to restore the Registry to its previous condition (choose the File→Import command). Refer to the Help file for Regedit for details.

The Registry consists of keys and values, arranged in a hierarchy. The top-level keys are

- `HKEY_CLASSES_ROOT`
- `HKEY_CURRENT_USER`
- `HKEY_LOCAL_MACHINE`
- `HKEY_USERS`
- `HKEY_CURRENT_CONFIG`

Excel's settings

Information used by Excel 2010 is stored in this Registry section:

```
HKEY_CURRENT_USER\Software\Microsoft\Office\14.0\Excel
```

In this section of the Registry, you'll find a number of keys that contain specific values that determine how Excel operates.

The Registry settings are updated automatically by Excel when Excel closes.



Note

It's important to understand that Excel reads the Windows Registry only once — when it starts up. In addition, Excel updates the Registry settings only when Excel closes normally. If Excel crashes (unfortunately, not an uncommon occurrence), the Registry information is not updated. For example, if you change one of Excel's settings, such as the visibility of the formula bar, this setting is not written to the Registry until Excel closes by normal means.

Table 4-6 lists some of the Registry sections that are relevant to Excel 2010. You may not find all these sections in your Registry database, and you may find some others.

Table 4-6: Excel Configuration Information in the Registry

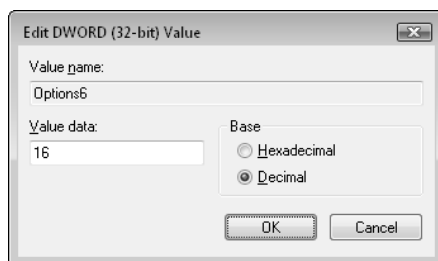
Section	Description
Add-In Manager	Lists add-ins that appear in the Add-Ins dialog box. Add-ins that are included with Excel do not appear in this list. If you have an add-in entry in this list box that you no longer use, you can remove it by using the Registry Editor.
Converters	Lists additional (external) file converters that are not built into Excel.
Error Checking	Holds the settings for formula error checking
File MRU	Holds information about the most recently used files (which appears in the Recent Documents list when you choose File→Recent).
Options	A catch-all section; holds a wide variety of settings.
Recent Templates	Stores the names of templates you've used recently.
Resiliency	Information used for recovering documents.
Security	Specifies the security options for opening files that contain macros.
Spell Checker	Stores information about your spell checker options.
StatusBar	Stores the user choices for what appears in the status bar.
UserInfo	Stores information about the user.

Although you can change most of the settings via the Excel Options dialog box, you can't change a few settings directly from Excel (but you can use the Registry Editor to make changes). For example, when you select a range of cells, you may prefer that the selected cells appear in high contrast white-on-black. There is no way to specify this setting in Excel, but you can add a new Registry key like this:

1. Open the Registry Editor and locate this section:

```
HKEY_CURRENT_USER\Software\Microsoft\Office\14.0\Excel\Options
```

2. Right-click and choose New→DWORD Value.
3. Name this value **Options6**.
4. Right-click the Options6 key and select Modify.
5. In the Edit DWORD Value dialog box, click the Decimal option and enter **16** (see Figure 4-10).

**Figure 4-10:** Setting a value for a Registry setting.

When you restart Excel, range selections will appear with a black background rather than the usual light blue. If you don't like this look, just delete the Options6 Registry entry.



If you have trouble starting Excel, the Registry keys may have become corrupt. You can try using the Registry Editor to delete the entire Excel section:

```
HKEY_CURRENT_USER\Software\Microsoft\Office\14.0\Excel
```

The next time Excel starts, it will rebuild the Registry keys. You will, however, lose all the customization information that was stored there.

PART

II

Excel Application Development

CHAPTER 5

What Is a Spreadsheet Application?

CHAPTER 6

Essentials of Spreadsheet Application Development

What Is a Spreadsheet Application?

In This Chapter

- Getting a working definition of a spreadsheet application
- Understanding the difference between a spreadsheet user and a spreadsheet developer
- Classifying spreadsheet users to help you conceptualize the audience for your applications
- Discussing why people use spreadsheets
- Exploring a taxonomy of the basic types of spreadsheets

Spreadsheet Applications

For the purposes of this book, a *spreadsheet application* is a *spreadsheet file* (or group of related files) that is designed so that someone other than the developer can perform useful work without extensive training. According to this definition, most of the spreadsheet files that you've developed probably don't qualify as spreadsheet applications. You may have dozens or hundreds of spreadsheet files on your hard drive, but it's a safe bet that most of them aren't really designed for others to use.

A good spreadsheet application has the following characteristics:

- It enables the end user to perform a task that he or she probably would not be able to do otherwise.
- It provides the appropriate solution to the problem. (A spreadsheet environment isn't always the optimal approach.)
- It accomplishes what it is supposed to do. This prerequisite may be obvious, but it's not at all uncommon for applications to fail this test.

- It produces accurate results and is free of bugs.
- It uses appropriate and efficient methods and algorithms to accomplish its job.
- It traps errors before the user is forced to deal with them.



Note

Note that errors and bugs are not the same. Attempting to divide by zero is an *error*, whereas failure to identify that error before it occurs is a *bug*.

- It does not allow the user to delete or modify important components accidentally (or intentionally).
- Its user interface is clear and consistent so that the user always knows how to proceed.
- Its formulas, macros, and user interface elements are well documented, allowing for subsequent changes, if necessary.
- It is designed so that it can be modified in simple ways without making major changes. A basic fact of life is that a user's needs change over time.
- It has an easily accessible help system that provides useful information on at least the major procedures.
- It is designed to be portable and to run on any system that has the proper software (in this case, a copy of the appropriate version of Excel).

It should come as no surprise that it is possible to create spreadsheet applications for many different usage levels, ranging from simple fill-in-the-blank templates to extremely complex applications that use a custom interface and that may not even look like spreadsheets.

The Developer and the End User

I've already used the terms *developer* and *end user*, and you will see them frequently throughout this book. Because you've gotten this far, I think I can safely assume that you're either a spreadsheet application developer or a potential developer.

My definitions regarding developers and end users are simple. The person who creates the spreadsheet application is the *developer*. For joint projects, there are multiple developers: a development *team*. The person who uses the results of the developer's spreadsheet programming efforts is the *end user* (which I often shorten to simply *user*). In many cases, there will be multiple end users, and often the developer is one of the users.

Who are developers? What do they do?

I've spent about 20 years trading methodologies and hanging out (usually in a virtual manner online) with the motley crew of folks who call themselves spreadsheet developers. I divide them into two primary groups:

- **Insiders** are developers who are intimately involved with the users and thoroughly understand their needs. In many cases, these developers are also users of the application. Often, they develop an application in response to a particular problem.
- **Outsiders** are developers who are hired to produce a solution to a problem. In most cases, developers in this category are familiar with the business in general but not with the specifics of the application they are developing. In other cases, these developers are already employed by the company that requests the application (but they normally work in a different department).

Some developers devote all their time to development efforts. These developers may be either insiders or outsiders. A fair number of consultants (outsiders) make a decent living developing spreadsheet applications on a freelance basis.

Other spreadsheet developers don't work full time at the task and may not even realize they are developing spreadsheet applications. These developers are often office computer gurus who seem to know everything about computers and software. These folks often create spreadsheet applications as a way to make their lives easier — the time spent developing a well-designed application for others can often save hours of training time and can greatly reduce the time spent answering others' questions.

Spreadsheet developers are typically involved in the following activities, often performing most or all of each task on their own:

- Determining the needs of the user
- Planning an application that meets these needs
- Determining the most appropriate user interface
- Creating the spreadsheet, formulas, macros, and user interface
- Testing the application under all reasonable sets of conditions
- Making the application relatively user-friendly (often based on results from the testing)
- Making the application aesthetically appealing and intuitive
- Documenting the development effort
- Distributing the application to users
- Updating the application if and when it's necessary



Cross-Ref

I discuss these developer activities in more detail in Chapter 6.

Developers must have a thorough understanding of their development environment (in this case, Excel). And there's certainly a lot to know when it comes to Excel. Developing nontrivial spreadsheet applications with Excel requires an in-depth knowledge of formulas, functions, macros,

custom dialog boxes, user interface elements, and add-ins. Most Excel users, of course, don't meet these qualifications and have no intention of ever learning these details — which brings me to the next topic: classifying spreadsheet users.

Classifying spreadsheet users

Over the years, I've found that it's often useful to classify people who use spreadsheets (including both developers and end users) along two dimensions: their *degree of experience* with spreadsheets and their *interest in learning* about spreadsheets.

To keep things simple, each of these two dimensions has three levels. These levels can be combined in nine combinations, which are shown in Table 5-1. In reality, only seven segments are worth thinking about because both moderately experienced and very experienced spreadsheet users generally have at least *some* interest in spreadsheets. (After all, that's what motivated them to get their experience.) Users who have a lot of spreadsheet experience and a low level of interest would make very bad developers.

Table 5-1: Classification of Spreadsheet Users by Experience and Interest

	No Interest	Moderately Interested	Very Interested
Little Experience	User	User	User/Potential Developer
Moderately Experienced	N/A	User	Developer
Very Experienced	N/A	User	Developer

It should be clear that spreadsheet developers must have a great deal of experience with spreadsheets as well as a high interest in spreadsheets. Those with little spreadsheet experience but a great deal of interest are potential developers. All they need is more experience. If you're reading this book, you probably fall into one of the boxes in the last column of the table.

The audience for spreadsheet applications

The remaining segments in the preceding table comprise spreadsheet end users, whom you can think of as the consumers of spreadsheet applications. When you develop a spreadsheet application for others to use, you need to know which of these groups of people will actually be using your application.

Users with little experience and no interest in learning more about spreadsheets make up a large percentage of all spreadsheet users, probably the largest group of all. These are the people who need to use a spreadsheet for their jobs but who view the spreadsheet simply as a means to an end. Typically, they know very little about computers and software, and they usually have no interest in learning anything more than what's required to get their work done. They might even feel a bit intimidated by computers. Often, these users don't even know which version of Excel they use, and they are largely unfamiliar with what it can do. Obviously, applications developed for this group must be user-friendly. By that I mean straightforward, unintimidating, easy to use, and as foolproof as possible.

From the developer's point of view, a more interesting group is comprised of users who have little or moderate spreadsheet experience but who are interested in learning more. These users understand the concept of formulas, use worksheet functions, and generally have a good idea of what the product is capable of doing. These users generally appreciate the work that you put into an application and are often impressed by your efforts. Even better, they'll often make excellent suggestions for improving your applications. Applications developed for this group should also be user-friendly, but they can also be more complex and customizable than applications designed for the less experienced and less interested groups.

Solving Problems with Excel

In the previous sections, I cover the basic concept of a spreadsheet application, discuss the end users and developers of such applications, and even attempt to figure out why people use spreadsheets at all. Now, it's time to take a look at the types of tasks that are appropriate for spreadsheet applications.

You may already have a good idea of the types of tasks for which you can use a spreadsheet. Traditionally, spreadsheet software has been used for numerical applications that are largely interactive. Corporate budgets are an excellent example of this interactivity. After the model has been set up (that is, after formulas have been developed), working with a budget is simply a matter of plugging in amounts and observing the bottom-line totals. Often, budgeters simply need to allocate fixed resources among various activities and present the results in a reasonably attractive (or at least legible) format. Excel, of course, is ideal for this scenario.

Budget-type problems, however, probably account for only a small percentage of your spreadsheet-development time. If you're like me, you've learned that uses for Excel can often extend well beyond the types of tasks for which spreadsheets were originally designed.

Here are just a few examples of nontraditional ways that you can use Excel:

- **As a presentation device:** For example, with minimal effort, you can create an attractive, interactive, on-screen slide show with only Excel. PowerPoint is a better choice, but Excel will do in a pinch.
- **As a data-entry tool:** For repetitive data-entry tasks, a spreadsheet is often the most efficient route to take. You can then export the data to a variety of formats for use in other programs.
- **As a database manager:** If you're dealing with a fairly small amount of data, you may find it much easier to manage it using Excel rather than a program like Access.
- **As a forms generator:** For creating attractive printed forms, many find it easier to use Excel's formatting capabilities than to learn a desktop publishing package.
- **As a text processor:** Excel's text functions and macro capability enable you to manipulate text in ways that are impossible using a word processor.
- **As a platform for simple games:** Clearly, Excel was not designed with gaming in mind. However, I've downloaded (and written) some interesting strategy games by using the tools found in Excel and other spreadsheets.

You can probably think of many more examples for this list.

Ironically, the versatility of spreadsheets is a double-edged sword. On one hand, it's tempting to try to use a spreadsheet for every problem that crops up. On the other hand, you'll often be spinning your wheels by trying to use a spreadsheet for a problem that's better suited for a different solution.

Basic Spreadsheet Types

In this section, I classify spreadsheets into several basic types to provide a better perspective on how spreadsheet applications fit into the overall scheme of things. This is all quite arbitrary, of course, and is based solely on my own experience. Moreover, the categories have quite a bit of overlap, but they cover most of the spreadsheets that I've seen and developed.

My names for these categories are as follows:

- Quick-and-dirty
- For-your-eyes-only
- Single-user applications
- Spaghetti applications
- Utility applications
- Add-ins that contain worksheet functions
- Single-block budgets
- What-if models
- Data storage and access
- Database front ends
- Turnkey applications

I discuss each of these categories in the following sections.

Quick-and-dirty spreadsheets

This is probably the most common type of spreadsheet. Most of the spreadsheets in this category are fairly small and are developed to quickly solve a problem or answer a question. Here's an example: You're about to buy a new car, and you want to figure out your monthly payment for various loan amounts. Or perhaps you need to generate a chart that shows your company's sales by month, so you quickly enter 12 values and whip out a chart, which you paste into your word processor.

In both of the preceding cases, you can probably input the entire model in a few minutes, and you certainly won't take the time to document your work. You probably won't even think of developing any macros or custom dialog boxes. In fact, you might not even deem these simple spreadsheets worthy of saving to disk. Obviously, spreadsheets in this category are not applications.

For-your-eyes-only spreadsheets

As the name implies, no one except you — the creator — will ever see or use the spreadsheets that fall into this category. An example of this type might be a file in which you keep information relevant to your income taxes. You open the file whenever a check comes in the mail, you incur an expense that can be justified as business, you buy tax-deductible Girl Scout cookies, and so on. Another example is a spreadsheet that you use to keep track of your employees' time records (sick leave, vacation, and so on).

Spreadsheets in this category differ from quick-and-dirty spreadsheets in that you use them more than once, so you save these spreadsheets to files. But, again, they're not worth spending a great deal of time on. You might apply some simple formatting, but that's about it. This type of spreadsheet also lacks any type of error detection because you understand how the formulas are set up; you know enough to avoid inputting data that will produce erroneous results. If an error does crop up, you immediately know what caused it.

Spreadsheets in this category don't qualify as applications, although they sometimes increase in sophistication over time.

Single-user applications

This is a spreadsheet application that only the developer uses, but its complexity extends beyond the spreadsheets in the for-your-eyes-only category. For example, I developed a workbook to keep track of registered users for my software applications. It started out as a simple worksheet database (for my eyes only), but then I realized that I could also use it to generate mailing labels and invoices. One day I spent an hour or so writing macros and then realized that I had converted this workbook from a for-your-eyes-only spreadsheet to a single-user application.

Creating single-user applications for yourself is an excellent way to get practice with Excel's developer's tools. For example, you can learn to create custom dialog boxes, modify the user interface, write Visual Basic for Applications (VBA) macros, and so on.



Tip

Working on a meaningful project (even if it's meaningful only to you) is the best way to learn advanced features in Excel — or any other software, for that matter.

Spaghetti applications

An all-too-common type of spreadsheet is what I call a *spaghetti application*. The term stems from the fact that the parts of the application are difficult to follow, much like a plate of

spaghetti. Most of these spreadsheets begin life as a reasonably focused, single-user application. But over time, they're passed along to others who make their own modifications. As requirements change and employees come and go, new parts are added, and others are ignored. Before too long, the original purpose of the workbook may have been forgotten. The result is a file that is used frequently, but no one really understands exactly how it all works.

Everyone who's involved with it knows that the spaghetti application should be completely reworked. But because nobody really understands it, the situation tends to worsen over time. Spreadsheet consultants make a lot of money untangling such applications. I've found that, in many cases, the most efficient solution is to redefine the users' needs and build a new application from scratch.

Utility applications

Good as it is, I still find quite a bit lacking in Excel. This brings me to the next category of spreadsheets: *utility applications*. Utilities are special tools designed to perform a single recurring task. For example, if you often import text into Excel, you may want some additional text-handling commands, such as the ability to convert selected text to uppercase (without using formulas). The solution? Develop a text-handling utility that does exactly what you want.



Note

The Power Utility Pak is a collection of utility applications for Excel. I developed these utilities to extend Excel's functionality. These utilities work just like normal Excel commands. You can download a trial version of the Power Utility Pak from my Web site (www.spreadsheetpage.com), and you can get a discounted copy of the licensed version by using the coupon located at the back of the book. And if you're interested, the complete VBA source code is also available for a small fee.

The best utility applications are very general in nature. Most macros are designed to perform a specific operation on a specific type of data found in a specific type of workbook. A good utility essentially works like a command normally found in Excel. In other words, the utility needs to recognize the context in which a command is executed and take appropriate action. This usually requires quite a bit of error-handling code so that the utility can handle any situation that comes up.

Utility applications always use macros and may or may not use custom dialog boxes. Fortunately, Excel makes creating such utilities relatively easy, and they can be converted to add-ins and attached to Excel's user interface so that they appear to be part of Excel.



Cross-Ref

The topic of creating utilities is so important that I devote an entire chapter to it. Chapter 16 discusses how to create custom Excel utilities with VBA.

Add-ins that contain worksheet functions

As you know, Excel has many worksheet functions that you can use in formulas. Chances are that you've needed a particular function, only to find that it doesn't exist. The solution? Create your

own by using VBA. Custom worksheet functions can often simplify your formulas and make your spreadsheet easier to maintain.



Cross-Ref

In Chapter 10, you'll find everything you need to know about creating custom worksheet functions, including lots of examples.

Single-block budgets

By a *single-block budget*, I mean a spreadsheet (not necessarily a budget model) that essentially consists of one block of cells. The top row might contain names that correspond to time (months, quarters, or years), and the left column usually contains categories of some type. Typically, the bottom row and right column contain formulas that add the numbers together. There may or may not be formulas that compute subtotals within the block.

This is a very common type of spreadsheet. In most cases, simple single-block budget models are not good candidates for applications because they are simple to begin with, but there *are* exceptions. For example, you might consider converting such a spreadsheet into an application if the model is an unwieldy 3-D spreadsheet, needs to include consolidations from other files, or will be used by departmental managers who may not understand spreadsheets.

What-if models

Many consider the what-if model category to be the epitome of spreadsheets at their best. The ability to instantly recalculate thousands of formulas makes spreadsheet software the ideal tool for financial modeling and other models that depend on the values of several variables. If you think about it, just about any spreadsheet that contains formulas is a what-if model (which are often distributed as templates). Changing the value of a cell used in a formula is akin to asking “what if . . .?” My view of this category, however, is a bit more sophisticated. It includes spreadsheets designed exclusively for systematically analyzing the effects of various inputs.

What-if models often benefit from additional work to make them more user-friendly, especially if the model will be used for a lengthy period of time. Creating a good user interface on an application can make it very easy for anyone to use, including computer-illiterates. As an example, you might create an interface that lets users provide names for various sets of assumptions and then lets them instantly view the results of a selected scenario and create a perfectly formatted summary chart with the click of a button.

Data storage and access spreadsheets

A large percentage of Excel workbooks consist of one or more database tables (sometimes known as *lists*). These tables are used to track just about anything you can think of. Most people find that it's much easier to view and manipulate data in a spreadsheet than it is using normal database software. If the tables are set up properly, they can be summarized with a pivot table.

Spreadsheets in this category are often candidates for applications, especially if end users need to perform things like data validation and pivot table summaries.

For more sophisticated database applications, such as those that use multiple tables with relationships between them, you'll be better off using a real database program such as Access.

Database front ends

Increasingly, spreadsheet products are used to access external databases. Spreadsheet users can access data stored in external files, even if they come in a variety of formats, by using tools that Excel provides. When you create an application that does this, it's sometimes referred to as an *executive information system*, or *EIS*. This sort of system combines data from several sources and summarizes it for users.

Accessing external databases from a spreadsheet often strikes fear in the hearts of beginning users. Creating an executive information system is therefore an ideal sort of Excel application because its chief goal is usually ease of use.

Turnkey applications

The final category of spreadsheet types is the most complex. By *turnkey*, I mean ready to go, with little or no preparation by the end user. For example, the user loads the file and is presented with a user interface that makes user choices perfectly clear. Turnkey applications may not even look as if they are being powered by a spreadsheet, and, often, the user interacts completely with dialog boxes rather than cells. I've heard these types of applications referred to as "dictator applications" because the user can perform only the operations that the developer has allowed.

Actually, you can convert many of the categories just described into turnkey applications. The critical common elements, as I discuss throughout the remainder of the book, include good planning, error handling, and user interface design.

Essentials of Spreadsheet Application Development

In This Chapter

- Discovering the basic steps involved in spreadsheet application development
- Determining end users' needs
- Planning applications to meet users' needs
- Developing and testing your applications
- Documenting your development efforts and writing user documentation

Steps for Application Development

There is no simple, surefire recipe for developing an effective spreadsheet application. Everyone has his or her own style for creating such applications, and I haven't discovered one best way that works for everyone. In addition, every project is different and, therefore, requires its own approach. Finally, the demands and technical expertise of the people you work with (or for) also play a role in how the development process proceeds.

As I mention in the preceding chapter, spreadsheet developers typically perform the following activities:

- Determine the needs of the user(s)
- Plan an application that meets these needs
- Determine the most appropriate user interface
- Create the spreadsheet, formulas, macros, and user interface
- Test and debug the application
- Attempt to make the application bulletproof

- Make the application aesthetically appealing and intuitive
- Document the development effort
- Develop user documentation and Help systems
- Distribute the application to the user
- Update the application when necessary

Not all these steps are required for each application, and the order in which these activities are performed varies from project to project. I describe each of these activities in the pages that follow, and in most cases, I cover the technical details in subsequent chapters.

Determining User Needs

When you undertake a new Excel project, one of your first steps is to identify exactly what the end users require. Failure to thoroughly assess the end users' needs early on often results in additional work later when you have to adjust the application so that it does what it was supposed to do in the first place.

In some cases, you'll be intimately familiar with the end users — you may even be an end user yourself. In other cases (for example, if you're a consultant developing a project for a new client), you may know little or nothing about the users or their situations.

How do you determine the needs of the user? If you've been asked to develop a spreadsheet application, it's a good idea to meet with the end users and ask very specific questions. Better yet, get everything in writing, create flow diagrams, pay attention to minor details, and do anything else to ensure that the product you deliver is the product that is needed.

Here are some guidelines that may help make this phase easier:

- Don't assume that you know what the user needs. Second-guessing at this stage almost always causes problems later on.
- If possible, talk directly to the end users of the application, not just their supervisor or manager.
- Learn what, if anything, is currently being done to meet the users' needs. You might be able to save some work by simply adapting an existing application. At the very least, looking at current solutions will familiarize you with the operation.
- Identify the resources available at the user's site. For example, try to determine whether you must work around any hardware or software limitations.
- If possible, determine the specific hardware systems that will be used. If your application will be used on slower systems, you need to take that into account. See the later section "System speed."

- Identify which version(s) of Excel is (are) in use. Although Microsoft does everything in its power to urge users to upgrade to the latest version of the software, the majority of Excel users haven't upgraded to the most recent version.
- Understand the skill levels of the end users. This information will help you design the application appropriately.
- Determine how long the application will be used and whether any changes are anticipated during the lifetime of the project. Knowing this information may influence the amount of effort that you put into the project and help you plan for changes.

One final note: Don't be surprised if the project specifications change before you complete the application. This occurrence is quite common, and you're in a better position if you expect changes rather than being surprised by them. Just make sure that your contract (if you have one) addresses the issue of changing specifications.

Planning an Application That Meets User Needs

After you determine the end users' needs, it's very tempting to jump right in and start fiddling around in Excel. Take it from someone who suffers from this problem: Try to restrain yourself. Builders don't construct a house without a set of blueprints, and you shouldn't build a spreadsheet application without some type of plan. The formality of your plan depends on the scope of the project and your general style of working, but you should spend at least *some* time thinking about what you're going to do and coming up with a plan of action.

Before rolling up your sleeves and settling down at your keyboard, you'll benefit by taking some time to consider the various ways you can approach the problem. This planning period is where a thorough knowledge of Excel pays off. Avoiding blind alleys rather than stumbling into them is always a good idea.

If you ask a dozen Excel experts to design an application based on very precise specifications, chances are that you'll get a dozen different implementations of the project that meet those specifications. Of those solutions, some will definitely be better than the others because Excel often provides several different options to accomplish a task. If you know Excel inside and out, you'll have a good idea of the potential methods at your disposal, and you can choose the one most appropriate for the project at hand. Often, a bit of creative thinking yields an unusual approach that's vastly superior to other methods.

So at the beginning stage of this planning period, consider some general options, such as these:

- **File structure:** Think about whether you want to use one workbook with multiple sheets, several single-sheet workbooks, or a template file.
- **Data structure:** You should always consider how your data will be structured, and also determine whether you will be using external database files or storing everything in worksheets.

- **Formulas versus VBA:** Should you use formulas or write Visual Basic for Applications (VBA) procedures to perform calculations? Both methods have advantages and disadvantages.
- **Add-in or workbook file:** In some cases, an add-in may be the best choice for your final product. Or, perhaps you might use an add-in in conjunction with a standard workbook.
- **Version of Excel:** Will your Excel application be used with Excel 2010 only? With Excel 2007? What about Excel 2003 and earlier versions? Will your application also be run on a Macintosh? These considerations are very important because each new version of Excel adds features that aren't available in previous versions. The new user interface introduced in Excel 2007 makes it more challenging than ever to create an application that works with older versions.
- **Error handling:** Error handling is a major issue with applications. You need to determine how your application will detect and deal with errors. For example, if your application applies formatting to the active worksheet, you need to be able to handle a case in which a chart sheet is active.
- **Use of special features:** If your application needs to summarize a lot of data, you may want to consider using Excel's pivot table feature. Or, you may want to use Excel's data validation feature as a check for valid data entry.
- **Performance issues:** The time to start thinking about increasing the speed and efficiency of your application is at the development stage, not when the application is completed and users are complaining.
- **Level of security:** As you may know, Excel provides several protection options to restrict access to particular elements of a workbook. For example, you can lock cells so that formulas cannot be changed, and you can assign a password to prevent unauthorized users from viewing or accessing specific files. Determining up front exactly what you need to protect — and what level of protection is necessary — will make your job easier.



Note

Be aware that Excel's protection features aren't 100-percent effective — far from it. If you desire complete and absolute security for your application, Excel probably isn't the best platform.

You'll probably have to deal with many other project-specific considerations in this phase. The important thing is that you consider all options and don't settle on the first solution that comes to mind.

Another design consideration is remembering to plan for change. You'll do yourself a favor if you make your application as generic as possible. For example, don't write a procedure that works with only a specific range of cells. Rather, write a procedure that accepts any range as an argument. When the inevitable changes are requested, such a design makes it easier for you to carry out the revisions. Also, you may find that the work that you do for one project is similar to the work that you do for another. Keeping reusability in mind when you are planning a project is always a good idea.



Learning while you develop

Now a few words about reality: Excel is a moving target. Excel's upgrade cycle is approximately 18 to 24 months, which means that you have fewer than two years to get up to speed with its current innovations before you have even more innovations to contend with.

Excel 5, which introduced VBA, represented a major paradigm shift for Excel developers. Thousands of people up until that point earned their living developing Excel applications (in Excel 2, 3, and 4) that were largely based on the XLM macro language. Beginning with Excel 5, dozens of new tools became available, and developers, for the most part, eagerly embraced them.

When Excel 97 became available, developers faced yet another shift. This new version introduced a new file format, the Visual Basic Editor (VBE), and UserForms as a replacement for dialog sheets. Excel 2000, 2002, and 2003 introduced additional features, but these changes weren't as radical as those in previous upgrades.

Excel 2007 was perhaps the most significant upgrade ever. The key challenge is dealing with the new Ribbon user interface. In the past, creating custom menus and toolbars was relatively easy, and you could do it entirely using VBA. But modifying the Ribbon requires quite a bit of additional work, and you'll need to go beyond VBA to make it happen. In addition, the new file formats will require some additional considerations. You may find it more efficient to create two versions of your applications: one for Excel 2007 and 2010, and one for Excel 2003 and earlier versions.

VBA isn't difficult to learn, but it definitely takes time to become comfortable with it — and even more time to master it. Consequently, it's not uncommon to be in the process of learning VBA while you're developing applications with it. In fact, I think it's impossible to learn VBA without developing applications. If you're like me, you'll find it much easier to learn VBA if you have a project that requires it. Learning VBA just for the sake of learning VBA usually doesn't work.

One thing that I've learned from experience is to avoid letting the end user completely guide your approach to a problem. For example, suppose that you meet with a manager who tells you that the department needs an application to write text files that will be imported into another application. Don't confuse the user's need with the solution. The user's real need is to share data. Using an intermediate text file to do it is just one possible solution to the need. There may be better ways to approach the problem. In other words, don't let the users define their problem by stating it in terms of a solution approach. Determining the best approach is *your* job.

Determining the Most Appropriate User Interface

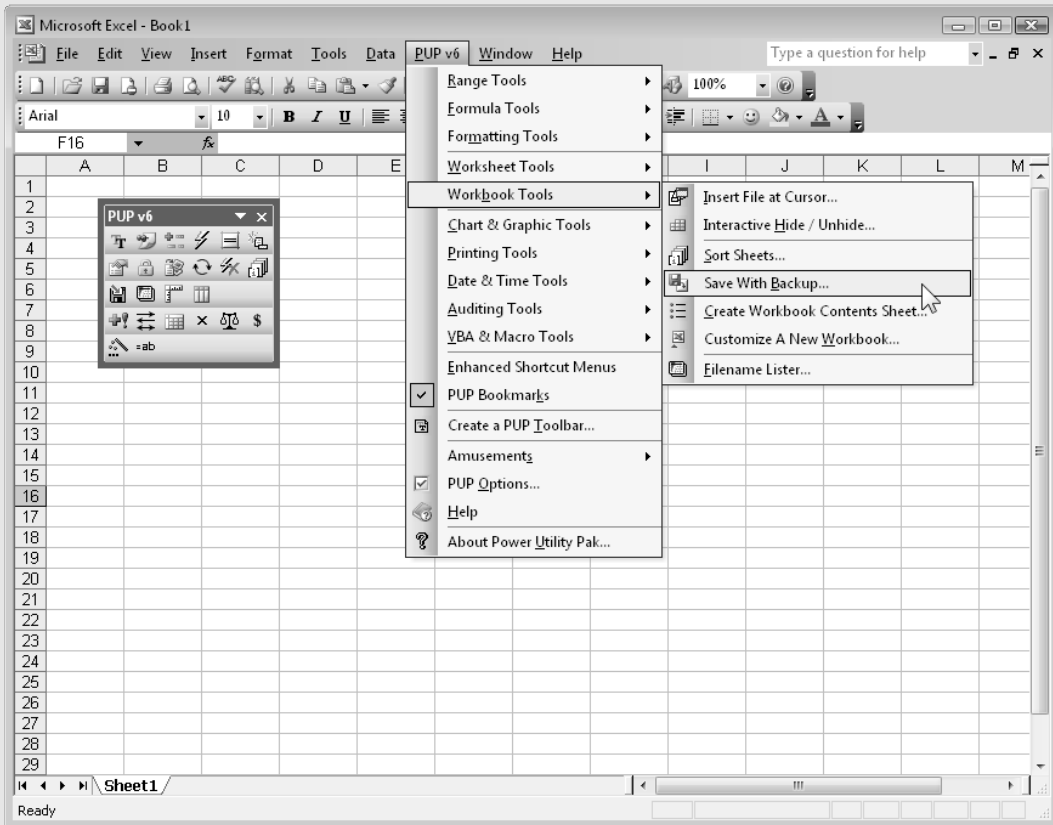
When you develop spreadsheets that others will use, you need to pay special attention to the user interface. By *user interface*, I mean the method by which the user interacts with the application and executes your VBA macros.



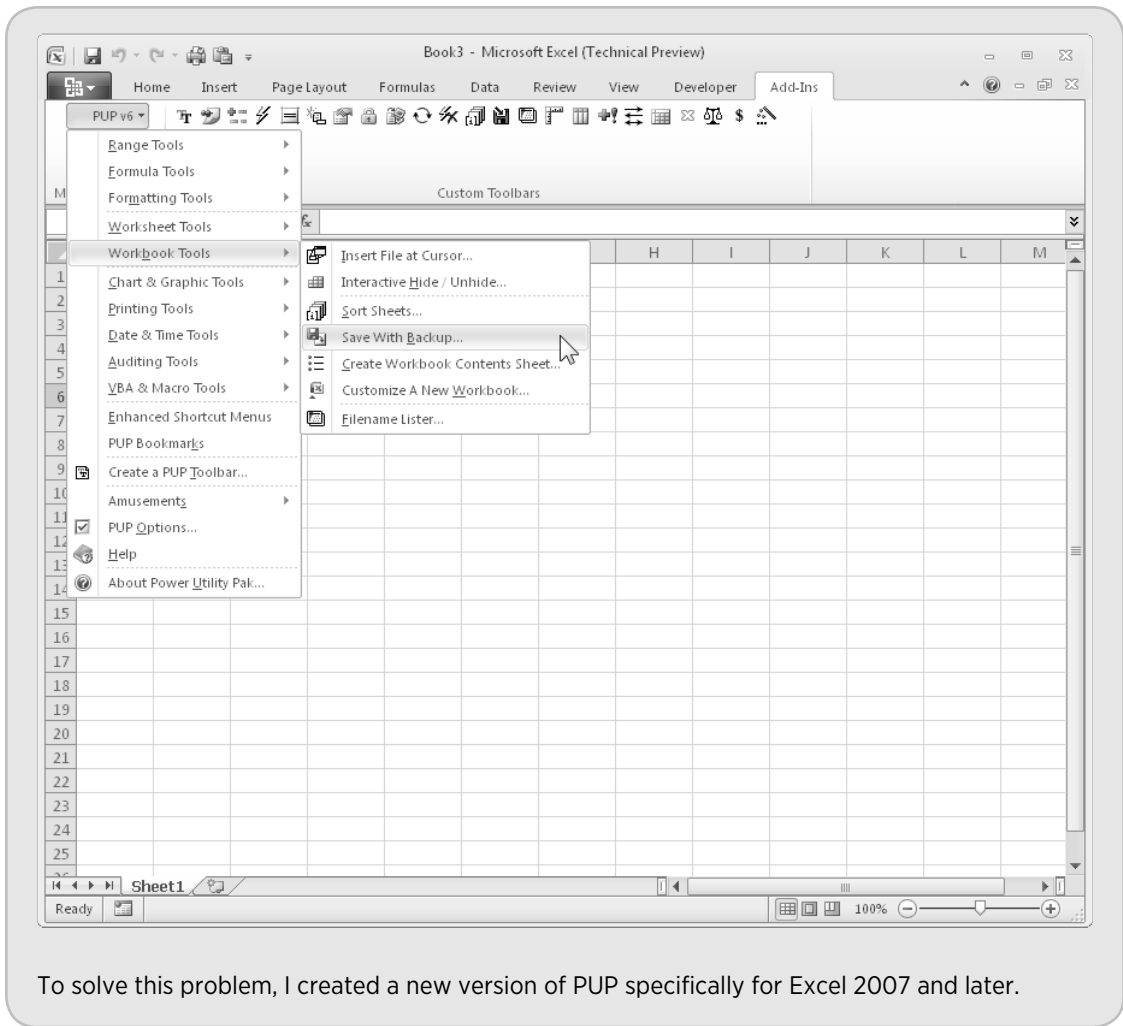
Menu and toolbar compatibility

Excel 2010 still supports custom menus and toolbars, but the way these UI elements are handled may not be to your liking.

The following figure shows a custom menu and toolbar displayed in Excel 2003. The menu and toolbar were created using my Power Utility Pak add-in. Each menu item and toolbar button executes a macro.



As shown in the following figure, when the Power Utility Pak add-in is installed in Excel 2010, the custom menu appears in a group labeled Add-Ins→Menu Commands, and the custom toolbar is in a group labeled Add-Ins→Custom Toolbars. (You can't resize or move the toolbars.) These Ribbon groups display the menu additions and toolbars for all the applications or add-ins that are loaded. The menu items and toolbar buttons still function, but the designer's original UI conception has been compromised.



To solve this problem, I created a new version of PUP specifically for Excel 2007 and later.

With Excel 2010 (and Excel 2007), some of these decisions are irrelevant. Custom menus and toolbars are, for all intents and purposes, obsolete. Consequently, developers must learn how to work with the Ribbon.

Excel provides several features that are relevant to user interface design:

- Ribbon customization
- Shortcut menu customization
- Shortcut keys
- Custom dialog boxes (UserForms)
- Controls (such as a ListBox or a CommandButton) placed directly on a worksheet

I discuss these features briefly in the following sections and cover them more thoroughly in later chapters.

Customizing the Ribbon

The Ribbon UI introduced in Excel 2007 is a dramatic shift in user interface design. Fortunately, the developer has a fair amount of control over the Ribbon. Although Excel 2010 allows the end user to modify the Ribbon, making UI changes via code isn't a simple task.



Cross-Ref

See Chapter 22 for information about working with the Ribbon.

Customizing shortcut menus

Excel 2010 still allows the VBA developer to customize the right-click shortcut menus. Figure 6-1 shows a customized shortcut menu that appears when you right-click a row number. Notice that this shortcut menu has several menu items (those with a “P” icon) that aren't normally available.

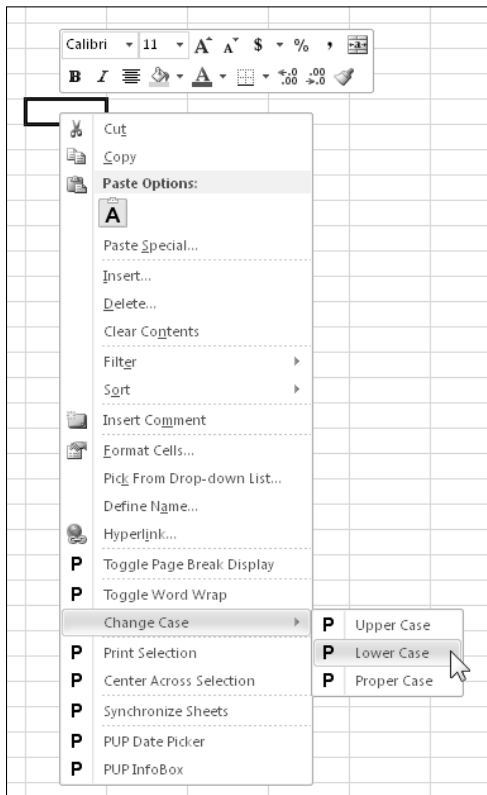


Figure 6-1: An example of a customized shortcut menu.



Cross-Ref

Chapter 23 describes how to work with shortcut menus using VBA.

Creating shortcut keys

Another user interface option at your disposal is to create custom shortcut keys. Excel lets you assign a Ctrl key (or Shift+Ctrl key) combination to a macro. When the user presses the key combination, the macro executes.

Be aware, however, of these two caveats: First, you must make it clear to the user which keys are active and what they do; second, you need to be careful not to assign a key combination that's already used for something else. A key combination that you assign to a macro takes precedence over the built-in shortcut keys. For example, Ctrl+S is a built-in Excel shortcut key used to save the current file. If you assign this key combination to a macro, you lose the capability to save the file with Ctrl+S. Remember that shortcut keys are case-sensitive, so you can use a combination such as Ctrl+Shift+S.

Creating custom dialog boxes

Anyone who has used a personal computer for any length of time is undoubtedly familiar with dialog boxes. Consequently, custom Excel dialog boxes can play a major role in the user interfaces that you design for your applications. Figure 6-2 shows an example of a custom dialog box.

A custom dialog box is known as a *UserForm*. A UserForm can solicit user input, get a user's options or preferences, and direct the flow of your entire application. You create and edit UserForms in the VBE. The elements that make up a UserForm (buttons, drop-down lists, check boxes, and so on) are called *controls* — more specifically, *ActiveX controls*. Excel provides a standard assortment of ActiveX controls, and you can also incorporate third-party controls.

After adding a control to a dialog box, you can link it to a worksheet cell so that it doesn't require any macros (except a simple macro to display the dialog box). Linking a control to a cell is easy, but it's not always the best way to get user input from a dialog box. Most of the time, you want to develop VBA macros that work with your custom dialog boxes.



Cross-Ref

I cover UserForms in detail in Part IV.

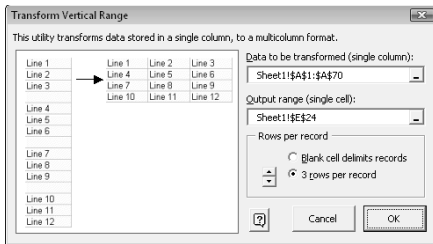


Figure 6-2: A dialog box created with Excel's UserForm feature.

Using ActiveX controls on a worksheet

Excel also lets you add the UserForm ActiveX controls to a worksheet's *drawing layer* (an invisible layer on top of a sheet that holds pictures, charts, and other objects). Figure 6-3 shows a simple worksheet model with several UserForm controls inserted directly on the worksheet. This sheet contains the following ActiveX controls: a CheckBox, a ScrollBar, and two sets of OptionButtons. This workbook uses no macros. Rather, the controls are linked to worksheet cells.



On the CD

This workbook is available on the companion CD-ROM. The file is named `worksheet controls.xlsx`.

Perhaps the most common control is a CommandButton. By itself, a CommandButton doesn't do anything, so you need to attach a macro to each CommandButton.

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									

Mortgage Loan Parameters

Purchase Price:

☐ Finance the \$5,000 loan

Pct. Down Payment:

☐ 10%

☐ 15%

☒ 20%

Loan Term:

☐ 30-year fixed

☒ 15-year fixed

Loan Amount:

Monthly Payment:

[Amortization Schedule](#)

Linked Cells

565 Interest from scroller
5.65 Percent

FALSE	Loan Fee
\$276,000	Loan

FALSE	30-year
TRUE	15-year
15 Year term	

FALSE	10% down
FALSE	15% down
TRUE	20% down
20% Down payment	

Figure 6-3: You can add UserForm controls to worksheets and link them to cells.

Using dialog box controls directly in a worksheet often eliminates the need for custom dialog boxes. You can often greatly simplify the operation of a spreadsheet by adding a few ActiveX controls (or Form controls) to a worksheet. These ActiveX controls let the user make choices by operating familiar controls rather than making entries into cells.

Access these controls by using the Developer→Controls→Insert command (see Figure 6-4). If the Developer tab isn't on the Ribbon, add it by using the Customize Ribbon tab of the Excel Options dialog box.

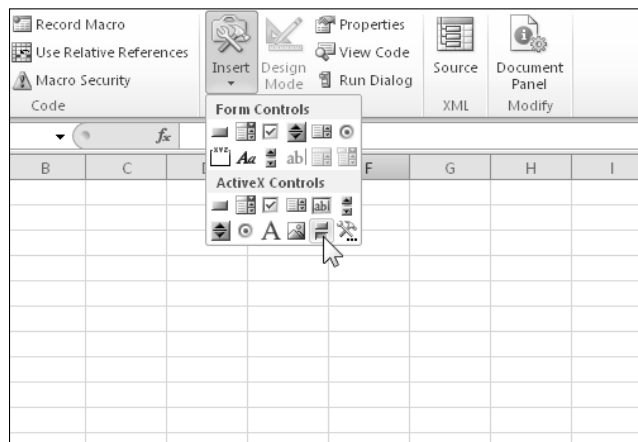


Figure 6-4: Worksheet controls.

The controls come in two types: Form Controls and ActiveX Controls. Both sets of controls have their advantages and disadvantages. Generally, the Form controls are easier to use, but the ActiveX controls are a bit more flexible. Table 6-1 summarizes these two classes of controls.

Table 6-1: ActiveX Controls Versus Form Controls

	ActiveX Controls	Form Controls
Excel versions	97, 2000, 2002, 2003, 2007, 2010	5, 95, 97, 2000, 2002, 2003, 2007, 2010
Controls available	CheckBox, TextBox, CommandButton, OptionButton, ListBox, ComboBox, ToggleButton, SpinButton, ScrollBar, Label, Image (and others can be added)	GroupBox, Button, CheckBox, OptionButton, ListBox, DropDown (ComboBox), ScrollBar, Spinner
Macro code storage	In the code module for the Sheet	In any standard VBA module
Macro name	Corresponds to the control name (for example, <code>CommandButton1_Click</code>)	Any name you specify
Correspond to . . .	UserForm controls	Pre-Excel 97 Dialog Sheet controls
Customization	Extensive, using the Properties box	Minimal
Respond to events	Yes	Click or Change events only

Executing the development effort

After you identify user needs, determine the approach that you'll take to meet those needs, and decide on the components that you'll use for the user interface, it's time to get down to the nitty-gritty and start creating the application. This step, of course, comprises a great deal of the total time that you spend on a particular project.

How you go about developing the application depends on your own personal style and the nature of the application. Except for simple fill-in-the-blanks template workbooks, your application will probably use macros. Developing the macros is the tough part. Creating macros in Excel is easy, but creating *good* macros is difficult.

Concerning Yourself with the End User

In this section, I discuss the important development issues that surface as your application becomes more and more workable and as the time to package and distribute your work grows nearer.

Testing the application

How many times have you used a commercial software application, only to have it bomb out on you at a crucial moment? Most likely, the problem was caused by insufficient testing that didn't catch all the bugs. All nontrivial software has bugs, but in the best software, the bugs are simply more obscure. As you'll see, you sometimes must work around the bugs in Excel to get your application to perform properly.

After you create your application, you need to test it. Testing is one of the most crucial steps; it's not uncommon to spend as much time testing and debugging an application as you did creating the application in the first place. Actually, you should be doing a great deal of testing during the development phase. After all, whether you're writing a VBA routine or creating formulas in a worksheet, you want to make sure that the application is working the way it's supposed to work.

Like standard compiled applications, spreadsheet applications that you develop are prone to bugs. A *bug* can be defined as (1) something that does happen but shouldn't happen while a program (or application) is running, or (2) something that doesn't happen when it should happen. Both species of bugs are equally nasty, and you should plan on devoting a good portion of your development time to testing the application under all reasonable conditions and fixing any problems that you find. In some cases, unfortunately, the problems aren't entirely your fault. Excel, too, has its problems (see the "Bugs? In Excel?" sidebar).

I probably don't need to tell you to thoroughly test any spreadsheet application that you develop for others. And depending on its eventual audience, you may want to make your application bulletproof. In other words, try to anticipate all the errors and screw-ups that could possibly occur and make concerted efforts to avoid them — or, at least, to handle them gracefully. This foresight not only helps the end user but also makes it easier on you and protects your reputation. Also consider using beta testing; your end users are likely candidates because they're the ones who will be using your product. (See the upcoming sidebar "What about beta testing?")



Bugs? In Excel?

You may think that a product like Excel, which is used by millions of people throughout the world, would be relatively free of bugs. Think again. Excel is such a complex piece of software that it is only natural to expect some problems with it. And Excel *does* have some problems.

Getting a product like Excel out the door isn't easy, even for a company like Microsoft with seemingly unlimited resources. Releasing a software product involves compromises and trade-offs. It's commonly known that most major software vendors release their products with full knowledge that they contain bugs. Most bugs are considered insignificant enough to ignore. Software companies could postpone their releases by a few months and fix many of them, but software, like everything else, is ruled by economics. The benefits of delaying a product's release often don't exceed the costs involved. Although Excel definitely has its share of bugs, my guess is that the majority of Excel users never encounter one.

In this book, I point out the problems with Excel that I know about. You'll surely discover some more on your own. Some problems occur only with a particular version of Excel — and under a specific configuration involving hardware and/or software. These bugs are the worst ones of all because they aren't easily reproducible.

So what's a developer to do? It's called a *workaround*. If something that you try to do doesn't work — and all indications say that it *should* work — it's time to move on to Plan B. Frustrating? Sure. A waste of your time? Absolutely. It's all part of being a developer.

Although you can't conceivably test for all possibilities, your macros should be able to handle common types of errors. For example, what if the user enters a text string instead of a numeric value? What if the user tries to run your macro when a workbook isn't open? What if he cancels a dialog box without making any selections? What happens if the user presses Ctrl+F6 and jumps to the next window? When you gain experience, these types of issues become very familiar, and you account for them without even thinking.

Making the application bulletproof

If you think about it, destroying a spreadsheet is fairly easy. Erasing one critical formula or value can cause errors throughout the entire worksheet — and perhaps even other dependent worksheets. Even worse, if the damaged workbook is saved, it replaces the good copy on disk. Unless a backup procedure is in place, the user of your application may be in trouble, and *you'll* probably be blamed for it.



What about beta testing?

Software manufacturers typically have a rigorous testing cycle for new products. After extensive internal testing, the pre-release product is usually sent to a group of interested users for *beta testing*. This phase often uncovers additional problems that are usually corrected before the product's final release.

If you're developing an Excel application that more than a few people will use, you may want to consider a beta test. This test enables your intended users to use your application in its intended setting on different hardware (usually).

The beta period should begin after you've completed all your own testing and you feel that the application is ready to distribute. You'll need to identify a group of users to help you. The process works best if you distribute everything that will ultimately be included in your application: user documentation, the installation program, help, and so on. You can evaluate the beta test in a number of ways, including face-to-face discussions, questionnaires, and phone calls.

You almost always become aware of problems that you need to correct or improvements that you need to make before you undertake a widespread distribution of the application. Of course, a beta testing phase takes additional time, and not all projects can afford that luxury.

Obviously, you can easily see why you need to add some protection when users — especially novices — will be using your worksheets. Excel provides several techniques for protecting worksheets and parts of worksheets:

- **Lock specific cells:** You can lock specific cells (by using the Protection tab in the Format Cells dialog box) so that users can't change them. Locking takes effect only when the document is protected with the Review→Changes→Protect Sheet command. The Protect Sheet dialog box has options that allow you to specify which actions users can perform on a protected sheet (see Figure 6-5).



Figure 6-5: Using the Protect Sheet dialog box to specify what users can and can't do.

- **Hide the formulas in specific cells:** You can hide the formulas in specific cells (by using the Protection tab in the Format Cells dialog box) so that others can't see them. Again, hiding takes effect only when the document is protected by choosing the Review→Changes→Protect Sheet command.
- **Protect an entire workbook:** You can protect an entire workbook — the structure of the workbook, the window position and size, or both. Use the Review→Changes→Protect Workbook command for this purpose.
- **Lock objects on the worksheet:** Use the Properties tab in the Size and Properties dialog box to lock objects (such as shapes) and prevent them from being moved or changed. To access the Size and Properties dialog box, select the object and then click the dialog box launcher in the Drawing Tools→Format→Size group. (This context tab appears only when an object is selected.) Locking objects takes effect only when the document is protected via the Review→Changes→Protect Sheet command. By default, all objects are locked.
- **Hide rows, columns, sheets, and documents:** You can hide rows, columns, sheets, and entire workbooks. Doing so helps prevent the worksheet from looking cluttered and also provides some modest protection against prying eyes.
- **Designate an Excel workbook as read-only recommended:** You can designate an Excel workbook as read-only recommended (and use a password) to ensure that the file can't be overwritten with any changes. You do this designation in the General Options dialog box. Display this dialog box by choosing File→Save As. In the Save As dialog box, click the Tools button and choose General Options.
- **Assign a password:** You can assign a password to prevent unauthorized users from opening your file. Choose File→Info→Protect Workbook→Encrypt With Password.
- **Use a password-protected add-in:** You can use a password-protected add-in, which doesn't allow the user to change *anything* on its worksheets.



How secure are Excel's passwords?

As far as I know, Microsoft has never advertised Excel as a secure program. And for good reason: Circumventing Excel's password system is actually quite easy to do. Several commercial programs are available that can break passwords. Excel 2002 and later versions seem to have stronger security than previous versions, but a determined user can still crack them. Bottom line? Don't think of password protection as foolproof. Sure, it will be effective for the casual user. But if someone *really* wants to break your password, he can probably do so.

Making the application aesthetically appealing and intuitive

If you've used many different software packages, you've undoubtedly seen examples of poorly designed user interfaces, difficult-to-use programs, and just plain ugly screens. If you're developing spreadsheets for other people, you should pay particular attention to how the application looks.

How a computer program looks can make all the difference in the world to users, and the same is true with the applications that you develop with Excel. Beauty, however, is in the eye of the beholder. If your skills lean more in the analytical direction, consider enlisting the assistance of someone with a more aesthetic sensibility to provide help with design.

The good news is that, beginning with Excel 2007, new features make creating better-looking spreadsheets a relatively easy task. If you stick with the pre-designed cell styles, your work stands a good chance of looking good. And, with the click of a mouse, you can apply a new theme that completely transforms the look of the workbook — and still looks good.

Unfortunately, Excel 2010 adds nothing new in the area of UserForm design, so you're on your own in that area.

End users appreciate a good-looking user interface, and your applications will have a much more polished and professional look if you devote additional time to design and aesthetic considerations. An application that looks good demonstrates that its developer cared enough about the product to invest extra time and effort. Take the following suggestions into account:

- **Strive for consistency.** When designing dialog boxes, for example, try to emulate the look and feel of Excel's dialog boxes whenever possible. Be consistent with formatting, fonts, text size, and colors.
- **Keep it simple.** A common mistake that developers make is trying to cram too much information into a single screen or dialog box. A good rule is to present only one or two chunks of information at a time.
- **Break down input screens.** If you use an input screen to solicit information from the user, consider breaking it up into several, less crowded screens. If you use a complex dialog box, you may want to break it up by using a MultiPage control, which lets you create a familiar tabbed dialog box.
- **Don't overdo color.** Use color sparingly. It's very easy to overdo color and make the screen look gaudy.
- **Monitor typography and graphics.** Pay attention to numeric formats and use consistent typefaces, font sizes, and borders.

Evaluating aesthetic qualities is very subjective. When in doubt, strive for simplicity and clarity.



Note

Versions prior to Excel 2007 used a pallet of 56 colors. That restriction has been removed, and Excel now supports more than 16 million colors.

Creating a user Help system

With regard to user documentation, you basically have two options: paper-based documentation or electronic documentation. Providing electronic help is standard fare in Windows applications. Fortunately, your Excel applications can also provide help — even context-sensitive help. Developing help text takes quite a bit of additional effort, but for a large project, it may be worth it. Figure 6-6 shows an example of a custom Help system in compiled HTML format.

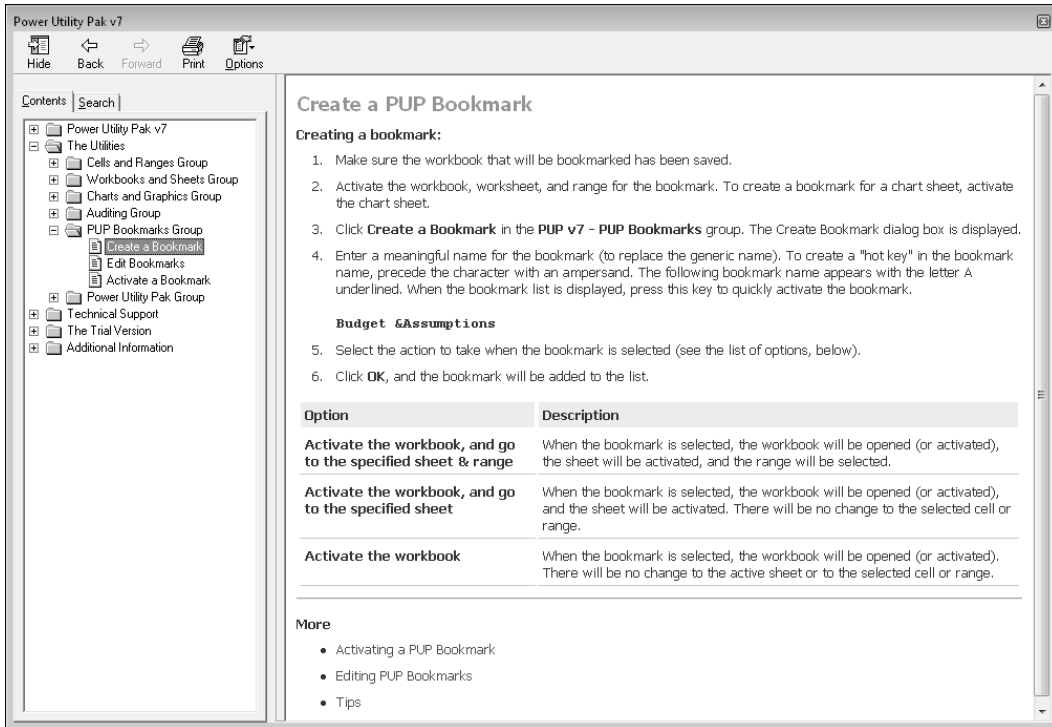


Figure 6-6: An example of a custom help file for an Excel add-in.

Another point to consider is support for your application. In other words, who gets the phone call if the user encounters a problem? If you aren't prepared to handle routine questions, you need to identify someone who is. In some cases, you want to arrange it so that only highly technical or bug-related issues escalate to the developer.



Cross-Ref

In Chapter 24, I discuss several alternatives for providing help for your applications.

Documenting the development effort

Putting a spreadsheet application together is one thing. Making it understandable for other people is another. As with traditional programming, it's important that you thoroughly document your work. Such documentation helps you if you need to go back to it (and you will), and it helps anyone else whom you might pass it on to.



You may want to consider a couple of things when you document your project. For example, if you were hired to develop an Excel application, you may not want to share all your hard-earned secrets by thoroughly documenting *everything*. If this situation is the case, you should maintain two versions: one thoroughly documented (for your own reference) and the other partially documented (for other users).

How do you document a workbook application? You can either store the information in a worksheet or use another file. You can even use a paper document, if you prefer. Perhaps the easiest way is to use a separate worksheet to store your comments and key information for the project. For VBA code, use comments liberally. (VBA text preceded with an apostrophe is ignored because that text is designated as a comment.) Although an elegant piece of VBA code can seem perfectly obvious to you today, when you come back to it in a few months, your reasoning may be completely obscured unless you use the VBA comment feature.

Distributing the application to the user

You've completed your project, and you're ready to release it to the end users. How do you go about distributing it? You can choose from many ways to distribute your application, and the method that you choose depends on many factors.

You could just hand over a CD-ROM, scribble a few instructions, and be on your way. Or, you may want to install the application yourself — but this approach isn't always feasible. Another option is to develop an official setup program that performs the task automatically. You can write such a program in a traditional programming language, purchase a generic setup program, or write your own in VBA.

Excel 2000 and later versions incorporate technology to enable developers to digitally sign their applications. This process is designed to help end users identify the author of an application, to ensure that the project has not been altered, and to help prevent the spread of macro viruses or other potentially destructive code. To digitally sign a project, you first apply for a digital certificate from a formal certificate authority (or, you can self-sign your project by creating your own digital certificate). Refer to the Help system or the Microsoft Web site for additional information.



Why is there no runtime version of Excel?

When you distribute your application, you need to be sure that each end user has a licensed copy of the appropriate version of Excel. Distributing a copy of Excel along with your application is illegal. Why, you might ask, doesn't Microsoft provide a runtime version of Excel? A *runtime version* is an executable program that can load files but not create them. With a runtime version, the end user wouldn't need a copy of Excel to run your application. (This is common with database programs.)

I've never seen a clear or convincing reason why Microsoft doesn't have a runtime version of Excel, and no other spreadsheet manufacturer offers a runtime version of its product, either. The most likely reason is that spreadsheet vendors fear that doing so would reduce sales of the software. Or, it may be that developing a runtime version would require a tremendous amount of programming that would just never pay off.

On a related note . . . Microsoft does offer an Excel file *viewer*. This product lets you view Excel files if you don't own a copy of Excel. Macros, however, won't execute. You can get a copy of this free file viewer from the Microsoft Web site (<http://office.microsoft.com/downloads>).

Updating the application when necessary

After you distribute your application, you're finished with it, right? You can sit back, enjoy yourself, and try to forget about the problems that you encountered (and solved) during the course of developing your application. In rare cases, yes, you may be finished. More often, however, the users of your application won't be completely satisfied. Sure, your application adheres to all the *original* specifications, but things change. Seeing an application working often causes the user to think of other things that the application could be doing. I'm talking *updates*.

When you need to update or revise your application, you'll appreciate that you designed it well in the first place and that you fully documented your efforts. If not, well . . . we learn from our experiences.

Other Development Issues

You need to keep several other issues in mind when developing an application — especially if you don't know exactly who will be using the application. If you're developing an application that will have widespread use (a shareware application, for example), you have no way of knowing how the application will be used, what type of system it will run on, or what other software will be running concurrently.

The user's installed version of Excel

With every new release of Excel, the issue of compatibility rears its head. As I write this book, Excel 2010 is about to be released — yet many large corporations are still using Excel 2003 and some use even earlier versions.

Unfortunately, there is no guarantee that an application developed for, say, Excel 2000 will work perfectly with later versions of Excel. If you need your application to work with a variety of Excel versions, the best approach is to work with the lowest version — and then test it thoroughly with all other versions.

Things get even more complicated when you consider Excel's subversions. Microsoft distributes service releases (SRs), Service Packs (SPs), and security updates to correct problems. In some cases, your Excel application won't work correctly unless the user has installed a particular update.



Cross-Ref

I discuss compatibility issues in Chapter 26.

Language issues

Consider yourself very fortunate if all your end users have the English language version of Excel. Non-English versions of Excel aren't always 100 percent compatible, so that means additional testing on your part. In addition, keep in mind that two users can both be using the English language version of Excel yet use different Windows regional settings. In some cases, you may need to be aware of potential problems.



Cross-Ref

I briefly discuss language issues in Chapter 26.

System speed

You're probably a fairly advanced computer user and tend to keep your hardware reasonably up to date. In other words, you have a fairly powerful system that is probably better than the average user's system. In some cases, you'll know exactly what hardware the end users of your applications are using. If so, it's vitally important that you test your application on that system. A procedure that executes almost instantaneously on your system may take several seconds on another system. In the world of computers, several seconds may be unacceptable.



Tip

When you gain more experience with VBA, you'll discover that there are ways to get the job done, and there are ways to get the job done *fast*. It's a good idea to get into the habit of coding for speed. Other chapters in this book can certainly help you out in this area.

Video modes

As you probably know, users' video displays vary widely. As I write this book, the most commonly used video resolution is 1280 x 1024, followed closely by 1024 x 768. Systems with a resolution of 800 x 600 are becoming much less common, but quite a few are still in use. Higher resolution displays and even dual displays are becoming increasingly common. Just because you have a super-high-resolution monitor, you can't assume that everyone else does.

Video resolution can be a problem if your application relies on specific information being displayed on a single screen. For example, if you develop an input screen that fills the screen in 1280 x 1024 mode, users with a 1024 x 768 display won't be able to see the whole input screen without scrolling or zooming.

Also, it's important to realize that a *restored* (that is, not maximized or minimized) workbook is displayed at its previous window size and position. In the extreme case, it's possible that a window saved by using a high-resolution display may be completely off the screen when opened on a system running in a lower resolution.

Unfortunately, you can't automatically scale things so that they look the same regardless of the display resolution. In some cases, you can zoom the worksheet (using the Zoom control in the status bar), but doing so reliably may be difficult. Unless you're certain of the video resolution that the users of your application will use, you should probably design your application so it works with the lowest common denominator — 800 x 600 or 1024 x 768 mode.

As you discover later in the book (see Chapter 10), you can determine the user's video resolution by using Windows API calls from VBA. In some cases, you may want to programmatically adjust things depending on the user's video resolution.

PART



Understanding Visual Basic for Applications

CHAPTER 7

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CHAPTER 8

VBA Programming Fundamentals

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CHAPTER 11

VBA Programming Examples and Techniques

Introducing Visual Basic for Applications

In This Chapter

- Introducing VBA — the programming language built into Excel
- Discovering how VBA differs from traditional spreadsheet macro languages and the Visual Basic language
- Using the Visual Basic Editor (VBE)
- Working in the Code windows in the VBE and customizing the VBE environment
- Using Excel's macro recorder
- Getting an overview of objects, collections, properties, and methods
- Reviewing a case study of the `Comment` object
- Looking at specific information and examples of working with `Range` objects
- Accessing a lot of information about Excel objects, properties, and methods

Getting Some BASIC Background

Many hard-core programmers scoff at the idea of programming in BASIC. The name itself (an acronym for Beginner's All-purpose Symbolic Instruction Code) suggests that BASIC isn't a professional language. In fact, BASIC was first developed in the early 1960s as a way to teach programming techniques to college students. BASIC caught on quickly and is available in hundreds of dialects for many types of computers.

BASIC has evolved and improved over the years. For example, in many early implementations, BASIC was an *interpreted* language. Each line was interpreted before it was executed, causing slow performance. Most modern dialects of BASIC allow the code to be *compiled* — converted to machine code — which results in faster and more efficient execution.

BASIC gained quite a bit of respectability in 1991 when Microsoft released Visual Basic for Windows. This product made it easy for the masses to develop stand-alone applications for Windows. Visual Basic has very little in common with early versions of BASIC, but Visual Basic is the foundation on which VBA was built.

Delving in to VBA

Excel 5 was the first application on the market to feature Visual Basic for Applications (VBA). VBA is best thought of as Microsoft's common application scripting language, and it's included with most Office 2010 applications and even in applications from other vendors. Therefore, if you master VBA by using Excel, you'll be able to jump right in and write macros for other Microsoft (and some non-Microsoft) products. Even better, you'll be able to create complete solutions that use features across various applications.

Object models

The secret to using VBA with other applications lies in understanding the *object model* for each application. VBA, after all, simply manipulates objects, and each product (Excel, Word, Access, PowerPoint, and so on) has its own unique object model. You can program an application by using the objects that the application exposes.

Excel's object model, for example, exposes several very powerful data analysis objects, such as worksheets, charts, pivot tables, and numerous mathematical, financial, engineering, and general business functions. With VBA, you can work with these objects and develop automated procedures. While you work with VBA in Excel, you gradually build an understanding of the object model. **Warning:** The object model will be very confusing at first. Eventually, however, the pieces come together — and all of a sudden, you realize that you've mastered it!

VBA versus XLM

Before version 5, Excel used a powerful (but very cryptic) macro language called *XLM*. Later versions of Excel (including Excel 2010) still execute XLM macros, but the capability to record macros in XLM was removed beginning with Excel 97. As a developer, you should be aware of XLM (in case you ever encounter macros written in that system), but you should use VBA for your development work.



Note

Don't confuse the XLM macro language with eXtensible Markup Language (XML). Although these terms share the same letters, they have nothing in common. *XML* is a storage format for structured data. The Office 2010 applications use XML as their default file format.



Is VBA becoming obsolete?

For the past few years, I've heard rumors that Microsoft is going to remove VBA from the Office applications and replace it with .NET. My understanding is that these rumors are completely unfounded. Sure, Microsoft has developed another way to automate Office applications, but VBA will be around for quite a while — at least in Excel for Windows. Microsoft *has* removed VBA from Excel for Macintosh, but that was no great loss because most Excel VBA apps don't even attempt to be compatible with the Mac version.

Why will VBA survive? Because literally millions of VBA-based solutions are in use and VBA is much easier to learn and use than the alternative.

Covering the Basics of VBA

Before I get into the meat of things, I suggest that you read through the material in this section to get a broad overview of where I'm heading. I cover these topics in the remainder of this chapter.

Following is a quick-and-dirty summary of what VBA is all about:

- **Code:** You perform actions in VBA by executing VBA code. You write (or record) VBA code, which is stored in a VBA module.
- **Module:** VBA modules are stored in an Excel workbook file, but you view or edit a module by using the Visual Basic Editor (VBE). A VBA module consists of procedures.
- **Procedures:** A procedure is basically a unit of computer code that performs some action. VBA supports two types of procedures: `Sub` procedures and `Function` procedures.
 - **Sub:** A `Sub` procedure consists of a series of statements and can be executed in a number of ways. Here's an example of a simple `Sub` procedure called `Test`: This procedure calculates a simple sum and then displays the result in a message box.

```
Sub Test()  
    Sum = 1 + 1  
    MsgBox "The answer is " & Sum  
End Sub
```

- **Function:** A VBA module can also have `Function` procedures. A `Function` procedure returns a single value (or possibly an array). A `Function` can be called from another VBA procedure or used in a worksheet formula. Here's an example of a `Function` named `AddTwo`:

```
Function AddTwo(arg1, arg2)  
    AddTwo = arg1 + arg2  
End Function
```

- **Objects:** VBA manipulates objects contained in its host application. (In this case, Excel is the host application.) Excel provides you with more than 100 classes of objects to manipulate. Examples of objects include a workbook, a worksheet, a range on a worksheet, a chart, and a shape. Many more objects are at your disposal, and you can use VBA code to manipulate them. Object classes are arranged in a hierarchy.

Objects also can act as containers for other objects. For example, Excel is an object called `Application`, and it contains other objects, such as `Workbook` objects. The `Workbook` object contains other objects, such as `Worksheet` objects and `Chart` objects. A `Worksheet` object contains objects such as `Range` objects, `PivotTable` objects, and so on. The arrangement of these objects is referred to as Excel's *object model*.

- **Collections:** Like objects form a *collection*. For example, the `Worksheets` collection consists of all the worksheets in a particular workbook. Collections are objects in themselves.
- **Object hierarchy:** When you refer to a contained or member object, you specify its position in the object hierarchy by using a period (also known as a *dot*) as a separator between the container and the member. For example, you can refer to a workbook named `Book1.xlsx` as

```
Application.Workbooks("Book1.xlsx")
```

This code refers to the `Book1.xlsx` workbook in the `Workbooks` collection. The `Workbooks` collection is contained in the Excel `Application` object. Extending this type of referencing to another level, you can refer to `Sheet1` in `Book1` as

```
Application.Workbooks("Book1.xlsx").Worksheets("Sheet1")
```

You can take it to still another level and refer to a specific cell as follows:

```
Application.Workbooks("Book1.xlsx").Worksheets("Sheet1").Range("A1")
```

- **Active objects:** If you omit a specific reference to an object, Excel uses the active objects. If `Book1` is the active workbook, the preceding reference can be simplified as

```
Worksheets("Sheet1").Range("A1")
```

If you know that `Sheet1` is the active sheet, you can simplify the reference even more:

```
Range("A1")
```

- **Objects properties:** Objects have *properties*. A property can be thought of as a *setting* for an object. For example, a range object has properties such as `Value` and `Address`. A chart object has properties such as `HasTitle` and `Type`. You can use VBA to determine object properties and also to change them. Some properties are read-only properties and can't be changed by using VBA.

You refer to properties by combining the object with the property, separated by a period. For example, you can refer to the value in cell A1 on `Sheet1` as

```
Worksheets("Sheet1").Range("A1").Value
```

- **VBA variables:** You can assign values to VBA variables. Think of a variable as a name that you can use to store a particular value. To assign the value in cell A1 on `Sheet1` to a variable called `Interest`, use the following VBA statement:

```
Interest = Worksheets("Sheet1").Range("A1").Value
```

- **Object methods:** Objects have methods. A *method* is an action that is performed with the object. For example, one of the methods for a `Range` object is `ClearContents`. This method clears the contents of the range. You specify methods by combining the object with the method, separated by a period. For example, to clear the contents of cell A1 on the active worksheet, use

```
Range("A1").ClearContents
```

- **Standard programming constructs:** VBA also includes many constructs found in modern programming languages, including arrays, loops, and so on.
- **Events:** Some objects recognize specific events, and you can write VBA code that is executed when the event occurs. For example, opening a workbook triggers a `Workbook_Open` event. Changing a cell in a worksheet triggers a `Worksheet_Change` event.

Believe it or not, the preceding section pretty much describes VBA. Now it's just a matter of learning the details.



An analogy

If you like analogies, here's one for you that may help you understand the relationships between objects, properties, and methods in VBA. In this analogy, I compare Excel with a fast-food restaurant chain.

The basic unit of Excel is a `Workbook` object. In a fast-food chain, the basic unit is an individual restaurant. With Excel, you can add workbooks and close workbooks, and the set of all the open workbooks is known as `Workbooks` (a collection of `Workbook` objects). Similarly, the management of a fast-food chain can add restaurants and close restaurants — and all the restaurants in the chain can be viewed as the `Restaurants` collection — a collection of `Restaurant` objects.

An Excel workbook is an object, but it also contains other objects, such as worksheets, charts, VBA modules, and so on. Furthermore, each object in a workbook can contain its own objects. For example, a `Worksheet` object can contain `Range` objects, `PivotTable` objects, `Shape` objects, and so on.

continued

continued

Continuing with the analogy, a fast-food restaurant (like a workbook) contains objects, such as the `Kitchen`, `DiningArea`, and `Tables` (a collection). Furthermore, management can add or remove objects from the `Restaurant` object. For example, management can add more tables to the `Tables` collection. Each of these objects can contain other objects. For example, the `Kitchen` object has a `Stove` object, a `VentilationFan` object, a `Chef` object, a `Sink` object, and so on.

So far, so good. This analogy seems to work. Let's see whether I can take it further.

Excel objects have properties. For example, a `Range` object has properties such as `Value` and `Name`, and a `Shape` object has properties such as `Width` and `Height`. Not surprisingly, objects in a fast-food restaurant also have properties. The `Stove` object, for example, has properties such as `Temperature` and `NumberOfBurners`. The `VentilationFan` object has its own set of properties (`TurnedOn`, `RPM`, and so on).

Besides properties, Excel's objects also have methods, which perform operations on objects. For example, the `ClearContents` method erases the contents of a `Range` object. An object in a fast-food restaurant also has methods. You can easily envision a `ChangeThermostat` method for a `Stove` object, or a `SwitchOn` method for a `VentilationFan` object.

With Excel, methods sometimes change an object's properties. The `ClearContents` method for a `Range` object changes the `Range Value` property. Similarly, the `ChangeThermostat` method on a `Stove` object affects its `Temperature` property.

With VBA, you can write procedures to manipulate Excel's objects. In a fast-food restaurant, the management can give orders to manipulate the objects in the restaurants. ("Turn on the stove and switch the ventilation fan to high.") Now is it clear?

Introducing the Visual Basic Editor

All your VBA work is done in the Visual Basic Editor (VBE). The VBE is a separate application that works seamlessly with Excel. By *seamlessly*, I mean that Excel takes care of the details of opening the VBE when you need it. You can't run VBE separately; Excel must be running in order for the VBE to run.



Note

VBA modules are stored in workbook files. However, the VBA modules aren't visible unless you activate the VBE.

Displaying Excel's Developer tab

The Excel Ribbon doesn't display the Developer tab by default. If you're going to be working with VBA, it's essential that you turn on the Developer tab:

1. Right-click the Ribbon and choose Customize the Ribbon.
Excel displays the Customize Ribbon tab of the Excel Options dialog box.
2. In the list box on the right, place a checkmark next to Developer.
3. Click OK.

After you perform these steps, Excel displays a new tab, as shown in Figure 7-1.

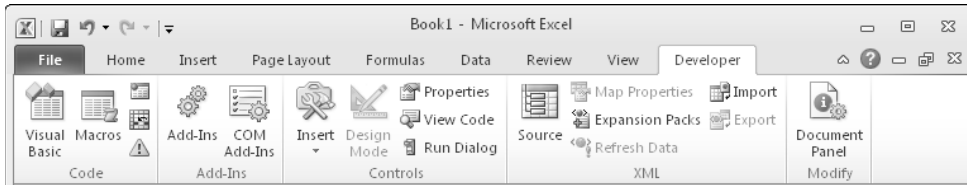


Figure 7-1: By default, the Developer tab is not displayed.

Activating the VBE

When you're working in Excel, you can switch to the VBE by using either of the following techniques:

- Press Alt+F11.
- Choose Developer→Code→Visual Basic.

In addition, you can access two special modules as follows. (These special VBA modules are used for event-handler procedures, which I describe in Chapter 19.)

- Right-click a sheet tab and choose View Code, which takes you to the code module for the sheet.
- Right-click a workbook's title bar and choose View Code, which takes you to the code module for the workbook. If the workbook window is maximized in Excel, the workbook window's title bar is not visible.

Figure 7-2 shows the VBE. Chances are that your VBE window won't look exactly like the window shown in the figure. This window is highly customizable — you can hide windows, change their sizes, dock them, rearrange them, and so on.

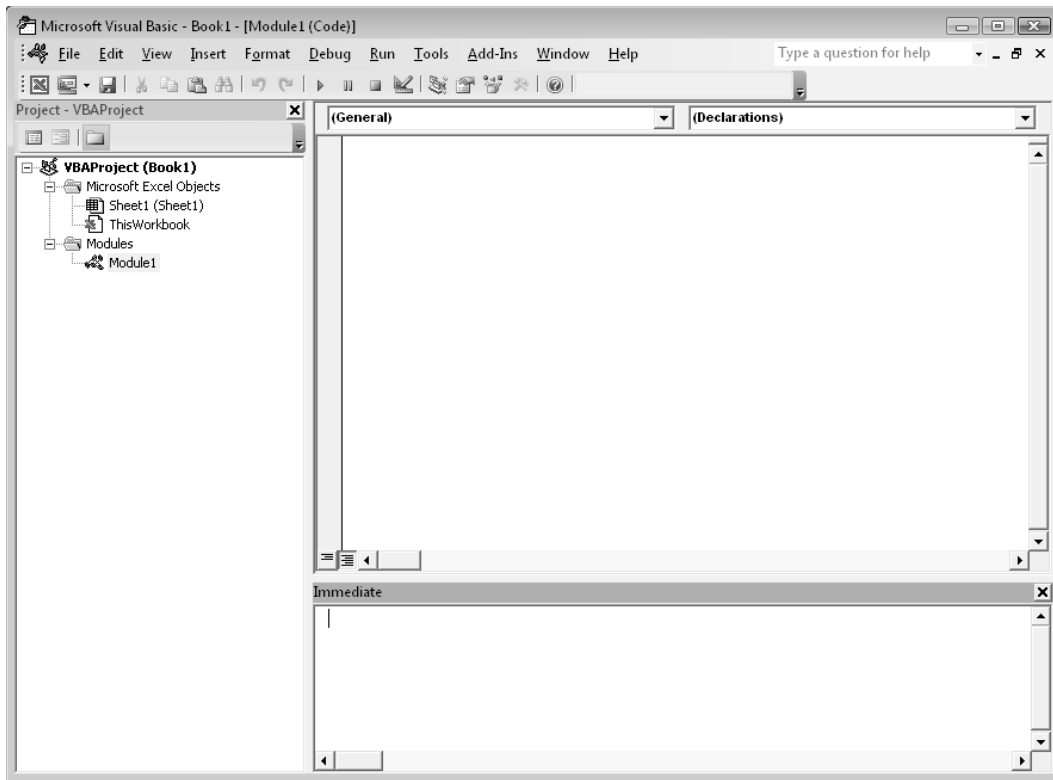


Figure 7-2: The Visual Basic Editor window.

The VBE windows

The VBE has a number of parts. I briefly describe some of the key components in the following list:

- **VBE menu bar:** Although Excel uses a fancy new Ribbon interface, the VBE is still stuck in the menu and toolbar world. The VBE menu bar works like every other menu bar that you've encountered. It contains commands that you use to work with the various components in the VBE. Also, you'll find that many of the menu commands have shortcut keys associated with them. For example, the View→Immediate Window command has a shortcut key of Ctrl+G.



Tip

The VBE also features shortcut menus. As you'll discover, you can right-click virtually anything in a VBE window to get a shortcut menu of common commands.

- **VBE toolbars:** The Standard toolbar, which is directly under the menu bar by default, is one of six VBE toolbars available. (The menu bar is also considered a toolbar.) You can customize toolbars, move them around, display other toolbars, and so on. Choose View→Toolbars→Customize to work with VBE toolbars.

- **Project Explorer window:** The Project Explorer window displays a tree diagram that consists of every workbook that is currently open in Excel (including add-ins and hidden workbooks). Each workbook is known as a *project*. I discuss the Project Explorer window in more detail in the next section (“Working with the Project Explorer”).

If the Project Explorer window isn’t visible, press Ctrl+R. To hide the Project Explorer window, click the Close button in its title bar or right-click anywhere in the Project Explorer window and select Hide from the shortcut menu.

- **Code window:** A Code window (sometimes known as a Module window) contains VBA code. Every item in a project’s tree has an associated code window. To view a code window for an object, double-click the object in the Project Explorer window. For example, to view the code window for the `Sheet1` object, double-click `Sheet1` in the Project Explorer window. Unless you’ve added some VBA code, the Code window is empty.

Another way to view the Code window for an object is to select the object in the Project Explorer window and then click the View Code button in the toolbar at the top of the Project Explorer window.

I discuss Code windows later in this chapter (see “Working with Code Windows”).

- **Immediate window:** The Immediate window is most useful for executing VBA statements directly, testing statements, and debugging your code. This window may or may not be visible. If the Immediate window isn’t visible, press Ctrl+G. To close the Immediate window, click the Close button in its title bar (or right-click anywhere in the Immediate window and select Hide from the shortcut menu).

Working with the Project Explorer

When you’re working in the VBE, each Excel workbook and add-in that’s currently open is considered a *project*. You can think of a project as a collection of objects arranged as an expandable tree. You can expand a project by clicking the plus sign (+) at the left of the project’s name in the Project Explorer window. You contract a project by clicking the minus sign (–) to the left of a project’s name. If you try to expand a project that’s protected with a password, you’re prompted to enter the password.



Note

The top of the Project Explorer window contains three icons. The third icon, named *Toggle Folder*, controls whether the objects in a project are displayed in a hierarchy or are shown in a single nonhierarchical list.

Figure 7-3 shows a Project Explorer window with four projects listed (two XLAM add-ins and two workbooks).

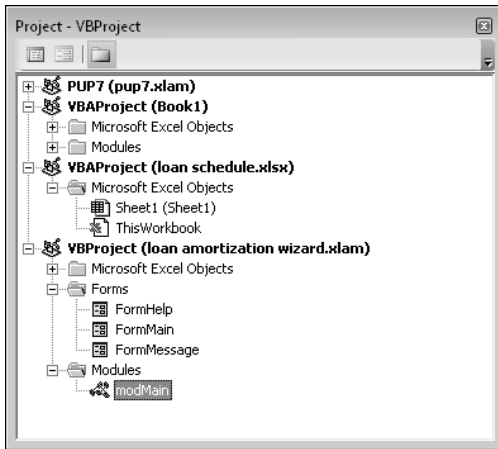


Figure 7-3: A Project Explorer window with four projects listed.



Caution

When you activate the VBE, you can't assume that the code module that's displayed corresponds to the highlighted object in the Project Explorer window. To make sure that you're working in the correct code module, always double-click the object in the Project Explorer window.

If you have many workbooks and add-ins loaded, the Project Explorer window can be a bit overwhelming. Unfortunately, you can't hide projects in the Project Explorer window. However, you probably want to keep the project outlines contracted if you're not working on them.

When viewing the Project Explorer in folder view, every project expands to show at least one node called Microsoft Excel Objects. This node expands to show an item for each worksheet and chart sheet in the workbook (each sheet is considered an object) and another object called `ThisWorkbook` (which represents the `Workbook` object). If the project has any VBA modules, the project listing also shows a Modules node, and the modules are listed there. A project can also contain a node called Forms that contains `UserForm` objects (also known as custom dialog boxes). If your project has any class modules, it displays another node called Class Modules. Similarly, if your project has any references, you see another node called References. The References node is a bit misleading because references can't contain any VBA code.

Adding a new VBA module

To add a new VBA module to a project, select the project's name in the Project Explorer window and choose **Insert**→**Module**. Or you can just right-click the project's name and choose **Insert**→**Module** from the shortcut menu.

When you record a macro, Excel automatically inserts a VBA module to hold the recorded code.

Removing a VBA module

If you need to remove a VBA module, a class module, or a UserForm from a project, select the module's name in the Project Explorer window and choose **File→Remove xxx** (where xxx is the name of the module). Or you can right-click the module's name and choose **Remove xxx** from the shortcut menu. You're asked whether you want to export the module before removing it. (See the next section for details.)

You can't remove code modules associated with the workbook (the `ThisWorkbook` code module) or with a sheet (for example, the `Sheet1` code module).

Exporting and importing objects

Except for those listed under the **References** node, you can save every object in a project to a separate file. Saving an individual object in a project is called *exporting*. It stands to reason that you can also *import* objects into a project. Exporting and importing objects might be useful if you want to use a particular object (such as a VBA module or a UserForm) in a different project.

To export an object, select it in the Project Explorer window and choose **File→Export File**. You get a dialog box that asks for a filename. Note that the object remains in the project. (Only a copy of it is exported.) If you export a `UserForm` object, any code associated with the UserForm is also exported.

To import a file into a project, select the project's name in the Project Explorer window and choose **File→Import File**. You get a dialog box that asks for a file. You can import only a file that has been exported by choosing the **File→Export File** command.



Tip

If you want to copy a module or UserForm to another project, you don't need to export and then import the object. Make sure that both projects are open; then simply activate the Project Explorer and drag the object from one project to the other. The original module or UserForm remains, and a copy is added to the other project.

Working with Code Windows

When you become proficient with VBA, you'll be spending *lots* of time working in code windows. Each object in a project has an associated code window. To summarize, these objects can be

- The workbook itself (`ThisWorkbook` in the Project Explorer window)
- A worksheet or chart sheet in a workbook (for example, `Sheet1` or `Chart1` in the Project Explorer window)
- A VBA module
- A *class module* (a special type of module that lets you create new object classes)
- A UserForm

Minimizing and maximizing windows

Depending on how many workbooks and add-ins are open, the VBE can have lots of code windows, and things can get a bit confusing. Code windows are much like worksheet windows in Excel. You can minimize them, maximize them, rearrange them, and so on. Most people find it most efficient to maximize the Code window that they're working in. Doing so enables you to see more code and keeps you from getting distracted. To maximize a Code window, click the maximize button in its title bar or just double-click its title bar. To restore a Code window (make it nonmaximized), click the Restore button (below the Application title bar).

Sometimes, you may want to have two or more Code windows visible. For example, you might want to compare the code in two modules or perhaps copy code from one module to another. To view two or more Code windows at once, make sure that the active code window isn't maximized. Then drag and resize the windows that you want to view.

Minimizing a code window gets it out of the way. You can also click the Close button in a Code window's title bar to close the window completely. To open it again, just double-click the appropriate object in the Project Explorer window.

The VBE doesn't have a menu command to close a workbook. You must reactivate Excel and close it from there. You can, however, use the Immediate window to close a workbook or an add-in. Just activate the Immediate window (press Ctrl+G if it's not visible), type a VBA statement like the one that follows, and press Enter:

```
Workbooks ("myaddin.xlam").Close
```

As you'll see, this statement executes the `Close` method of the `Workbook` object, which closes a workbook. In this case, the workbook happens to be an add-in.

Storing VBA code

In general, a code window can hold four types of code:

- **Sub procedures:** A *procedure* is a set of instructions that performs some action.
- **Function procedures:** A *function* is a set of instructions that returns a single value or an array (similar in concept to a worksheet function, such as SUM).
- **Property procedures:** These are special procedures used in class modules.
- **Declarations:** A *declaration* is information about a variable that you provide to VBA. For example, you can declare the data type for variables you plan to use.

A single VBA module can store any number of Sub procedures, Function procedures, and declarations. How you organize a VBA module is completely up to you. Some people prefer to keep all their VBA code for an application in a single VBA module; others like to split up the code into several different modules.



Note

Although you have lots of flexibility regarding where to store your VBA code, there are some restrictions. Event handler procedures must be located in the Code window for the object that responds to the event. For example, if you write a procedure that executes when the workbook is opened, that procedure must be located in the Code window for the `ThisWorkbook` object, and the procedure must have a special name. This concept will become clearer when I discuss events (Chapter 19) and UserForms (Part IV).

Entering VBA code

Before you can do anything meaningful, you must have some VBA code in a Code window. This VBA code must be within a procedure. A procedure consists of VBA statements. For now, I focus on one type of Code window: a VBA module.

You can add code to a VBA module in three ways:

- **Enter the code manually.** Use your keyboard to type your code.
- **Use the macro-recorder feature.** Use Excel's macro-recorder feature to record your actions and convert them into VBA code.
- **Copy and paste.** Copy the code from another module and paste it into the module that you're working in.

Entering code manually

Sometimes, the most direct route is the best one. Entering code directly involves . . . well, entering the code directly. In other words, you type the code by using your keyboard. You can use the Tab key to indent the lines that logically belong together — for example, the conditional statements between the `If` and `End If` statements. Indenting isn't necessary, but it makes the code easier to read, so it's a good habit to acquire.



Pause for a terminology break

Throughout this book, I use the terms *routine*, *procedure*, and *macro*. Programming people typically use the word *procedure* to describe an automated task. In Excel, a procedure is also known as a *macro*. Technically, a procedure can be a `Sub` procedure or a `Function` procedure, both of which are sometimes called *routines*. I use all these terms pretty much interchangeably. There is, however, an important difference between `Sub` procedures and `Function` procedures. This distinction becomes apparent in Chapters 9 and 10.

Entering and editing text in a VBA module works just as you would expect. You can select text, copy it or cut it, and then paste it to another location.

A single instruction in VBA can be as long as you need it to be. For readability's sake, however, you may want to break a lengthy instruction into two or more lines. To do so, end the line with a space followed by an underscore character and then press Enter and continue the instruction on the following line. The following code, for example, is a single VBA statement split over four lines:

```
MsgBox "Can't find " & UCase(SHORTCUTMENUFILE) _  
    & vbCrLf & vbCrLf & "The file should be located in " _  
    & ThisWorkbook.Path & vbCrLf & vbCrLf _  
    & "You may need to reinstall BudgetMan", vbCritical, APPNAME
```

Notice that I indented the last three lines of this statement. Doing so is optional, but it helps clarify the fact that these four lines are, in fact, a single statement.



Tip

Like Excel, the VBE has multiple levels of Undo and Redo. Therefore, if you find that you deleted an instruction that you shouldn't have, you can click the Undo button (or press Ctrl+Z) repeatedly until the instruction comes back. After undoing, you can click the Redo button (or press Ctrl+Y) to redo changes that were previously undone. This feature can be a lifesaver, so I recommend that you play around with it until you understand how it works.

To get a feel for entering a VBA procedure, try this: Insert a VBA module into a project and then enter the following procedure into the Code window of the module:

```
Sub SayHello()  
    Msg = "Is your name " & Application.UserName & "?"  
    Ans = MsgBox(Msg, vbYesNo)  
    If Ans = vbNo Then  
        MsgBox "Oh, never mind."  
    Else  
        MsgBox "I must be clairvoyant!"  
    End If  
End Sub
```

Figure 7-4 shows how this code looks in a VBA module.



Note

While you enter the code, notice that the VBE makes some adjustments to the text that you enter. For example, if you omit the space before or after an equal sign (=), VBE inserts the space for you. Also, the color of some of the text is changed. These adjustments are all perfectly normal, and you'll appreciate them later.

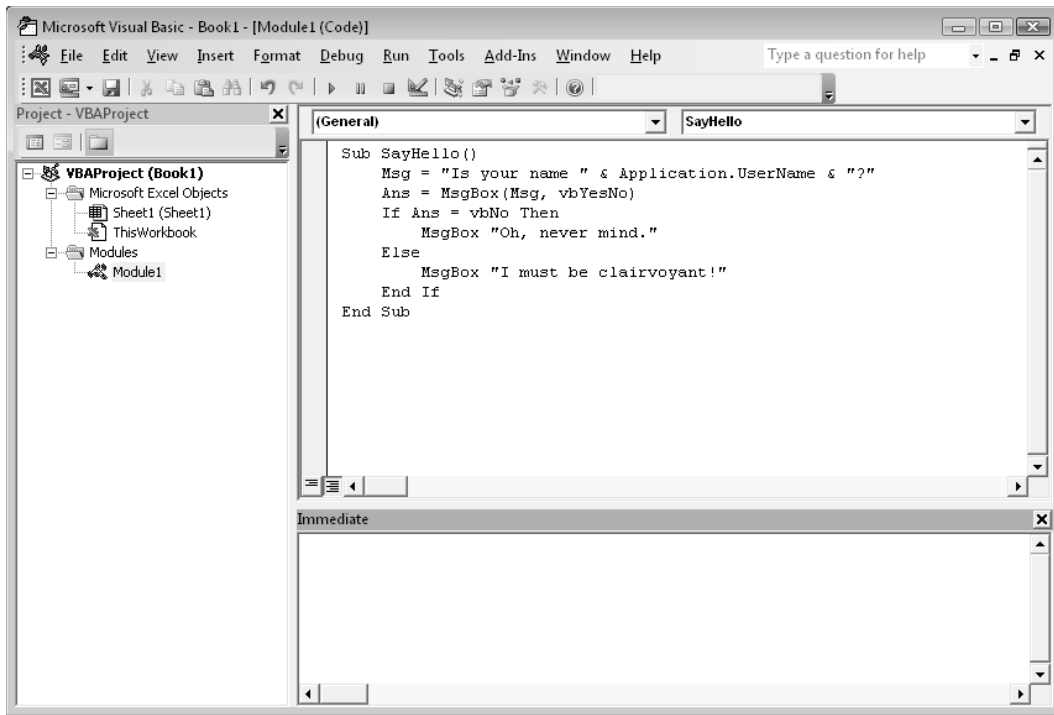


Figure 7-4: Your first VBA procedure.

To execute the `SayHello` procedure, make sure that the cursor is located anywhere within the text that you typed. Then do any of the following:

- Press F5.
- Choose Run → Run Sub/UserForm.
- Click the Run Sub/UserForm button on the Standard toolbar.

If you entered the code correctly, the procedure executes, and you can respond to a simple dialog box (see Figure 7-5) that displays the username, as listed in the Excel Options dialog box. Notice that Excel is activated when the macro executes. At this point, it's not important that you understand how the code works; that becomes clear later in this chapter and in subsequent chapters.

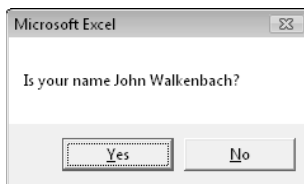


Figure 7-5: The result of running the procedure in Figure 7-4.

**Note**

Most of the time, you'll be executing your macros from Excel. However, it's often more efficient to test your macro by running it directly from the VBE.

What you did in this exercise was write a VBA `Sub` procedure (also known as a *macro*). When you issued the command to execute the macro, the VBE quickly compiled the code and executed it. In other words, each instruction was evaluated, and Excel simply did what it was told to do. You can execute this macro any number of times, although it tends to lose its appeal after a while.

For the record, this simple procedure uses the following concepts (all of which I cover later in the book):

- Declaring a procedure (the first line)
- Assigning a value to variables (`Msg` and `Ans`)
- Concatenating strings (using the `&` operator)
- Using a built-in VBA function (`MsgBox`)
- Using built-in VBA constants (`vbYesNo` and `vbNo`)
- Using an `If-Then-Else` construct
- Ending a procedure (the last line)

Not bad for a first effort, eh?

Using the macro recorder

Another way to get code into a VBA module is to record your actions by using the Excel macro recorder.

No matter how hard you try, there is absolutely no way to record the `SayHello` procedure shown in the previous section. As you'll see, recording macros is very useful, but it has some limitations. In fact, when you record a macro, you almost always need to make adjustments or enter some code manually.

This next example shows how to record a macro that simply changes the page setup to landscape orientation. If you want to try these, start with a blank workbook:

1. Activate a worksheet in the workbook (any worksheet will do).
2. Choose **Developer**→**Code**→**Record Macro**.
Excel displays its Record Macro dialog box.
3. Click OK to accept the default setting for the macro.

Excel automatically inserts a new VBA module into the workbook's VBA project. From this point on, Excel converts your actions into VBA code. Notice that Excel's status bar displays a blue square. You can click that control to stop recording.

4. Choose Page Layout→Page Setup→Orientation→Landscape.
5. Select Developer→Code→Stop Recording (or click the blue square in the status bar).
Excel stops recording your actions.

To view the macro, activate the VBE (pressing Alt+F11 is the easiest way) and locate the project in the Project Explorer window. Double-click the `Modules` node to expand it. Then double-click the `Module1` item to display the code window. (If the project already had a `Module1`, the new macro will be in `Module2`.) The code generated by this single Excel command is shown in Figure 7-6. Remember that code lines preceded by an apostrophe are comments and are not executed.

You may be surprised by the amount of code generated by this single command. (I know I was the first time I tried something like this.) Although you changed only one simple setting in the Page Setup tab, Excel generates more than 50 lines of code that affects dozens of print settings.

This code listing brings up an important concept. The Excel macro recorder is not the most efficient way to generate VBA code. More often than not, the code produced when you record a macro is overkill. Consider the recorded macro that switches to landscape mode. Practically every statement in that macro is extraneous. You can simplify this macro considerably by deleting the extraneous code. Deleting extraneous code makes the macro easier to read, and the macro also runs a bit faster because it doesn't do things that are unnecessary. In fact, you can simplify this recorded macro to the following:

```
Sub Macro1()  
    With ActiveSheet.PageSetup  
        .Orientation = xlLandscape  
    End With  
End Sub
```

I deleted all the code except for the line that sets the `Orientation` property. Actually, you can simplify this macro even more because the `With-End With` construct isn't necessary when you're changing only one property:

```
Sub Macro1()  
    ActiveSheet.PageSetup.Orientation = xlLandscape  
End Sub
```

In this example, the macro changes the `Orientation` property of the `PageSetup` object on the active sheet. By the way, `xlLandscape` is a built-in constant that's provided to make things easier for you. The variable `xlLandscape` has a value of 2, and `xlPortrait` has a value of 1. The following macro works the same as the preceding `Macro1`:

```
Sub Macro1a()  
    ActiveSheet.PageSetup.Orientation = 2  
End Sub
```



Figure 7-6: Code generated by Excel's macro recorder.

Most would agree that it's easier to remember the name of the constant than the arbitrary numbers. You can use the Help system to learn the relevant constants for a particular command.

You could have entered this procedure directly into a VBA module. To do so, you would have to know which objects, properties, and methods to use. Obviously, recording the macro is much faster, and this example has a built-in bonus: You also learned that the `PageSetup` object has an `Orientation` property.



Note

A point that I make clear throughout this book is that recording your actions is perhaps the *best* way to learn VBA. When in doubt, try recording. Although the result may not be exactly what you want, chances are that it will steer you in the right direction. You can use the Help system to check out the objects, properties, and methods that appear in the recorded code.



Cross-Ref

I discuss the macro recorder in more detail later in this chapter. See the section “The Macro Recorder.”

Copying VBA code

So far, I’ve covered typing code directly into a module and recording your actions to generate VBA code. The final method of getting code into a VBA module is to copy it from another module. For example, you may have written a procedure for one project that would also be useful in your current project. Rather than re-enter the code, you can simply open the workbook, activate the module, and use the normal Clipboard copy-and-paste procedures to copy it into your current VBA module. After you’ve finished pasting, you can modify the code as necessary.

And don’t forget about the Internet. You’ll find thousands of VBA code examples at Web sites, forums, and blogs. It’s a simple matter to copy code from a browser and paste it into a VBA module.



Tip

As I note previously in this chapter, you can also import an entire module that has been exported.

Customizing the VBE Environment

If you’re serious about becoming an Excel programmer, you’ll be spending a lot of time with the VBE window. To help make things as comfortable as possible, the VBE provides quite a few customization options.

When the VBE is active, choose **Tools**→**Options**. You see a dialog box with four tabs: Editor, Editor Format, General, and Docking. I discuss some of the most useful options on these tabs in the sections that follow. By the way, don’t confuse this Options dialog box with the Excel Options dialog box, which you bring up by choosing **Office**→**Excel Options** in Excel.

Using the Editor tab

Figure 7-7 shows the options that you access by clicking the Editor tab of the Options dialog box.

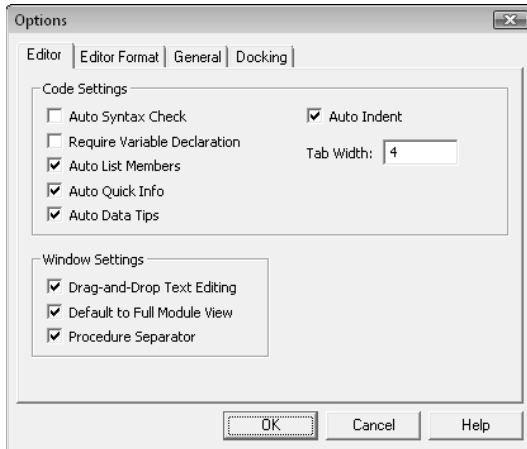


Figure 7-7: The Editor tab of the Options dialog box.

Auto Syntax Check option

The Auto Syntax Check setting determines whether the VBE pops up a dialog box if it discovers a syntax error while you're entering your VBA code. The dialog box tells you roughly what the problem is. If you don't choose this setting, VBE flags syntax errors by displaying them in a different color from the rest of the code, and you don't have to deal with any dialog boxes popping up on your screen.

I keep this setting turned off because I find the dialog boxes annoying, and I can usually figure out what's wrong with an instruction. But if you're new to VBA, you might find the Auto Syntax Check assistance helpful.

Require Variable Declaration option

If the Require Variable Declaration option is set, VBE inserts the following statement at the beginning of each new VBA module that you insert:

```
Option Explicit
```

If this statement appears in your module, you must explicitly define each variable that you use. Variable declaration is an excellent habit to get into, although it does require additional effort on your part. If you don't declare your variables, they will all be of the `Variant` data type, which is flexible but not efficient in terms of storage or speed. I discuss variable declaration in more depth in Chapter 8.

**Note**

Changing the **Require Variable Declaration** option affects only new modules, not existing modules.

Auto List Members option

If the Auto List Members option is set, VBE provides help when you're entering your VBA code by displaying a list of member items for an object. These items include methods and properties for the object that you typed.

This option is very helpful, and I always keep it turned on. Figure 7-8 shows an example of Auto List Members (which will make a lot more sense when you actually start writing VBA code). In this example, VBE is displaying a list of members for the `Application` object. The list changes as you type additional characters, showing only the members that begin with the characters you type. You can just select an item from the list and press Tab (or double-click the item), thus avoiding typing it. Using the Auto List Members list also ensures that the item is spelled correctly.

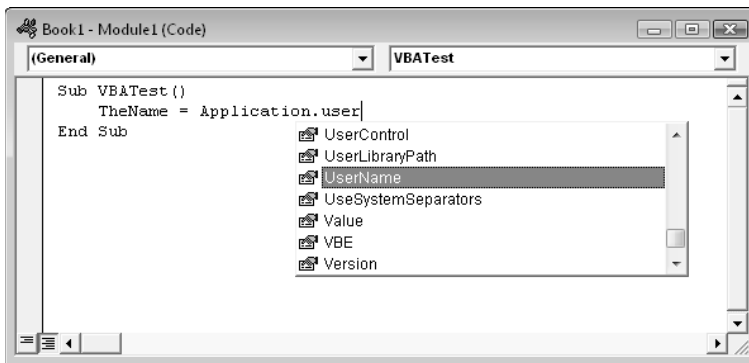


Figure 7-8: An example of Auto List Members.

Auto Quick Info option

If the Auto Quick Info option is set, the VBE displays information about the arguments available for functions, properties, and methods while you type. This information can be very helpful, and I always leave this setting on. Figure 7-9 shows this feature in action. It's displaying the syntax for the `Cells` property.

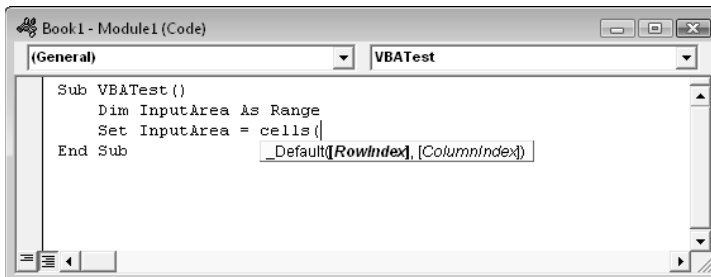


Figure 7-9: An example of Auto Quick Info offering help about the `Cells` property.

Auto Data Tips option

If the Auto Data Tips option is set, you can hover your mouse pointer over a variable, and VBE displays the value of the variable. This technique works only when the procedure is paused while debugging. When you enter the wonderful world of debugging, you'll definitely appreciate this option. I always keep this option turned on.

Auto Indent option

The Auto Indent setting determines whether VBE automatically indents each new line of code by the same amount as the previous line. I'm a big fan of using indentations in my code, so I keep this option on. You can also specify the number of characters to indent; the default is four.



Tip

Use the Tab key, not the space bar, to indent your code. Using the Tab key results in more consistent spacing. In addition, you can use Shift+Tab to unindent a line of code. These keys also work if you select more than one statement.

Drag-and-Drop Text Editing option

The Drag-and-Drop Text Editing option, when enabled, lets you copy and move text by dragging and dropping. I keep this option turned on, but I never use drag-and-drop editing. I prefer to use keyboard shortcuts for copying and pasting.

Default to Full Module View option

The Default to Full Module View option specifies how procedures are viewed. If this option is set, procedures in the code window appear as a single scrollable window. If this option is turned off, you can see only one procedure at a time. I keep this setting turned on.

Procedure Separator option

When the Procedure Separator option is turned on, the VBE displays separator bars between procedures in a code window (assuming that the Default to Full Module View option is also selected). I like the visual cues that show where my procedures end, so I keep this option turned on.

Using the Editor Format tab

Figure 7-10 shows the Editor Format tab of the Options dialog box. The options on this tab control the appearance of the VBE itself.

- **Code Colors option:** The Code Colors option lets you set the text color (foreground and background) and the indicator color displayed for various elements of VBA code. Choosing these colors is largely a matter of individual preference. Personally, I find the default colors to be just fine. But for a change of scenery, I occasionally play around with these settings.

- **Font option:** The Font option lets you select the font that's used in your VBA modules. For best results, stick with a fixed-width font (monofont) such as Courier New. In a *fixed-width font*, all characters are exactly the same width. Using fixed-width characters makes your code much more readable because the characters are nicely aligned vertically and you can easily distinguish multiple spaces.
- **Size setting:** The Size setting specifies the size of the font in the VBA modules. This setting is a matter of personal preference determined by your video display resolution and your eyesight. The default size of 10 (points) works for me.
- **Margin Indicator Bar option:** The Margin Indicator Bar option controls the display of the vertical margin indicator bar in your modules. You should keep this turned on; otherwise, you won't be able to see the helpful graphical indicators when you're debugging your code.

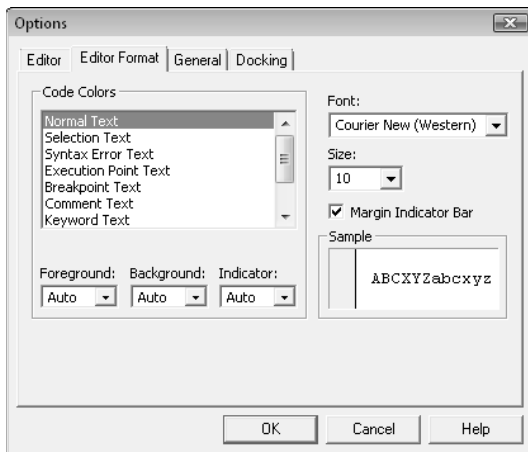


Figure 7-10: The Editor Format tab of the Options dialog box.

Using the General tab

Figure 7-11 shows the following options available under the General tab in the Options dialog box:

- **Form Grid Settings:** The options in this section are for UserForms (custom dialog boxes); they let you specify a grid to help align controls on the UserForm. When you have some experience designing UserForms, you can determine whether a grid display is helpful or not.
- **Show ToolTips check box:** This checkbox refers to toolbar buttons. There's no reason to turn off the ToolTips display.
- **Collapse Proj. Hides Windows option:** If checked, this setting causes the windows to close automatically when you collapse a project in the Project window. I keep this setting turned on.

- **Edit and Continue section:** This area contains one option, which may be useful for debugging. When checked, VBA displays a message if your variables are about to lose their values because of a problem.
- **Error Trapping settings:** These settings determine what happens when an error is encountered. If you write any error-handling code, make sure that the Break on Unhandled Errors option is set. If the Break on All Errors option is set, error-handling code is ignored (which is hardly ever what you want). I discuss error-handling techniques in Chapter 9.
- **Compile settings:** The two Compile settings deal with compiling your code. I keep both of these options turned on. Compiling code is virtually instantaneous unless the project is extremely large.

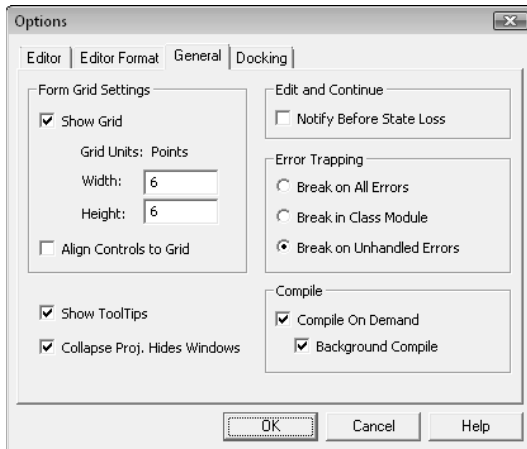


Figure 7-11: The General tab of the Options dialog box.

Using the Docking tab

Figure 7-12 shows the Docking tab of the Options dialog box. These options determine how the various windows in the VBE behave. When a window is docked, it's fixed in place along one of the edges of the VBE window. Docking windows makes it much easier to identify and locate a particular window. If you turn off all docking, you have a big mess of windows that are very confusing. Generally, you'll find that the default settings work fine.

To dock a window, just drag it to the desired location. For example, you might want to dock the Project Explorer window to the left side of the screen. Just drag its title bar to the left, and you see an outline that shows it docked. Release the mouse, and the window is docked.

**Note**

Docking windows in the VBE has always been a bit problematic. Often, you find that some windows simply refuse to be docked. I've found that if you persist long enough, the procedure will eventually work. Unfortunately, I don't have any secret window-docking techniques.

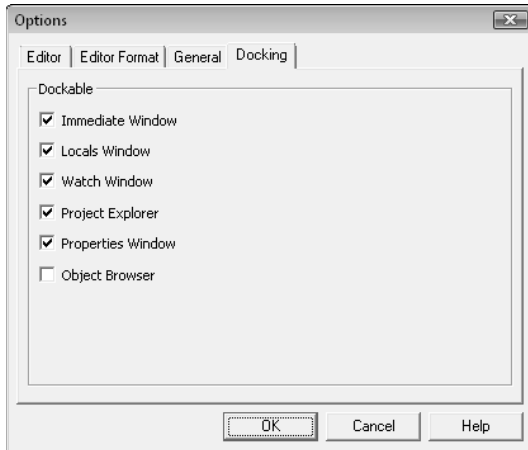


Figure 7-12: The Docking tab of the Options dialog box.

The Macro Recorder

Earlier in this chapter, I discuss the *macro recorder*, which is a tool that converts your Excel actions into VBA code. This section covers the macro recorder in more detail.

**Note**

This is another reminder to make sure that Excel displays the Developer tab in the Ribbon. If you don't see this tab, refer to “Displaying Excel's Developer tab” earlier in this chapter.

The macro recorder is an *extremely* useful tool, but remember the following points:

- The macro recorder is appropriate only for simple macros or for recording a small part of a more complex macro.
- Not all the actions you make in Excel get recorded.
- The macro recorder can't generate code that performs *looping* (that is, repeating statements), assigns variables, executes statements conditionally, displays dialog boxes, and so on.

- The macro recorder always creates `Sub` procedures. You can't create a `Function` procedure by using the macro recorder.
- The code that is generated depends on certain settings that you specify.
- You'll often want to clean up the recorded code to remove extraneous commands.

What the macro recorder actually records

The Excel macro recorder translates your mouse and keyboard actions into VBA code. I could probably write several pages describing how this translation occurs, but the best way to show you is by example. Follow these steps:

1. Start with a blank workbook.
2. Make sure that the Excel window isn't maximized.
You don't want it to fill the entire screen.
3. Press Alt+F11 to activate the VBE window.
Note: Make sure that this window isn't maximized. Otherwise, you won't be able to see the VBE window and Excel's window at the same time.
4. Resize and arrange Excel's window and the VBE window so that both are visible. (For best results, minimize any other applications that are running.)
5. Activate Excel, choose Developer→Code→Record Macro and then click OK to start the macro recorder.
6. Activate the VBE window.
7. In the Project Explorer window, double-click `Module1` to display that module in the code window.
8. Close the Project Explorer window in the VBE to maximize the view of the code window.

Your screen layout should look something like the example in Figure 7-13. The size of the windows depends on your video resolution. If you happen to have a dual display system, just put the VBA window on one display and the Excel window on the other display.

Now move around in the worksheet and select various Excel commands. Watch while the code is generated in the window that displays the VBA module. Select cells, enter data, format cells, use the Ribbon commands, create a chart, manipulate graphic objects, and so on. I guarantee that you'll be enlightened while you watch the code being spit out before your very eyes.

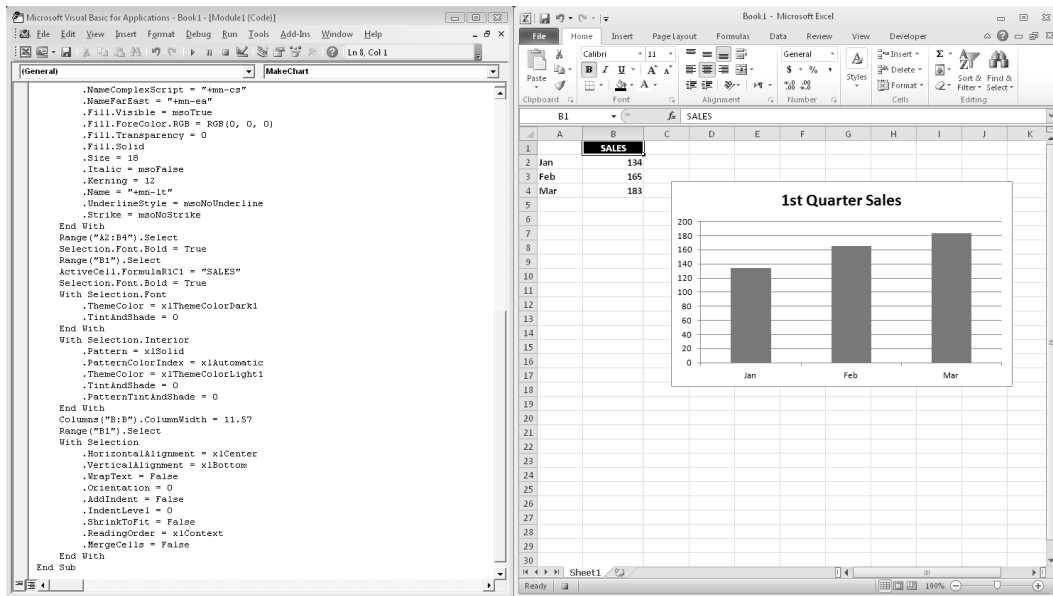


Figure 7-13: A convenient window arrangement for watching the macro recorder do its thing.

Relative or absolute recording?

When recording your actions, Excel normally records *absolute references* to cells. In other words, when you select a cell, it will remember that exact cell (not the cell relative to the current active cell). To demonstrate how absolute references work, perform these steps and examine the code:

1. Activate a worksheet and start the macro recorder.
2. Activate cell B1.
3. Enter **Jan** into cell B1.
4. Move to cell C1 and enter **Feb**.
5. Continue this process until you've entered the first six months of the year in B1:G1.
6. Click cell B1 to activate it again.
7. Stop the macro recorder and examine the new code in the VBE.

Excel generates the following code:

```
Sub Macro1()
    Range("B1").Select
    ActiveCell.FormulaR1C1 = "Jan"
    Range("C1").Select
    ActiveCell.FormulaR1C1 = "Feb"
    Range("D1").Select
```

```
ActiveCell.FormulaR1C1 = "Mar"  
Range("E1").Select  
ActiveCell.FormulaR1C1 = "Apr"  
Range("F1").Select  
ActiveCell.FormulaR1C1 = "May"  
Range("G1").Select  
ActiveCell.FormulaR1C1 = "Jun"  
Range("B1").Select  
End Sub
```

To execute this macro from within Excel, choose **Developer**→**Code**→**Macros** (or press Alt+F8) and select **Macro1** (or whatever the macro is named) and click the **Run** button.

The macro, when executed, re-creates the actions that you performed when you recorded it. These same actions occur regardless of which cell is active when you execute the macro. Recording a macro using absolute references always produces the exact same results.

In some cases, however, you want your recorded macro to work with cell locations in a *relative* manner. For example, you'd probably want such a macro to start entering the month names in the active cell. In such a case, you want to use relative recording to record the macro.

You control how references are recorded by using the **Developer**→**Code**→**Use Relative References** button. This button is a toggle. When the button appears in a different color, the macro recorder records relative references. When the button appears in the standard color, the macro recorder records absolute references. You can change the recording method at any time, even in the middle of recording.

To see how relative referencing is recorded, erase the cells in B1:G1 and then perform the following steps:

1. Activate cell B1.
2. Choose **Developer**→**Code**→**Record Macro**.
3. Click **OK** to begin recording.
4. Click the **Use Relative Reference** button to change the recording mode to relative.
After you click this button, it appears in a different color.
5. Enter the first six months' names in B1:G1, as in the previous example.
6. Select cell B1.
7. Stop the macro recorder.

With the recording mode set to relative, the code that Excel generates is quite different:

```
Sub Macro2()  
ActiveCell.FormulaR1C1 = "Jan"  
ActiveCell.Offset(0, 1).Range("A1").Select  
ActiveCell.FormulaR1C1 = "Feb"
```



```

ActiveCell.Offset(0, 1).Range("A1").Select
ActiveCell.FormulaR1C1 = "Mar"
ActiveCell.Offset(0, 1).Range("A1").Select
ActiveCell.FormulaR1C1 = "Apr"
ActiveCell.Offset(0, 1).Range("A1").Select
ActiveCell.FormulaR1C1 = "May"
ActiveCell.Offset(0, 1).Range("A1").Select
ActiveCell.FormulaR1C1 = "Jun"
ActiveCell.Offset(0, -5).Range("A1").Select
End Sub

```

To test this macro, start by activating a cell other than cell B1. Then choose the Developer→Code→Macros command. Select the macro name and then click the Run button. The month names are entered beginning at the active cell.

Notice that I varied the recording procedure slightly in this example: I activated the beginning cell *before* I started recording. This step is important when you record macros that use the active cell as a base.

Although it looks rather complicated, this macro is actually quite simple. The first statement simply enters Jan into the active cell. (It uses the active cell because it's not preceded by a statement that selects a cell.) The next statement uses the Select method (along with the Offset property) to move the selection one cell to the right. The next statement inserts more text, and so on. Finally, the original cell is selected by calculating a relative offset rather than an absolute cell. Unlike the preceding macro, this one always starts entering text in the active cell.



Note

You'll notice that this macro generates code that appears to reference cell A1 — which may seem strange because cell A1 wasn't even involved in the macro. This code is simply a byproduct of how the macro recorder works. (I discuss the Offset property later in this chapter.) At this point, all you need to know is that the macro works as it should.

The point here is that the recorder has two distinct modes, and you need to be aware of which mode you're recording in. Otherwise, the result may not be what you expected.

By the way, the code generated by Excel is more complex than it needs to be, and it's not even the most efficient way to code the operation. The macro that follows, which I entered manually, is a simpler and faster way to perform this same operation. This example demonstrates that VBA doesn't have to select a cell before it puts information into it — an important concept that can speed things up considerably.

```

Sub Macro3 ()
    ActiveCell.Offset(0, 0) = "Jan"
    ActiveCell.Offset(0, 1) = "Feb"
    ActiveCell.Offset(0, 2) = "Mar"
    ActiveCell.Offset(0, 3) = "Apr"
    ActiveCell.Offset(0, 4) = "May"
    ActiveCell.Offset(0, 5) = "Jun"
End Sub

```

In fact, this macro can be made even more efficient by using the `With-End With` construct:

```
Sub Macro4()  
    With ActiveCell  
        .Offset(0, 0) = "Jan"  
        .Offset(0, 1) = "Feb"  
        .Offset(0, 2) = "Mar"  
        .Offset(0, 3) = "Apr"  
        .Offset(0, 4) = "May"  
        .Offset(0, 5) = "Jun"  
    End With  
End Sub
```

Or, if you're a VBA guru, you can impress your colleagues by using a single statement:

```
Sub Macro5()  
    ActiveCell.Resize(, 6) = Array("Jan", "Feb", "Mar", "Apr", "May", "Jun")  
End Sub
```

Recording options

When you record your actions to create VBA code, you have several options in the Record Macro dialog box. The following list describes your options.

- **Macro name:** You can enter a name for the procedure that you're recording. By default, Excel uses the names `Macro1`, `Macro2`, and so on for each macro that you record. I usually just accept the default name and change the name of the procedure later. You, however, might prefer to name the macro before you record it. The choice is yours.
- **Shortcut key:** The Shortcut key option lets you execute the macro by pressing a shortcut key combination. For example, if you enter **w** (lowercase), you can execute the macro by pressing `Ctrl+W`. If you enter **W** (uppercase), the macro comes alive when you press `Ctrl+Shift+W`. Keep in mind that a shortcut key assigned to a macro overrides a built-in shortcut key (if one exists). For example, if you assign `Ctrl+B` to a macro, you won't be able to use the key combination to toggle the bold attribute in cells.

You can always add or change a shortcut key at any time, so you don't need to set this option while recording a macro.

- **Store Macro In:** The Store Macro In option tells Excel where to store the macro that it records. By default, Excel puts the recorded macro in a module in the active workbook. If you prefer, you can record it in a new workbook (Excel opens a blank workbook) or in your Personal Macro Workbook. (Read more about this in the sidebar, "The Personal Macro Workbook.")

**Note**

Excel remembers your choice, so the next time you record a macro, it defaults to the same location you used previously.

- **Description:** If you like, you can enter a description for you macro in the Description box. Text you enter here appears at the beginning of your macro as a comment.

Cleaning up recorded macros

Earlier in this chapter, you see how recording your actions while you issue a single command (the Page Layout→Page Setup→Orientation command) produces an enormous amount of VBA code. This example shows how, in many cases, the recorded code includes extraneous commands that you can delete.

The macro recorder doesn't always generate the most efficient code. If you examine the generated code, you see that Excel generally records what is selected (that is, an object) and then uses the `Selection` object in subsequent statements. For example, here's what is recorded if you select a range of cells and then use some buttons on the Home tab to change the numeric formatting and apply bold and italic:

```
Range("A1:C5").Select
Selection.Style = "Comma"
Selection.Font.Bold = True
Selection.Font.Italic = True
```

The recorded VBA code works, but it's just one way to perform these actions. You can also use the more efficient `With-End With` construct, as follows:

```
Range("A1:C5").Select
With Selection
    .Style = "Comma"
    .Font.Bold = True
    .Font.Italic = True
End With
```



The Personal Macro Workbook

When you record a macro, one of your options is to record it to your Personal Macro Workbook. If you create some VBA macros that you find particularly useful, you may want to store these routines on your Personal Macro Workbook. This workbook is named `Personal.xlsb` and is stored in your XLStart directory. Whenever you start Excel, this workbook is loaded, and you have access to the macros stored in the workbook. `Personal.xlsb` is a hidden workbook, so it's out of your way when you're working in Excel.

The `Personal.xlsb` file doesn't exist until you record a macro to it.

Or you can avoid the `Select` method altogether and write the code even more efficiently:

```
With Range("A1:C5")  
    .Style = "Comma"      .Font.Bold = True  
    .Font.Italic = True  
End With
```

If speed is essential in your application, you always want to examine any recorded VBA code closely to make sure that it's as efficient as possible.

You, of course, need to understand VBA thoroughly before you start cleaning up your recorded macros. But for now, just be aware that recorded VBA code isn't always the best, most efficient code.



About the code examples

Throughout this book, I present many small snippets of VBA code to make a point or to provide an example. Often, this code might consist of just a single statement. In some cases, the example consists of only an *expression*, which isn't a valid instruction by itself.

For example, the following is an expression:

```
Range("A1").Value
```

To test an expression, you must evaluate it. The `MsgBox` function is a handy tool for this:

```
MsgBox Range("A1").Value
```

To try out these examples, put the statement within a procedure in a VBA module, like this:

```
Sub Test()  
    ' statement goes here  
End Sub
```

Then put the cursor anywhere within the procedure and press F5 to execute it. Also, make sure that the code is being executed within the proper context. For example, if a statement refers to `Sheet1`, make sure that the active workbook actually has a sheet named `Sheet1`.

If the code is just a single statement, you can use the VBE Immediate window. The Immediate window is very useful for executing a statement “immediately” — without having to create a procedure. If the Immediate window isn't displayed, press Ctrl+G in the VBE.

Just type the VBA statement in the Immediate window and press Enter. To evaluate an expression in the Immediate window, precede the expression with a question mark (?). The question mark is a shortcut for `Print`. For example, you can type the following into the Immediate window:

```
? Range("A1").Value
```

The result of this expression is displayed in the next line of the Immediate window.

About Objects and Collections

If you've worked through the first part of this chapter, you have an overview of VBA, and you know the basics of working with VBA modules in the VBE. You've also seen some VBA code and were exposed to concepts like objects and properties. This section gives you additional details about objects and collections of objects.

When you work with VBA, you must understand the concept of objects and Excel's object model. It helps to think of objects in terms of a *hierarchy*. At the top of this model is the `Application` object — in this case, Excel itself. But if you're programming in VBA with Microsoft Word, the `Application` object is Word.

The object hierarchy

The `Application` object (that is, Excel) contains other objects. Here are a few examples of objects contained in the `Application` object:

- `Workbooks` (a collection of all `Workbook` objects)
- `Windows` (a collection of all `Window` objects)
- `AddIns` (a collection of all `AddIn` objects)

Some objects can contain other objects. For example, the `Workbooks` collection consists of all open `Workbook` objects, and a `Workbook` object contains other objects, a few of which are as follows:

- `Worksheets` (a collection of `Worksheet` objects)
- `Charts` (a collection of `Chart` objects)
- `Names` (a collection of `Name` objects)

Each of these objects, in turn, can contain other objects. The `Worksheets` collection consists of all `Worksheet` objects in a `Workbook`. A `Worksheet` object contains many other objects, which include the following:

- `ChartObjects` (a collection of `ChartObject` objects)
- `Range`
- `PageSetup`
- `PivotTables` (a collection of `PivotTable` objects)

If this seems confusing, trust me, it *will* make sense, and you'll eventually realize that this object hierarchy setup is quite logical and well structured. By the way, the complete Excel object model is covered in the Help system.

About collections

Another key concept in VBA programming is collections. A *collection* is a group of objects of the same class, and a collection is itself an object. As I note earlier, `Workbooks` is a collection of all `Workbook` objects currently open. `Worksheets` is a collection of all `Worksheet` objects contained in a particular `Workbook` object. You can work with an entire collection of objects or with an individual object in a collection. To reference a single object from a collection, you put the object's name or index number in parentheses after the name of the collection, like this:

```
Worksheets ("Sheet1")
```

If `Sheet1` is the first worksheet in the collection, you could also use the following reference:

```
Worksheets (1)
```

You refer to the second worksheet in a `Workbook` as `Worksheets (2)`, and so on.

There is also a collection called `Sheets`, which is made up of all sheets in a workbook, whether they're worksheets or chart sheets. If `Sheet1` is the first sheet in the workbook, you can reference it as follows:

```
Sheets (1)
```

Referring to objects

When you refer to an object using VBA, you often must qualify the object by connecting object names with a period (also known as a *dot operator*). What if you had two workbooks open and they both had a worksheet named `Sheet1`? The solution is to qualify the reference by adding the object's container, like this:

```
Workbooks ("Book1") .Worksheets ("Sheet1")
```

Without the workbook qualifier, VBA would look for `Sheet1` in the active workbook.

To refer to a specific range (such as cell A1) on a worksheet named `Sheet1` in a workbook named `Book1`, you can use the following expression:

```
Workbooks ("Book1") .Worksheets ("Sheet1") .Range ("A1")
```

The fully qualified reference for the preceding example also includes the `Application` object, as follows:

```
Application.Workbooks("Book1").Worksheets("Sheet1").Range("A1")
```

Most of the time, however, you can omit the `Application` object in your references; it is assumed. If the `Book1` object is the active workbook, you can even omit that object reference and use this:

```
Worksheets("Sheet1").Range("A1")
```

And — I think you know where I'm going with this — if `Sheet1` is the active worksheet, you can use an even simpler expression:

```
Range("A1")
```



Contrary to what you might expect, Excel doesn't have an object that refers to an individual cell that is called `Cell`. A single cell is simply a `Range` object that happens to consist of just one element.

Simply referring to objects (as in these examples) doesn't do anything. To perform anything meaningful, you must read or modify an object's properties or specify a method to be used with an object.

Properties and Methods

It's easy to be overwhelmed with properties and methods; literally thousands are available. In this section, I describe how to access properties and methods of objects.

Object properties

Every object has properties. For example, a `Range` object has a property called `Value`. You can write VBA code to display the `Value` property or write VBA code to set the `Value` property to a specific value. Here's a procedure that uses the VBA `MsgBox` function to pop up a box that displays the value in cell `A1` on `Sheet1` of the active workbook:

```
Sub ShowValue()  
    MsgBox Worksheets("Sheet1").Range("A1").Value  
End Sub
```

**Note**

The VBA `MsgBox` function provides an easy way to display results while your VBA code is executing. I use it extensively throughout this book.

The code in the preceding example displays the current setting of the `Value` property of a specific cell: cell A1 on a worksheet named `Sheet1` in the active workbook. Note that if the active workbook doesn't have a sheet named `Sheet1`, the macro generates an error.

What if you want to change the `Value` property? The following procedure changes the value displayed in cell A1 by changing the cell's `Value` property:

```
Sub ChangeValue()  
    Worksheets("Sheet1").Range("A1").Value = 123.45  
End Sub
```

After executing this routine, cell A1 on `Sheet1` has the value 123.45.

You may want to enter these procedures into a module and experiment with them.

**Note**

Most objects have a default property. For a `Range` object, the default property is the `Value` property. Therefore, you can omit the `.Value` part from the preceding code, and it has the same effect. However, it's usually considered good programming practice to include the property in your code, even if it is the default property.

The statement that follows accesses the `HasFormula` and the `Formula` properties of a `Range` object:

```
If Range("A1").HasFormula Then MsgBox Range("A1").Formula
```

I use an `If-Then` construct to display a message box conditionally: If the cell has a formula, then display the formula by accessing the `Formula` property. If cell A1 doesn't have a formula, nothing happens.

The `Formula` property is a read-write property, so you can also specify a formula by using VBA:

```
Range("D12").Formula = "=RAND()*100"
```

Object methods

In addition to properties, objects also have methods. A *method* is an action that you perform with an object. Here's a simple example that uses the `Clear` method on a `Range` object. After you execute this procedure, A1:C3 on `Sheet1` is empty, and all cell formatting is removed.


```
Sub ZapRange()  
    Worksheets("Sheet1").Range("A1:C3").Clear  
End Sub
```

If you'd like to delete the values in a range but keep the formatting, use the `ClearContents` method of the `Range` object.

Most methods also take arguments to define the action further. Here's an example that copies cell A1 to cell B1 by using the `Copy` method of the `Range` object. In this example, the `Copy` method has one argument (the destination of the copy). Notice that I use the line continuation character sequence (a space followed by an underscore) in this example. You can omit the line continuation sequence and type the statement on a single line.

```
Sub CopyOne()  
    Worksheets("Sheet1").Range("A1").Copy _  
        Worksheets("Sheet1").Range("B1")  
End Sub
```

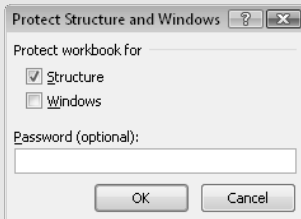


Specifying arguments for methods and properties

An issue that often leads to confusion among new VBA programmers concerns arguments for methods and properties. Some methods use arguments to further clarify the action to be taken, and some properties use arguments to further specify the property value. In some cases, one or more of the arguments are optional.

If a method uses arguments, place the arguments after the name of the method, separated by commas. If the method uses optional arguments, you can insert blank placeholders for the optional arguments. Later in this sidebar, I show you how to insert these placeholders.

Consider the `Protect` method for a workbook object. Check the Help system, and you'll find that the `Protect` method takes three arguments: password, structure, and windows. These arguments correspond to the three options in the Protect Structure and Windows dialog box.



continued

continued

If you want to protect a workbook named `MyBook.xlsx`, for example, you might use a statement like this:

```
Workbooks("MyBook.xlsx").Protect "xyzyzy", True, False
```

In this case, the workbook is protected with a password (argument 1). Its structure is protected (argument 2) but not its windows (argument 3).

If you don't want to assign a password, you can use a statement like this:

```
Workbooks("MyBook.xlsx").Protect , True, False
```

Notice that the first argument is omitted and that I specified the placeholder by using a comma.

Another approach, which makes your code more readable, is to use named arguments. Here's an example of how you use named arguments for the preceding example:

```
Workbooks("MyBook.xlsx").Protect Structure:=True, Windows:=False
```

Using named arguments is a good idea, especially for methods that have many optional arguments and also when you need to use only a few of them. When you use named arguments, you don't need to use a placeholder for missing arguments.

For properties (and methods) that return a value, you must use parentheses around the arguments. For example, the `Address` property of a `Range` object takes five arguments, all of which are optional. Because the `Address` property returns a value, the following statement isn't valid because the parentheses are omitted:

```
MsgBox Range("A1").Address False ' invalid
```

The proper syntax for such a statement requires parentheses, as follows:

```
MsgBox Range("A1").Address(False)
```

You can also write the statement using a named argument:

```
MsgBox Range("A1").Address(rowAbsolute:=False)
```

These nuances will become clearer as you gain more experience with VBA.

The Comment Object: A Case Study

To help you better understand the properties and methods available for an object, I focus on a particular object: the `Comment` object. In Excel, you create a `Comment` object when you choose the **Review**→**Comments**→**New Comment** command to enter a cell comment. In the sections that follow, you get a feel for working with objects.

Viewing Help for the Comment object

One way to learn about a particular object is to look it up in the Help system. Figure 7-14 shows some Help topics for the `Comment` object. I found this Help screen by typing **comment** in the VBE Type a Question for Help box (to the right of the menu bar). Notice that the Help screen has a link at the bottom labeled **Comment Object Members**. Click that link to view the properties and methods for this object.

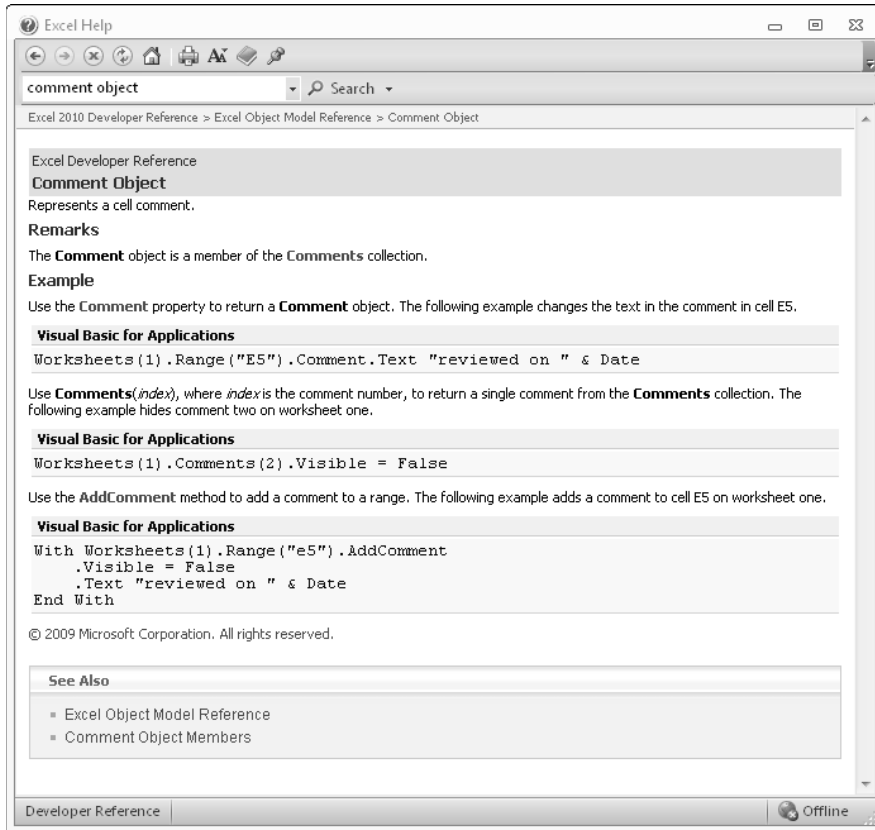


Figure 7-14: The main Help screen for the `Comment` object.



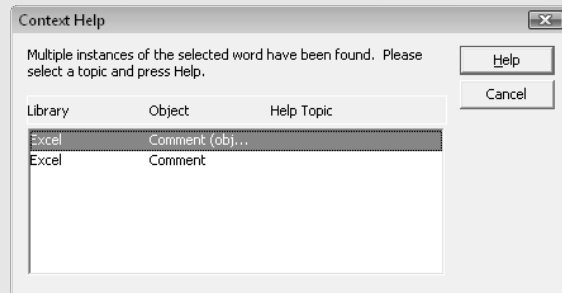
Using the Help system

The easiest way to get specific help about a particular object, property, or method is to type the word in a code window and press F1. If there is any ambiguity about the word that you typed, you get a dialog box like the one shown in the following figure.

continued

continued

Unfortunately, the items listed in the dialog box aren't always clear, so locating the correct help topic may require some trial and error. The dialog box in the figure appears when you type **Comment** and then press F1. In this case, although `Comment` is an object, it may behave like a property. Clicking the first item displays the help topic for the `Comment` object; clicking the second item displays the help topic for the `Comment` property.



Properties of a Comment object

The `Comment` object has six properties. Table 7-1 contains a list of these properties, along with a brief description of each. If a property is *read-only*, your VBA code can read the property but can't change it.

Table 7-1: Properties of a Comment Object

Property	Read-Only	Description
Application	Yes	Returns an object that represents the application that created the comment (that is, Excel).
Author	Yes	Returns the name of the person who created the comment.
Creator	Yes	Returns an integer that indicates the application in which the object was created.
Parent	Yes	Returns the parent object for the comment. (It is always a <code>Range</code> object.)
Shape	Yes	Returns a <code>Shape</code> object that represents the shape attached to the comment.
Visible	No	Is <code>True</code> if the comment is visible.

Methods of a Comment object

Table 7-2 shows the methods that you can use with a `Comment` object. Again, these methods perform common operations that you may have performed manually with a comment at some point . . . but you probably never thought of these operations as methods.

Table 7-2: Methods of a Comment Object

Method	Description
Delete	Deletes a comment.
Next	Returns a <code>Comment</code> object that represents the next comment in the worksheet.
Previous	Returns a <code>Comment</code> object that represents the previous comment in the worksheet.
Text	Returns or sets the text in a comment (takes three arguments).



Note

You may be surprised to see that `Text` is a method rather than a property, which leads to an important point: The distinction between properties and methods isn't always clear-cut, and the object model isn't perfectly consistent. In fact, it's not really important that you distinguish between properties and methods. As long as you get the syntax correct, it doesn't matter whether a word in your code is a property or a method.

The Comments collection

Recall that a collection is a group of like objects. Every worksheet has a `Comments` collection, which consists of all `Comment` objects on the worksheet. If the worksheet has no comments, this collection is empty. Comments appear in the collection based on their position in the worksheet: left-to-right and then top-to-bottom.

For example, the following code refers to the first comment on `Sheet1` of the active workbook:

```
Worksheets("Sheet1").Comments(1)
```

The following statement displays the text contained in the first comment on `Sheet1`:

```
MsgBox Worksheets("Sheet1").Comments(1).Text
```

Unlike most objects, a `Comment` object doesn't have a `Name` property. Therefore, to refer to a specific comment, you must either use an index number or (more frequently) use the `Comment` property of a `Range` object to return a specific comment.

The `Comments` collection is also an object and has its own set of properties and methods. For example, the `Comments` collection has a `Count` property that stores the number of items in the collection — which is the number of `Comment` objects in the active worksheet. The following statement displays the total number of comments on the active worksheet:

```
MsgBox ActiveSheet.Comments.Count
```

The next example shows the address of the cell that has the first comment:

```
MsgBox ActiveSheet.Comments(1).Parent.Address
```

Here, `Comments(1)` returns the first `Comment` object in the `Comments` collection. The `Parent` property of the `Comment` object returns its container, which is a `Range` object. The message box displays the `Address` property of the `Range`. The net effect is that the statement displays the address of the cell that contains the first comment.

You can also loop through all the comments on a sheet by using the `For Each-Next` construct. (Looping is explained in Chapter 8.) Here's an example that displays a separate message box for each comment on the active worksheet:

```
For Each cmt in ActiveSheet.Comments
    MsgBox cmt.Text
Next cmt
```

If you'd rather not deal with a series of message boxes, use this procedure to print the comments to the Immediate window in the VBE:

```
For Each cmt in ActiveSheet.Comments
    Debug.Print cmt.Text
Next cmt
```

About the `Comment` property

In this section, I've been discussing the `Comment` object. If you dig through the Help system, you'll find that a `Range` object has a property named `Comment`. If the cell contains a comment, the `Comment` *property* returns a `Comment` *object*. For example, the following code refers to the `Comment` object in cell A1:

```
Range("A1").Comment
```

If this comment were the first one on the sheet, you could refer to the same `Comment` object as follows:

```
ActiveSheet.Comments(1)
```

To display the comment in cell A1 in a message box, use a statement like this:

```
MsgBox Range("A1").Comment.Text
```

If cell A1 doesn't contain a comment, this statement generates an error.



The fact that a property can return an object is a very important concept — a difficult one to grasp, perhaps, but critical to mastering VBA.

Objects within a Comment object

Working with properties is confusing at first because some properties actually return objects. Suppose that you want to determine the background color of a particular comment on `Sheet1`. If you look through the list of properties for a `Comment` object, you won't find anything that relates to color. Rather, you must do these steps:

1. Use the `Comment` object's `Shape` property to return the `Shape` object that's contained in the comment.
2. Use the `Shape` object's `Fill` property to return a `FillFormat` object.
3. Use the `FillFormat` object's `ForeColor` property to return a `ColorFormat` object.
4. Use the `ColorFormat` object's `RGB` property to get the color value.

Put another way, getting at the interior color for a `Comment` object involves accessing other objects contained in the `Comment` object. Here's a look at the object hierarchy that's involved:

```
Application (Excel)
  Workbook object
    Worksheet object
      Comment object
        Shape object
          FillFormat object
            ColorFormat object
```

I'll be the first to admit it: This process can get very confusing! But, as an example of the elegance of VBA, you can write a single statement to change the color of a comment:

```
Worksheets("Sheet1").Comments(1).Shape.Fill.ForeColor _  
    .RGB = RGB(0, 255, 0)
```

Or, if you use the `SchemeColor` property (which ranges from 0 to 80), the code is

```
Worksheets("Sheet1").Comments(1).Shape.Fill.ForeColor _  
    .SchemeColor = 12
```

This type of referencing is certainly not intuitive at first, but it will eventually make sense. Fortunately, recording your actions in Excel almost always yields some insights regarding the hierarchy of the objects involved.

By the way, to change the color of the text in a comment, you need to access the `Comment` object's `TextFrame` object, which contains the `Characters` object, which contains the `Font` object. Then you have access to the `Font` object's `Color` or `ColorIndex` properties. Here's an example that sets the `ColorIndex` property to 5:

```
Worksheets("Sheet1").Comments(1) _  
    .Shape.TextFrame.Characters.Font.ColorIndex = 5
```



Cross-Ref

Refer to Chapter 30 for more information on colors.

Determining whether a cell has a comment

The following statement displays the comment in cell A1 of the active sheet:

```
MsgBox Range("A1").Comment.Text
```

If cell A1 doesn't have a comment, executing this statement generates a cryptic error message: `Object variable or With block variable not set`.

To determine whether a particular cell has a comment, you can write code to check whether the `Comment` object is `Nothing`. (Yes, `Nothing` is a valid keyword.) The following statement displays `True` if cell A1 doesn't have a comment:

```
MsgBox Range("A1").Comment Is Nothing
```


Note that I use the `Is` keyword and not an equal sign.

You can take this one step further and write a statement that displays the cell comment only if the cell actually has a comment (and does not generate an error if the cell lacks a comment). The statement that follows accomplishes this task:

```
If Not Range("A1").Comment Is Nothing Then _  
    MsgBox Range("A1").Comment.Text
```

Notice that I used the `Not` keyword, which negates the `True` value that's returned if the cell has no comment. The statement, in essence, uses a double-negative to test a condition: If the comment isn't nothing, then display it. If this statement is confusing, think about it for a while, and it will make sense.

Adding a new Comment object

You may have noticed that the list of methods for the `Comment` object doesn't include a method to add a new comment. This is because the `AddComment` method belongs to the `Range` object. The following statement adds a comment (an empty comment) to cell A1 on the active worksheet:

```
Range("A1").AddComment
```

If you consult the Help system, you discover that the `AddComment` method takes an argument that represents the text for the comment. Therefore, you can add a comment and then add text to the comment with a single statement:

```
Range("A1").AddComment "Formula developed by JW."
```



Note

The `AddComment` method generates an error if the cell already contains a comment. To avoid the error, your code can check whether the cell has a comment before adding one.



On the CD

If you'd like to see these `Comment` object properties and methods in action, check out the example workbook on the companion CD-ROM. This workbook, named `comment object.xlsm`, contains several examples that manipulate `Comment` objects with VBA code. You probably won't understand all the code at this point, but you will get a feel for how you can use VBA to manipulate an object.

Some Useful Application Properties

When you're working with Excel, only one workbook at a time can be active. And if the sheet is a worksheet, one cell is the active cell (even if a multicell range is selected). VBA knows about active workbooks, worksheets, and cells and lets you refer to these active objects in a simplified manner. This method of referring to objects is often useful because you won't always know the exact workbook, worksheet, or range that you want to operate on. VBA makes it easy by providing properties of the `Application` object. For example, the `Application` object has an `ActiveCell` property that returns a reference to the active cell. The following instruction assigns the value 1 to the active cell:

```
ActiveCell.Value = 1
```

Notice that I omitted the reference to the `Application` object in the preceding example because it's assumed. It's important to understand that this instruction will fail if the active sheet isn't a worksheet. For example, if VBA executes this statement when a chart sheet is active, the procedure halts, and you get an error message.

If a range is selected in a worksheet, the active cell is a cell within the selected range. In other words, the active cell is always a single cell (never a multicell range).

The `Application` object also has a `Selection` property that returns a reference to whatever is selected, which may be a single cell (the active cell), a range of cells, or an object such as `ChartObject`, `TextBox`, or `Shape`.

Table 7-3 lists the other `Application` properties that are useful when working with cells and ranges.

Table 7-3: Some Useful Properties of the Application Object

Property	Object Returned
<code>ActiveCell</code>	The active cell.
<code>ActiveChart</code>	The active chart sheet or chart contained in a <code>ChartObject</code> on a worksheet. This property is <code>Nothing</code> if a chart isn't active.
<code>ActiveSheet</code>	The active sheet (worksheet or chart).
<code>ActiveWindow</code>	The active window.
<code>ActiveWorkbook</code>	The active workbook.
<code>Selection</code>	The object selected. (It could be a <code>Range</code> object, <code>Shape</code> , <code>ChartObject</code> , and so on.)
<code>ThisWorkbook</code>	The workbook that contains the VBA procedure being executed. This object may or may not be the same as the <code>ActiveWorkbook</code> object.

The advantage of using these properties to return an object is that you don't need to know which cell, worksheet, or workbook is active, and you don't need to provide a specific reference to it. This allows you to write VBA code that isn't specific to a particular workbook, sheet, or range. For example, the following instruction clears the contents of the active cell, even though the address of the active cell isn't known:

```
ActiveCell.ClearContents
```

The example that follows displays a message that tells you the name of the active sheet:

```
MsgBox ActiveSheet.Name
```

If you want to know the name and directory path of the active workbook, use a statement like this:

```
MsgBox ActiveWorkbook.FullName
```

If a range on a worksheet is selected, you can fill the entire range with a value by executing a single statement. In the following example, the `Selection` property of the `Application` object returns a `Range` object that corresponds to the selected cells. The instruction simply modifies the `Value` property of this `Range` object, and the result is a range filled with a single value:

```
Selection.Value = 12
```

Note that if something other than a range is selected (such as a `ChartObject` or a `Shape`), the preceding statement generates an error because `ChartObject` and `Shape` objects don't have a `Value` property.

The following statement, however, enters a value of 12 into the `Range` object that was selected before a non-`Range` object was selected. If you look up the `RangeSelection` property in the Help system, you find that this property applies only to a `Window` object.

```
ActiveWindow.RangeSelection.Value = 12
```

To find out how many cells are selected in the active window, access the `Count` property. Here's an example:

```
MsgBox ActiveWindow.RangeSelection.Count
```

Working with Range Objects

Much of the work that you will do in VBA involves cells and ranges in worksheets. The earlier discussion on relative versus absolute macro recording (see “Relative or absolute recording?”) exposes you to working with cells in VBA, but you need to know a lot more.

A `Range` object is contained in a `Worksheet` object and consists of a single cell or range of cells on a single worksheet. In the sections that follow, I discuss three ways of referring to `Range` objects in your VBA code:

- The `Range` property of a `Worksheet` or `Range` class object
- The `Cells` property of a `Worksheet` object
- The `Offset` property of a `Range` object

The Range property

The `Range` property returns a `Range` object. If you consult the Help system for the `Range` property, you learn that this property has two syntaxes:

```
object.Range(cell11)
object.Range(cell11, cell12)
```

The `Range` property applies to two types of objects: a `Worksheet` object or a `Range` object. Here, `cell11` and `cell12` refer to placeholders for terms that Excel recognizes as identifying the range (in the first instance) and delineating the range (in the second instance). Following are a few examples of using the `Range` property.

You’ve already seen examples like the following one earlier in the chapter. The instruction that follows simply enters a value into the specified cell. In this case, it puts the value 12.3 into cell A1 on `Sheet1` of the active workbook:

```
Worksheets("Sheet1").Range("A1").Value = 12.3
```

The `Range` property also recognizes defined names in workbooks. Therefore, if a cell is named `Input`, you can use the following statement to enter a value into that named cell:

```
Worksheets("Sheet1").Range("Input").Value = 100
```

The example that follows enters the same value into a range of 20 cells on the active sheet. If the active sheet isn’t a worksheet, the statement causes an error message:

```
ActiveSheet.Range("A1:B10").Value = 2
```



Working with merged cells

Working with merged cells can be tricky. If a range contains merged cells, you may need to take some special action with the macros. For example, if cells A1:D1 are merged, the statement that follows selects columns A through D (not just column B, as you might expect):

```
Columns("B:B").Select
```

I don't know if this unexpected behavior is intentional or whether it's a bug. However, it can cause your macro to behave in a manner that you didn't expect. Merged cells can also cause problems with sorting.

To determine whether a particular range contains any merged cells, you can use the following VBA function. The function returns `True` if any cell in the argument range is a merged cell. (Refer to Chapter 10 for more information about Function procedures.)

```
Function ContainsMergedCells(rng As Range)
    Dim cell As Range
    ContainsMergedCells = False
    For Each cell In rng
        If cell.MergeCells Then
            ContainsMergedCells = True
            Exit Function
        End If
    Next cell
End Function
```

To refer to merged cells, you can reference the entire merged range or just the upper-left cell within the merged range. For example, if a worksheet contains four cells merged into one (A1, B1, A2, and B1), reference the merged cells using either of the following expressions:

```
Range("A1:B2")
Range("A1")
```

If you attempt to assign a value to a cell in a merged range that's not the upper-left cell, VBA ignores the instruction and doesn't generate an error. For example, the following statement has no effect if A1:B2 is merged:

```
Range("B2").Value = 43
```

Some operations cause Excel to display a confirmation message. For example, if A1:B2 is merged, the following statement generates a message: *This operation will cause some merged cells to unmerge. Do you wish to continue?*

```
Range("B2").Delete
```

Bottom line? Be careful with merged cells. Some have suggested that this feature wasn't very well thought-out before it was implemented. I tend to agree.

The next example produces exactly the same result as the preceding example:

```
Range("A1", "B10") = 2
```

The sheet reference is omitted, however, so the active sheet is assumed. Also, the value property is omitted, so the default property (which is `Value` for a `Range` object) is assumed. This example also uses the second syntax of the `Range` property. With this syntax, the first argument is the cell at the top left of the range, and the second argument is the cell at the lower right of the range.

The following example uses the Excel range intersection operator (a space) to return the intersection of two ranges. In this case, the intersection is a single cell, C6. Therefore, this statement enters 3 into cell C6:

```
Range("C1:C10 A6:E6") = 3
```

And finally, this next example enters the value 4 into five cells: that is, a noncontiguous range. The comma serves as the union operator.

```
Range("A1,A3,A5,A7,A9") = 4
```

So far, all the examples have used the `Range` property on a `Worksheet` object. As I mentioned, you can also use the `Range` property on a `Range` object. This concept can be rather confusing, but bear with me.

Following is an example of using the `Range` property on a `Range` object. (In this case, the `Range` object is the active cell.) This example treats the `Range` object as if it were the upper-left cell in the worksheet, and then it enters a value of 5 into the cell that *would be* B2. In other words, the reference returned is relative to the upper-left corner of the `Range` object. Therefore, the statement that follows enters a value of 5 into the cell directly to the right and one row below the active cell:

```
ActiveCell.Range("B2") = 5
```

I *said* this is confusing. Fortunately, you can access a cell relative to a range in a much clearer way: the `Offset` property. I discuss this property after the next section.

The Cells property

Another way to reference a range is to use the `Cells` property. You can use the `Cells` property, like the `Range` property, on `Worksheet` objects and `Range` objects. Check the Help system, and you see that the `Cells` property has three syntaxes:

```
object.Cells(rowIndex, columnIndex)
object.Cells(rowIndex)
object.Cells
```

Some examples demonstrate how to use the `Cells` property. The first example enters the value 9 into cell A1 on `Sheet1`. In this case, I'm using the first syntax, which accepts the index number of the row (from 1 to 1048576) and the index number of the column (from 1 to 16384):

```
Worksheets("Sheet1").Cells(1, 1) = 9
```

Here's an example that enters the value 7 into cell D3 (that is, row 3, column 4) in the active worksheet:

```
ActiveSheet.Cells(3, 4) = 7
```

You can also use the `Cells` property on a `Range` object. When you do so, the `Range` object returned by the `Cells` property is relative to the upper-left cell of the referenced `Range`. Confusing? Probably. An example may help clear up any confusion. The following instruction enters the value 5 into the active cell. Remember, in this case, the active cell is treated as if it were cell A1 in the worksheet:

```
ActiveCell.Cells(1, 1) = 5
```



Note

The real advantage of this type of cell referencing will be apparent when I discuss variables and looping (see Chapter 8). In most cases, you don't use actual values for the arguments; rather, you use variables.

To enter a value of 5 into the cell directly below the active cell, you can use the following instruction:

```
ActiveCell.Cells(2, 1) = 5
```

Think of the preceding example as though it said this: "Start with the active cell and consider this cell as cell A1. Place 5 in the cell in the second row and the first column."

The second syntax of the `Cells` method uses a single argument that can range from 1 to 17,179,869,184. This number is equal to the number of cells in an Excel 2010 worksheet. The cells are numbered starting from A1 and continuing right and then down to the next row. The 16,384th cell is XFD1; the 16,385th is A2.

The next example enters the value 2 into cell SZ1 (which is the 520th cell in the worksheet) of the active worksheet:

```
ActiveSheet.Cells(520) = 2
```

To display the value in the last cell in a worksheet (XFD1048576), use this statement:

```
MsgBox ActiveSheet.Cells(17179869184)
```

You can also use this syntax with a `Range` object. In this case, the cell returned is relative to the `Range` object referenced. For example, if the `Range` object is A1:D10 (40 cells), the `Cells` property can have an argument from 1 to 40 and can return one of the cells in the `Range` object. In the following example, a value of 2000 is entered into cell A2 because A2 is the fifth cell (counting from the top, to the right, and then down) in the referenced range:

```
Range("A1:D10").Cells(5) = 2000
```



Note

In the preceding example, the argument for the `Cells` property isn't limited to values between 1 and 40. If the argument exceeds the number of cells in the range, the counting continues as if the range were taller than it actually is. Therefore, a statement like the preceding one could change the value in a cell that's outside of the range A1:D10. The statement that follows, for example, changes the value in cell A11:

```
Range("A1:D10").Cells(41)=2000
```



Getting information from a cell

If you need to get the contents of a cell, VBA provides several properties. Following are the most commonly used properties:

- The `Formula` property returns the formula, if the cell has one. If the cell doesn't contain a formula, it returns the value in the cell. The `Formula` property is a read/write property. Variations on this property include `FormulaR1C1`, `FormulaLocal`, and `FormulaArray`. (Consult the Help system for details.)
- The `Value` property returns the raw, unformatted value in the cell. This property is a read/write property.
- The `Text` property returns the text that is displayed in the cell. If the cell contains a numeric value, this property includes all the formatting, such as commas and currency symbols. The `Text` property is a read-only property.
- The `Value2` property is just like the `Value` property, except that it doesn't use the `Date` and `Currency` data types. Rather, this property converts `Date` and `Currency` data types to `Variants` containing `Doubles`. If a cell contains the date 12/6/2010, the `Value` property returns it as a `Date`, while the `Value2` property returns it as a `double` (for example, 40518).

The third syntax for the `Cells` property simply returns all cells on the referenced worksheet. Unlike the other two syntaxes, in this one, the return data isn't a single cell. This example uses the `ClearContents` method on the range returned by using the `Cells` property on the active worksheet. The result is that the content of every cell on the worksheet is cleared:

```
ActiveSheet.Cells.ClearContents
```

The Offset property

The `Offset` property, like the `Range` and `Cells` properties, also returns a `Range` object. But unlike the other two methods that I discussed, the `Offset` property applies only to a `Range` object and no other class. Its syntax is as follows:

```
object.Offset(rowOffset, columnOffset)
```

The `Offset` property takes two arguments that correspond to the relative position from the upper-left cell of the specified `Range` object. The arguments can be positive (down or to the right), negative (up or to the left), or zero. The example that follows enters a value of 12 into the cell directly below the active cell:

```
ActiveCell.Offset(1,0).Value = 12
```

The next example enters a value of 15 into the cell directly above the active cell:

```
ActiveCell.Offset(-1,0).Value = 15
```

If the active cell is in row 1, the `Offset` property in the preceding example generates an error because it can't return a `Range` object that doesn't exist.

The `Offset` property is quite useful, especially when you use variables within looping procedures. I discuss these topics in the next chapter.

When you record a macro using the relative reference mode, Excel uses the `Offset` property to reference cells relative to the starting position (that is, the active cell when macro recording begins). For example, I used the macro recorder to generate the following code. I started with the cell pointer in cell B1, entered values into B1:B3, and then returned to B1.

```
Sub Macro1()  
    ActiveCell.FormulaR1C1 = "1"  
    ActiveCell.Offset(1, 0).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "2"  
    ActiveCell.Offset(1, 0).Range("A1").Select
```

```
ActiveCell.FormulaR1C1 = "3"  
ActiveCell.Offset(-2, 0).Range("A1").Select  
End Sub
```

Notice that the macro recorder uses the `FormulaR1C1` property. Normally, you want to use the `Value` property to enter a value into a cell. However, using `FormulaR1C1` or even `Formula` produces the same result.

Also notice that the generated code references cell A1 — a cell that was even involved in the macro. This notation is a quirk in the macro recording procedure that makes the code more complex than necessary. You can delete all references to `Range("A1")`, and the macro still works perfectly:

```
Sub Modified_Macro1()  
    ActiveCell.FormulaR1C1 = "1"  
    ActiveCell.Offset(1, 0).Select  
    ActiveCell.FormulaR1C1 = "2"  
    ActiveCell.Offset(1, 0).Select  
    ActiveCell.FormulaR1C1 = "3"  
    ActiveCell.Offset(-2, 0).Select  
End Sub
```

In fact, here's a much more efficient version of the macro (which I wrote myself) that doesn't do any selecting:

```
Sub Macro1()  
    ActiveCell = 1  
    ActiveCell.Offset(1, 0) = 2  
    ActiveCell.Offset(2, 0) = 3  
End Sub
```

Things to Know about Objects

The preceding sections introduced you to objects (including collections), properties, and methods. But I've barely scratched the surface.

Essential concepts to remember

In this section, I note some additional concepts that are essential for would-be VBA gurus. These concepts become clearer when you work with VBA and read subsequent chapters:

- **Objects have unique properties and methods.** Each object has its own set of properties and methods. Some objects, however, share some properties (for example, `Name`) and some methods (such as `Delete`).
- **You can manipulate objects without selecting them.** This idea may be contrary to how you normally think about manipulating objects in Excel. The fact is that it's usually more efficient to perform actions on objects without selecting them first. When you record a macro, Excel generally selects the object first. This step isn't necessary and may actually make your macro run more slowly.
- **It's important that you understand the concept of collections.** Most of the time, you refer to an object indirectly by referring to the collection that it's in. For example, to access a `Workbook` object named `Myfile`, reference the `Workbooks` collection as follows:

```
Workbooks("Myfile.xlsx")
```

This reference returns an object, which is the workbook with which you're concerned.

- **Properties can return a reference to another object.** For example, in the following statement, the `Font` property returns a `Font` object contained in a `Range` object. `Bold` is a property of the `Font` object, not the `Range` object.

```
Range("A1").Font.Bold = True
```

- **You can refer to the same object in many different ways.** Assume that you have a workbook named `Sales`, and it's the only workbook open. Then assume that this workbook has one worksheet, named `Summary`. You can refer to the sheet in any of the following ways:

```
Workbooks("Sales.xlsx").Worksheets("Summary")  
Workbooks(1).Worksheets(1)  
Workbooks(1).Sheets(1)  
Application.ActiveWorkbook.ActiveSheet  
ActiveWorkbook.ActiveSheet  
ActiveSheet
```

The method that you use is usually determined by how much you know about the workspace. For example, if more than one workbook is open, the second and third methods aren't reliable. If you want to work with the active sheet (whatever it may be), any of the last three methods would work. To be absolutely sure that you're referring to a specific sheet on a specific workbook, the first method is your best choice.

Learning more about objects and properties

If this is your first exposure to VBA, you're probably a bit overwhelmed by objects, properties, and methods. I don't blame you. If you try to access a property that an object doesn't have, you get a runtime error, and your VBA code grinds to a screeching halt until you correct the problem.

Fortunately, there are several good ways to learn about objects, properties, and methods.

Read the rest of the book

Don't forget, the name of this chapter is "Introducing Visual Basic for Applications." The remainder of this book covers many additional details and provides many useful and informative examples.

Record your actions

The absolute best way to become familiar with VBA, without question, is to simply turn on the macro recorder and record some actions that you perform in Excel. This approach is a quick way to learn the relevant objects, properties, and methods for a task. It's even better if the VBA module in which the code is being recorded is visible while you're recording.

Use the Help system

The main source of detailed information about Excel's objects, methods, and procedures is the Help system. Many people forget about this resource.

Use the Object Browser

The *Object Browser* is a handy tool that lists every property and method for every object available. When the VBE is active, you can bring up the Object Browser in any of the following three ways:

- Press F2.
- Choose the View→Object Browser command from the menu.
- Click the Object Browser tool on the Standard toolbar.

The Object Browser is shown in Figure 7-15.

The drop-down list in the upper-left corner of the Object Browser includes a list of all object libraries that you have access to:

- Excel itself
- MSForms (used to create custom dialog boxes)
- Office (objects common to all Microsoft Office applications)
- Stdole (OLE automation objects)
- VBA
- The current project (the project that's selected in the Project Explorer) and any workbooks referenced by that project

Your selection in this upper-left drop-down list determines what is displayed in the Classes window, and your selection in the Classes window determines what is visible in the Members Of panel.

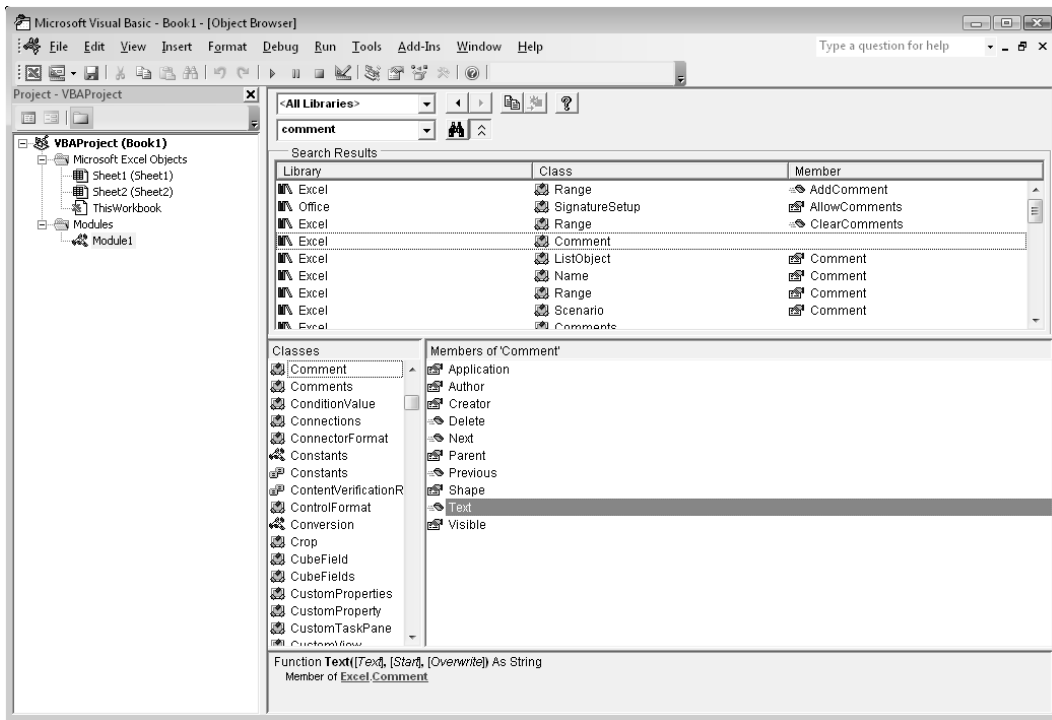


Figure 7-15: The Object Browser is a great reference source.

After you select a library, you can search for a particular text string to get a list of properties and methods that contain the text. You do so by entering the text in the second drop-down list and then clicking the binoculars (Search) icon. For example, assume that you're working on a project that manipulates cell comments:

1. Select the library of interest.
If you're not sure which object library is appropriate, you can select <All Libraries>.
2. Enter **Comment** in the drop-down list below the library list.
3. Click the binoculars icon to begin the text search.

The Search Results window displays the matching text. Select an object to display its classes in the Classes window. Select a class to display its members (properties, methods, and constants). Pay attention to the bottom pane, which shows more information about the object. You can press F1 to go directly to the appropriate help topic.

The Object Browser may seem complex at first, but its usefulness to you will increase over time.

Experiment with the Immediate window

As I describe in the sidebar earlier in this chapter (see “About the code examples”), the Immediate window of the VBE is very useful for testing statements and trying out various VBA expressions. I generally keep the Immediate window visible at all times, and I use it frequently to test various expressions and to help in debugging code.

VBA Programming Fundamentals

In This Chapter

- Understanding VBA language elements, including variables, data types, constants, and arrays
- Using VBA built-in functions
- Manipulating objects and collections
- Controlling the execution of your procedures

VBA Language Elements: An Overview

If you've used other programming languages, much of the information in this chapter may sound familiar. However, VBA has a few unique wrinkles, so even experienced programmers may find some new information.

In Chapter 7, I present an overview of objects, properties, and methods, but I don't tell you much about how to manipulate objects so that they do meaningful things. This chapter gently nudges you in that direction by exploring the VBA *language elements*, which are the keywords and control structures that you use to write VBA routines.

To get the ball rolling, I start by presenting a simple VBA `Sub` procedure. The following code, which is stored in a VBA module, calculates the sum of the first 100 positive integers. When the code finishes executing, the procedure displays a message with the result.

```
Sub VBA_Demo()  
    ' This is a simple VBA Example  
    Dim Total As Long, i As Long  
    Total = 0  
    For i = 1 To 100
```

```
        Total = Total + i
    Next i
    MsgBox Total
End Sub
```

This procedure uses some common VBA language elements, including:

- A comment (the line that begins with an apostrophe)
- A variable declaration statement (the line that begins with `Dim`)
- Two variables (`Total` and `i`)
- Two assignment statements (`Total = 0` and `Total = Total + i`)
- A looping structure (`For-Next`)
- A VBA function (`MsgBox`)

All these language elements are discussed in subsequent sections of this chapter.



Note

VBA procedures need not manipulate any objects. The preceding procedure, for example, doesn't do anything with objects. It simply works with numbers.



Entering VBA code

VBA code, which resides in a VBA module, consists of instructions. The accepted practice is to use one instruction per line. This standard isn't a requirement, however; you can use a colon to separate multiple instructions on a single line. The following example combines four instructions on one line:

```
Sub OneLine()
    x= 1: y= 2: z= 3: MsgBox x + y + z
End Sub
```

Most programmers agree that code is easier to read if you use one instruction per line:

```
Sub MultipleLines()
    x = 1
    y = 2
    z = 3
    MsgBox x + y + z
End Sub
```


Each line can be as long as you like; the VBA module window scrolls to the left when you reach the right side. For lengthy lines, you may want to use VBA's line continuation sequence: a space followed by an underscore (`_`). For example:

```
Sub LongLine()  
    SummedValue = _  
        Worksheets("Sheet1").Range("A1").Value + _  
        Worksheets("Sheet2").Range("A1").Value  
End Sub
```

When you record macros, Excel often uses underscores to break long statements into multiple lines.

After you enter an instruction, VBA performs the following actions to improve readability:

- **It inserts spaces between operators.** If you enter `Ans=1+2` (without spaces), for example, VBA converts it to

```
Ans = 1 + 2
```

- **It adjusts the case of the letters for keywords, properties, and methods.** If you enter the following text: `Result=activesheet.range("a1").value=12`

VBA converts it to

```
Result = ActiveSheet.Range("a1").Value = 12
```

Notice that text within quotation marks (in this case, `"a1"`) isn't changed.

- **Because VBA variable names aren't case-sensitive, the interpreter by default adjusts the names of all variables with the same letters so that their case matches the case of letters that you most recently typed.** For example, if you first specify a variable as `myvalue` (all lowercase) and then enter the variable as `MyValue` (mixed case), VBA changes all other occurrences of the variable to `MyValue`. An exception occurs if you declare the variable with `Dim` or a similar statement; in this case, the variable name always appears as it was declared.
- **VBA scans the instruction for syntax errors.** If VBA finds an error, it changes the color of the line and might display a message describing the problem. Choose the Visual Basic Editor Tools→Options command to display the Options dialog box, where you control the error color (use the Editor Format tab) and whether the error message is displayed (use the Auto Syntax Check option in the Editor tab).

Comments

A *comment* is descriptive text embedded within your code and ignored by VBA. It's a good idea to use comments liberally to describe what you're doing because an instruction's purpose isn't always obvious.

You can use a complete line for your comment, or you can insert a comment *after* an instruction on the same line. A comment is indicated by an apostrophe. VBA ignores any text that follows an apostrophe — except when the apostrophe is contained within quotation marks — up until the end of the line. For example, the following statement doesn't contain a comment, even though it has an apostrophe:

```
Msg = "Can't continue"
```

The following example shows a VBA procedure with three comments:

```
Sub CommentDemo()  
' This procedure does nothing of value  
  x = 0 'x represents nothingness  
' Display the result  
  MsgBox x  
End Sub
```

Although the apostrophe is the preferred comment indicator, you can also use the `Rem` keyword to mark a line as a comment. For example:

```
Rem -- The next statement prompts the user for a filename
```

The `Rem` keyword (short for *Remark*) is essentially a holdover from older versions of BASIC and is included in VBA for the sake of compatibility. Unlike the apostrophe, `Rem` can be written only at the beginning of a line, not on the same line as another instruction.



Tip

Using comments is definitely a good idea, but not all comments are equally beneficial. To be useful, comments should convey information that's not immediately obvious from reading the code. Otherwise, you're just chewing up valuable bytes and increasing the size of your workbook.

Following are a few general tips on making the best use of comments:

- Use comments to describe briefly the purpose of each procedure that you write.
- Use comments to describe changes that you make to a procedure.
- Use comments to indicate that you're using functions or constructs in an unusual or non-standard manner.
- Use comments to describe the purpose of variables so that you and other people can decipher otherwise cryptic names.

- Use comments to describe workarounds that you develop to overcome Excel bugs or limitations.
- Write comments *while* you code rather than after.



Tip

In some cases, you may want to test a procedure without including a particular instruction or group of instructions. Instead of deleting the instruction, simply turn it into a comment by inserting an apostrophe at the beginning. VBA then ignores the instruction(s) when the routine is executed. To convert the comment back to an instruction, just delete the apostrophe.

The Visual Basic Editor (VBE) Edit toolbar contains two very useful buttons. (The Edit toolbar isn't displayed by default. To display this toolbar, choose

View→Toolbars→Edit.) Select a group of instructions and then click the Comment Block button to convert the instructions to comments. The Uncomment Block button converts a group of comments back to instructions.

Variables, Data Types, and Constants

VBA's main purpose in life is to manipulate data. Some data resides in objects, such as worksheet ranges. Other data is stored in variables that you create.

A *variable* is simply a named storage location in your computer's memory. Variables can accommodate a wide variety of *data types* — from simple Boolean values (`True` or `False`) to large, double-precision values (see the following section). You assign a value to a variable by using the equal sign operator (more about this process in the upcoming section, "Assignment Statements").

You make your life easier if you get into the habit of making your variable names as descriptive as possible. VBA does, however, have a few rules regarding variable names:

- You can use alphabetic characters, numbers, and some punctuation characters, but the first character must be alphabetic.
- VBA doesn't distinguish between case. To make variable names more readable, programmers often use mixed case (for example, `InterestRate` rather than `interestrate`).
- You can't use spaces or periods. To make variable names more readable, programmers often use the underscore character (`Interest_Rate`).
- You can't embed special type declaration characters (`#`, `$`, `%`, `&`, or `!`) in a variable name.
- Variable names can be as long as 254 characters — but using such long variable names isn't recommended.

The following list contains some examples of assignment expressions that use various types of variables. The variable names are to the left of the equal sign. Each statement assigns the value to the right of the equal sign to the variable on the left.

```
x = 1
InterestRate = 0.075
LoanPayoffAmount = 243089.87
DataEntered = False
x = x + 1
MyNum = YourNum * 1.25
UserName = "Bob Johnson"
DateStarted = #12/14/2009#
```

VBA has many *reserved words*, which are words that you can't use for variable or procedure names. If you attempt to use one of these words, you get an error message. For example, although the reserved word `Next` might make a very descriptive variable name, the following instruction generates a syntax error:

```
Next = 132
```

Unfortunately, syntax error messages aren't always descriptive. If the Auto Syntax Check option is turned on you get the error: `Compile error: Expected: variable`. If Auto Syntax Check is turned off, attempting to execute this statement results in: `Compile error: Syntax error`. It would be more helpful if the error message were something like `Reserved word used as a variable`. So if an instruction produces a strange error message, check the VBA Help system to ensure that your variable name doesn't have a special use in VBA.

Defining data types

VBA makes life easy for programmers because it can automatically handle all the details involved in dealing with data. Not all programming languages make it so easy. For example, some languages are *strictly typed*, which means that the programmer must explicitly define the data type for every variable used.

Data type refers to how data is stored in memory — as integers, real numbers, strings, and so on. Although VBA can take care of data typing automatically, it does so at a cost: slower execution and less efficient use of memory. As a result, letting VBA handle data typing may present problems when you're running large or complex applications. Another advantage of explicitly declaring your variables as a particular data type is that VBA can perform some additional error checking at the compile stage. These errors might otherwise be difficult to locate.

Table 8-1 lists VBA's assortment of built-in data types. (Note that you can also define custom data types, which I describe later in this chapter in "User-Defined Data Types.")

Table 8-1: VBA Built-In Data Types

Data Type	Bytes Used	Range of Values
Byte	1 byte	0 to 255
Boolean	2 bytes	True or False
Integer	2 bytes	-32,768 to 32,767
Long	4 bytes	-2,147,483,648 to 2,147,483,647
Single	4 bytes	-3.402823E38 to -1.401298E-45 (for negative values); 1.401298E-45 to 3.402823E38 (for positive values)
Double	8 bytes	-1.79769313486232E308 to -4.94065645841247E-324 (negative values); 4.94065645841247E-324 to 1.79769313486232E308 (for positive values)
Currency	8 bytes	-922,337,203,685,477.5808 to 922,337,203,685,477.5807
Decimal	12 bytes	+/-79,228,162,514,264,337,593,543,950,335 with no decimal point; +/-7.9228162514264337593543950335 with 28 places to the right of the decimal
Date	8 bytes	January 1, 0100 to December 31, 9999
Object	4 bytes	Any object reference
String (variable length)	10 bytes + string length	0 to approximately 2 billion characters
String (fixed length)	Length of string	1 to approximately 65,400 characters
Variant (with numbers)	16 bytes	Any numeric value up to the range of a double data type. It can also hold special values, such as Empty, Error, Nothing, and Null.
Variant (with characters)	22 bytes + string length	0 to approximately 2 billion
User-defined	Varies	Varies by element

**Note**

The `Decimal` data type is rather unusual because you can't actually declare it. In fact, it is a subtype of a variant. You need to use the `VBA.CDec` function to convert a variant to the `Decimal` data type.

Generally, it's best to use the data type that uses the smallest number of bytes yet still can handle all the data that will be assigned to it. When VBA works with data, execution speed is partially a function of the number of bytes that VBA has at its disposal. In other words, the fewer bytes used by data, the faster VBA can access and manipulate the data.

For worksheet calculation, Excel uses the `Double` data type, so that's a good choice for processing numbers in VBA when you don't want to lose any precision. For integer calculations, you can

use the `Integer` type (which is limited to values less than or equal to 32,767). Otherwise, use the `Long` data type. In fact, using the `Long` data type even for values less than 32,767 is recommended, because this data type may be a bit faster than using the `Integer` type. When dealing with Excel worksheet row numbers, you want to use the `Long` data type because the number of rows in a worksheet exceeds the maximum value for the `Integer` data type.



Benchmarking variant data types

To test whether data typing is important, I developed the following routine, which performs more than 300 million meaningless calculations in a loop and then displays the procedure's total execution time:

```
Sub TimeTest()
    Dim x As Long, y As Long
    Dim A As Double, B As Double, C As Double
    Dim i As Long, j As Long
    Dim StartTime As Date, EndTime As Date
    ' Store the starting time
    StartTime = Timer
    ' Perform some calculations
    x = 0
    y = 0
    For i = 1 To 10000
        x = x + 1
        y = x + 1
        For j = 1 To 10000
            A = x + y + i
            B = y - x - i
            C = x / y * i
        Next j
    Next i
    ' Get ending time
    EndTime = Timer
    ' Display total time in seconds
    MsgBox Format(EndTime - StartTime, "0.0")
End Sub
```

On my system, this routine took 7.7 seconds to run. (The time will vary, depending on your system's processor speed.) I then commented out the `Dim` statements, which declare the data types. That is, I turned the `Dim` statements into comments by adding an apostrophe at the beginning of the lines. As a result, VBA used the default data type, `Variant`. I ran the procedure again. It took 25.4 seconds, more than three times as long as before.

The moral is simple: If you want your VBA applications to run as fast as possible, declare your variables!

A workbook that contains this code is available on the companion CD-ROM in a file named `timing text.xlsm`.

Declaring variables

If you don't declare the data type for a variable that you use in a VBA routine, VBA uses the default data type, `Variant`. Data stored as a `Variant` acts like a chameleon: It changes type, depending on what you do with it.

The following procedure demonstrates how a variable can assume different data types:

```
Sub VariantDemo()  
    MyVar = "123"  
    MyVar = MyVar / 2  
    MyVar = "Answer: " & MyVar  
    MsgBox MyVar  
End Sub
```

In the `VariantDemo` procedure, `MyVar` starts out as a three-character string. Then this string is divided by two and becomes a numeric data type. Next, `MyVar` is appended to a string, converting `MyVar` back to a string. The `MsgBox` statement displays the final string: `Answer: 61.5`.

To further demonstrate the potential problems in dealing with `Variant` data types, try executing this procedure:

```
Sub VariantDemo2()  
    MyVar = "123"  
    MyVar = MyVar + MyVar  
    MyVar = "Answer: " & MyVar  
    MsgBox MyVar  
End Sub
```

The message box displays `Answer: 123123`. This is probably *not* what you wanted. When dealing with variants that contain text strings, the `+` operator performs string concatenation.

Determining a data type

You can use the VBA `TypeName` function to determine the data type of a variable. Here's a modified version of the previous procedure. This version displays the data type of `MyVar` at each step. You see that it starts out as a string, is then converted to a double, and finally ends up as a string again.

```
Sub VariantDemo2()  
    MyVar = "123"  
    MsgBox TypeName(MyVar)  
    MyVar = MyVar / 2  
    MsgBox TypeName(MyVar)  
    MyVar = "Answer: " & MyVar  
    MsgBox TypeName(MyVar)  
    MsgBox MyVar  
End Sub
```

Thanks to VBA, the data type conversion of undeclared variables is automatic. This process may seem like an easy way out, but remember that you sacrifice speed and memory — and you run the risk of errors that you may not even know about.

Declaring each variable in a procedure before you use it is an excellent habit. Declaring a variable tells VBA its name and data type. Declaring variables provides two main benefits:

- **Your programs run faster and use memory more efficiently.** The default data type, `Variant`, causes VBA to repeatedly perform time-consuming checks and reserve more memory than necessary. If VBA knows the data type, it doesn't have to investigate, and it can reserve just enough memory to store the data.
- **You avoid problems involving misspelled variable names.** This benefit assumes that you use `Option Explicit` to force yourself to declare all variables (see the next section). Say that you use an undeclared variable named `CurrentRate`. At some point in your routine, however, you insert the statement `CurentRate = .075`. This misspelled variable name, which is very difficult to spot, will likely cause your routine to give incorrect results.

Forcing yourself to declare all variables

To force yourself to declare all the variables that you use, include the following as the first instruction in your VBA module:

```
Option Explicit
```

When this statement is present, VBA won't even execute a procedure if it contains an undeclared variable name. VBA issues the error message shown in Figure 8-1, and you must declare the variable before you can proceed.

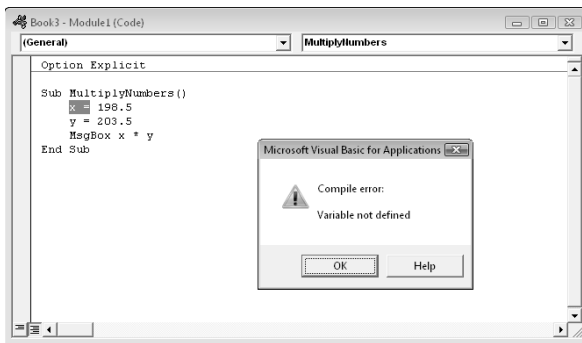


Figure 8-1: VBA's way of telling you that your procedure contains an undeclared variable.



A note about the examples in this chapter

This chapter contains many examples of VBA code, usually presented in the form of simple procedures. These examples demonstrate various concepts as simply as possible. Most of these examples don't perform any particularly useful task; in fact, the task can often be performed in a different (perhaps more efficient) way. In other words, don't use these examples in your own work. Subsequent chapters provide many more code examples that *are* useful.



Tip

To ensure that the `Option Explicit` statement is inserted automatically whenever you insert a new VBA module, enable the **Require Variable Declaration** option in the **Editor** tab of the **VBE Options** dialog box (choose **Tools**→**Options**). I highly recommend doing so. Be aware, however, that this option doesn't affect existing modules.

Scoping variables

A variable's *scope* determines in which modules and procedures you can use the variable. Table 8-2 lists the three ways in which a variable can be scoped.

Table 8-2: Variable Scope

Scope	How a Variable with This Scope Is Declared
Single procedure	Include a <code>Dim</code> or <code>Static</code> statement within the procedure.
Single module	Include a <code>Dim</code> or <code>Private</code> statement before the first procedure in a module.
All modules	Include a <code>Public</code> statement before the first procedure in a module.

I discuss each scope further in the following sections.

Local variables

A *local variable* is a variable declared within a procedure. You can use local variables only in the procedure in which they're declared. When the procedure ends, the variable no longer exists, and Excel frees up the memory that the variable used. If you need the variable to retain its value when the procedure ends, declare it as a `Static` variable. (See "Static variables," later in this section.)

The most common way to declare a local variable is to place a `Dim` statement between a `Sub` statement and an `End Sub` statement. `Dim` statements usually are placed right after the `Sub` statement, before the procedure's code.



Note

If you're curious about this word, `Dim` is a shortened form of *Dimension*. In old versions of BASIC, this statement was used exclusively to declare the dimensions for an array. In VBA, the `Dim` keyword is used to declare any variable, not just arrays.

The following procedure uses six local variables declared by using `Dim` statements:

```
Sub MySub()  
    Dim x As Integer  
    Dim First As Long  
    Dim InterestRate As Single  
    Dim TodaysDate As Date  
    Dim UserName As String  
    Dim MyValue  
    ' - [The procedure's code goes here] -  
End Sub
```

Notice that the last `Dim` statement in the preceding example doesn't declare a data type; it simply names the variable. As a result, that variable becomes a variant.

You also can declare several variables with a single `Dim` statement. For example:

```
Dim x As Integer, y As Integer, z As Integer  
Dim First As Long, Last As Double
```



Caution

Unlike some languages, VBA doesn't let you declare a group of variables to be a particular data type by separating the variables with commas. For example, the following statement, although valid, does *not* declare all the variables as integers:

```
Dim i, j, k As Integer
```

In VBA, only *k* is declared to be an integer; the other variables are declared variants. To declare *i*, *j*, and *k* as integers, use this statement:

```
Dim i As Integer, j As Integer, k As Integer
```

If a variable is declared with a local scope, other procedures in the same module can use the same variable name, but each instance of the variable is unique to its own procedure.

In general, local variables are the most efficient because VBA frees up the memory that they use when the procedure ends.

Module-wide variables

Sometimes, you want a variable to be available to all procedures in a module. If so, just declare the variable *before* the module's first procedure (outside of any procedures or functions).



Another way of data-typing variables

Like most other dialects of BASIC, VBA lets you append a character to a variable's name to indicate the data type. For example, you can declare the `MyVar` variable as an integer by tacking `%` onto the name:

```
Dim MyVar%
```

Type-declaration characters exist for most VBA data types. Data types not listed in the following table don't have type-declaration characters.

Data Type	Type-Declaration Character
Integer	%
Long	&
Single	!
Double	#
Currency	@
String	\$

This method of data typing is essentially a holdover from BASIC; it's better to declare your variables by using the other techniques described in this chapter. I list these type declaration characters here just in case you encounter them in an older program.

In the following example, the `Dim` statement is the first instruction in the module. Both `Procedure1` and `Procedure2` have access to the `CurrentValue` variable.

```
Dim CurrentValue as Long
Sub Procedure1()
'   - [Code goes here] -
End Sub
Sub Procedure2()
'   - [Code goes here] -
End Sub
```

The value of a module-wide variable retains its value when a procedure ends normally (that is, when it reaches the `End Sub` or `End Function` statement). An exception is if the procedure is halted with an `End` statement. When VBA encounters an `End` statement, all module-wide variables in all modules lose their values.

Public variables

To make a variable available to all the procedures in all the VBA modules in a project, declare the variable at the module level (before the first procedure declaration) by using the `Public` keyword rather than `Dim`. Here's an example:

```
Public CurrentRate as Long
```

The `Public` keyword makes the `CurrentRate` variable available to any procedure in the VBA project, even those in other modules within the project. You must insert this statement before the first procedure in a module (any module). This type of declaration must appear in a standard VBA module, not in a code module for a sheet or a UserForm.

Static variables

Static variables are a special case. They're declared at the procedure level, and they retain their value when the procedure ends normally. However, if the procedure is halted by an `End` statement, static variables *do* lose their values.

You declare static variables by using the `Static` keyword:

```
Sub MySub()  
    Static Counter as Long  
    '- [Code goes here] -  
End Sub
```

Working with constants

A variable's value may change while a procedure is executing (that's why it's called a *variable*). Sometimes, you need to refer to a named value or string that never changes: a *constant*.

Using constants throughout your code in place of hard-coded values or strings is an excellent programming practice. For example, if your procedure needs to refer to a specific value (such as an interest rate) several times, it's better to declare the value as a constant and use the constant's name rather than its value in your expressions. This technique not only makes your code more readable, it also makes it easier to change should the need arise — you have to change only one instruction rather than several.

Declaring constants

You declare constants with the `Const` statement. Here are some examples:

```
Const NumQuarters as Integer = 4  
Const Rate = .0725, Period = 12  
Const ModName as String = "Budget Macros"  
Public Const AppName as String = "Budget Application"
```



Variable naming conventions

Some programmers name variables so that users can identify their data types by just looking at their names. Personally, I don't use this technique very often because I think it makes the code more difficult to read, but you might find it helpful.

The naming convention involves using a standard lowercase prefix for the variable's name. For example, if you have a Boolean variable that tracks whether a workbook has been saved, you might name the variable `bWasSaved`. That way, it's clear that the variable is a Boolean variable. The following table lists some standard prefixes for data types:

Data Type	Prefix
Boolean	b
Integer	i
Long	l
Single	s
Double d	
Currency	c
Date/Time	dt
String	str
Object	obj
Variant	v
User-defined	u

The second example doesn't declare a data type. Consequently, VBA determines the data type from the value. The `Rate` variable is a `Double`, and the `Period` variable is an `Integer`. Because a constant never changes its value, you normally want to declare your constants as a specific data type.

Like variables, constants also have a scope. If you want a constant to be available within a single procedure only, declare it after the `Sub` or `Function` statement to make it a local constant. To make a constant available to all procedures in a module, declare it before the first procedure in the module. To make a constant available to all modules in the workbook, use the `Public` keyword and declare the constant before the first procedure in a module. For example:

```
Public Const InterestRate As Double = 0.0725
```



Note

If your VBA code attempts to change the value of a constant, you get an error (Assignment to constant not permitted). This message is what you would expect. A constant is a constant, not a variable.

Using predefined constants

Excel and VBA make available many predefined constants, which you can use without declaring. In fact, you don't even need to know the value of these constants to use them. The macro recorder generally uses constants rather than actual values. The following procedure uses a built-in constant (`xlLandscape`) to set the page orientation to landscape for the active sheet:

```
Sub SetToLandscape()  
    ActiveSheet.PageSetup.Orientation = xlLandscape  
End Sub
```

I discovered the `xlLandscape` constant by recording a macro. I also could have found this information in the Help system. And, if you have the `AutoList Members` option turned on, you can often get some assistance while you enter your code (see Figure 8-2). In many cases, VBA lists all the constants that you can assign to a property.



Figure 8-2: VBA displays a list of constants that you can assign to a property.

The actual value for `xlLandscape` is 2 (which you can discover by using the Immediate window). The other built-in constant for changing paper orientation is `xlPortrait`, which has a value of 1. Obviously, if you use the built-in constants, you don't really need to know their values.



Note

The Object Browser, which I discuss briefly in Chapter 7, can display a list of all Excel and VBA constants. In the VBE, press F2 to bring up the Object Browser.

Working with strings

Like Excel, VBA can manipulate both numbers and text (strings). There are two types of strings in VBA:

- *Fixed-length strings* are declared with a specified number of characters. The maximum length is 65,535 characters.
- *Variable-length strings* theoretically can hold up to 2 billion characters.

Each character in a string requires 1 byte of storage, plus a small amount of storage for the header of each string. When you declare a variable with a `Dim` statement as data type `String`, you can specify the length if you know it (that is, a fixed-length string), or you can let VBA handle it dynamically (a variable-length string).

In the following example, the `MyString` variable is declared to be a string with a maximum length of 50 characters. `YourString` is also declared as a string; but it's a variable-length string, so its length is unfixed.

```
Dim MyString As String * 50
Dim YourString As String
```

Working with dates

You can use a string variable to store a date, but if you do, it's not a real date (meaning you can't perform date calculations with it). Using the `Date` data type is a better way to work with dates.

A variable defined as a date uses 8 bytes of storage and can hold dates ranging from January 1, 0100, to December 31, 9999. That's a span of nearly 10,000 years — more than enough for even the most aggressive financial forecast! The `Date` data type is also useful for storing time-related data. In VBA, you specify dates and times by enclosing them between two hash marks (`#`).



Note

The range of dates that VBA can handle is much larger than Excel's own date range, which begins with January 1, 1900, and extends through December 31, 1999. Therefore, be careful that you don't attempt to use a date in a worksheet that is outside of Excel's acceptable date range.



Cross-Ref

In Chapter 10, I describe some relatively simple VBA functions that enable you to create formulas that work with pre-1900 dates in a worksheet.



About Excel's date bug

It is commonly known that Excel has a date bug: It incorrectly assumes that the year 1900 is a leap year. Even though there was no February 29, 1900, Excel accepts the following formula and displays the result as the 29th day of February, 1900:

```
=Date(1900,2,29)
```

VBA doesn't have this date bug. The VBA equivalent of Excel's DATE function is `DateSerial`. The following expression (correctly) returns March 1, 1900:

```
DateSerial(1900,2,29)
```

Therefore, Excel's date serial number system doesn't correspond exactly to the VBA date serial number system. These two systems return different values for dates between January 1, 1900, and February 28, 1900.

Here are some examples of declaring variables and constants as `Date` data types:

```
Dim Today As Date
Dim StartTime As Date
Const FirstDay As Date = #1/1/2010#
Const Noon = #12:00:00#
```



Dates are always defined using month/day/year format, even if your system is set up to display dates in a different format (for example, day/month/year).

Caution

If you use a message box to display a date, it's displayed according to your system's short date format. Similarly, a time is displayed according to your system's time format (either 12- or 24-hour). You can modify these system settings by using the Regional Settings option in the Windows Control Panel.

Assignment Statements

An *assignment statement* is a VBA instruction that makes a mathematical evaluation and assigns the result to a variable or an object. Excel's Help system defines *expression* as "a combination of keywords, operators, variables, and constants that yields a string, number, or object. An expression can perform a calculation, manipulate characters, or test data."

I couldn't have said it better myself. Much of the work done in VBA involves developing (and debugging) expressions. If you know how to create formulas in Excel, you'll have no trouble creating expressions in VBA. With a worksheet formula, Excel displays the result in a cell. The result of a VBA expression, on the other hand, can be assigned to a variable or used as a property value.

VBA uses the equal sign (=) as its assignment operator. The following are examples of assignment statements (the expressions are to the right of the equal sign):

```
x = 1
x = x + 1
x = (y * 2) / (z * 2)
FileOpen = True
FileOpen = Not FileOpen
Range("TheYear").Value = 2010
```



Tip

Expressions can be very complex. You may want to use the line continuation sequence (space followed by an underscore) to make lengthy expressions easier to read.

Often, expressions use functions. These functions can be built-in VBA functions, Excel's worksheet functions, or custom functions that you develop in VBA. I discuss built-in VBA functions later in this chapter (see the upcoming section "Built-in Functions").

Operators play a major role in VBA. Familiar operators describe mathematical operations, including addition (+), multiplication (*), division (/), subtraction (-), exponentiation (^), and string concatenation (&). Less familiar operators are the backslash (\) (used in integer division) and the Mod operator (used in modulo arithmetic). The Mod operator returns the remainder of one number divided by another. For example, the following expression returns 2:

```
17 Mod 3
```

VBA also supports the same comparison operators used in Excel formulas: equal to (=), greater than (>), less than (<), greater than or equal to (>=), less than or equal to (<=), and not equal to (<>).

With one exception, the order of precedence for operators in VBA is exactly the same as in Excel (see Table 8-3). And, of course, you can use parentheses to change the natural order of precedence.



Caution

The negation operator (a minus sign) is handled differently in VBA. In Excel, the following formula returns 25:

```
=-5^2
```

In VBA, x equals -25 after this statement is executed:

```
x = -5 ^ 2
```

VBA performs the exponentiation operation first and then applies the negation operator. The following statement returns 25:

```
x = (-5) ^ 2
```

Table 8-3: Operator Precedence

Operator	Operation	Order of Precedence
^	Exponentiation	1
* and /	Multiplication and division	2
+ and -	Addition and subtraction	3
&	Concatenation	4
=, <, >, <=, >=, <>	Comparison	5

In the statement that follows, `x` is assigned the value 10 because the multiplication operator has a higher precedence than the addition operator.

```
x = 4 + 3 * 2
```

To avoid ambiguity, you may prefer to write the statement as follows:

```
x = 4 + (3 * 2)
```

In addition, VBA provides a full set of logical operators, shown in Table 8-4. For complete details on these operators (including examples), use the VBA Help system.

Table 8-4: VBA Logical Operators

Operator	What It Does
Not	Performs a logical negation on an expression.
And	Performs a logical conjunction on two expressions.
Or	Performs a logical disjunction on two expressions.
Xor	Performs a logical exclusion on two expressions.
Eqv	Performs a logical equivalence on two expressions.
Imp	Performs a logical implication on two expressions.

The following instruction uses the `Not` operator to toggle the gridline display in the active window. The `DisplayGridlines` property takes a value of either `True` or `False`. Therefore, using the `Not` operator changes `False` to `True` and `True` to `False`.

```
ActiveWindow.DisplayGridlines = _  
    Not ActiveWindow.DisplayGridlines
```

The following expression performs a logical `And` operation. The `MsgBox` statement displays `True` only when `Sheet1` is the active sheet *and* the active cell is in Row 1. If either or both of these conditions aren't true, the `MsgBox` statement displays `False`.

```
MsgBox ActiveSheet.Name = "Sheet1" And ActiveCell.Row = 1
```

The following expression performs a logical `Or` operation. The `MsgBox` statement displays `True` when either `Sheet1` or `Sheet2` is the active sheet.

```
MsgBox ActiveSheet.Name = "Sheet1" Or ActiveSheet.Name = "Sheet2"
```

Arrays

An *array* is a group of elements of the same type that have a common name. You refer to a specific element in the array by using the array name and an index number. For example, you can define an array of 12 string variables so that each variable corresponds to the name of a month. If you name the array `MonthNames`, you can refer to the first element of the array as `MonthNames(0)`, the second element as `MonthNames(1)`, and so on, up to `MonthNames(11)`.

Declaring arrays

You declare an array with a `Dim` or `Public` statement, just as you declare a regular variable. You can also specify the number of elements in the array. You do so by specifying the first index number, the keyword `To`, and the last index number — all inside parentheses. For example, here's how to declare an array comprising exactly 100 integers:

```
Dim MyArray(1 To 100) As Integer
```



Tip

When you declare an array, you need specify only the upper index, in which case VBA assumes that 0 is the lower index. Therefore, the two statements that follow have the same effect:

```
Dim MyArray(0 to 100) As Integer  
Dim MyArray(100) As Integer
```

In both cases, the array consists of 101 elements.

By default, VBA assumes zero-based arrays. If you would like VBA to assume that 1 is the lower index for all arrays that declare only the upper index, include the following statement before any procedures in your module:

```
Option Base 1
```

Declaring multidimensional arrays

The array examples in the preceding section are one-dimensional arrays. VBA arrays can have up to 60 dimensions, although you'll rarely need more than three dimensions (a 3-D array). The following statement declares a 100-integer array with two dimensions (2-D):

```
Dim MyArray(1 To 10, 1 To 10) As Integer
```

You can think of the preceding array as occupying a 10-x-10 matrix. To refer to a specific element in a 2-D array, you need to specify two index numbers. For example, here's how you can assign a value to an element in the preceding array:

```
MyArray(3, 4) = 125
```

Following is a declaration for a 3-D array that contains 1,000 elements (visualize this array as a cube):

```
Dim MyArray(1 To 10, 1 To 10, 1 To 10) As Integer
```

Reference an item within the array by supplying three index numbers:

```
MyArray(4, 8, 2) = 0
```

Declaring dynamic arrays

A *dynamic array* doesn't have a preset number of elements. You declare a dynamic array with a blank set of parentheses:

```
Dim MyArray() As Integer
```

Before you can use a dynamic array in your code, however, you must use the `ReDim` statement to tell VBA how many elements are in the array. You can use a variable to assign the number of elements in

an array. Often the value of the variable isn't known until the procedure is executing. For example, if the variable `x` contains a number, you can define the array's size by using this statement:

```
ReDim MyArray (1 to x)
```

You can use the `ReDim` statement any number of times, changing the array's size as often as you need to. When you change an array's dimensions the existing values are destroyed. If you want to preserve the existing values, use `ReDim Preserve`. For example:

```
ReDim Preserve MyArray (1 to y)
```

Arrays crop up later in this chapter when I discuss looping ("Looping blocks of instructions").

Object Variables

An *object variable* is a variable that represents an entire object, such as a range or a worksheet. Object variables are important for two reasons:

- They can simplify your code significantly.
- They can make your code execute more quickly.

Object variables, like normal variables, are declared with the `Dim` or `Public` statement. For example, the following statement declares `InputArea` as a `Range` object variable:

```
Dim InputArea As Range
```

Use the `Set` keyword to assign an object to the variable. For example:

```
Set InputArea = Range("C16:E16")
```

To see how object variables simplify your code, examine the following procedure, which doesn't use an object variable:

```
Sub NoObjVar()  
    Worksheets("Sheet1").Range("A1").Value = 124  
    Worksheets("Sheet1").Range("A1").Font.Bold = True  
    Worksheets("Sheet1").Range("A1").Font.Italic = True  
    Worksheets("Sheet1").Range("A1").Font.Size = 14  
    Worksheets("Sheet1").Range("A1").Font.Name = "Cambria"  
End Sub
```

This routine enters a value into cell A1 of Sheet1 on the active workbook, applies some formatting, and changes the fonts and size. That's a lot of typing. To reduce wear and tear on your fingers (and make your code more efficient), you can condense the routine with an object variable:

```
Sub ObjVar()  
    Dim MyCell As Range  
    Set MyCell = Worksheets("Sheet1").Range("A1")  
    MyCell.Value = 124  
    MyCell.Font.Bold = True  
    MyCell.Font.Italic = True  
    MyCell.Font.Size = 14  
    MyCell.Font.Name = Cambria  
End Sub
```

After the variable `MyCell` is declared as a `Range` object, the `Set` statement assigns an object to it. Subsequent statements can then use the simpler `MyCell` reference in place of the lengthy `Worksheets("Sheet1").Range("A1")` reference.

**Tip**

After an object is assigned to a variable, VBA can access it more quickly than it can a normal, lengthy reference that has to be resolved. So when speed is critical, use object variables. One way to think about code efficiency is in terms of *dot processing*. Every time VBA encounters a dot, as in `Sheets(1).Range("A1")`, it takes time to resolve the reference. Using an object variable reduces the number of dots to be processed. The fewer the dots, the faster the processing time. Another way to improve the speed of your code is by using the `With-End With` construct, which also reduces the number of dots to be processed. I discuss this construct later in this chapter.

The true value of object variables becomes apparent when I discuss looping later in this chapter.

User-Defined Data Types

VBA lets you create custom, or *user-defined*, data types. A user-defined data type can ease your work with some types of data. For example, if your application deals with customer information, you may want to create a user-defined data type named `CustomerInfo`:

```
Type CustomerInfo  
    Company As String  
    Contact As String  
    RegionCode As Long  
    Sales As Double  
End Type
```



You define custom data types at the top of your module, before any procedures.

After you create a user-defined data type, you use a `Dim` statement to declare a variable as that type. Usually, you define an array. For example:

```
Dim Customers(1 To 100) As CustomerInfo
```

Each of the 100 elements in this array consists of four components (as specified by the user-defined data type, `CustomerInfo`). You can refer to a particular component of the record as follows:

```
Customers(1).Company = "Acme Tools"  
Customers(1).Contact = "Tim Robertson"  
Customers(1).RegionCode = 3  
Customers(1).Sales = 150674.98
```

You can also work with an element in the array as a whole. For example, to copy the information from `Customers(1)` to `Customers(2)`, use this instruction:

```
Customers(2) = Customers(1)
```

The preceding example is equivalent to the following instruction block:

```
Customers(2).Company = Customers(1).Company  
Customers(2).Contact = Customers(1).Contact  
Customers(2).RegionCode = Customers(1).RegionCode  
Customers(2).Sales = Customers(1).Sales
```

Built-in Functions

Like most programming languages, VBA has a variety of built-in functions that simplify calculations and operations. Many VBA functions are similar (or identical) to Excel worksheet functions. For example, the VBA function `UCase`, which converts a string argument to uppercase, is equivalent to the Excel worksheet function `UPPER`.



Appendix B contains a complete list of VBA functions, with a brief description of each. All are thoroughly described in the VBA Help system.

Cross-Ref



Tip

To get a list of VBA functions while you're writing your code, type VBA followed by a period (.). The VBE displays a list of all its members, including functions (see Figure 8-3). The functions are preceded by a green icon.

If this technique doesn't work for you, make sure that the Auto List Members option is selected. Choose Tools→Options and then click the Editor tab.

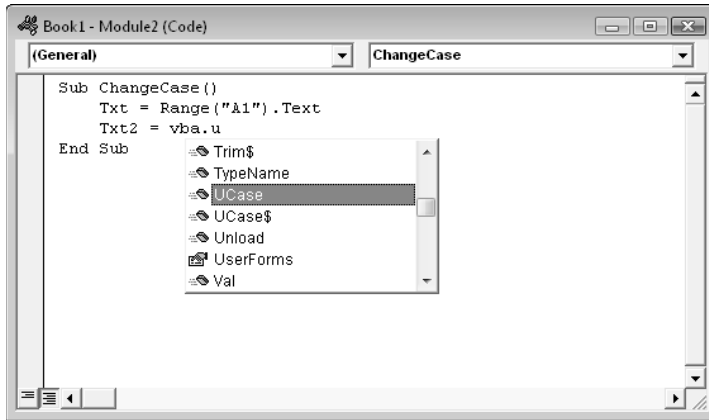


Figure 8-3: Displaying a list of VBA functions in the VBE.

You use functions in VBA expressions in much the same way that you use functions in worksheet formulas. Here's a simple procedure that calculates the square root of a variable (using the VBA `Sqr` function), stores the result in another variable, and then displays the result:

```
Sub ShowRoot()
    Dim MyValue As Double
    Dim SquareRoot As Double
    MyValue = 25
    SquareRoot = Sqr(MyValue)
    MsgBox SquareRoot
End Sub
```

The VBA `Sqr` function is equivalent to the Excel `SQRT` worksheet function.

You can use many (but not all) of Excel's worksheet functions in your VBA code. The `WorksheetFunction` object, which is contained in the `Application` object, holds all the worksheet functions that you can call from your VBA procedures.

To use a worksheet function in a VBA statement, just precede the function name with

```
Application.WorksheetFunction
```




The MsgBox function

The `MsgBox` function is one of the most useful VBA functions. Many of the examples in this chapter use this function to display the value of a variable.

This function often is a good substitute for a simple custom dialog box. It's also an excellent debugging tool because you can insert `MsgBox` functions at any time to pause your code and display the result of a calculation or assignment.

Most functions return a single value, which you assign to a variable. The `MsgBox` function not only returns a value but also displays a dialog box that the user can respond to. The value returned by the `MsgBox` function represents the user's response to the dialog box. You can use the `MsgBox` function even when you have no interest in the user's response but want to take advantage of the message display.

The official syntax of the `MsgBox` function has five arguments (those in square brackets are optional):

```
MsgBox(prompt[, buttons][, title][, helpfile, context])
```

- **prompt:** (Required) The message displayed in the pop-up display.
- **buttons:** (Optional) A value that specifies which buttons and which icons, if any, appear in the message box. Use built-in constants — for example, `vbYesNo`.
- **title:** (Optional) The text that appears in the message box's title bar. The default is `Microsoft Excel`.
- **helpfile:** (Optional) The name of the Help file associated with the message box.
- **context:** (Optional) The context ID of the Help topic. This represents a specific Help topic to display. If you use the `context` argument, you must also use the `helpfile` argument.

You can assign the value returned to a variable, or you can use the function by itself without an assignment statement. This example assigns the result to the variable `Ans`:

```
Ans = MsgBox("Continue?", vbYesNo + vbQuestion, "Tell me")  
If Ans = vbNo Then Exit Sub
```

Notice that I used the sum of two built-in constants (`vbYesNo + vbQuestion`) for the `buttons` argument. Using `vbYesNo` displays two buttons in the message box: one labeled Yes and one labeled No. Adding `vbQuestion` to the argument also displays a question mark icon. When the first statement is executed, `Ans` contains one of two values, represented by the constant `vbYes` or `vbNo`. In this example, if the user clicks the No button, the procedure ends.

See Chapter 12 for more information about the `MsgBox` function.

The following example demonstrates how to use an Excel worksheet function in a VBA procedure. Excel's infrequently used `ROMAN` function converts a decimal number into a Roman numeral.

```
Sub ShowRoman()  
    Dim DecValue As Long  
    Dim RomanValue As String  
    DecValue = 1939  
    RomanValue = Application.WorksheetFunction.Roman(DecValue)  
    MsgBox RomanValue  
End Sub
```

When you execute this procedure, the `MsgBox` function displays the string `MCMXXXIX`. Fans of old movies are often dismayed when they learn that Excel doesn't have a function to convert a Roman numeral to its decimal equivalent.

Keep in mind that you can't use worksheet functions that have an equivalent VBA function. For example, VBA can't access the Excel `SQRT` worksheet function because VBA has its own version of that function: `Sqr`. Therefore, the following statement generates an error:

```
MsgBox Application.WorksheetFunction.Sqrt(123) 'error
```



Cross-Ref

As I describe in Chapter 10, you can use VBA to create custom worksheet functions that work just like Excel's built-in worksheet functions.

Manipulating Objects and Collections

As an Excel programmer, you'll spend a lot of time working with objects and collections. Therefore, you want to know the most efficient ways to write your code to manipulate these objects and collections. VBA offers two important constructs that can simplify working with objects and collections:

- `With-End With` constructs
- `For Each-Next` constructs

With-End With constructs

The `With-End With` construct enables you to perform multiple operations on a single object. To start understanding how the `With-End With` construct works, examine the following procedure, which modifies six properties of a selection's formatting (the selection is assumed to be a `Range` object):

```
Sub ChangeFont1()  
    Selection.Font.Name = "Cambria"  
    Selection.Font.Bold = True
```

```
Selection.Font.Italic = True
Selection.Font.Size = 12
Selection.Font.Underline = xlUnderlineStyleSingle
Selection.Font.ThemeColor = xlThemeColorAccent1
End Sub
```

You can rewrite this procedure using the `With-End With` construct. The following procedure performs exactly like the preceding one:

```
Sub ChangeFont2()
    With Selection.Font
        .Name = "Cambria"
        .Bold = True
        .Italic = True
        .Size = 12
        .Underline = xlUnderlineStyleSingle
        .ThemeColor = xlThemeColorAccent1
    End With
End Sub
```

Some people think that the second incarnation of the procedure is actually more difficult to read. Remember, though, that the objective is increased speed. Although the first version may be more straightforward and easier to understand, a procedure that uses the `With-End With` construct to change several properties of an object can be faster than the equivalent procedure that explicitly references the object in each statement.



Note

When you record a VBA macro, Excel uses the `With-End With` construct every chance it gets. To see a good example of this construct, try recording your actions while you change the page orientation using the `Page Layout→Page Setup→Orientation` command.

For Each-Next constructs

Recall from the preceding chapter that a *collection* is a group of related objects. For example, the `Workbooks` collection is a collection of all open `Workbook` objects, and there are many other collections that you can work with.

Suppose that you want to perform some action on all objects in a collection. Or suppose that you want to evaluate all objects in a collection and take action under certain conditions. These occasions are perfect for the `For Each-Next` construct because you don't have to know how many elements are in a collection to use the `For Each-Next` construct.

The syntax of the `For Each-Next` construct is

```
For Each element In collection
    [instructions]
    [Exit For]
    [instructions]
Next [element]
```

The following procedure uses the `For Each-Next` construct with the `Worksheets` collection in the active workbook. When you execute the procedure, the `MsgBox` function displays each worksheet's `Name` property. (If five worksheets are in the active workbook, the `MsgBox` function is called five times.)

```
Sub CountSheets()
    Dim Item as Worksheet
    For Each Item In ActiveWorkbook.Worksheets
        MsgBox Item.Name
    Next Item
End Sub
```



Note

In the preceding example, `Item` is an object variable (more specifically, a `Worksheet` object). There's nothing special about the name `Item`; you can use any valid variable name in its place.

The next example uses `For Each-Next` to cycle through all objects in the `Windows` collection and count the number of windows that are hidden.

```
Sub HiddenWindows()
    Dim Cnt As Integer
    Dim Win As Window
    Cnt = 0
    For Each Win In Windows
        If Not Win.Visible Then Cnt = Cnt + 1
    Next Win
    MsgBox Cnt & " hidden windows."
End Sub
```

For each window, if the window is hidden, the `Cnt` variable is incremented. When the loop ends, the message box displays the value of `Cnt`.

Here's an example that closes all workbooks except the active workbook. This procedure uses the `If-Then` construct to evaluate each workbook in the `Workbooks` collection.

```
Sub CloseInactive()  
    Dim Book as Workbook  
    For Each Book In Workbooks  
        If Book.Name <> ActiveWorkbook.Name Then Book.Close  
    Next Book  
End Sub
```

A common use for the `For Each-Next` construct is to loop through all cells in a range. The next example of `For Each-Next` is designed to be executed after the user selects a range of cells. Here, the `Selection` object acts as a collection that consists of `Range` objects because each cell in the selection is a `Range` object. The procedure evaluates each cell and uses the VBA `UCase` function to convert its contents to uppercase. (Numeric cells are not affected.)

```
Sub MakeUpperCase()  
    Dim Cell as Range  
    For Each Cell In Selection  
        Cell.Value = UCase(Cell.Value)  
    Next Cell  
End Sub
```

VBA provides a way to exit a `For-Next` loop before all the elements in the collection are evaluated. Do this with an `Exit For` statement. The example that follows selects the first negative value in Row 1 of the active sheet:

```
Sub SelectNegative()  
    Dim Cell As Range  
    For Each Cell In Range("1:1")  
        If Cell.Value < 0 Then  
            Cell.Select  
            Exit For  
        End If  
    Next Cell  
End Sub
```

This example uses an `If-Then` construct to check the value of each cell. If a cell is negative, it's selected, and then the loop ends when the `Exit For` statement is executed.

Controlling Code Execution

Some VBA procedures start at the top and progress line by line to the bottom. Macros that you record, for example, always work in this fashion. Often, however, you need to control the flow of your routines by skipping over some statements, executing some statements multiple times, and testing conditions to determine what the routine does next.

The preceding section describes the `For Each-Next` construct, which is a type of loop. This section discusses the additional ways of controlling the execution of your VBA procedures:

- `GoTo` statements
- `If-Then` constructs
- `Select Case` constructs
- `For-Next` loops
- `Do While` loops
- `Do Until` loops

GoTo statements

The most straightforward way to change the flow of a program is to use a `GoTo` statement. This statement simply transfers program execution to a new instruction, which must be preceded by a label (a text string followed by a colon, or a number with no colon). VBA procedures can contain any number of labels, but a `GoTo` statement can't branch outside of a procedure.

The following procedure uses the VBA `InputBox` function to get the user's name. If the name is not *Howard*, the procedure branches to the `WrongName` label and ends. Otherwise, the procedure executes some additional code. The `Exit Sub` statement causes the procedure to end.

```
Sub GoToDemo()  
    UserName = InputBox("Enter Your Name:")  
    If UserName <> "Howard" Then GoTo WrongName  
    MsgBox ("Welcome Howard...")  
    ' -[More code here] -  
    Exit Sub  
WrongName:  
    MsgBox "Sorry. Only Howard can run this macro."  
End Sub
```

This simple procedure works, but it's not an example of good programming. In general, you should use the `GoTo` statement only when you have no other way to perform an action. In fact, the only time you *really* need to use a `GoTo` statement in VBA is for error handling (refer to Chapter 9).

Finally, it goes without saying that the preceding example is *not* intended to demonstrate an effective security technique!

If-Then constructs

Perhaps the most commonly used instruction grouping in VBA is the `If-Then` construct. This common instruction is one way to endow your applications with decision-making capability. Good decision-making is the key to writing successful programs.

The basic syntax of the `If-Then` construct is

```
If condition Then true_instructions [Else false_instructions]
```

The `If-Then` construct is used to execute one or more statements conditionally. The `Else` clause is optional. If included, the `Else` clause lets you execute one or more instructions when the condition that you're testing isn't `True`.

The following procedure demonstrates an `If-Then` structure without an `Else` clause. The example deals with time, and VBA uses a date-and-time serial number system similar to Excel's. The time of day is expressed as a fractional value — for example, noon is represented as `.5`. The `VBA Time` function returns a value that represents the time of day, as reported by the system clock. In the following example, a message is displayed if the time is before noon. If the current system time is greater than or equal to `.5`, the procedure ends, and nothing happens.

```
Sub GreetMe1()  
    If Time < 0.5 Then MsgBox "Good Morning"  
End Sub
```

Another way to code this routine is to use multiple statements, as follows:

```
Sub GreetMe1a()  
    If Time < 0.5 Then  
        MsgBox "Good Morning"  
    End If  
End Sub
```

Notice that the `If` statement has a corresponding `End If` statement. In this example, only one statement is executed if the condition is `True`. You can, however, place any number of statements between the `If` and `End If` statements.

If you want to display a different greeting when the time of day is after noon, add another `If-Then` statement, like so:

```
Sub GreetMe2()  
    If Time < 0.5 Then MsgBox "Good Morning"  
    If Time >= 0.5 Then MsgBox "Good Afternoon"  
End Sub
```

Notice that I used `>=` (greater than or equal to) for the second `If-Then` statement. This covers the remote chance that the time is precisely 12:00 noon.

Another approach is to use the `Else` clause of the `If-Then` construct. For example,

```
Sub GreetMe3()  
    If Time < 0.5 Then MsgBox "Good Morning" Else _  
        MsgBox "Good Afternoon"  
End Sub
```

Notice that I used the line continuation sequence; `If-Then-Else` is actually a single statement.

If you need to execute multiple statements based on the condition, use this form:

```
Sub GreetMe3a()  
    If Time < 0.5 Then  
        MsgBox "Good Morning"  
        ' Other statements go here  
    Else  
        MsgBox "Good Afternoon"  
        ' Other statements go here  
    End If  
End Sub
```

If you need to expand a routine to handle three conditions (for example, morning, afternoon, and evening), you can use either three `If-Then` statements or a form that uses `ElseIf`. The first approach is simpler:

```
Sub GreetMe4()  
    If Time < 0.5 Then MsgBox "Good Morning"  
    If Time >= 0.5 And Time < 0.75 Then MsgBox "Good Afternoon"  
    If Time >= 0.75 Then MsgBox "Good Evening"  
End Sub
```

The value `0.75` represents 6:00 p.m. — three-quarters of the way through the day and a good point at which to call it an evening.

In the preceding examples, every instruction in the procedure gets executed, even if the first condition is satisfied (that is, it's morning). A more efficient procedure would include a structure that ends the routine when a condition is found to be `True`. For example, it might display the `Good Morning` message in the morning and then exit without evaluating the other, superfluous conditions. True, the difference in speed is inconsequential when you design a procedure as small as this routine. But for more complex applications, you need another syntax:

```
If condition Then  
    [true_instructions]  
[ElseIf condition-n Then  
    [alternate_instructions]]
```



```
[Else  
    [default_instructions]]  
End If
```

Here's how you can use this syntax to rewrite the `GreetMe` procedure:

```
Sub GreetMe5()  
    If Time < 0.5 Then  
        MsgBox "Good Morning"  
    ElseIf Time >= 0.5 And Time < 0.75 Then  
        MsgBox "Good Afternoon"  
    Else  
        MsgBox "Good Evening"  
    End If  
End Sub
```

With this syntax, when a condition is `True`, the conditional statements are executed, and the `If-Then` construct ends. In other words, the extraneous conditions aren't evaluated. Although this syntax makes for greater efficiency, some find the code to be more difficult to understand.

The following procedure demonstrates yet another way to code this example. It uses nested `If-Then-Else` constructs (without using `ElseIf`). This procedure is efficient and also easy to understand. Note that each `If` statement has a corresponding `End If` statement.

```
Sub GreetMe6()  
    If Time < 0.5 Then  
        MsgBox "Good Morning"  
    Else  
        If Time >= 0.5 And Time < 0.75 Then  
            MsgBox "Good Afternoon"  
        Else  
            If Time >= 0.75 Then  
                MsgBox "Good Evening"  
            End If  
        End If  
    End If  
End Sub
```

The following is another example that uses the simple form of the `If-Then` construct. This procedure prompts the user for a value for `Quantity` and then displays the appropriate discount based on that value. Note that `Quantity` is declared as a `Variant` data type. This is because `Quantity` contains an empty string (not a numeric value) if the `InputBox` is cancelled. To keep it simple, this procedure doesn't perform any other error checking. For example, it doesn't ensure that the quantity entered is a non-negative numeric value.

```
Sub Discount1()  
    Dim Quantity As Variant  
    Dim Discount As Double  
    Quantity = InputBox("Enter Quantity: ")  
    If Quantity = "" Then Exit Sub  
    If Quantity >= 0 Then Discount = 0.1  
    If Quantity >= 25 Then Discount = 0.15  
    If Quantity >= 50 Then Discount = 0.2  
    If Quantity >= 75 Then Discount = 0.25  
    MsgBox "Discount: " & Discount  
End Sub
```

Notice that each `If-Then` statement in this procedure is always executed, and the value for `Discount` can change. The final value, however, is the desired value.

The following procedure is the previous one rewritten to use the alternate syntax. In this case, the procedure ends after executing the `True` instruction block.

```
Sub Discount2()  
    Dim Quantity As Variant  
    Dim Discount As Double  
    Quantity = InputBox("Enter Quantity: ")  
    If Quantity = "" Then Exit Sub  
    If Quantity >= 0 And Quantity < 25 Then  
        Discount = 0.1  
    ElseIf Quantity < 50 Then  
        Discount = 0.15  
    ElseIf Quantity < 75 Then  
        Discount = 0.2  
    Else  
        Discount = 0.25  
    End If  
    MsgBox "Discount: " & Discount  
End Sub
```

I find nested `If-Then` structures rather cumbersome. As a result, I usually use the `If-Then` structure only for simple binary decisions. When you need to choose among three or more alternatives, the `Select Case` structure (discussed next) is often a better construct to use.



VBA's IIf function

VBA offers an alternative to the `If-Then` construct: the `IIf` function. This function takes three arguments and works much like Excel's IF worksheet function. The syntax is

```
IIf(expr, truepart, falsepart)
```

- `expr`: (Required) Expression you want to evaluate.
- `truepart`: (Required) Value or expression returned if `expr` is `True`.
- `falsepart`: (Required) Value or expression returned if `expr` is `False`.

The following instruction demonstrates the use of the `IIf` function. The message box displays `Zero` if cell A1 contains a zero or is empty and displays `Nonzero` if cell A1 contains anything else.

```
MsgBox IIf(Range("A1") = 0, "Zero", "Nonzero")
```

It's important to understand that the third argument (`falsepart`) is always evaluated, even if the first argument (`expr`) is `True`. Therefore, the following statement generates a Division By Zero error if the value of `n` is 0 (zero):

```
MsgBox IIf(n = 0, 0, 1 / n)
```

Select Case constructs

The `Select Case` construct is useful for choosing among three or more options. this construct also works with two options and is a good alternative to `If-Then-Else`. The syntax for `Select Case` is as follows:

```
Select Case testexpression
    [Case expressionlist-n
        [instructions-n]]
    [Case Else
        [default_instructions]]
End Select
```

The following example of a `Select Case` construct shows another way to code the `GreetMe` examples that I presented in the preceding section:

```
Sub GreetMe()
    Dim Msg As String
    Select Case Time
        Case Is < 0.5
            Msg = "Good Morning"
```

```
        Case 0.5 To 0.75
            Msg = "Good Afternoon"
        Case Else
            Msg = "Good Evening"
    End Select
    MsgBox Msg
End Sub
```

And here's a rewritten version of the `Discount` example using a `Select Case` construct. This procedure assumes that `Quantity` is always an integer value. For simplicity, the procedure performs no error checking.

```
Sub Discount3()
    Dim Quantity As Variant
    Dim Discount As Double
    Quantity = InputBox("Enter Quantity: ")
    Select Case Quantity
        Case ""
            Exit Sub
        Case 0 To 24
            Discount = 0.1
        Case 25 To 49
            Discount = 0.15
        Case 50 To 74
            Discount = 0.2
        Case Is >= 75
            Discount = 0.25
    End Select
    MsgBox "Discount: " & Discount
End Sub
```

The `Case` statement also can use a comma to separate multiple values for a single case. The following procedure uses the VBA `WeekDay` function to determine whether the current day is a weekend (that is, the `WeekDay` function returns 1 or 7). The procedure then displays an appropriate message.

```
Sub GreetUser1()
    Select Case Weekday(Now)
        Case 1, 7
            MsgBox "This is the weekend"
        Case Else
            MsgBox "This is not the weekend"
    End Select
End Sub
```

The following example shows another way to code the previous procedure:

```
Sub GreetUser2()
    Select Case Weekday(Now)
        Case 2, 3, 4, 5, 6
            MsgBox "This is not the weekend"
        Case Else
            MsgBox "This is the weekend"
    End Select
End Sub
```

Any number of instructions can be written below each `Case` statement, and they're all executed if that case evaluates to `True`. If you use only one instruction per case, as in the preceding example, you might want to put the instruction on the same line as the `Case` keyword (but don't forget the VBA statement-separator character, the colon). This technique makes the code more compact. For example:

```
Sub Discount3()
    Dim Quantity As Variant
    Dim Discount As Double
    Quantity = InputBox("Enter Quantity: ")
    Select Case Quantity
        Case "": Exit Sub
        Case 0 To 24: Discount = 0.1
        Case 25 To 49: Discount = 0.15
        Case 50 To 74: Discount = 0.2
        Case Is >= 75: Discount = 0.25
    End Select
    MsgBox "Discount: " & Discount
End Sub
```



Tip

VBA exits a `Select Case` construct as soon as a `True` case is found. Therefore, for maximum efficiency, you should check the most likely case first.

`Select Case` structures can also be nested. The following procedure, for example, uses the VBA `TypeName` function to determine what is selected (a range, nothing, or anything else). If a range is selected, the procedure executes a nested `Select Case` and tests for the number of cells in the range. If one cell is selected, it displays `One cell is selected`. Otherwise, it displays a message with the number of selected rows.

```
Sub SelectionType()
    Select Case TypeName(Selection)
        Case "Range"
            Select Case Selection.Count
```

```

        Case 1
            MsgBox "One cell is selected"
        Case Else
            MsgBox Selection.Rows.Count & " rows"
        End Select
    Case "Nothing"
        MsgBox "Nothing is selected"
    Case Else
        MsgBox "Something other than a range"
    End Select
End Sub

```

This procedure also demonstrates the use of `Case Else`, a catch-all case. You can nest `Select Case` constructs as deeply as you need, but make sure that each `Select Case` statement has a corresponding `End Select` statement.

This procedure demonstrates the value of using indentation in your code to clarify the structure. For example, take a look at the same procedure without the indentations:

```

Sub SelectionType()
Select Case TypeName(Selection)
Case "Range"
Select Case Selection.Count
Case 1
MsgBox "One cell is selected"
Case Else
MsgBox Selection.Rows.Count & " rows"
End Select
Case "Nothing"
MsgBox "Nothing is selected"
Case Else
MsgBox "Something other than a range"
End Select
End Sub

```

Fairly incomprehensible, eh?

Looping blocks of instructions

Looping is the process of repeating a block of instructions. You might know the number of times to loop, or the number may be determined by the values of variables in your program.

The following code, which enters consecutive numbers into a range, demonstrates what I call a *bad loop*. The procedure uses two variables to store a starting value (`StartVal`) and the total number of cells to fill (`NumToFill`). This loop uses the `GoTo` statement to control the flow. If the `Cnt` variable, which keeps track of how many cells are filled, is less than the value of `NumToFill`, the program control loops back to `DoAnother`.

```
Sub BadLoop()  
    Dim StartVal As Integer  
    Dim NumToFill As Integer  
    Dim Cnt As Integer  
    StartVal = 1  
    NumToFill = 100  
    ActiveCell.Value = StartVal  
    Cnt = 1  
DoAnother:  
    ActiveCell.Offset(Cnt, 0).Value = StartVal + Cnt  
    Cnt = Cnt + 1  
    If Cnt < NumToFill Then GoTo DoAnother Else Exit Sub  
End Sub
```

This procedure works as intended, so why is it an example of bad looping? Programmers generally frown on using a `GoTo` statement when not absolutely necessary. Using `GoTo` statements to loop is contrary to the concept of structured coding. (See the “What is structured programming?” sidebar.) In fact, a `GoTo` statement makes the code much more difficult to read because representing a loop using line indentations is almost impossible. In addition, this type of unstructured loop makes the procedure more susceptible to error. Furthermore, using lots of labels results in *spaghetti code* — code that appears to have little or no structure and flows haphazardly.

Because VBA has several structured looping commands, you almost never have to rely on `GoTo` statements for your decision-making.

For-Next loops

The simplest type of a good loop is a `For-Next` loop. Its syntax is

```
For counter = start To end [Step stepval]  
    [instructions]  
    [Exit For]  
    [instructions]  
Next [counter]
```

Following is an example of a `For-Next` loop that doesn't use the optional `Step` value or the optional `Exit For` statement. This routine executes the `Sum = Sum + Sqr(Count)` statement 100 times and displays the result — that is, the sum of the square roots of the first 100 integers.

```
Sub SumSquareRoots()  
    Dim Sum As Double  
    Dim Count As Integer  
    Sum = 0  
    For Count = 1 To 100  
        Sum = Sum + Sqr(Count)  
    Next Count  
    MsgBox Sum  
End Sub
```



What is structured programming?

Hang around with programmers, and sooner or later you'll hear the term *structured programming*. You'll also discover that structured programs are considered superior to unstructured programs.

So what is structured programming? And can you do it with VBA?

The basic premise of structured programming is that a routine or code segment should have only one entry point and one exit point. In other words, a body of code should be a stand-alone unit, and program control should not jump into or exit from the middle of this unit. As a result, structured programming rules out the `GoTo` statement. When you write structured code, your program progresses in an orderly manner and is easy to follow — as opposed to spaghetti code, in which a program jumps around.

A structured program is easier to read and understand than an unstructured one. More important, it's also easier to modify.

VBA is a structured language. It offers standard structured constructs, such as `If-Then-Else` and `Select Case` and the `For-Next`, `Do Until`, and `Do While` loops. Furthermore, VBA fully supports modular code construction.

If you're new to programming, forming good structured-programming habits early is a good idea.

In this example, `Count` (the loop counter variable) starts out as 1 and increases by 1 each time the loop repeats. The `Sum` variable simply accumulates the square roots of each value of `Count`.



Caution

When you use `For-Next` loops, it's important to understand that the loop counter is a normal variable — nothing special. As a result, it's possible to change the value of the loop counter within the block of code executed between the `For` and `Next` statements. Changing the loop counter inside of a loop, however, is a bad practice and can cause unpredictable results. In fact, you should take precautions to ensure that your code doesn't change the loop counter.

You can also use a `Step` value to skip some values in the loop. Here's the same procedure rewritten to sum the square roots of the odd numbers between 1 and 100:

```
Sub SumOddSquareRoots()  
    Dim Sum As Double  
    Dim Count As Integer  
    Sum = 0  
    For Count = 1 To 100 Step 2  
        Sum = Sum + Sqr(Count)  
    Next Count  
    MsgBox Sum  
End Sub
```


In this procedure, `Count` starts out as 1 and then takes on values of 3, 5, 7, and so on. The final value of `Count` used within the loop is 99. When the loop ends, the value of `Count` is 101.

A `Step` value in a `For-Next` loop can also be negative. The procedure that follows deletes Rows 2, 4, 6, 8, and 10 of the active worksheet:

```
Sub DeleteRows()  
    Dim RowNum As Long  
    For RowNum = 10 To 2 Step -2  
        Rows(RowNum).Delete  
    Next RowNum  
End Sub
```

You may wonder why I used a negative `Step` value in the `DeleteRows` procedure. If you use a positive `Step` value, as shown in the following procedure, incorrect rows are deleted. That's because the row numbers below a deleted row get a new row number. For example, when Row 2 is deleted, Row 3 becomes the new Row 2. Using a negative `Step` value ensures that the correct rows are deleted.

```
Sub DeleteRows2()  
    Dim RowNum As Long  
    For RowNum = 2 To 10 Step 2  
        Rows(RowNum).Delete  
    Next RowNum  
End Sub
```

The following procedure performs the same task as the `BadLoop` example found at the beginning of the “Looping blocks of instructions” section. I eliminate the `GoTo` statement, however, converting a bad loop into a good loop that uses the `For-Next` structure.

```
Sub GoodLoop()  
    Dim StartVal As Integer  
    Dim NumToFill As Integer  
    Dim Cnt As Integer  
    StartVal = 1  
    NumToFill = 100  
    For Cnt = 0 To NumToFill - 1  
        ActiveCell.Offset(Cnt, 0).Value = StartVal + Cnt  
    Next Cnt  
End Sub
```

`For-Next` loops can also include one or more `Exit For` statements within the loop. When this statement is encountered, the loop terminates immediately and control passes to the statement following the `Next` statement of the current `For-Next` loop. The following example demonstrates use of the `Exit For` statement. This procedure determines which cell has the largest value in Column A of the active worksheet:

```

Sub ExitForDemo()
    Dim MaxVal As Double
    Dim Row As Long
    MaxVal = Application.WorksheetFunction.Max(Range("A:A"))
    For Row = 1 To 1048576
        If Cells(Row, 1).Value = MaxVal Then
            Exit For
        End If
    Next Row
    MsgBox "Max value is in Row " & Row
    Cells(Row, 1).Activate
End Sub

```

The maximum value in the column is calculated by using the Excel MAX function, and the value is assigned to the `MaxVal` variable. The `For-Next` loop checks each cell in the column. If the cell being checked is equal to `MaxVal`, the `Exit For` statement terminates the loop and the statements following the `Next` statement are executed. These statements display the row of the maximum value and activate the cell.



Note

The `ExitForDemo` procedure is presented to demonstrate how to exit from a `For-Next` loop. However, it's not the most efficient way to activate the largest value in a range. In fact, a single statement does the job:

```

Range("A:A").Find(Application.WorksheetFunction.Max _
    (Range("A:A"))).Activate

```

The previous examples use relatively simple loops. But you can have any number of statements in the loop, and you can even nest `For-Next` loops inside other `For-Next` loops. Here's an example that uses nested `For-Next` loops to initialize a 10 x 10 x 10 array with the value -1. When the procedure is finished, each of the 1,000 elements in `MyArray` contains -1.

```

Sub NestedLoops()
    Dim MyArray(1 to 10, 1 to 10, 1 to 10)
    Dim i As Integer, j As Integer, k As Integer
    For i = 1 To 10
        For j = 1 To 10
            For k = 1 To 10
                MyArray(i, j, k) = -1
            Next k
        Next j
    Next i
    ' [More code goes here]
End Sub

```

Do While loops

This section describes another type of looping structure available in VBA. Unlike a `For-Next` loop, a `Do While` loop executes as long as a specified condition is met.

A `Do While` loop can have either of two syntaxes:

```
Do [While condition]
    [instructions]
    [Exit Do]
    [instructions]
Loop
```

or

```
Do
    [instructions]
    [Exit Do]
    [instructions]
Loop [While condition]
```

As you can see, VBA lets you put the `While` condition at the beginning or the end of the loop. The difference between these two syntaxes involves the point in time when the condition is evaluated. In the first syntax, the contents of the loop may never be executed. In the second syntax, the statements inside the loop are always executed at least one time.

The following examples insert a series of dates into the active worksheet. The dates correspond to the days in the current month, and the dates are entered in a column beginning at the active cell.

These examples use some VBA date-related functions:

- `Date` **returns the current date.**
- `Month` **returns the month number for a date supplied as its argument.**
- `DateSerial` **returns a date for the year, month, and day supplied as arguments.**

The first example demonstrates a `Do While` loop that tests the condition at the beginning of the loop: The `EnterDates1` procedure writes the dates of the current month to a worksheet column, beginning with the active cell.

```
Sub EnterDates1()
    ' Do While, with test at the beginning
    Dim TheDate As Date
    TheDate = DateSerial(Year(Date), Month(Date), 1)
    Do While Month(TheDate) = Month(Date)
        ActiveCell = TheDate
```

```

        TheDate = TheDate + 1
        ActiveCell.Offset(1, 0).Activate
    Loop
End Sub

```

This procedure uses a variable, `TheDate`, which contains the dates that are written to the worksheet. This variable is initialized with the first day of the current month. Inside of the loop, the value of `TheDate` is entered into the active cell, `TheDate` is incremented, and the next cell is activated. The loop continues while the month of `TheDate` is the same as the month of the current date.

The following procedure has the same result as the `EnterDates1` procedure, but it uses the second `Do While` loop syntax, which checks the condition at the end of the loop.

```

Sub EnterDates2()
'    Do While, with test at the end
    Dim TheDate As Date
    TheDate = DateSerial(Year(Date), Month(Date), 1)
    Do
        ActiveCell = TheDate
        TheDate = TheDate + 1
        ActiveCell.Offset(1, 0).Activate
    Loop While Month(TheDate) = Month(Date)
End Sub

```

The following is another `Do While` loop example. This procedure opens a text file, reads each line, converts the text to uppercase, and then stores it in the active sheet, beginning with cell A1 and continuing down the column. The procedure uses the VBA `EOF` function, which returns `True` when the end of the file has been reached. The final statement closes the text file.

```

Sub DoWhileDemo1()
    Dim LineCt As Long
    Dim LineOfText As String
    Open "c:\data\textfile.txt" For Input As #1
    LineCt = 0
    Do While Not EOF(1)
        Line Input #1, LineOfText
        Range("A1").Offset(LineCt, 0) = UCase(LineOfText)
        LineCt = LineCt + 1
    Loop
    Close #1
End Sub

```



Cross-Ref

For additional information about reading and writing text files using VBA, see Chapter 27.

`Do While` loops can also contain one or more `Exit Do` statements. When an `Exit Do` statement is encountered, the loop ends immediately and control passes to the statement following the `Loop` statement.

Do Until loops

The `Do Until` loop structure is very similar to the `Do While` structure. The difference is evident only when the condition is tested. In a `Do While` loop, the loop executes *while* the condition is `True`; in a `Do Until` loop, the loop executes *until* the condition is `True`.

`Do Until` also has two syntaxes:

```
Do [Until condition]
    [instructions]
    [Exit Do]
    [instructions]
Loop
```

or

```
Do
    [instructions]
    [Exit Do]
    [instructions]
Loop [Until condition]
```

The two examples that follow perform the same action as the `Do While` date entry examples in the previous section. The difference in these two procedures is where the condition is evaluated (at the beginning or the end of the loop).

```
Sub EnterDates3()
' Do Until, with test at beginning
Dim TheDate As Date
TheDate = DateSerial(Year(Date), Month(Date), 1)
Do Until Month(TheDate) <> Month(Date)
    ActiveCell = TheDate
    TheDate = TheDate + 1
    ActiveCell.Offset(1, 0).Activate
Loop
End Sub
```

```
Sub EnterDates4()
' Do Until, with test at end
Dim TheDate As Date
TheDate = DateSerial(Year(Date), Month(Date), 1)
```

```

Do
    ActiveCell = TheDate
    TheDate = TheDate + 1
    ActiveCell.Offset(1, 0).Activate
Loop Until Month(TheDate) <> Month(Date)
End Sub

```

The following example was originally presented for the `Do While` loop but has been rewritten to use a `Do Until` loop. The only difference is the line with the `Do` statement. This example makes the code a bit clearer because it avoids the negative required in the `Do While` example.

```

Sub DoUntilDemo1()
    Dim LineCt As Long
    Dim LineOfText As String
    Open "c:\data\textfile.txt" For Input As #1
    LineCt = 0
    Do Until EOF(1)
        Line Input #1, LineOfText
        Range("A1").Offset(LineCt, 0) = UCase(LineOfText)
        LineCt = LineCt + 1
    Loop
    Close #1
End Sub

```



Note

VBA supports yet another type of loop, `While Wend`. This looping structure is included primarily for compatibility purposes. I mention it here in case you ever encounter such a loop. Here's how the date entry procedure looks when it's coded to use a `While Wend` loop:

```

Sub EnterDates5()
    Dim TheDate As Date
    TheDate = DateSerial(Year(Date), Month(Date), 1)
    While Month(TheDate) = Month(Date)
        ActiveCell = TheDate
        TheDate = TheDate + 1
        ActiveCell.Offset(1, 0).Activate
    Wend
End Sub

```

Working with VBA Sub Procedures

In This Chapter

- Declaring and creating VBA Sub procedures
- Executing procedures
- Passing arguments to a procedure
- Using error-handling techniques
- An example of developing a useful procedure

About Procedures

A *procedure* is a series of VBA statements that resides in a VBA module, which you access in the Visual Basic Editor (VBE). A module can hold any number of procedures. A procedure holds a group of VBA statements that accomplishes a desired task. Most VBA code is contained in procedures.

You have a number of ways to *call*, or execute, procedures. A procedure is executed from beginning to end, but it can also be ended prematurely.



Tip

A procedure can be any length, but many people prefer to avoid creating extremely long procedures that perform many different operations. You may find it easier to write several smaller procedures, each with a single purpose. Then, design a main procedure that calls those other procedures. This approach can make your code easier to maintain.

Some procedures are written to receive arguments. An *argument* is simply information that is used by the procedure and that is passed to the procedure when it is executed. Procedure arguments work much like the arguments that you use in Excel worksheet functions. Instructions

within the procedure generally perform logical operations on these arguments, and the results of the procedure are usually based on those arguments.



Cross-Ref

Although this chapter focuses on `Sub` procedures, VBA also supports `Function` procedures, which I discuss in Chapter 10. Chapter 11 has many additional examples of procedures, both `Sub` and `Function`, that you can incorporate into your work.

Declaring a Sub procedure

A procedure declared with the `Sub` keyword must adhere to the following syntax:

```
[Private | Public][Static] Sub name ([arglist])  
    [instructions]  
    [Exit Sub]  
    [instructions]  
End Sub
```

Here's a description of the elements that make up a `Sub` procedure:

- **Private:** (Optional) Indicates that the procedure is accessible only to other procedures in the same module.
- **Public:** (Optional) Indicates that the procedure is accessible to all other procedures in all other modules in the workbook. If used in a module that contains an `Option Private Module` statement, the procedure is not available outside the project.
- **Static:** (Optional) Indicates that the procedure's variables are preserved when the procedure ends.
- **Sub:** (Required) The keyword that indicates the beginning of a procedure.
- **name:** (Required) Any valid procedure name.
- **arglist:** (Optional) Represents a list of variables, enclosed in parentheses, that receive arguments passed to the procedure. Use a comma to separate arguments. If the procedure uses no arguments, a set of empty parentheses is required.
- **instructions:** (Optional) Represents valid VBA instructions.
- **Exit Sub:** (Optional) A statement that forces an immediate exit from the procedure prior to its formal completion.
- **End Sub:** (Required) Indicates the end of the procedure.



Note

With a few exceptions, all VBA instructions in a module must be contained within procedures. Exceptions include module-level variable declarations, user-defined data type definitions, and a few other instructions that specify module-level options (for example, `Option Explicit`).



Naming procedures

Every procedure must have a name. The rules governing procedure names are generally the same as those for variable names. Ideally, a procedure's name should describe what its contained processes do. A good rule is to use a name that includes a verb and a noun (for example, `ProcessDate`, `PrintReport`, `Sort_Array`, or `CheckFilename`). Unless you're writing a quick and dirty procedure that you'll use once and delete, avoid meaningless names such as `DoIt`, `Update`, and `Fix`.

Some programmers use sentence-like names that describe the procedure (for example, `WriteReportToTextFile` and `Get_Print_Options_ and_Print_Report`).

Scoping a procedure

In the preceding chapter, I note that a variable's *scope* determines the modules and procedures in which you can use the variable. Similarly, a procedure's scope determines which other procedures can call it.

Public procedures

By default, procedures are *public* — that is, they can be called by other procedures in any module in the workbook. It's not necessary to use the `Public` keyword, but programmers often include it for clarity. The following two procedures are both public:

```
Sub First()  
' ... [code goes here] ...  
End Sub  
  
Public Sub Second()  
' ... [code goes here] ...  
End Sub
```

Private procedures

Private procedures can be called by other procedures in the same module but not by procedures in other modules.



Note

When a user displays the Macro dialog box, Excel shows only the public procedures. Therefore, if you have procedures that are designed to be called only by other procedures in the same module, you should make sure that those procedures are declared as *Private*. Doing so prevents the user from running these procedures from the Macro dialog box.

The following example declares a private procedure named `MySub`:

```
Private Sub MySub()  
' ... [code goes here] ...  
End Sub
```



Tip

You can force all procedures in a module to be private — even those declared with the `Public` keyword — by including the following statement before your first `Sub` statement:

```
Option Private Module
```

If you write this statement in a module, you can omit the `Private` keyword from your `Sub` declarations.

Excel's macro recorder normally creates new `Sub` procedures called `Macro1`, `Macro2`, and so on. Unless you modify the recorded code, these procedures are all public procedures, and they will never use any arguments.

Executing Sub Procedures

In this section, I describe the various ways to *execute*, or call, a VBA `Sub` procedure:

- With the **Run→Run Sub/UserForm** command (in the VBE menu). Or you can press the F5 shortcut key, or click the **Run Sub/UserForm** button on the Standard toolbar.
- From Excel's Macro dialog box.
- By using the Ctrl key shortcut assigned to the procedure (assuming that you assigned one).
- By clicking a button or a shape on a worksheet. The button or shape must have the procedure assigned to it.
- From another procedure that you write. `Sub` and `Function` procedures can execute other procedures.
- From a custom control in the Ribbon. In addition, built-in Ribbon controls can be “repurposed” to execute a macro.
- From a customized shortcut menu.
- When an event occurs. These events include opening the workbook, saving the workbook, closing the workbook, changing a cell's value, activating a sheet, and many other things.
- From the Immediate window in the VBE. Just type the name of the procedure, including any arguments that may apply, and press Enter.

I discuss these methods of executing procedures in the following sections.



Note

In many cases, a procedure won't work properly unless it's executed in the appropriate context. For example, if a procedure is designed to work with the active worksheet, it will fail if a chart sheet is active. A good procedure incorporates code that checks for the appropriate context and exits gracefully if it can't proceed.

Executing a procedure with the Run Sub/UserForm command

The VBE Run→Run Sub/UserForm menu command is used primarily to test a procedure while you're developing it. You would never require a user to activate the VBE to execute a procedure. Choose Run→Run Sub/UserForm in the VBE to execute the current procedure (in other words, the procedure that contains the cursor). Or, press F5, or use the Run Sub/UserForm button on the Standard toolbar.

If the cursor isn't located within a procedure when you issue the Run Sub/UserForm command, VBE displays its Macro dialog box so that you can select a procedure to execute.

Executing a procedure from the Macro dialog box

Choosing Excel's Developer→Code→Macros command displays the Macro dialog box, as shown in Figure 9-1. (You can also press Alt+F8 to access this dialog box.) Use the Macros In drop-down box to limit the scope of the macros displayed (for example, show only the macros in the active workbook).

The Macro dialog box does *not* display

- Function procedures
- Sub procedures declared with the `Private` keyword
- Sub procedures that require one or more arguments
- Sub procedures contained in add-ins



Tip

Even though procedures stored in an add-in are not listed in the Macro dialog box, you still can execute such a procedure if you know the name. Simply type the procedure name in the Macro Name field in the Macro dialog box and then click Run.

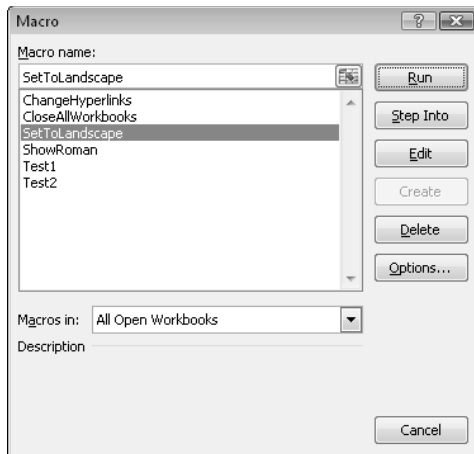


Figure 9-1: The Macro dialog box.

Executing a procedure with a Ctrl+shortcut key combination

You can assign a Ctrl+shortcut key combination to any procedure that doesn't use any arguments. If you assign the Ctrl+U key combo to a procedure named `UpdateCustomerList`, for example, pressing Ctrl+U executes that procedure.

When you begin recording a macro, the Record Macro dialog box gives you the opportunity to assign a shortcut key. However, you can assign a shortcut key at any time. To assign a Ctrl shortcut key to a procedure (or to change a procedure's shortcut key), follow these steps:

1. Activate Excel and choose Developer→Code→Macros.
2. Select the appropriate procedure from the list box in the Macro dialog box.
3. Click the Options button to display the Macro Options dialog box (see Figure 9-2).

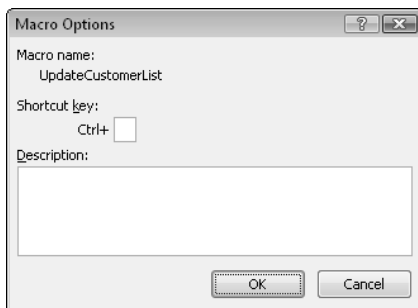


Figure 9-2: The Macro Options dialog box lets you assign a Ctrl key shortcut and an optional description to a procedure.

4. Enter a character into the Ctrl+ text box.
Note: The character that you enter into the Ctrl+ text box is case-sensitive. If you enter a lowercase s, the shortcut key combo is Ctrl+S. If you enter an uppercase S, the shortcut key combo is Ctrl+Shift+S.
5. Enter a description (optional). If you enter a description for a macro, it's displayed at the bottom of the Macro dialog box when the procedure is selected in the list box.
6. Click OK to close the Macro Options dialog box and then click Cancel to close the Macro dialog box.

**Caution**

If you assign one of Excel's predefined shortcut key combinations to a procedure, your key assignment takes precedence over the predefined key assignment. For example, Ctrl+S is the Excel predefined shortcut key for saving the active workbook. But if you assign Ctrl+S to a procedure, pressing Ctrl+S no longer saves the active workbook.

**Tip**

The following keyboard keys are *not* used by Excel 2010 for Ctrl+key combinations: E, J, M, and Q. Excel doesn't use too many Ctrl+Shift+key combinations. In fact, you can use any of them *except* F, L, N, O, P, and W.

Executing a procedure from the Ribbon

Excel's Ribbon user interface was introduced in Excel 2007. In that version, customizing the Ribbon required writing XML code to add a new button (or other control) to the Ribbon. Note that you modify the Ribbon in this way outside of Excel, and you can't do it using VBA.

**New Feature**

Excel 2010 allows users to modify the Ribbon directly from Excel. It's a simple matter to add a new control to the Ribbon and assign a VBA macro to the control.

**Cross-Ref**

Refer to Chapter 22 for more information about customizing the Ribbon.

Executing a procedure from a customized shortcut menu

You can also execute a macro by clicking a menu item in a customized shortcut menu. A shortcut menu appears when you right-click an object or range in Excel.

**Cross-Ref**

Refer to Chapter 23 for more information about customizing shortcut menus.

Executing a procedure from another procedure

One of the most common ways to execute a procedure is from another VBA procedure. You have three ways to do this:

- Enter the procedure's name, followed by its arguments (if any) separated by commas.
- Use the `Call` keyword followed by the procedure's name and then its arguments (if any) enclosed in parentheses and separated by commas.
- Use the `Run` method of the `Application` object. The `Run` method is useful when you need to run a procedure whose name is assigned to a variable. You can then pass the variable as an argument to the `Run` method.

The following example demonstrates the first method. In this case, the `MySub` procedure processes some statements (not shown), executes the `UpdateSheet` procedure, and then executes the rest of the statements.

```
Sub MySub()  
' ... [code goes here] ...  
    UpdateSheet  
' ... [code goes here] ...  
End Sub  
  
Sub UpdateSheet()  
' ... [code goes here] ...  
End Sub
```

The following example demonstrates the second method. The `Call` keyword executes the `Update` procedure, which requires one argument; the calling procedure passes the argument to the called procedure. I discuss procedure arguments later in this chapter (see “Passing Arguments to Procedures”).

```
Sub MySub()  
    MonthNum = InputBox("Enter the month number: ")  
    Call UpdateSheet(MonthNum)  
' ... [code goes here] ...  
End Sub  
  
Sub UpdateSheet(MonthSeq)  
' ... [code goes here] ...  
End Sub
```



Tip

Even though it's optional, some programmers always use the `Call` keyword just to make it perfectly clear that another procedure is being called.

The next example uses the `Run` method to execute the `UpdateSheet` procedure and then to pass `MonthNum` as the argument.

```
Sub MySub()  
    MonthNum = InputBox("Enter the month number: ")  
    Application.Run "UpdateSheet", MonthNum  
    ' ... [code goes here] ...  
End Sub  
  
Sub UpdateSheet(MonthSeq)  
    ' ... [code goes here] ...  
End Sub
```

Perhaps the best reason to use the `Run` method is when the procedure name is assigned to a variable. In fact, it's the only way to execute a procedure in such a way. The following example demonstrates this. The `Main` procedure uses the VBA `WeekDay` function to determine the day of the week (an integer between 1 and 7, beginning with Sunday). The `SubToCall` variable is assigned a string that represents a procedure name. The `Run` method then calls the appropriate procedure (either `WeekEnd` or `Daily`).

```
Sub Main()  
    Dim SubToCall As String  
    Select Case WeekDay(Now)  
        Case 1, 7: SubToCall = "WeekEnd"  
        Case Else: SubToCall = "Daily"  
    End Select  
    Application.Run SubToCall  
End Sub  
  
Sub WeekEnd()  
    MsgBox "Today is a weekend"  
    ' Code to execute on the weekend  
    ' goes here  
End Sub  
  
Sub Daily()  
    MsgBox "Today is not a weekend"  
    ' Code to execute on the weekdays  
    ' goes here  
End Sub
```

Calling a procedure in a different module

If VBA can't locate a called procedure in the current module, it looks for public procedures in other modules in the same project.

If you need to call a private procedure from another procedure, both procedures must reside in the same module.

You can't have two procedures with the same name in the same module, but you can have identically named procedures in different modules within the project. You can force VBA to execute an *ambiguously named* procedure — that is, another procedure in a different module that has the same name. To do so, precede the procedure name with the module name and a dot. For example, say that you define procedures named `MySub` in `Module1` and `Module2`. If you want a procedure in `Module2` to call the `MySub` in `Module1`, you can use either of the following statements:

```
Module1.MySub  
Call Module1.MySub
```

If you do not differentiate between procedures that have the same name, you get an `Ambiguous name detected` error message.

Calling a procedure in a different workbook

In some cases, you may need your procedure to execute another procedure defined in a different workbook. To do so, you have two options: Either establish a reference to the other workbook or use the `Run` method and specify the workbook name explicitly.

To add a reference to another workbook, choose the VBE's `Tools`→`References` command. Excel displays the References dialog box (see Figure 9-3), which lists all available references, including all open workbooks. Simply check the box that corresponds to the workbook that you want to add as a reference and then click `OK`. After you establish a reference, you can call procedures in the workbook as if they were in the same workbook as the calling procedure.

A referenced workbook doesn't have to be open when you create the reference; it's treated like a separate object library. Use the `Browse...` button in the References dialog box to establish a reference to a workbook that isn't open.

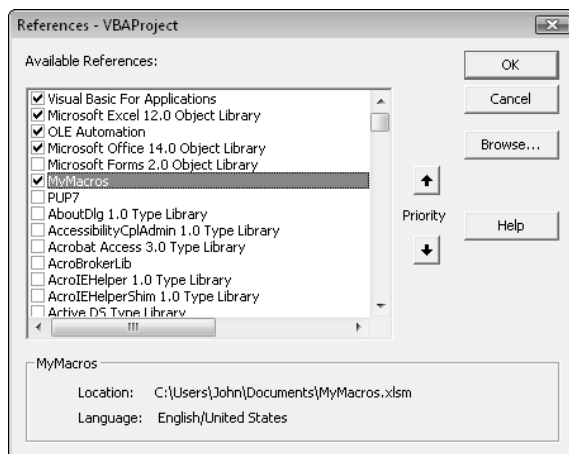


Figure 9-3: The References dialog box lets you establish a reference to another workbook.

When you open a workbook that contains a reference to another workbook, the referenced workbook is opened automatically.



Note

the workbook names that appear in the list of references are listed by their VBE project names. By default, every project is initially named *VBAProject*. Therefore, the list may contain several identically named items. To distinguish a project, change its name in the Project Properties dialog box. Click the project name in the Project window and then choose **Tools**→**xxxx Properties** (where *xxxx* is the current project name). In the Project Properties dialog box, click the General tab and change the name displayed in the Project Name field.

The list of references displayed in the References dialog box also includes object libraries and ActiveX controls that are registered on your system. Your Excel workbooks always include references to the following object libraries:

- Visual Basic for Applications
- Microsoft Excel 14.0 Object Library
- OLE Automation
- Microsoft Office 14.0 Object Library
- Microsoft Forms 2.0 Object Library (this reference is included only if your project includes a UserForm)



Note

Any additional references to other workbooks that you add are also listed in your project outline in the Project Explorer window in the VBE. These references are listed under a node called **References**.

If you've established a reference to a workbook that contains the procedure `MySub`, for example, you can use either of the following statements to call `MySub`:

```
YourSub  
Call YourSub
```

To precisely identify a procedure in a different workbook, specify the project name, module name, and procedure name by using the following syntax:

```
MyProject.MyModule.MySub
```

Alternatively, you can use the `Call` keyword:

```
Call MyProject.MyModule.MySub
```

Another way to call a procedure in a different workbook is to use the `Run` method of the `Application` object. This technique doesn't require that you establish a reference, but the workbook that contains the procedure must be open. The following statement executes the `Consolidate` procedure located in a workbook named `budget_macros.xlsm`:

```
Application.Run "'budget_macros.xlsm'!Consolidate"
```



Why call other procedures?

If you're new to programming, you may wonder why anyone would ever want to call a procedure from another procedure. You may ask, "Why not just put the code from the called procedure into the calling procedure and keep things simple?"

One reason is to clarify your code. The simpler your code, the easier it is to maintain and modify. Smaller routines are easier to decipher and then debug. Examine the accompanying procedure, which does nothing but call other procedures. This procedure is very easy to follow.

```
Sub Main()  
    Call GetUserOptions  
    Call ProcessData  
    Call CleanUp  
    Call CloseItDown  
End Sub
```

Calling other procedures also eliminates redundancy. Suppose that you need to perform an operation at ten different places in your routine. Rather than enter the code ten times, you can write a procedure to perform the operation and then simply call the procedure ten times. Also, if you need to make a change, you make it only one time rather than ten times.

Also, you may have a series of general-purpose procedures that you use frequently. If you store these in a separate module, you can import the module to your current project and then call these procedures as needed — which is much easier than copying and pasting the code into your new procedures.

Creating several small procedures rather than a single large one is often considered good programming practice. A modular approach not only makes your job easier but also makes life easier for the people who wind up working with your code.

Executing a procedure by clicking an object

Excel provides a variety of objects that you can place on a worksheet or chart sheet, and you can attach a macro to any of these objects. These objects fall into several classes:

- ActiveX controls
- Forms controls
- Inserted objects (Shapes, SmartArt, WordArt, charts, and pictures)



Note

The **Developer→Controls→Insert** drop-down list contains two types of controls that you can insert on a worksheet: Form controls and ActiveX controls. The ActiveX controls are similar to the controls that you use in a UserForm. The Forms controls were designed for Excel 5 and Excel 95, but you can still use them in later versions (which may be preferable in some cases).

Unlike the Form controls, you can't use the ActiveX controls to execute an arbitrary macro. An ActiveX control executes a specially named macro. For example, if you insert an ActiveX button control named `CommandButton1`, clicking the button executes a macro named `CommandButton1_Click`, which must be located in the code module for the sheet on which the control was inserted.

Refer to Chapter 13 for information about using controls on worksheets.

To assign a procedure to a `Button` object from the Form controls, follow these steps:

1. Select **Developer→Controls→Insert** and click the button icon in the Form Controls group.
2. Click the worksheet to create the button.

Or, you can drag your mouse on the worksheet to change the default size of the button.

Excel jumps right in and displays the Assign Macro dialog box (see Figure 9-4). It proposes a macro that's based on the button's name.

3. Select or enter the macro that you want to assign to the button and then click OK.

You can always change the macro assignment by right-clicking the button and choosing **Assign Macro**.

To assign a macro to a Shape, SmartArt, WordArt, chart, or picture, right-click the object and choose **Assign Macro** from the shortcut menu.

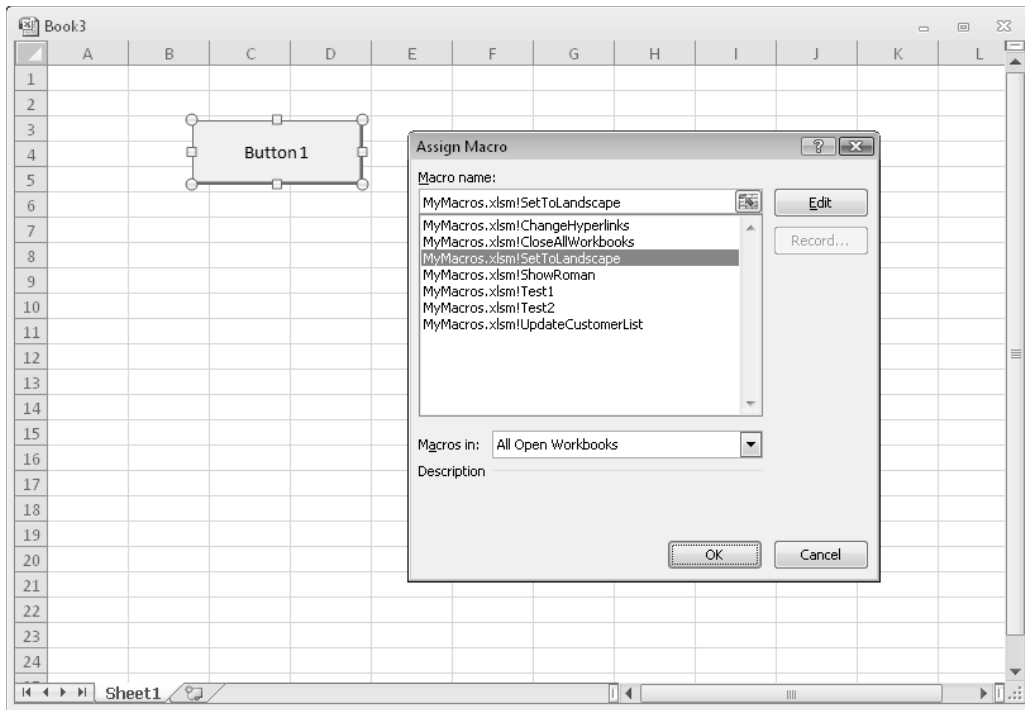


Figure 9-4: Assigning a macro to a button.

Executing a procedure when an event occurs

You might want a procedure to execute when a particular event occurs. Examples of events include opening a workbook, entering data into a worksheet, saving a workbook, clicking a `CommandButton` ActiveX control, and many others. A procedure that is executed when an event occurs is an *event handler* procedure. Event handler procedures are characterized by the following:

- They have special names that are made up of an object, an underscore, and the event name. For example, the procedure that is executed when a workbook is opened is `Workbook_Open`.
- They're stored in the Code module for the particular object.



Cross-Ref

Chapter 19 is devoted to event handler procedures.

Executing a procedure from the Immediate window

You also can execute a procedure by entering its name in the Immediate window of the VBE. If the Immediate window isn't visible, press `Ctrl+G`. The Immediate window executes VBA statements while you enter them. To execute a procedure, simply enter the name of the procedure in the Immediate window and press `Enter`.

This method can be quite useful when you're developing a procedure because you can insert commands to display results in the Immediate window. The following procedure demonstrates this technique:

```
Sub ChangeCase()  
    Dim MyString As String  
    MyString = "This is a test"  
    MyString = UCase(MyString)  
    Debug.Print MyString  
End Sub
```

Figure 9-5 shows what happens when you enter **ChangeCase** in the Immediate window: The `Debug.Print` statement displays the result immediately.

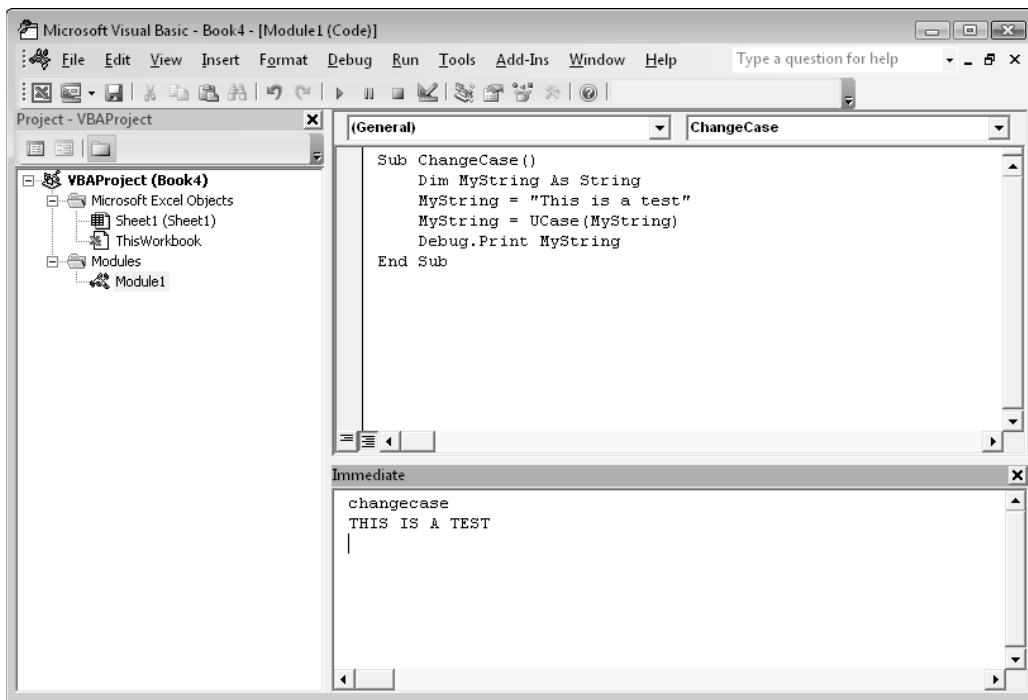


Figure 9-5: Executing a procedure by entering its name in the Immediate window.

Passing Arguments to Procedures

A procedure's *arguments* provide it with data that it uses in its instructions. The data that's passed by an argument can be any of the following:

- A variable
- A constant

- An array
- An object

The use of arguments by procedures is very similar to their use of worksheet functions in the following respects:

- A procedure may not require any arguments.
- A procedure may require a fixed number of arguments.
- A procedure may accept an indefinite number of arguments.
- A procedure may require some arguments, leaving others optional.
- A procedure may have all optional arguments.

For example, a few of Excel's worksheet functions, such as `RAND` and `NOW`, use no arguments. Others, such as `COUNTIF`, require two arguments. Others still, such as `SUM`, can use up to 255 arguments. Still other worksheet functions have optional arguments. The `PMT` function, for example, can have five arguments (three are required; two are optional).

Most of the procedures that you've seen so far in this book have been declared without arguments. They were declared with just the `Sub` keyword, the procedure's name, and a set of empty parentheses. Empty parentheses indicate that the procedure does not accept arguments.

The following example shows two procedures. The `Main` procedure calls the `ProcessFile` procedure three times (the `Call` statement is in a `For-Next` loop). Before calling `ProcessFile`, however, a three-element array is created. Inside the loop, each element of the array becomes the argument for the procedure call. The `ProcessFile` procedure takes one argument (named `TheFile`). Notice that the argument goes inside parentheses in the `Sub` statement. When `ProcessFile` finishes, program control continues with the statement after the `Call` statement.

```
Sub Main()  
    Dim File(1 To 3) As String  
    Dim i as Integer  
    File(1) = "dept1.xlsx"  
    File(2) = "dept2.xlsx"  
    File(3) = "dept3.xlsx"  
    For i = 1 To 3  
        Call ProcessFile(File(i))  
    Next i  
End Sub  
  
Sub ProcessFile(TheFile)  
    Workbooks.Open FileName:=TheFile  
    ' ...[more code here]...  
End Sub
```

You can also, of course, pass *literals* (that is, not variables) to a procedure. For example:

```
Sub Main()  
    Call ProcessFile("budget.xlsx")  
End Sub
```

You can pass an argument to a procedure in two ways:

- **By reference:** Passing an argument by reference simply passes the memory address of the variable. Changes to the argument within the procedure are made to the original variable. This is the default method of passing an argument.
- **By value:** Passing an argument by value passes a *copy* of the original variable. Consequently, changes to the argument within the procedure are not reflected in the original variable.

The following example demonstrates this concept. The argument for the `Process` procedure is passed by reference (the default method). After the `Main` procedure assigns a value of 10 to `MyValue`, it calls the `Process` procedure and passes `MyValue` as the argument. The `Process` procedure multiplies the value of its argument (named `YourValue`) by 10. When `Process` ends and program control passes back to `Main`, the `MsgBox` function displays `MyValue: 100`.

```
Sub Main()  
    Dim MyValue As Integer  
    MyValue = 10  
    Call Process(MyValue)  
    MsgBox MyValue  
End Sub  
  
Sub Process(YourValue)  
    YourValue = YourValue * 10  
End Sub
```

If you don't want the called procedure to modify any variables passed as arguments, you can modify the called procedure's argument list so that arguments are passed to it by *value* rather than by *reference*. To do so, precede the argument with the `ByVal` keyword. This technique causes the called routine to work with a copy of the passed variable's data — not the data itself. In the following procedure, for example, the changes made to `YourValue` in the `Process` procedure do not affect the `MyValue` variable in `Main`. As a result, the `MsgBox` function displays 10 and not 100.

```
Sub Process(ByVal YourValue)  
    YourValue = YourValue * 10  
End Sub
```

In most cases, you'll be content to use the default reference method of passing arguments. However, if your procedure needs to use data passed to it in an argument — and you must keep the original data intact — you'll want to pass the data by value.

A procedure's arguments can mix and match by value and by reference. Arguments preceded with `ByVal` are passed by value; all others are passed by reference.



Note

If you pass a variable defined as a user-defined data type to a procedure, it must be passed by reference. Attempting to pass it by value generates an error.

Because I didn't declare a data type for any of the arguments in the preceding examples, all the arguments have been of the `Variant` data type. But a procedure that uses arguments can define the data types directly in the argument list. The following is a `Sub` statement for a procedure with two arguments of different data types. The first is declared as an integer, and the second is declared as a string.

```
Sub Process(Iterations As Integer, TheFile As String)
```



Using public variables versus passing arguments to a procedure

In Chapter 8, I point out how a variable declared as `Public` (at the top of the module) is available to all procedures in the module. In some cases, you may want to access a `Public` variable rather than pass the variable as an argument when calling another procedure.

For example, the procedure that follows passes the value of `MonthVal` to the `ProcessMonth` procedure:

```
Sub MySub()  
    Dim MonthVal as Integer  
    ' ... [code goes here]  
    MonthVal = 4  
    Call ProcessMonth(MonthVal)  
    ' ... [code goes here]  
End Sub
```

An alternative approach, which doesn't use an argument, is

```
Public MonthVal as Integer  
  
Sub MySub()  
    ' ... [code goes here]  
    MonthVal = 4  
    Call ProcessMonth2  
    ' ... [code goes here]  
End Sub
```

In the revised code, because `MonthVal` is a public variable, the `ProcessMonth2` procedure can access it, thus eliminating the need for an argument for the `ProcessMonth2` procedure.

When you pass arguments to a procedure, the data that is passed as the argument must match the argument's data type. For example, if you call `Process` in the preceding example and pass a string variable for the first argument, you get an error: `ByRef argument type mismatch`.



Note

Arguments are relevant to both `Sub` procedures and `Function` procedures. In fact, arguments are more often used in `Function` procedures. In Chapter 10, where I focus on `Function` procedures, I provide additional examples of using arguments with your routines, including how to handle optional arguments.

Error-Handling Techniques

When a VBA procedure is running, errors can (and probably will) occur. These include either *syntax errors* (which you must correct before you can execute a procedure) or *runtime errors* (which occur while the procedure is running). This section deals with runtime errors.



Caution

for error-handling procedures to work, the **Break on All Errors** setting *must* be turned off. In the VBE, choose **Tools**→**Options** and click the **General** tab in the **Options** dialog box. If **Break on All Errors** is selected, VBA ignores your error-handling code. You'll usually want to use the **Break on Unhandled Errors** option.

Normally, a runtime error causes VBA to stop, and the user sees a dialog box that displays the error number and a description of the error. A good application doesn't make the user deal with these messages. Rather, it incorporates error-handling code to trap errors and take appropriate actions. At the very least, your error-handling code can display a more meaningful error message than the one VBA pops up.



Cross-Ref

Appendix C lists all the VBA error codes and descriptions.

Trapping errors

You can use the `On Error` statement to specify what happens when an error occurs. Basically, you have two choices:

- **Ignore the error and let VBA continue.** Your code can later examine the `Err` object to determine what the error was and then take action, if necessary.
- **Jump to a special error-handling section of your code to take action.** This section is placed at the end of the procedure and is also marked by a label.

To cause your VBA code to continue when an error occurs, insert the following statement in your code:

```
On Error Resume Next
```

Some errors are inconsequential, and you can ignore them without causing a problem. But you might want to determine what the error was. When an error occurs, you can use the `Err` object to determine the error number. You can use the VBA `Error` function to display the text that corresponds to the `Err.Number` value. For example, the following statement displays the same information as the normal Visual Basic error dialog box (the error number and the error description):

```
MsgBox "Error " & Err & ": " & Error(Err.Number)
```

Figure 9-6 shows a VBA error message, and Figure 9-7 shows the same error displayed in a message box. You can, of course, make the error message a bit more meaningful to your end users by using more descriptive text.



Note

Referencing `Err` is equivalent to accessing the `Number` property of the `Err` object. Therefore, the following two statements have the same effect:

```
MsgBox Err  
MsgBox Err.Number
```

You also use the `On Error` statement to specify a location in your procedure to jump to when an error occurs. You use a label to mark the location. For example:

```
On Error GoTo ErrorHandler
```

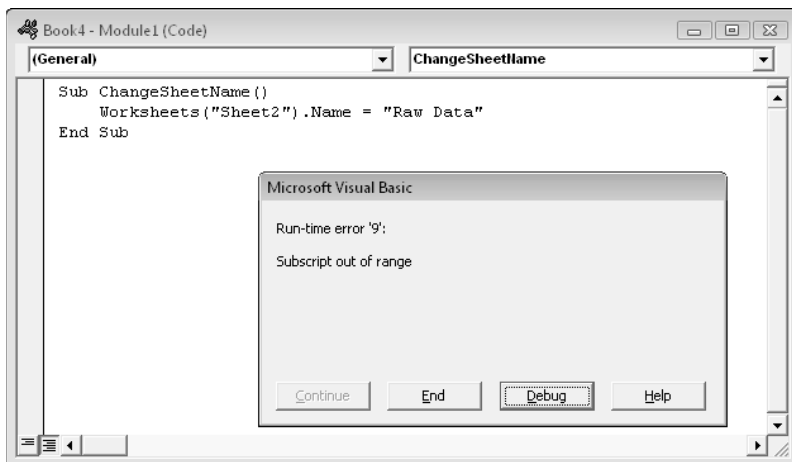


Figure 9-6: VBA error messages aren't always user friendly.

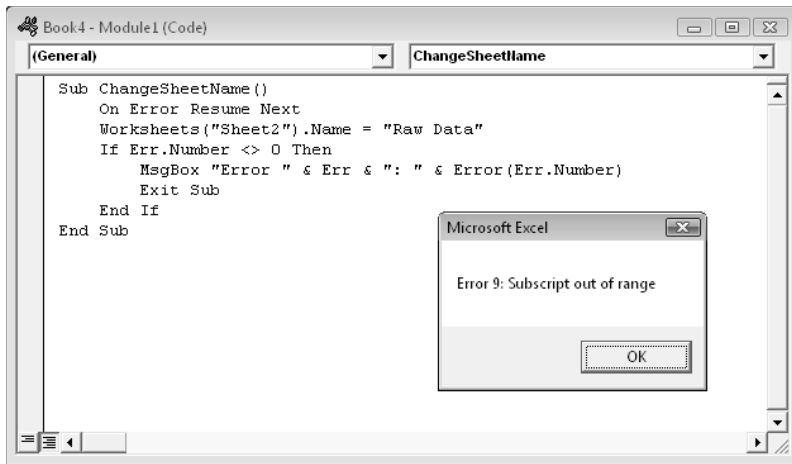


Figure 9-7: You can create a message box to display the error code and description.

Error-handling examples

The first example demonstrates an error that you can safely ignore. The `SpecialCells` method selects cells that meet a certain criterion.



Note

The `SpecialCells` method is equivalent to choosing the **Home**→**Editing**→**Find & Select**→**Go To Special** command. The **Go To Special** dialog box provides you with a number of choices. For example, you can select cells that contain a numeric constant (nonformula).

In the example that follows, which doesn't use any error handling, the `SpecialCells` method selects all the cells in the current range selection that contain a formula that returns a number. If no cells in the selection qualify, VBA displays the error message shown in Figure 9-8.

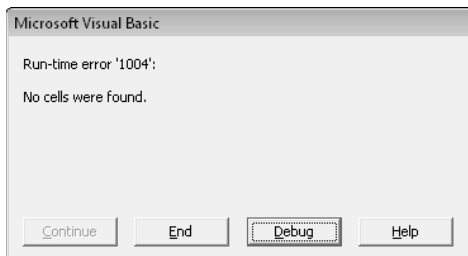


Figure 9-8: The `SpecialCells` method generates this error if no cells are found.

```
Sub SelectFormulas()
    Selection.SpecialCells(xlFormulas, xlNumbers).Select
    ' ...[more code goes here]
End Sub
```

Following is a variation that uses the `On Error Resume Next` statement to prevent the error message from appearing:

```
Sub SelectFormulas2()  
    On Error Resume Next  
    Selection.SpecialCells(xlFormulas, xlNumbers).Select  
    On Error GoTo 0  
    ' ...[more code goes here]  
End Sub
```

The `On Error GoTo 0` statement restores normal error handling for the remaining statements in the procedure.

The following procedure uses an additional statement to determine whether an error did occur. If so, the user is informed by a message.

```
Sub SelectFormulas3()  
    On Error Resume Next  
    Selection.SpecialCells(xlFormulas, xlNumbers).Select  
    If Err.Number = 1004 Then MsgBox "No formula cells were found."  
    On Error GoTo 0  
    ' ...[more code goes here]  
End Sub
```

If the `Number` property of `Err` is equal to anything other than 0, then an error occurred. The `If` statement checks to see if `Err.Number` is equal to 1004 and displays a message box if it is. In this example, the code is checking for a specific error number. To check for any error, use a statement like this:

```
If Err.Number <> 0 Then MsgBox "An error occurred."
```

The next example demonstrates error handling by jumping to a label.

```
Sub ErrorDemo()  
    On Error GoTo Handler  
    Selection.Value = 123  
    Exit Sub  
Handler:  
    MsgBox "Cannot assign a value to the selection."  
End Sub
```

The procedure attempts to assign a value to the current selection. If an error occurs (for example, a range isn't selected or the sheet is protected), the assignment statement results in an error. The `On Error` statement specifies a jump to the `Handler` label if an error occurs. Notice the use of

the `Exit Sub` statement before the label. This statement prevents the error-handling code from being executed if no error occurs. If this statement is omitted, the error message is displayed even if an error does not occur.

Sometimes, you can take advantage of an error to get information. The example that follows simply checks whether a particular workbook is open. It doesn't use any error handling.

```
Sub CheckForFile1()  
    Dim FileName As String  
    Dim FileExists As Boolean  
    Dim book As Workbook  
    FileName = "BUDGET.XLSX"  
    FileExists = False  
    ' Cycle through all open workbooks  
    For Each book In Workbooks  
        If UCase(book.Name) = FileName Then FileExists = True  
    Next book  
    ' Display appropriate message  
    If FileExists Then  
        MsgBox FileName & " is open."  
    Else  
        MsgBox FileName & " is not open."  
    End If  
End Sub
```

Here, a `For Each-Next` loop cycles through all objects in the `Workbooks` collection. If the workbook is open, the `FileExists` variable is set to `True`. Finally, a message is displayed that tells the user whether the workbook is open.

You can rewrite the preceding routine to use error handling to determine whether the file is open. In the example that follows, the `On Error Resume Next` statement causes VBA to ignore any errors. The next instruction attempts to reference the workbook by assigning the workbook to an object variable (by using the `Set` keyword). If the workbook isn't open, an error occurs. The `If-Then-Else` structure checks the value property of `Err` and displays the appropriate message. This procedure uses no looping, so it's slightly more efficient.

```
Sub CheckForFile()  
    Dim FileName As String  
    Dim x As Workbook  
    FileName = "BUDGET.XLSX"  
    On Error Resume Next  
    Set x = Workbooks(FileName)  
    If Err = 0 Then  
        MsgBox FileName & " is open."  
    Else  
        MsgBox FileName & " is not open."  
    End If  
    On Error GoTo 0  
End Sub
```



Cross-Ref

Chapter 11 presents several additional examples that use error handling.

A Realistic Example That Uses Sub Procedures

In this chapter, I describe the basics of creating `Sub` procedures. Most of the previous examples, I will admit, have been rather wimpy. The remainder of this chapter is a real-life exercise that demonstrates many of the concepts covered in this and the preceding two chapters.

This section describes the development of a useful utility that qualifies as an application as defined in Chapter 5. More important, I demonstrate the *process* of analyzing a problem and then solving it with VBA. I wrote this section with VBA newcomers in mind. As a result, I don't simply present the code, but I also show how to find out what you need to know to develop the code.



On the CD

You can find the completed application, named `sheet sorter.xlsm`, on the companion CD-ROM.

The goal

The goal of this exercise is to develop a utility that rearranges a workbook by alphabetizing its sheets (something that Excel can't do on its own). If you tend to create workbooks that consist of many sheets, you know that locating a particular sheet can be difficult. If the sheets are ordered alphabetically, however, it's easier to find a desired sheet.

Project requirements

Where to begin? One way to get started is to list the requirements for your application. When you develop your application, you can check your list to ensure that you're covering all the bases.

Here's the list of requirements that I compiled for this example application:

1. It should sort the sheets (that is, worksheets and chart sheets) in the active workbook in ascending order of their names.
2. It should be easy to execute.
3. It should always be available. In other words, the user shouldn't have to open a workbook to use this utility.
4. It should work properly for any workbook that's open.
5. It should not display any VBA error messages.

What you know

Often, the most difficult part of a project is figuring out where to start. In this case, I started by listing things that I know about Excel that may be relevant to the project requirements:

- Excel doesn't have a command that sorts sheets, so I'm not re-inventing the wheel.
- I can't create this type of macro by recording my actions. However, the macro might be useful to provide some key information.
- I can move a sheet easily by dragging its sheet tab.

Mental note: Turn on the macro recorder and drag a sheet to a new location to find out what kind of code this action generates.

- Excel also has a Move or Copy dialog box, which is displayed when I right-click a sheet tab and choose Move or Copy. Would recording a macro of this command generate different code than moving a sheet manually?
- I'll need to know how many sheets are in the active workbook. I can get this information with VBA.
- I'll need to know the names of all the sheets. Again, I can get this information with VBA.
- Excel has a command that sorts data in worksheet cells.

Mental note: Maybe I can transfer the sheet names to a range and use this feature. Or, maybe VBA has a sorting method that I can take advantage of.

- Thanks to the Macro Options dialog box, it's easy to assign a shortcut key to a macro.
- If a macro is stored in the Personal Macro Workbook, it will always be available.
- I need a way to test the application while I develop it. For certain, I don't want to be testing it using the same workbook in which I'm developing the code.

Mental note: Create a dummy workbook for testing purposes.

- If I develop the code properly, VBA won't display any errors.

Mental note: Wishful thinking . . .

The approach

Although I still didn't know exactly how to proceed, I could devise a preliminary, skeleton plan that describes the general tasks required:

1. Identify the active workbook.
2. Get a list of all the sheet names in the workbook.
3. Count the sheets.

4. Sort the sheet names (somehow).
5. Rearrange the sheets so they correspond to the sorted sheet names.

What you need to know

I saw a few holes in the plan. I knew that I had to determine the following:

- How to identify the active workbook
- How to count the sheets in the active workbook
- How to get a list of the sheet names
- How to sort the list
- How to rearrange the sheets according to the sorted list



Tip

When you lack critical information about specific methods or properties, you can consult this book or the VBA Help system. You may eventually discover what you need to know. Your best bet, however, is to turn on the macro recorder and examine the code that it generates when you perform some relevant actions. You'll almost always get some clues as to how to proceed.

Some preliminary recording

Here's an example of using the macro recorder to learn about VBA. I started with a workbook that contained three worksheets. Then I turned on the macro recorder and specified my Personal Macro Workbook as the destination for the macro. With the macro recorder running, I dragged the third worksheet to the first sheet position. Here's the code that was generated by the macro recorder:

```
Sub Macro1()  
    Sheets("Sheet3").Select  
    Sheets("Sheet3").Move Before:=Sheets(1)  
End Sub
```

I searched the VBA Help for *Move* and discovered that it's a method that moves a sheet to a new location in the workbook. It also takes an argument that specifies the location for the sheet. This information is very relevant to the task at hand. Curious, I then turned on the macro recorder to see whether using the Move or Copy dialog box would generate different code. It didn't.

Next, I needed to find out how many sheets were in the active workbook. I searched Help for the word *Count* and found out that it's a property of a collection. I activated the Immediate window in the VBE and typed the following statement:

```
? ActiveWorkbook.Count
```

Error! After a little more thought, I realized that I needed to get a count of the sheets within a workbook. So I tried this:

```
? ActiveWorkbook.Sheets.Count
```

Success. Figure 9-9 shows the result. More useful information.

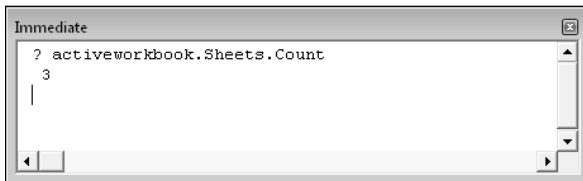


Figure 9-9: Use the VBE Immediate window to test a statement.

What about the sheet names? Time for another test. I entered the following statement in the Immediate window:

```
? ActiveWorkbook.Sheets(1).Name
```

This told me that the name of the first sheet is *Sheet3*, which is correct (because I'd moved it). More good information to keep in mind.

Then I remembered something about the *For Each-Next* construct: It's useful for cycling through each member of a collection. After consulting the Help system, I created a short procedure to test it:

```
Sub Test()  
    For Each Sht In ActiveWorkbook.Sheets  
        MsgBox Sht.Name  
    Next Sht  
End Sub
```

Another success. This macro displayed three message boxes, each showing a different sheet name.

Finally, it was time to think about sorting options. From the Help system, I learned that the `Sort` method applies to a `Range` object. So one option was to transfer the sheet names to a range and then sort the range, but that seemed like overkill for this application. I thought that a better option was to dump the sheet names into an array of strings and then sort the array by using VBA code.

Initial setup

Now I knew enough to get started writing some serious code. Before doing so, however, I needed to do some initial setup work. To re-create my steps, follow these instructions:

1. Create an empty workbook with five worksheets, named `Sheet1`, `Sheet2`, `Sheet3`, `Sheet4`, and `Sheet5`.
2. Move the sheets around randomly so that they aren't in any particular order.
3. Save the workbook as `Test.xlsx`.
4. Activate the VBE and select the `Personal.xlsb` project in the Project Window.

If `Personal.xlsb` doesn't appear in the Project window in the VBE, it means that you've never used the Personal Macro Workbook. To have Excel create this workbook for you, simply record a macro (any macro) and specify the Personal Macro Workbook as the destination for the macro.

5. Insert a new VBA module in `Personal.xlsb` (choose `Insert`→`Module`).
6. Create an empty `Sub` procedure called `SortSheets` (see Figure 9-10).

Actually, you can store this macro in any module in the Personal Macro Workbook. However, keeping each group of related macros in a separate module is a good idea. That way, you can easily export the module and import it into a different project later on.

7. Activate Excel and choose `Developer`→`Code`→`Macros` to display the Macro dialog box.
8. In the Macro dialog box, select the `SortSheets` procedure and click the `Options` button to assign a shortcut key to this macro.

The `Ctrl+Shift+S` key combination is a good choice.

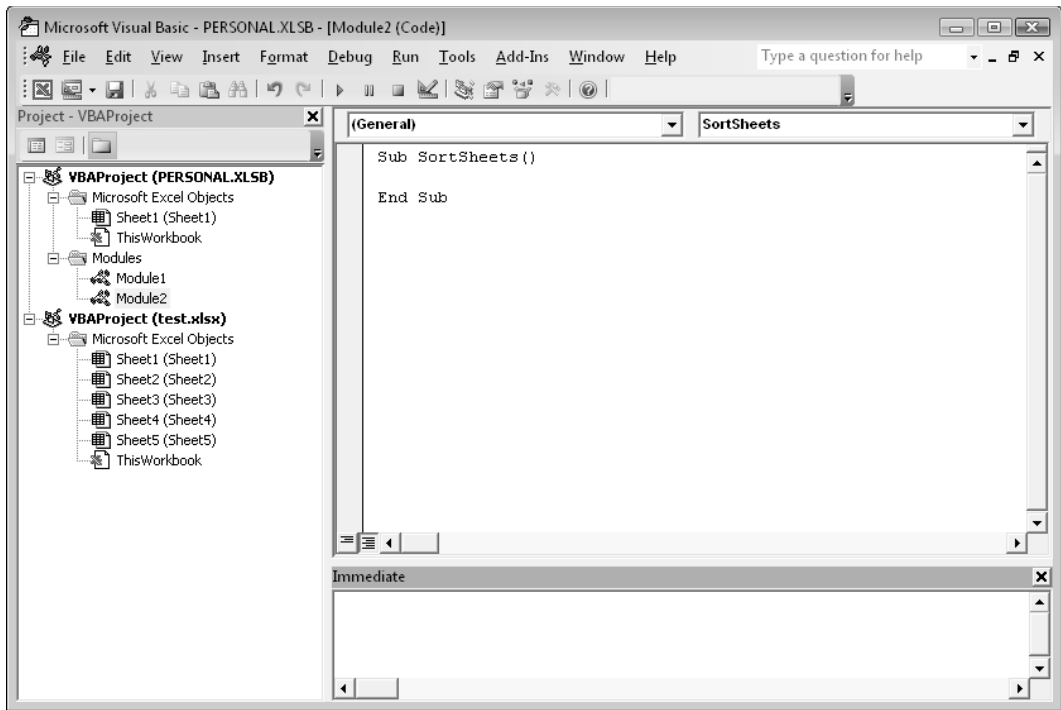


Figure 9-10: An empty procedure in a module located in the Personal Macro Workbook.

Code writing

Now it's time to write some code. I knew that I needed to put the sheet names into an array of strings. Because I didn't know yet how many sheets were in the active workbook, I used a `Dim` statement with empty parentheses to declare the array. I knew that I could use `ReDim` afterward to redimension the array for the actual number of elements.

I entered the following code, which inserted the sheet names into the `SheetNames` array. I also added a `MsgBox` function within the loop just to assure me that the sheets' names were indeed being entered into the array.

```
Sub SortSheets()
' Sorts the sheets of the active workbook
Dim SheetNames() as String
Dim i as Long
Dim SheetCount as Long
SheetCount = ActiveWorkbook.Sheets.Count
ReDim SheetNames(1 To SheetCount)
For i = 1 To SheetCount
    SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    MsgBox SheetNames(i)
Next i
End Sub
```

To test the preceding code, I activated the `Test.xlsx` workbook and pressed Ctrl+Shift+S. Five message boxes appeared, each displaying the name of a sheet in the active workbook. So far, so good.

By the way, I'm a major proponent of testing your work as you go. I tend to work in small steps and set things up so that I'm convinced that each small step is working properly before I continue. When you're convinced that your code is working correctly, remove the `MsgBox` statement. (These message boxes become annoying after a while.)



Tip

Rather than use the `MsgBox` function to test your work, you can use the `Print` method of the `Debug` object to display information in the Immediate window. For this example, use the following statement in place of the `MsgBox` statement:

```
Debug.Print SheetNames(i)
```

This technique is much less intrusive than using `MsgBox` statements. Just make sure that you remember to remove the statement when you're finished.

At this point, the `SortSheets` procedure simply creates an array of sheet names corresponding to the sheets in the active workbook. Two steps remain: Sort the elements in the `SheetNames` array and then rearrange the sheets to correspond to the sorted array.

Writing the Sort procedure

It was time to sort the `SheetNames` array. One option was to insert the sorting code in the `SortSheets` procedure, but I thought a better approach was to write a general-purpose sorting procedure that I could reuse with other projects. (Sorting arrays is a common operation.)

You might be a bit daunted by the thought of writing a sorting procedure. The good news is that it's relatively easy to find commonly used routines that you can use or adapt. The Internet, of course, is a great source for such information.

You can sort an array in many ways. I chose the *bubble sort* method; although it's not a particularly fast technique, it's easy to code. Blazing speed isn't really a requirement in this particular application.

The bubble sort method uses a nested `For-Next` loop to evaluate each array element. If the array element is greater than the next element, the two elements swap positions. The code includes a nested loop, so this evaluation is repeated for every pair of items (that is, $n - 1$ times).



Cross-Ref

In Chapter 11, I present some other sorting routines and compare them in terms of speed.

Here's the sorting procedure I developed (after consulting a few programming Web sites to get some ideas):

```
Sub BubbleSort(List() As String)
'   Sorts the List array in ascending order
  Dim First As Long, Last As Long
  Dim i As Long, j As Long
  Dim Temp As String
  First = LBound(List)
  Last = UBound(List)
  For i = First To Last - 1
    For j = i + 1 To Last
      If List(i) > List(j) Then
        Temp = List(j)
        List(j) = List(i)
        List(i) = Temp
      End If
    Next j
  Next i
End Sub
```

This procedure accepts one argument: a one-dimensional array named `List`. An array passed to a procedure can be of any length. I used the `LBound` and `UBound` functions to assign the lower bound and upper bound of the array to the variables `First` and `Last`, respectively.

Here's a little temporary procedure that I used to test the `BubbleSort` procedure:

```
Sub SortTester()
  Dim x(1 To 5) As String
  Dim i As Long
  x(1) = "dog"
  x(2) = "cat"
  x(3) = "elephant"
  x(4) = "aardvark"
  x(5) = "bird"
  Call BubbleSort(x)
  For i = 1 To 5
    Debug.Print i, x(i)
  Next i
End Sub
```

The `SortTester` routine creates an array of five strings, passes the array to `BubbleSort`, and then displays the sorted array in the Immediate window. I eventually deleted this code because it served its purpose.

After I was satisfied that this procedure worked reliably, I modified `SortSheets` by adding a call to the `BubbleSort` procedure, passing the `SheetNames` array as an argument. At this point, my module looked like this:

```
Sub SortSheets()
    Dim SheetNames() As String
    Dim SheetCount as Long
    Dim i as Long
    SheetCount = ActiveWorkbook.Sheets.Count
    ReDim SheetNames(1 To SheetCount)
    For i = 1 To SheetCount
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    Next i
    Call BubbleSort(SheetNames)
End Sub

Sub BubbleSort(List() As String)
    ' Sorts the List array in ascending order
    Dim First As Long, Last As Long
    Dim i As Long, j As Long
    Dim Temp As String
    First = LBound(List)
    Last = UBound(List)
    For i = First To Last - 1
        For j = i + 1 To Last
            If List(i) > List(j) Then
                Temp = List(j)
                List(j) = List(i)
                List(i) = Temp
            End If
        Next j
    Next i
End Sub
```

When the `SheetSort` procedure ends, it contains an array that consists of the sorted sheet names in the active workbook. To verify this, you can display the array contents in the VBE Immediate window by adding the following code at the end of the `SortSheets` procedure (if the Immediate window is not visible, press Ctrl+G):

```
For i = 1 To SheetCount
    Debug.Print SheetNames(i)
Next i
```

So far, so good. Next step: Write some code to rearrange the sheets to correspond to the sorted items in the `SheetNames` array.

The code that I recorded earlier proved useful. Remember the instruction that was recorded when I moved a sheet to the first position in the workbook?

```
Sheets("Sheet3").Move Before:=Sheets(1)
```

After a little thought, I was able to write a `For-Next` loop that would go through each sheet and move it to its corresponding sheet location, specified in the `SheetNames` array:

```
For i = 1 To SheetCount
    Sheets(SheetNames(i)).Move Before:=Sheets(i)
Next i
```

For example, the first time through the loop, the loop counter `i` is 1. The first element in the `SheetNames` array is (in this example) `Sheet1`. Therefore, the expression for the `Move` method within the loop evaluates to

```
Sheets("Sheet1").Move Before:= Sheets(1)
```

The second time through the loop, the expression evaluates to

```
Sheets("Sheet2").Move Before:= Sheets(2)
```

I then added the new code to the `SortSheets` procedure:

```
Sub SortSheets()
    Dim SheetNames() As String
    Dim SheetCount as Long
    Dim i as Long
    SheetCount = ActiveWorkbook.Sheets.Count
    ReDim SheetNames(1 To SheetCount)
    For i = 1 To SheetCount
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    Next i
    Call BubbleSort(SheetNames)
    For i = 1 To SheetCount
        ActiveWorkbook.Sheets(SheetNames(i)).Move _
            Before:=ActiveWorkbook.Sheets(i)
    Next i
End Sub
```

I did some testing, and it seemed to work just fine for the `Test.xlsx` workbook.

Time to clean things up. I made sure that all the variables used in the procedures were declared, and then I added a few comments and blank lines to make the code easier to read. The `SortSheets` procedure looked like the following:

```
Sub SortSheets()  
' This routine sorts the sheets of the  
' active workbook in ascending order.  
' Use Ctrl+Shift+S to execute  
  
    Dim SheetNames() As String  
    Dim SheetCount As Long  
    Dim i As Long  
  
' Determine the number of sheets & ReDim array  
    SheetCount = ActiveWorkbook.Sheets.Count  
    ReDim SheetNames(1 To SheetCount)  
  
' Fill array with sheet names  
    For i = 1 To SheetCount  
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name  
    Next i  
  
' Sort the array in ascending order  
    Call BubbleSort(SheetNames)  
  
' Move the sheets  
    For i = 1 To SheetCount  
        ActiveWorkbook.Sheets(SheetNames(i)).Move _  
            Before:= ActiveWorkbook.Sheets(i)  
    Next i  
End Sub
```

Everything seemed to be working. To test the code further, I added a few more sheets to `Test.xlsx` and changed some of the sheet names. It worked like a charm.

More testing

I was tempted to call it a day. However, just because the procedure worked with the `Test.xlsx` workbook didn't mean that it would work with all workbooks. To test it further, I loaded a few other workbooks and retried the routine. I soon discovered that the application wasn't perfect. In fact, it was far from perfect. I identified the following problems:

- Workbooks with many sheets took a long time to sort because the screen was continually updated during the move operations.

- The sorting didn't always work. For example, in one of my tests, a sheet named `SUMMARY` (all uppercase) appeared before a sheet named `Sheet1`. This problem was caused by the `BubbleSort` procedure — an uppercase *U* is “greater than” a lowercase *h*.
- If Excel had no visible workbook windows, pressing the `Ctrl+Shift+S` shortcut key combo caused the macro to fail.
- If the workbook's structure was protected, the `Move` method failed.
- After sorting, the last sheet in the workbook became the active sheet. Changing the user's active sheet isn't a good practice; it's better to keep the user's original sheet active.
- If I interrupted the macro by pressing `Ctrl+Break`, VBA displayed an error message.
- The macro can't be reversed (that is, the `Undo` command is always disabled when a macro is executed). If the user accidentally presses `Ctrl+Shift+S`, the workbook sheets are sorted, and the only way to get them back to their original order is by doing it manually.

Fixing the problems

Fixing the screen-updating problem was a breeze. I inserted the following instruction to turn off screen updating while the sheets were being moved:

```
Application.ScreenUpdating = False
```

This statement causes Excel's windows to freeze while the macro is running. A beneficial side effect is that it also speeds up the macro considerably. After the macro completes its operation, screen updating is turned back on automatically.

It was also easy to fix the problem with the `BubbleSort` procedure: I used VBA's `UCase` function to convert the sheet names to uppercase for the comparison. This caused all the comparisons to be made by using uppercase versions of the sheet names. The corrected line read as follows:

```
If UCase(List(i)) > UCase(List(j)) Then
```



Tip

Another way to solve the “case” problem is to add the following statement to the top of your module:

```
Option Compare Text
```

This statement causes VBA to perform string comparisons based on a case-insensitive text sort order. In other words, *A* is considered the same as *a*.

To prevent the error message that appears when no workbooks are visible, I added some error checking. I used `On Error Resume Next` to ignore the error and then checked the value of `Err`. If `Err` is not equal to 0, it means that an error occurred. Therefore, the procedure ends. The error-checking code is

```
On Error Resume Next
SheetCount = ActiveWorkbook.Sheets.Count
If Err <> 0 Then Exit Sub ' No active workbook
```

It occurred to me that I could avoid using `On Error Resume Next`. The following statement is a more direct approach to determining whether a workbook isn't visible and doesn't require any error handling. This statement can go at the top of the `SortSheets` procedure:

```
If ActiveWorkbook Is Nothing Then Exit Sub
```

There's usually a good reason that a workbook's structure is protected. I decided that the best approach was to not attempt to unprotect the workbook. Rather, the code should display a message box warning and let the user unprotect the workbook and re-execute the macro. Testing for a protected workbook structure was easy — the `ProtectStructure` property of a `Workbook` object returns `True` if a workbook is protected. I added the following block of code:

```
' Check for protected workbook structure
If ActiveWorkbook.ProtectStructure Then
    MsgBox ActiveWorkbook.Name & " is protected.", _
        vbCritical, "Cannot Sort Sheets."
    Exit Sub
End If
```

If the workbook's structure is protected, the user sees a message box like the one shown in Figure 9-11.

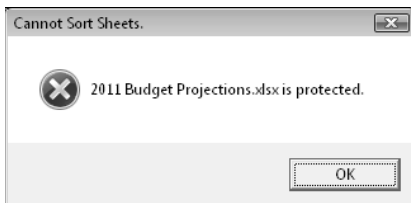


Figure 9-11: This message box tells the user that the sheets cannot be sorted.

To reactivate the original active sheet after the sorting was performed, I wrote code that assigned the original sheet to an object variable (`OldActiveSheet`) and then activated that sheet when the routine was finished. Here's the statement that assigns the variable:

```
Set OldActive = ActiveSheet
```

This statement activates the original active worksheet:

```
OldActive.Activate
```

Pressing Ctrl+Break normally halts a macro, and VBA usually displays an error message. But because one of my goals was to avoid VBA error messages, I inserted a command to prevent this situation. From the VBA Help system, I discovered that the `Application` object has an `EnableCancelKey` property that can disable Ctrl+Break. So I added the following statement at the top of the routine:

```
Application.EnableCancelKey = xlDisabled
```



Caution

Be very careful when you disable the Cancel key. If your code gets caught in an infinite loop, you can't break out of it. For best results, insert this statement *only after you're sure* that everything is working properly.

To prevent the problem of accidentally sorting the sheets, I added the following statement to the procedure, before the Ctrl+Break key is disabled:

```
If MsgBox("Sort the sheets in the active workbook?", _  
vbQuestion + vbYesNo) <> vbYes Then Exit Sub
```

When the user executes the `SortSheets` procedure, he sees the message box in Figure 9-12.

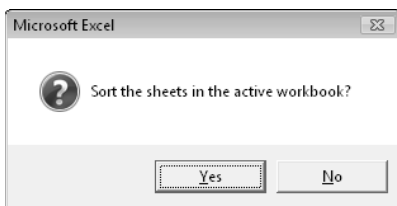


Figure 9-12: This message box appears before the sheets are sorted.

After I made all these corrections, the `SortSheets` procedure looked like this:

```
Option Explicit
Sub SortSheets()
'   This routine sorts the sheets of the
'   active workbook in ascending order.
'   Use Ctrl+Shift+S to execute

    Dim SheetNames() As String
    Dim i As Long
    Dim SheetCount As Long
    Dim OldActiveSheet As Object

    If ActiveWorkbook Is Nothing Then Exit Sub ' No active workbook
    SheetCount = ActiveWorkbook.Sheets.Count

'   Check for protected workbook structure
    If ActiveWorkbook.ProtectStructure Then
        MsgBox ActiveWorkbook.Name & " is protected.", _
            vbCritical, "Cannot Sort Sheets."
        Exit Sub
    End If

'   Make user verify
    If MsgBox("Sort the sheets in the active workbook?", _
        vbQuestion + vbYesNo) <> vbYes Then Exit Sub

'   Disable Ctrl+Break
    Application.EnableCancelKey = xlDisabled

'   Get the number of sheets
    SheetCount = ActiveWorkbook.Sheets.Count

'   Redimension the array
    ReDim SheetNames(1 To SheetCount)

'   Store a reference to the active sheet
    Set OldActiveSheet = ActiveSheet

'   Fill array with sheet names
    For i = 1 To SheetCount
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    Next i

'   Sort the array in ascending order
    Call BubbleSort(SheetNames)

'   Turn off screen updating
    Application.ScreenUpdating = False
```

```
' Move the sheets
For i = 1 To SheetCount
    ActiveWorkbook.Sheets(SheetNames(i)).Move _
        Before:=ActiveWorkbook.Sheets(i)
Next i
' Reactivate the original active sheet
OldActiveSheet.Activate
End Sub
```

Utility availability

Because the `SortSheets` macro is stored in the Personal Macro Workbook, it's available whenever Excel is running. At this point, you can execute the macro by selecting the macro's name from the Macro dialog box (Alt+F8 displays this dialog box) or by pressing Ctrl+Shift+S. Another option is to add a command to the Ribbon.

To add a command, follow these steps:

1. Right-click any area of the Ribbon and choose *Customize the Ribbon*.
2. In the *Customize Ribbon* tab of the Excel Options dialog box, choose *Macros* from the drop-down list labeled *Choose Commands From*.
3. Click the item labeled `PERSONAL.XLSB!SortSheets`.
4. Use the controls in the box on the right to specify the ribbon tab and create a new group.
(You can't add a command to an existing group.)

I created a group named *Worksheets* in the *View* tab, and renamed the new item to *Short Sheets* (see Figure 9-13).

Evaluating the project

So there you have it. The utility meets all the original project requirements: It sorts all sheets in the active workbook, it can be executed easily, it's always available, it seems to work for any workbook, and I have yet to see it display a VBA error message.



Note

The procedure still has one slight problem: The sorting is strict and may not always be “logical.” For example, after sorting, `Sheet10` is placed before `Sheet2`. Most would want `Sheet2` to be listed before `Sheet10`. Solving that problem is the beyond the scope of this introductory exercise.

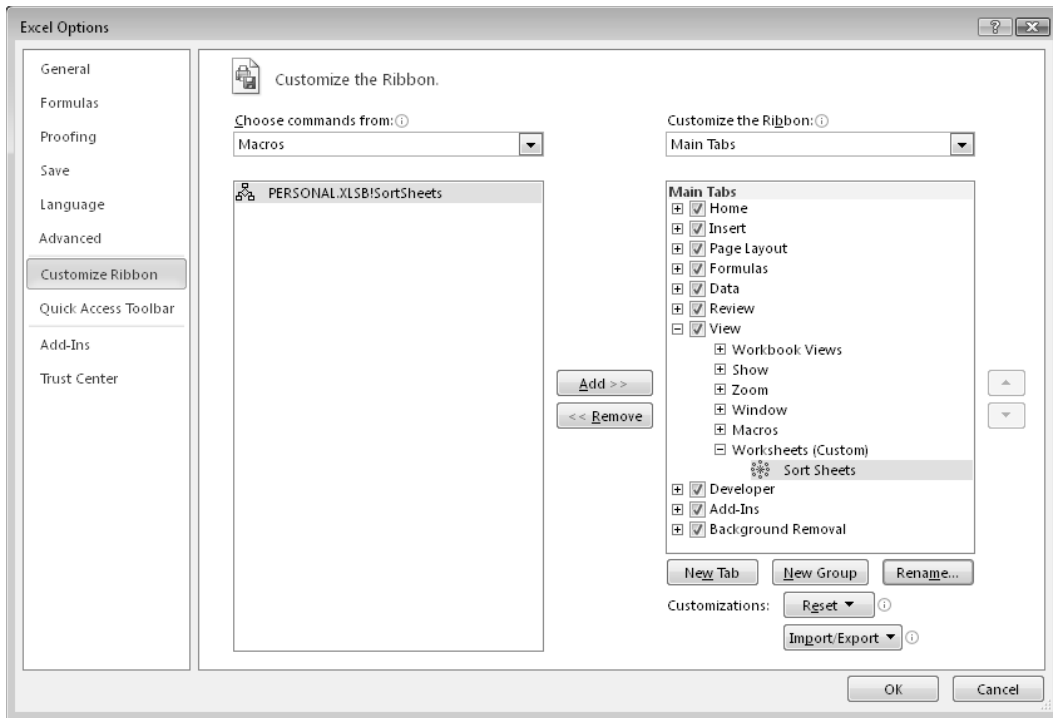


Figure 9-13: Adding a new command to the ribbon.

Creating Function Procedures

In This Chapter

- Understanding the difference between `Sub` procedures and `Function` procedures
- Creating custom functions
- Looking at `Function` procedures and function arguments
- Creating a function that emulates Excel's `SUM` function
- Using functions that enable you to work with pre-1900 dates in your worksheets
- Debugging functions, dealing with the Insert Function dialog box, and using add-ins to store custom functions
- Calling the Windows Application Programming Interface (API) to perform otherwise impossible feats

Sub Procedures versus Function Procedures

A *function* is a VBA procedure that performs calculations and returns a value. You can use these functions in your Visual Basic for Applications (VBA) code or in formulas.

VBA enables you to create `Sub` procedures and `Function` procedures. You can think of a `Sub` procedure as a command that either the user or another procedure can execute. `Function` procedures, on the other hand, usually return a single value (or an array), just like Excel worksheet functions and VBA built-in functions. As with built-in functions, your `Function` procedures can use arguments.

`Function` procedures are quite versatile, and you can use them in two situations:

- As part of an expression in a VBA procedure
- In formulas that you create in a worksheet

In fact, you can use a `Function` procedure anywhere that you can use an Excel worksheet function or a VBA built-in function. As far as I know, the only exception is that you can't use a VBA function in a data validation formula.

I cover `Sub` procedures in the preceding chapter, and in this chapter, I discuss `Function` procedures.



Cross-Ref

Chapter 11 has many useful and practical examples of `Function` procedures. You can incorporate many of these techniques into your work.

Why Create Custom Functions?

You're undoubtedly familiar with Excel worksheet functions; even novices know how to use the most common worksheet functions, such as `SUM`, `AVERAGE`, and `IF`. Excel 2010 includes more than 400 predefined worksheet functions that you can use in formulas. If that's not enough, however, you can create custom functions by using VBA.

With all the functions available in Excel and VBA, you might wonder why you'd ever need to create new functions. The answer: to simplify your work. With a bit of planning, custom functions are very useful in worksheet formulas and VBA procedures.

Often, for example, you can create a custom function that can significantly shorten your formulas. And shorter formulas are more readable and easier to work with. I should also point out, however, that custom functions used in your formulas are usually much slower than built-in functions. And, of course, the user must enable macros in order to use these functions.

When you create applications, you may notice that some procedures repeat certain calculations. In such cases, consider creating a custom function that performs the calculation. Then you can simply call the function from your procedure. A custom function can eliminate the need for duplicated code, thus reducing errors.

Also, coworkers often can benefit from your specialized functions. And some may be willing to pay you to create custom functions that save them time and work.

Although many cringe at the thought of creating custom worksheet functions, the process isn't difficult. In fact, I *enjoy* creating custom functions. I especially like how my custom functions appear in the Insert Function dialog box along with Excel built-in functions, as if I'm re-engineering the software in some way.

In this chapter, I tell you what you need to know to start creating custom functions, and I provide lots of examples.

An Introductory Function Example

Without further ado, this section presents an example of a VBA `Function` procedure.

The following is a custom function defined in a VBA module. This function, named `RemoveVowels`, uses a single argument. The function returns the argument, but with all the vowels removed.

```
Function RemoveVowels(Txt) As String
' Removes all vowels from the Txt argument
  Dim i As Long
  RemoveVowels = ""
  For i = 1 To Len(Txt)
    If Not UCase(Mid(Txt, i, 1)) Like "[AEIOU]" Then
      RemoveVowels = RemoveVowels & Mid(Txt, i, 1)
    End If
  Next i
End Function
```

This function certainly isn't the most useful one I've written, but it demonstrates some key concepts related to functions. I explain how this function works later, in the "Analyzing the custom function" section.



Caution

When you create custom functions that will be used in a worksheet formula, make sure that the code resides in a normal VBA module. If you place your custom functions in a code module for a UserForm, a Sheet, or ThisWorkbook, they won't work in your formulas. Your formulas will return a #NAME? error.

Using the function in a worksheet

When you enter a formula that uses the `RemoveVowels` function, Excel executes the code to get the value. Here's an example of how you'd use the function in a formula:

```
=RemoveVowels(A1)
```

See Figure 10-1 for examples of this function in action. The formulas are in column B, and they use the text in column A as their arguments. As you can see, the function returns the single argument, but with the vowels removed.

Actually, the function works pretty much like any built-in worksheet function. You can insert it in a formula by choosing **Formulas**→**Function Library**→**Insert Function** or by clicking the **Insert Function Wizard** icon to the left of the formula bar. Either of these actions displays the **Insert Function** dialog box. In the **Insert Function** dialog box, your custom functions are located, by default, in the **User Defined** category.

You can also nest custom functions and combine them with other elements in your formulas. For example, the following formula nests the `RemoveVowels` function inside Excel's `UPPER` function. The result is the original string (sans vowels), converted to uppercase.

```
=UPPER (RemoveVowels (A1) )
```

	A	B
1	Every good boy does fine.	vry gd by ds fn.
2	antidisestablishmentarianism	ntdsstblshmntnsm
3	Microsoft Excel	Mcrsft xcl
4	abcdefghijklmnopqrstuvwxyz	bcd fghjklmnpqrstvwxyz
5	A failure to communicate.	flr t cmmnct.
6	This sentence has no vowels.	Ths sntnc hs n vwls.
7		
8		
9		

Figure 10-1: Using a custom function in a worksheet formula.

Using the function in a VBA procedure

In addition to using custom functions in worksheet formulas, you can use them in other VBA procedures. The following VBA procedure, which is defined in the same module as the custom `RemoveVowels` function, first displays an input box to solicit text from the user. Then the procedure uses the VBA built-in `MsgBox` function to display the user input after the `RemoveVowels` function processes it (see Figure 10-2). The original input appears as the caption in the message box.

```
Sub ZapTheVowels()
    Dim UserInput as String
    UserInput = InputBox("Enter some text:")
    MsgBox RemoveVowels(UserInput), vbInformation, UserInput
End Sub
```

In the example shown in Figure 10-2, the string entered in response to the `InputBox` function was `Excel 2010 Power Programming With VBA`. The `MsgBox` function displays the text without vowels.

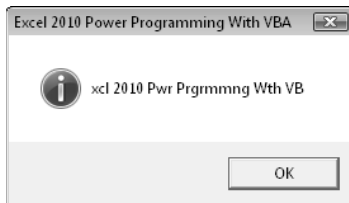


Figure 10-2: Using a custom function in a VBA procedure.

Analyzing the custom function

Function procedures can be as complex as you need them to be. Most of the time, they're more complex and much more useful than this sample procedure. Nonetheless, an analysis of this example may help you understand what is happening.

Here's the code, again:

```
Function RemoveVowels(Txt) As String
' Removes all vowels from the Txt argument
Dim i As Long
RemoveVowels = ""
For i = 1 To Len(Txt)
    If Not UCase(Mid(Txt, i, 1)) Like "[AEIOU]" Then
        RemoveVowels = RemoveVowels & Mid(Txt, i, 1)
    End If
Next i
End Function
```

Notice that the procedure starts with the keyword `Function`, rather than `Sub`, followed by the name of the function (`RemoveVowels`). This custom function uses only one argument (`Txt`), enclosed in parentheses. `As String` defines the data type of the function's return value. Excel uses the `Variant` data type if no data type is specified.

The second line is an optional comment that describes what the function does. This line is followed by a `Dim` statement, which declares the variable (`i`) used in the procedure as type `Long`.



Note

Notice that I use the function name as a variable here. When a function ends, it always returns the current value of the variable that corresponds to the function's name.

The next five instructions make up a `For-Next` loop. The procedure loops through each character in the input and builds the string. The first instruction within the loop uses VBA's `Mid` function to return a single character from the input string and converts this character to uppercase. That character is then compared to a list of characters by using VBA's `Like` operator. In other words, the `If` clause is true if the character isn't A, E, I, O, or U. In such a case, the character is appended to the `RemoveVowels` variable.

When the loop is finished, `RemoveVowels` consists of the input string with all the vowels removed. This string is the value that the function returns.

The procedure ends with an `End Function` statement.

Keep in mind that you can do the coding for this function in a number of different ways. Here's a function that accomplishes the same result but is coded differently:

```
Function RemoveVowels(txt) As String
' Removes all vowels from the Txt argument
Dim i As Long
```

```

Dim TempString As String
TempString = ""
For i = 1 To Len(txt)
    Select Case ucase(Mid(txt, i, 1))
        Case "A", "E", "I", "O", "U"
            'Do nothing
        Case Else
            TempString = TempString & Mid(txt, i, 1)
    End Select
Next i
RemoveVowels = TempString
End Function

```

In this version, I used a string variable (`TempString`) to store the vowel-less string as it's being constructed. Then, before the procedure ends, I assigned the contents of `TempString` to the function's name. This version also uses a `Select Case` construct rather than an `If-Then` construct.



On the CD

Both versions of this function are available on the companion CD-ROM. The file is named `remove_vowels.xlsm`.



What custom worksheet functions can't do

When you develop custom functions, it's important to understand a key distinction between functions that you call from other VBA procedures and functions that you use in worksheet formulas. Function procedures used in worksheet formulas must be passive. For example, code within a `Function` procedure can't manipulate ranges or change things on the worksheet. An example can help make this limitation clear.

You may be tempted to write a custom worksheet function that changes a cell's formatting. For example, it may be useful to have a formula that uses a custom function to change the color of text in a cell based on the cell's value. Try as you might, however, such a function is impossible to write. No matter what you do, the function won't change the worksheet. Remember, a function simply returns a value. It can't perform actions with objects.

That said, I should point out one notable exception. You can change the text in a cell *comment* by using a custom VBA function. I'm not sure if this behavior is intentional, or if it's a bug in Excel. In any case, modifying a comment via a function seems to work reliably. Here's the function:

```

Function ModifyComment(Cell As Range, Cmt As String)
    Cell.Comment.Text Cmt
End Function

```

Here's an example of using this function in a formula. The formula replaces the comment in cell A1 with new text. The function won't work if cell A1 doesn't have a comment.

```
=ModifyComment(A1,"Hey, I changed your comment")
```

Function Procedures

A custom `Function` procedure has much in common with a `Sub` procedure. (For more information on `Sub` procedures, see Chapter 9.)

The syntax for declaring a function is as follows:

```
[Public | Private][Static] Function name ([arglist])[As type]
    [instructions]
    [name = expression]
    [Exit Function]
    [instructions]
    [name = expression]
End Function
```

The `Function` procedure contains the following elements:

- **Public:** (Optional) Indicates that the `Function` procedure is accessible to all other procedures in all other modules in all active Excel VBA projects.
- **Private:** (Optional) Indicates that the `Function` procedure is accessible only to other procedures in the same module.
- **Static:** (Optional) Indicates that the values of variables declared in the `Function` procedure are preserved between calls.
- **Function:** (Required) Indicates the beginning of a procedure that returns a value or other data.
- **name:** (Required) Represents any valid `Function` procedure name, which must follow the same rules as a variable name.
- **arglist:** (Optional) Represents a list of one or more variables that represent arguments passed to the `Function` procedure. The arguments are enclosed in parentheses. Use a comma to separate pairs of arguments.
- **type:** (Optional) Is the data type returned by the `Function` procedure.
- **instructions:** (Optional) Are any number of valid VBA instructions.
- **Exit Function:** (Optional) Is a statement that forces an immediate exit from the `Function` procedure prior to its completion.
- **End Function:** (Required) Is a keyword that indicates the end of the `Function` procedure.

A key point to remember about a custom function written in VBA is that a value is always assigned to the function's name a minimum of one time, generally when it has completed execution.

To create a custom function, start by inserting a VBA module. You can use an existing module, as long as it's a normal VBA module. Enter the keyword `Function`, followed by the function name and a list of its arguments (if any) in parentheses. You can also declare the data type of the return value by using the `As` keyword (this is optional, but recommended). Insert the VBA code that performs the work, making sure that the appropriate value is assigned to the term corresponding to the function name at least once within the body of the `Function` procedure. End the function with an `End Function` statement.

Function names must adhere to the same rules as variable names. If you plan to use your custom function in a worksheet formula, be careful if the function name is also a cell address. For example, if you use something like `J21` as a function name, you can't use the function in a worksheet formula.

The best advice is to avoid using function names that are also cell references, including named ranges. And, avoid using function names that correspond to Excel's built-in function names. In the case of a function name conflict, Excel always uses its built-in function.

A function's scope

In Chapter 9, I discuss the concept of a procedure's scope (public or private). The same discussion applies to functions: A function's scope determines whether it can be called by procedures in other modules or in worksheets.

Here are a few things to keep in mind about a function's scope:

- If you don't declare a function's scope, its default is `Public`.
- Functions declared `As Private` don't appear in Excel's Insert Function dialog box. Therefore, when you create a function that should be used only in a VBA procedure, you should declare it `Private` so that users don't try to use it in a formula.
- If your VBA code needs to call a function that's defined in another workbook, set up a reference to the other workbook by choosing the Visual Basic Editor (VBE) **Tools**→**References** command.

Executing function procedures

Although you can execute a `Sub` procedure in many ways, you can execute a `Function` procedure in only four ways:

- Call it from another procedure.
- Use it in a worksheet formula.
- Use it in a formula that's used to specify conditional formatting.
- Call it from the VBE Immediate window.

From a procedure

You can call custom functions from a VBA procedure the same way that you call built-in functions. For example, after you define a function called `SumArray`, you can enter a statement like the following:

```
Total = SumArray(MyArray)
```

This statement executes the `SumArray` function with `MyArray` as its argument, returns the function's result, and assigns it to the `Total` variable.

You also can use the `Run` method of the `Application` object. Here's an example:

```
Total = Application.Run ("SumArray", "MyArray")
```

The first argument for the `Run` method is the function name. Subsequent arguments represent the argument(s) for the function. The arguments for the `Run` method can be literal strings (as shown above), numbers, or variables.

In a worksheet formula

Using custom functions in a worksheet formula is like using built-in functions except that you must ensure that Excel can locate the `Function` procedure. If the `Function` procedure is in the same workbook, you don't have to do anything special. If it's in a different workbook, you may have to tell Excel where to find it.

You can do so in three ways:

- **Precede the function name with a file reference.** For example, if you want to use a function called `CountNames` that's defined in an open workbook named `Myfuncs.xlsm`, you can use the following reference:

```
=Myfuncs.xlsm!CountNames(A1:A1000)
```

If you insert the function with the `Insert Function` dialog box, the workbook reference is inserted automatically.

- **Set up a reference to the workbook.** You do so by choosing the `VBE Tools` → `References` command. If the function is defined in a referenced workbook, you don't need to use the worksheet name. Even when the dependent workbook is assigned as a reference, the `Paste Function` dialog box continues to insert the workbook reference (although it's not necessary).
- **Create an add-in.** When you create an add-in from a workbook that has `Function` procedures, you don't need to use the file reference when you use one of the functions in a formula. The add-in must be installed, however. I discuss add-ins in Chapter 21.

You'll notice that unlike `Sub` procedures, your `Function` procedures don't appear in the Macro dialog box when you issue the `Developer→Code→Macros` command. In addition, you can't choose a function when you issue the `VBE Run→Sub/UserForm` command (or press F5) if the cursor is located in a `Function` procedure. (You get the Macro dialog box that lets you choose a macro to run.) As a result, you need to do a bit of extra up-front work to test your functions while you're developing them. One approach is to set up a simple procedure that calls the function. If the function is designed to be used in worksheet formulas, you'll want to enter a simple formula to test it.

In a conditional formatting formula

When you specify conditional formatting, one of the options is to create a formula. The formula must be a logical formula (that is, it must return either `TRUE` or `FALSE`). If the formula returns `TRUE`, the condition is met, and formatting is applied to the cell.

You can use custom VBA functions in your conditional formatting formulas. For example, here's a simple VBA function that returns `TRUE` if its argument is a cell that contains a formula:

```
Function CELLHASFORMULA(cell) As Boolean
    CELLHASFORMULA = cell.HasFormula
End Function
```

After defining this function in a VBA module, you can set up a conditional formatting rule so that cells that contain a formula contain different formatting:

1. Select the range that will contain the conditional formatting.
For example, select A1:G20.
2. Choose `Home→Styles→Conditional Formatting→New Rule`.
3. In the New Formatting Rule dialog box, select the option labeled `Use a Formula to Determine Which Cells to Format`.
4. Enter this formula in the formula box — but make sure that the cell reference argument corresponds to the upper-left cell in the range that you selected in Step 1:

```
=CELLHASFORMULA (A1)
```

5. Click the `Format` button to specify the formatting for cells that meet this condition.
6. Click `OK` to apply the conditional formatting rule to the selected range.

Cells in the range that contain a formula will display the formatting you specified. Figure 10-3 shows the New Formatting Rule dialog box, specifying a custom function in a formula.

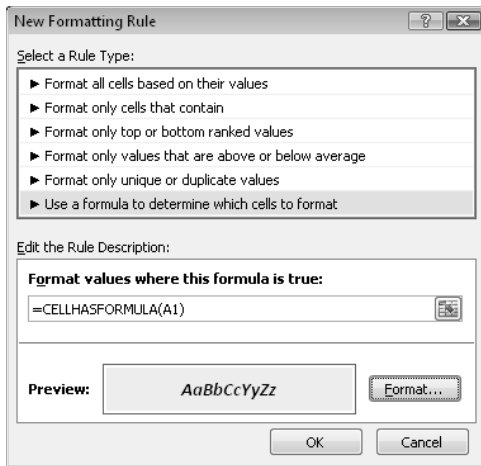


Figure 10-3: Using a custom VBA function for conditional formatting.

From the VBE Immediate Window

The final way to call a `Function` procedure is from the VBE Immediate window. This method is generally used only for testing purposes. Figure 10-4 shows an example.

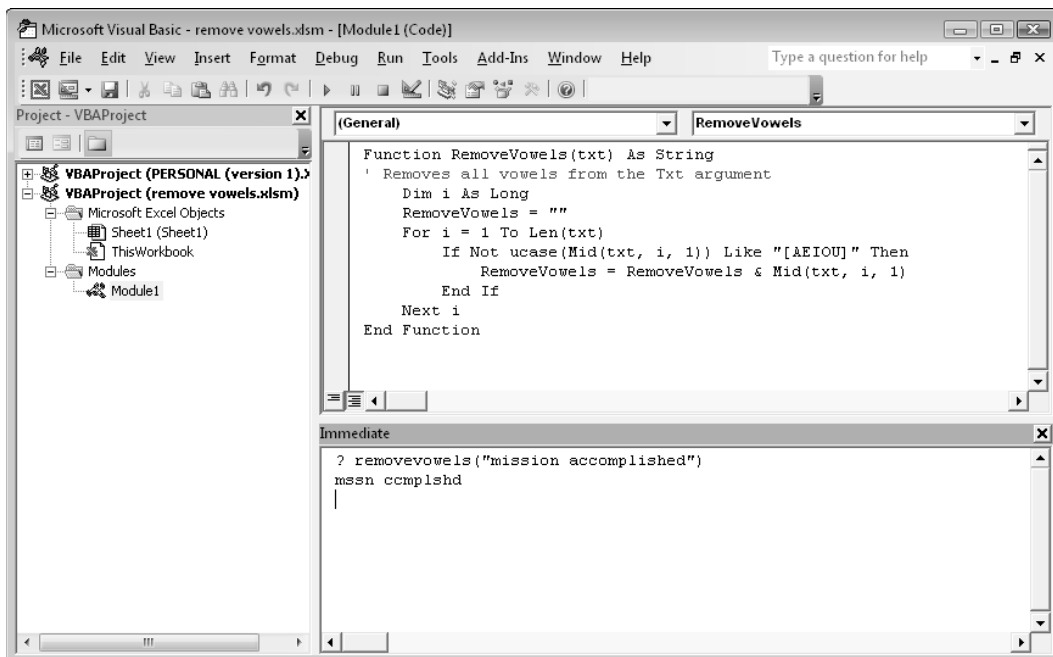


Figure 10-4: Calling a `Function` procedure from the Immediate window.

Function Arguments

Keep in mind the following points about Function procedure arguments:

- Arguments can be variables (including arrays), constants, literals, or expressions.
- Some functions don't have arguments.
- Some functions have a fixed number of required arguments (from 1 to 60).
- Some functions have a combination of required and optional arguments.



Reinventing the wheel

Just for fun, I wrote my own version of Excel's UPPER function (which converts a string to all uppercase) and named it UpCase:

```
Function UpCase(InString As String) As String
'   Converts its argument to all uppercase.
    Dim StringLength As Integer
    Dim i As Integer
    Dim ASCIIVal As Integer
    Dim CharVal As Integer

    StringLength = Len(InString)
    UpCase = InString
    For i = 1 To StringLength
        ASCIIVal = Asc(Mid(InString, i, 1))
        CharVal = 0
        If ASCIIVal >= 97 And ASCIIVal <= 122 Then
            CharVal = -32
            Mid(UpCase, i, 1) = Chr(ASCIIVal + CharVal)
        End If
    Next i
End Function
```

Note: A workbook that contains this function is on the companion CD-ROM in a file named `upper case.xlsm`.

Notice that I resisted the urge to take the easy route — using the VBA `UCase` function.

I was curious to see how the custom function differed from the built-in function, so I created a worksheet that called the function 20,000 times, using random names. The worksheet took about 20 seconds to calculate. I then substituted Excel's UPPER function and ran the test again. The recalculation time was virtually instantaneous. I don't claim that my `UpCase` function is the optimal algorithm for this task, but it's safe to say that a custom function will never match the speed of Excel's built-in functions.

For another example of reinventing the wheel, see “Emulating Excel's SUM Function,” later in this chapter.

**Note**

If your formula uses a custom worksheet function and it returns #VALUE!, your function has an error. The error may be caused by logical errors in your code or by passing incorrect arguments to the function. See “Debugging Functions,” later in this chapter.

Function Examples

In this section, I present a series of examples that demonstrate how to use arguments effectively with functions. By the way, this discussion also applies to `Sub` procedures.

Functions with no argument

Like `Sub` procedures, `Function` procedures need not have arguments. Excel, for example, has a few built-in functions that don’t use arguments, including `RAND`, `TODAY`, and `NOW`. You can create similar functions.

This section contains examples of functions that don’t use an argument.

**On the CD**

A workbook that contains these functions is available on the companion CD-ROM. The file is named `no argument.xlsm`.

Here’s a simple example of a function that doesn’t use an argument. The following function returns the `UserName` property of the `Application` object. This name appears in the Excel Options dialog box (General tab) and is stored in the Windows Registry.

```
Function User()  
    ' Returns the name of the current user  
    User = Application.UserName  
End Function
```

When you enter the following formula, the cell returns the name of the current user (assuming that it’s listed properly in the Registry):

```
=User()
```

**Note**

When you use a function with no arguments in a worksheet formula, you must include a set of empty parentheses. This requirement isn’t necessary if you call the function in a VBA procedure, although including the empty parentheses does make it clear that you’re calling a function.

To use this function in another procedure, you can assign it to a variable, use it in an expression, or use it as an argument for another function.

The following example calls the `User` function and uses the return value as an argument for the `MsgBox` statement. The concatenation operator (&) joins the literal string with the result of the `User` function.

```
Sub ShowUser()  
    MsgBox "Your name is " & User()  
End Sub
```

The `User` function demonstrates how you can create a *wrapper* function that simply returns a property or the result of a VBA function. Following are three additional wrapper functions that take no argument:

```
Function ExcelDir() As String  
    ' Returns the directory in which Excel is installed  
    ExcelDir = Application.Path  
End Function  
  
Function SheetCount()  
    ' Returns the number of sheets in the workbook  
    SheetCount = Application.Caller.Parent.Parent.Sheets.Count  
End Function  
  
Function SheetName()  
    ' Returns the name of the worksheet  
    SheetName = Application.Caller.Parent.Name  
End Function
```

Here's another example of a function that doesn't take an argument. I used to use Excel's `RAND` function to quickly fill a range of cells with values. But I didn't like the fact that the random numbers changed whenever the worksheet was recalculated. So I remedied this issue by converting the formulas to values.

Then I realized that I could create a custom function that returned random numbers that didn't change. I used the VBA built-in `Rnd` function, which returns a random number between 0 and 1. The custom function is as follows:

```
Function StaticRand()  
    ' Returns a random number that doesn't  
    ' change when recalculated  
    StaticRand = Rnd()  
End Function
```

If you want to generate a series of random integers between 0 and 1,000, you can use a formula such as this:

```
=INT(StaticRand()*1000)
```



Controlling function recalculation

When you use a custom function in a worksheet formula, when is it recalculated?

Custom functions behave like Excel's built-in worksheet functions. Normally, a custom function is recalculated only when it needs to be — which is only when any of the function's arguments are modified. You can, however, force functions to recalculate more frequently. Adding the following statement to a `Function` procedure makes the function recalculate whenever the sheet is recalculated. If you're using automatic calculation mode, a calculation occurs whenever any cell is changed.

```
Application.Volatile True
```

The `Volatile` method of the `Application` object has one argument (either `True` or `False`). Marking a `Function` procedure as volatile forces the function to be calculated whenever recalculation occurs for any cell in the worksheet.

For example, the custom `StaticRand` function can be changed to emulate Excel's `RAND` function using the `Volatile` method:

```
Function NonStaticRand()  
' Returns a random number that  
' changes with each calculation  
Application.Volatile True  
NonStaticRand = Rnd()  
End Function
```

Using the `False` argument of the `Volatile` method causes the function to be recalculated only when one or more of its arguments change as a result of a recalculation. (If a function has no arguments, this method has no effect.)

To force an entire recalculation, including nonvolatile custom functions, press `Ctrl+Alt+F9`. This key combination will, for example, generate new random numbers for the `StaticRand` function presented in this chapter.

The values produced by this formula never change when the worksheet is calculated normally. However, you can force the formula to recalculate by pressing `Ctrl+Alt+F9`.

A function with one argument

This section describes a function for sales managers who need to calculate the commissions earned by their sales forces. The calculations in this example are based on the following table:

Monthly Sales	Commission Rate
0-\$9,999	8.0%
\$10,000-\$19,999	10.5%
\$20,000-\$39,999	12.0%
\$40,000+	14.0%

Note that the commission rate is nonlinear and also depends on the month's total sales. Employees who sell more earn a higher commission rate.

You can calculate commissions for various sales amounts entered into a worksheet in several ways. If you're not thinking too clearly, you can waste lots of time and come up with a lengthy formula such as this one:

```
=IF (AND (A1>=0, A1<=9999.99) , A1*0.08,
    IF (AND (A1>=10000, A1<=19999.99) , A1*0.105,
    IF (AND (A1>=20000, A1<=39999.99) , A1*0.12,
    IF (A1>=40000, A1*0.14, 0) ) ) )
```

This approach is bad for a couple of reasons. First, the formula is overly complex, making it difficult to understand. Second, the values are hard-coded into the formula, making the formula difficult to modify.

A better (non-VBA) approach is to use a lookup table function to compute the commissions. For example, the following formula uses `VLOOKUP` to retrieve the commission value from a range named `Table` and multiplies that value by the value in cell `A1`.

```
=VLOOKUP(A1,Table,2)*A1
```

Yet another approach (which eliminates the need to use a lookup table) is to create a custom function such as the following:

```
Function Commission(Sales)
    Const Tier1 = 0.08
    Const Tier2 = 0.105
    Const Tier3 = 0.12
    Const Tier4 = 0.14
    ' Calculates sales commissions
    Select Case Sales
        Case 0 To 9999.99: Commission = Sales * Tier1
        Case 1000 To 19999.99: Commission = Sales * Tier2
        Case 20000 To 39999.99: Commission = Sales * Tier3
        Case Is >= 40000: Commission = Sales * Tier4
    End Select
End Function
```

After you enter this function in a VBA module, you can use it in a worksheet formula or call the function from other VBA procedures.

Entering the following formula into a cell produces a result of 3,000; the amount — 25,000 — qualifies for a commission rate of 12 percent:

```
=Commission(25000)
```

Even if you don't need custom functions in a worksheet, creating Function procedures can make your VBA coding much simpler. For example, if your VBA procedure calculates sales commissions, you can use the exact same function and call it from a VBA procedure. Here's a tiny procedure that asks the user for a sales amount and then uses the `Commission` function to calculate the commission due:

```
Sub CalcComm()  
    Dim Sales as Long  
    Sales = InputBox("Enter Sales:")  
    MsgBox "The commission is " & Commission(Sales)  
End Sub
```

The `CalcComm` procedure starts by displaying an input box that asks for the sales amount. Then it displays a message box with the calculated sales commission for that amount.

This Sub procedure works, but it's rather crude. Following is an enhanced version that displays formatted values and keeps looping until the user clicks No (see Figure 10-5).

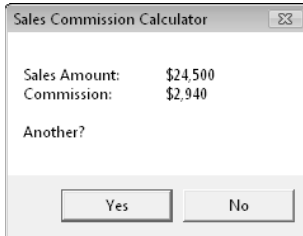


Figure 10-5: Using a function to display the result of a calculation.

```
Sub CalcComm()  
    Dim Sales As Long  
    Dim Msg As String, Ans As String  
  
    ' Prompt for sales amount  
    Sales = Val(InputBox("Enter Sales:", _  
        "Sales Commission Calculator"))  
  
    ' Build the Message  
    Msg = "Sales Amount:" & vbTab & Format(Sales, "$#,##0.00")  
    Msg = Msg & vbCrLf & "Commission:" & vbTab  
    Msg = Msg & Format(Commission(Sales), "$#,##0.00")  
    Msg = Msg & vbCrLf & vbCrLf & "Another?"  
  
    ' Display the result and prompt for another  
    Ans = MsgBox(Msg, vbYesNo, "Sales Commission Calculator")  
    If Ans = vbYes Then CalcComm  
End Sub
```



Use arguments, not cell references

All ranges that are used in a custom function should be passed as arguments. Consider the following function, which returns the value in A1, multiplied by 2:

```
Function DoubleCell()  
    DoubleCell = Range("A1") * 2  
End Function
```

Although this function works, at times, it may return an incorrect result. Excel's calculation engine can't account for ranges in your code that aren't passed as arguments. Therefore, in some cases, all precedents may not be calculated before the function's value is returned. The `DoubleCell` function should be written as follows, with A1 passed as the argument:

```
Function DoubleCell(cell)  
    DoubleCell = cell * 2  
End Function
```

This function uses two VBA built-in constants: `vbTab` represents a tab (to space the output), and `vbCrLf` specifies a carriage return and line feed (to skip to the next line). VBA's `Format` function displays a value in a specified format (in this case, with a dollar sign, comma, and two decimal places).

In both of these examples, the `Commission` function must be available in the active workbook; otherwise, Excel displays an error message saying that the function isn't defined.

A function with two arguments

Imagine that the aforementioned hypothetical sales managers implement a new policy to help reduce turnover: The total commission paid is increased by 1 percent for every year that the salesperson has been with the company.

I modified the custom `Commission` function (defined in the preceding section) so that it takes two arguments. The new argument represents the number of years. Call this new function `Commission2`:

```
Function Commission2(Sales, Years)  
'    Calculates sales commissions based on  
'    years in service  
    Const Tier1 = 0.08  
    Const Tier2 = 0.105  
    Const Tier3 = 0.12  
    Const Tier4 = 0.14  
    Select Case Years  
        Case 0 To 9999.99: Commission2 = Sales * Tier1  
        Case 1000 To 19999.99: Commission2 = Sales * Tier2
```



```
Case 20000 To 39999.99: Commission2 = Sales * Tier3
Case Is >= 40000: Commission2 = Sales * Tier4
End Select
Commission2 = Commission2 + (Commission2 * Years / 100)
End Function
```

Pretty simple, eh? I just added the second argument (*Years*) to the `Function` statement and included an additional computation that adjusts the commission.

Here's an example of how you can write a formula using this function (it assumes that the sales amount is in cell A1 and the number of years the salesperson has worked is in cell B1):

```
=Commission2(A1,B1)
```



On the CD

All these commission-related procedures are available on the companion CD-ROM in a file named `commission functions.xlsm`.

A function with an array argument

A `Function` procedure also can accept one or more arrays as arguments, process the array(s), and return a single value. The array can also consist of a range of cells.

The following function accepts an array as its argument and returns the sum of its elements:

```
Function SumArray(List) As Double
    Dim Item As Variant
    SumArray = 0
    For Each Item In List
        If WorksheetFunction.IsNumber(Item) Then _
            SumArray = SumArray + Item
    Next Item
End Function
```

Excel's `ISNUMBER` function checks to see whether each element is a number before adding it to the total. Adding this simple error-checking statement eliminates the type-mismatch error that occurs when you try to perform arithmetic with something other than a number.

The following procedure demonstrates how to call this function from a `Sub` procedure. The `MakeList` procedure creates a 100-element array and assigns a random number to each element. Then the `MsgBox` function displays the sum of the values in the array by calling the `SumArray` function.

```
Sub MakeList()  
    Dim Nums(1 To 100) As Double  
    Dim i as Integer  
    For i = 1 To 100  
        Nums(i) = Rnd * 1000  
    Next i  
    MsgBox SumArray(Nums)  
End Sub
```

Notice that the `SumArray` function doesn't declare the data type of its argument (it's a variant). Because it's not declared as a specific numeric type, the function also works in your worksheet formulas in which the argument is a `Range` object. For example, the following formula returns the sum of the values in A1:C10:

```
=SumArray(A1:C10)
```

You might notice that, when used in a worksheet formula, the `SumArray` function works very much like Excel's `SUM` function. One difference, however, is that `SumArray` doesn't accept multiple arguments. Understand that this example is for educational purposes only. Using the `SumArray` function in a formula offers absolutely no advantages over the Excel `SUM` function.



On the CD

This example, named `array argument.xlsm`, is available on the companion CD-ROM.

A function with optional arguments

Many of Excel's built-in worksheet functions use optional arguments. An example is the `LEFT` function, which returns characters from the left side of a string. Its syntax is

```
LEFT(text,num_chars)
```

The first argument is required, but the second is optional. If the optional argument is omitted, Excel assumes a value of 1. Therefore, the following two formulas return the same result:

```
=LEFT(A1,1)  
=LEFT(A1)
```

The custom functions that you develop in VBA also can have optional arguments. You specify an optional argument by preceding the argument's name with the keyword `Optional`. In the argument list, optional arguments must appear after any required arguments.

Following is a simple function example that returns the user's name. The function's argument is optional.

```
Function User(Optional UpperCase As Variant)
    If IsMissing(UpperCase) Then UpperCase = False
    User = Application.UserName
    If UpperCase Then User = UCase(User)
End Function
```

If the argument is `False` or omitted, the user's name is returned without any changes. If the argument is `True`, the user's name is converted to uppercase (using the VBA `UCase` function) before it's returned. Notice that the first statement in the procedure uses the VBA `IsMissing` function to determine whether the argument was supplied. If the argument is missing, the statement sets the `UpperCase` variable to `False` (the default value).

All the following formulas are valid, and the first two produce the same result:

```
=User()
=User(False)
=User(True)
```

**Note**

If you need to determine whether an optional argument was passed to a function, you must declare the optional argument as a `Variant` data type. Then you can use the `IsMissing` function within the procedure, as demonstrated in this example. In other words, the argument for the `IsMissing` function must always be a `Variant` data type.

The following is another example of a custom function that uses an optional argument. This function randomly chooses one cell from an input range and returns that cell's contents. If the second argument is `True`, the selected value changes whenever the worksheet is recalculated (that is, the function is made volatile). If the second argument is `False` (or omitted), the function isn't recalculated unless one of the cells in the input range is modified.

```
Function DrawOne(Rng As Variant, Optional Recalc As Variant = False)
    ' Chooses one cell at random from a range
    ' Make function volatile if Recalc is True
    Application.Volatile Recalc
    ' Determine a random cell
    DrawOne = Rng(Int((Rng.Count) * Rnd + 1))
End Function
```

Notice that the second argument for `DrawOne` includes the `Optional` keyword, along with a default value.

All the following formulas are valid, and the first two have the same effect:

```
=DrawOne(A1:A100)  
=DrawOne(A1:A100, False)  
=DrawOne(A1:A100, True)
```

This function might be useful for choosing lottery numbers, picking a winner from a list of names, and so on.



On the CD

This function is available on the companion CD-ROM. The filename is `draw.xlsm`.

A function that returns a VBA array

VBA includes a useful function called `Array`. The `Array` function returns a variant that contains an array (that is, multiple values). If you're familiar with array formulas in Excel, you have a head start on understanding VBA's `Array` function. You enter an array formula into a cell by pressing Ctrl+Shift+Enter. Excel inserts curly braces around the formula to indicate that it's an array formula.



Cross-Ref

See Chapter 3 for more details on array formulas.



Note

It's important to understand that the array returned by the `Array` function isn't the same as a normal array that's made up of elements of the `Variant` data type. In other words, a variant array isn't the same as an array of variants.

The `MonthNames` function, which follows, is a simple example that uses VBA's `Array` function in a custom function:

```
Function MonthNames()  
    MonthNames = Array("Jan", "Feb", "Mar", "Apr", "May", "Jun", _  
        "Jul", "Aug", "Sep", "Oct", "Nov", "Dec")  
End Function
```

The `MonthNames` function returns a horizontal array of month names. You can create a multicell array formula that uses the `MonthNames` function. Here's how to use it: Make sure that the function code is present in a VBA module. Then in a worksheet, select multiple cells in a row (start by selecting 12 cells). Then enter the formula that follows (without the braces) and press Ctrl+Shift+Enter:

```
{=MonthNames() }
```

What if you'd like to generate a vertical list of month names? No problem; just select a vertical range, enter the following formula (without the braces), and then press Ctrl+Shift+Enter:

```
{=TRANSPOSE(MonthNames())}
```

This formula uses the Excel TRANSPOSE function to convert the horizontal array to a vertical array.

The following example is a variation on the MonthNames function:

```
Function MonthNames(Optional MIndex)
    Dim AllNames As Variant
    Dim MonthVal As Long
    AllNames = Array("Jan", "Feb", "Mar", "Apr", _
        "May", "Jun", "Jul", "Aug", "Sep", "Oct", _
        "Nov", "Dec")
    If IsMissing(MIndex) Then
        MonthNames = AllNames
    Else
        Select Case MIndex
            Case Is >= 1
                ' Determine month value (for example, 13=1)
                MonthVal = (MIndex - 1) Mod 12
                MonthNames = AllNames(MonthVal)
            Case Is <= 0 ' Vertical array
                MonthNames = Application.Transpose(AllNames)
        End Select
    End If
End Function
```

Notice that I use the VBA IsMissing function to test for a missing argument. In this situation, it isn't possible to specify the default value for the missing argument in the argument list of the function because the default value is defined within the function. You can use the IsMissing function only if the optional argument is a variant.

This enhanced function uses an optional argument that works as follows:

- **If the argument is missing**, the function returns a horizontal array of month names.
- **If the argument is less than or equal to 0**, the function returns a vertical array of month names. It uses Excel's TRANSPOSE function to convert the array.
- **If the argument is greater than or equal to 1**, it returns the month name that corresponds to the argument value.



Note

This procedure uses the `Mod` operator to determine the month value. The `Mod` operator returns the remainder after dividing the first operand by the second. Keep in mind that the `AllNames` array is zero-based and that indices range from 0 to 11. In the statement that uses the `Mod` operator, 1 is subtracted from the function's argument. Therefore, an argument of 13 returns 0 (corresponding to Jan), and an argument of 24 returns 11 (corresponding to Dec).

You can use this function in a number of ways, as illustrated in Figure 10-6.

Range A1:L1 contains the following formula entered as an array. Start by selecting A1:L1, enter the formula (without the braces), and then press `Ctrl+Shift+Enter`.

```
{=MonthNames() }
```

Range A3:A14 contains integers from 1 to 12. Cell B3 contains the following (nonarray) formula, which was copied to the 11 cells below it:

```
=MonthNames(A3)
```

Range D3:D14 contains the following formula entered as an array:

```
{=MonthNames(-1) }
```

	A	B	C	D	E	F	G	H	I	J	K	L	
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2													
3		1 Jan		Jan		Mar							
4		2 Feb		Feb									
5		3 Mar		Mar									
6		4 Apr		Apr									
7		5 May		May									
8		6 Jun		Jun									
9		7 Jul		Jul									
10		8 Aug		Aug									
11		9 Sep		Sep									
12		10 Oct		Oct									
13		11 Nov		Nov									
14		12 Dec		Dec									
15													

Figure 10-6: Different ways of passing an array or a single value to a worksheet.

Range F3 contains this (nonarray) formula:

```
=MonthNames(3)
```



To enter an array formula, you must press **Ctrl+Shift+Enter** (and don't enter the curly braces).



The lower bound of an array, created using the `Array` function, is determined by the lower bound specified with the `Option Base` statement at the top of the module. If there is no `Option Base` statement, the default lower bound is 0.



On the CD

A workbook that demonstrates the `MonthNames` function is available on the companion CD-ROM. The file is named `month names.xslm`.

A function that returns an error value

In some cases, you might want your custom function to return a particular error value. Consider the `RemoveVowels` function, which I presented earlier in this chapter:

```
Function RemoveVowels(Txt) As String
' Removes all vowels from the Txt argument
    Dim i As Long
    RemoveVowels = ""
    For i = 1 To Len(Txt)
        If Not UCase(Mid(Txt, i, 1)) Like "[AEIOU]" Then
            RemoveVowels = RemoveVowels & Mid(Txt, i, 1)
        End If
    Next i
End Function
```

When used in a worksheet formula, this function removes the vowels from its single-cell argument. If the argument is a numeric value, this function returns the value as a string. You may prefer that the function returns an error value (`#N/A`), rather than the numeric value converted to a string.

You may be tempted simply to assign a string that looks like an Excel formula error value. For example:

```
RemoveVowels = "#N/A"
```

Although the string *looks* like an error value, other formulas that may reference it don't treat it as such. To return a *real* error value from a function, use the VBA `CVErr` function, which converts an error number to a real error.

Fortunately, VBA has built-in constants for the errors that you want to return from a custom function. These errors are Excel formula error values and not VBA runtime error values. These constants are as follows:

- xlErrDiv0 (for #DIV/0!)
- xlErrNA (for #N/A)
- xlErrName (for #NAME?)
- xlErrNull (for #NULL!)
- xlErrNum (for #NUM!)
- xlErrRef (for #REF!)
- xlErrValue (for #VALUE!)

To return a #N/A error from a custom function, you can use a statement like this:

```
RemoveVowels = CVErr(xlErrNA)
```

The revised `RemoveVowels` function follows. This function uses an `If-Then` construct to take a different action if the argument isn't text. It uses Excel's `ISTEXT` function to determine whether the argument is text. If the argument is text, the function proceeds normally. If the cell doesn't contain text (or is empty), the function returns the #N/A error.

```
Function RemoveVowels(Txt) As Variant
' Removes all vowels from the Txt argument
' Returns #VALUE if Txt is not a string
    Dim i As Long
    RemoveVowels = ""
    If Application.WorksheetFunction.Istext(Txt) Then
        For i = 1 To Len(Txt)
            If Not UCase(Mid(Txt, i, 1)) Like "[AEIOU]" Then
                RemoveVowels = RemoveVowels & Mid(Txt, i, 1)
            End If
        Next i
    Else
        RemoveVowels = CVErr(xlErrNA)
    End If
End Function
```



Note

Notice that I also changed the data type for the function's return value. Because the function can now return something other than a string, I changed the data type to `Variant`.

A function with an indefinite number of arguments

Some Excel worksheet functions take an indefinite number of arguments. A familiar example is the SUM function, which has the following syntax:

```
SUM(number1,number2...)
```

The first argument is required, but you can specify as many as 254 additional arguments. Here's an example of a SUM function with four range arguments:

```
=SUM(A1:A5,C1:C5,E1:E5,G1:G5)
```

You can even mix and match the argument types. For example, the following example uses three arguments: the first is a range, the second is a value, and the third is an expression.

```
=SUM(A1:A5,12,24*3)
```

You can create Function procedures that have an indefinite number of arguments. The trick is to use an array as the last (or only) argument, preceded by the keyword ParamArray.



Note

ParamArray can apply only to the *last* argument in the procedure's argument list. It's always a Variant data type, and it's always an optional argument (although you don't use the Optional keyword).

Following is a function that can have any number of single-value arguments. (It doesn't work with multicell range arguments.) It simply returns the sum of the arguments.

```
Function SimpleSum(ParamArray arglist() As Variant) As Double
    For Each arg In arglist
        SimpleSum = SimpleSum + arg
    Next arg
End Function
```

To modify this function so that it works with multicell range arguments, you need to add another loop, which processes each cell in each of the arguments:

```
Function SimpleSum(ParamArray arglist() As Variant) As Double
    Dim cell As Range
    For Each arg In arglist
        For Each cell In arg
            SimpleSum = SimpleSum + cell
        Next cell
    Next arg
End Function
```

The `SimpleSum` function is similar to Excel's `SUM` function, but it's not nearly as flexible. Try it by using various types of arguments, and you'll see that it fails if any of the cells contains a non-value, or if you use a literal value for an argument.

Emulating Excel's `SUM` function

In this section, I present a custom function called `MySum`. Unlike the `SimpleSum` function listed in the previous section, the `MySum` function emulates Excel's `SUM` function (almost) perfectly.

Before you look at the code for `MySum`, take a minute to think about the Excel `SUM` function. It is, in fact, very versatile. It can have as many as 255 arguments (even “missing” arguments), and the arguments can be numerical values, cells, ranges, text representations of numbers, logical values, and even embedded functions. For example, consider the following formula:

```
=SUM(B1,5,"6",,TRUE,SQRT(4),A1:A5,D:D,C2*C3)
```

This perfectly valid formula contains all the following types of arguments, listed here in the order of their presentation:

- A single cell reference
- A literal value
- A string that looks like a value
- A missing argument
- A logical `TRUE` value
- An expression that uses another function
- A simple range reference
- A range reference that includes an entire column
- An expression that calculates the product of two cells

The `MySum` function (see Listing 10-1) handles all these argument types.



On the CD

A workbook containing the `MySum` function is available on the companion CD-ROM. The file is named `mysum function.xlsm`.

Listing 10-1: `MySum` Function

```
Function MySum(ParamArray args() As Variant) As Variant
' Emulates Excel's SUM function

' Variable declarations
```

```

Dim i As Variant
Dim TempRange As Range, cell As Range
Dim ECode As String
Dim m, n
MySum = 0
' Process each argument
For i = 0 To UBound(args)
'   Skip missing arguments
  If Not IsMissing(args(i)) Then
'     What type of argument is it?
    Select Case TypeName(args(i))
      Case "Range"
'        Create temp range to handle full row or column ranges
        Set TempRange = Intersect(args(i).Parent.UsedRange, _
          args(i))
        For Each cell In TempRange
          If IsError(cell) Then
            MySum = cell ' return the error
            Exit Function
          End If
          If cell = True Or cell = False Then
            MySum = MySum + 0
          Else
            If IsNumeric(cell) Or IsDate(cell) Then _
              MySum = MySum + cell
            End If
          End If
        Next cell
      Case "Variant()"
        n = args(i)
        For m = LBound(n) To UBound(n)
          MySum = MySum(MySum, n(m)) 'recursive call
        Next m
      Case "Null" 'ignore it
      Case "Error" 'return the error
        MySum = args(i)
        Exit Function
      Case "Boolean"
'        Check for literal TRUE and compensate
        If args(i) = "True" Then MySum = MySum + 1
      Case "Date"
        MySum = MySum + args(i)
      Case Else
        MySum = MySum + args(i)
    End Select
  End If
Next i
End Function

```

Figure 10-7 shows a workbook with various formulas that use SUM and MySum. As you can see, the functions return identical results.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		1	TRUE	First		1	One	5:00 PM			1				
2		4	FALSE	"2"	#N/A	Two		4-Jan							
3		2	TRUE		3	Three		5-Jan							
4															
5	SUM -->	7	0	3	#N/A	0	1/11/18 5:00 PM	1	1	100	11.48913	31	#DIV/0!	#VALUE!	3.708333
6															
7	MYSUM -->	7	0	3	#N/A	0	1/11/18 5:00 PM	1	1	100	11.48913	31	#DIV/0!	#VALUE!	3.708333
8															

Figure 10-7: Comparing SUM with MySum.

If you're interested in learning how this function works, create a formula that uses the function. Then, set a breakpoint in the code and step through the statements line by line. (See "Debugging Functions," later in this chapter.) Try this for several different argument types, and you'll soon have a good feel for how this function works. As you study the code for MySum, keep the following points in mind:

- Missing arguments (determined by the `IsMissing` function) are simply ignored.
- The procedure uses VBA's `TypeName` function to determine the type of argument (Range, Error, and so on). Each argument type is handled differently.
- For a range argument, the function loops through each cell in the range, determines the type of data in the cell, and (if appropriate) adds its value to a running total.
- The data type for the function is `Variant` because the function needs to return an error if any of its arguments is an error value.
- If an argument contains an error (for example, `#DIV/0!`), the `MySum` function simply returns the error — just as Excel's SUM function does.
- Excel's SUM function considers a text string to have a value of 0 unless it appears as a literal argument (that is, as an actual value, not a variable). Therefore, `MySum` adds the cell's value only if it can be evaluated as a number. (VBA's `IsNumeric` function is used to determine whether a string can be evaluated as a number.)
- For range arguments, the function uses the `Intersect` method to create a temporary range that consists of the intersection of the range and the sheet's used range. This technique handles cases in which a range argument consists of a complete row or column, which would take forever to evaluate.

You may be curious about the relative speeds of SUM and MySum. MySum, of course, is much slower, but just how much slower depends on the speed of your system and the formulas themselves. On my system, a worksheet with 5,000 SUM formulas recalculates instantly. After I replace the SUM functions with MySum functions, it takes about eight seconds. MySum may be improved a bit, but it can never come close to SUM's speed.

By the way, I hope you understand that the point of this example is *not* to create a new SUM function. Rather, it demonstrates how to create custom worksheet functions that look and work like those built into Excel.

Extended Date Functions

A common complaint among Excel users is the inability to work with dates prior to 1900. For example, genealogists often use Excel to keep track of birth and death dates. If either of those dates occurs in a year prior to 1900, calculating the number of years the person lived isn't possible.

I created a series of functions that take advantage of the fact that VBA can work with a much larger range of dates. The earliest date recognized by VBA is January 1, 0100.



Caution

Beware of Calendar changes. Be careful if you use dates prior to 1752. Differences between the historical American, British, Gregorian, and Julian calendars can result in inaccurate computations.

The functions are

- **XDATE(y,m,d,fmt):** Returns a date for a given year, month, and day. As an option, you can provide a date formatting string.
- **XDATEADD(xdate1,days,fmt):** Adds a specified number of days to a date. As an option, you can provide a date formatting string.
- **XDATEDIF(xdate1,xdate2):** Returns the number of days between two dates.
- **XDATEYEARDIF(xdate1,xdate2):** Returns the number of full years between two dates (useful for calculating ages).
- **XDATEYEAR(xdate1):** Returns the year of a date.
- **XDATEMONTH(xdate1):** Returns the month of a date.
- **XDATEDAY(xdate1):** Returns the day of a date.
- **XDATEDOW(xdate1):** Returns the day of the week of a date (as an integer between 1 and 7).

Figure 10-8 shows a workbook that uses some of these functions.

Keep in mind that the date returned by these functions is a *string*, not a real date. Therefore, you can't perform mathematical operations on the returned value using Excel's standard operators. You can, however, use the return value as an argument for other Extended Date functions.

	A	B	C	D	E	F	G	H	I
5									
6	President	Year	Month	Day	XDATE	XDATEDIF	XDATEYEARDIF	XDATEDOW	
7	George Washington	1732	2	22	February 22, 1732	101,407	277	Friday	
8	John Adams	1735	10	30	October 30, 1735	100,061	273	Sunday	
9	Thomas Jefferson	1743	4	13	April 13, 1743	97,339	266	Saturday	
10	James Madison	1751	3	16	March 16, 1751	94,445	258	Tuesday	
11	James Monroe	1758	4	28	April 28, 1758	91,845	251	Friday	
12	John Quincy Adams	1767	7	11	July 11, 1767	88,484	242	Saturday	
13	Andrew Jackson	1767	3	15	March 15, 1767	88,602	242	Sunday	
14	Martin Van Buren	1782	12	5	December 5, 1782	82,858	226	Thursday	
15	William Henry Harrison	1773	2	9	February 9, 1773	86,444	236	Tuesday	
16	John Tyler	1790	3	29	March 29, 1790	80,187	219	Monday	
17	James K. Polk	1795	11	2	November 2, 1795	78,143	213	Monday	
18	Zachary Taylor	1784	11	24	November 24, 1784	82,138	224	Wednesday	
19	Millard Fillmore	1800	1	7	January 7, 1800	76,616	209	Tuesday	
20	Franklin Pierce	1804	11	23	November 23, 1804	74,835	204	Friday	
21	James Buchanan	1791	4	23	April 23, 1791	79,797	218	Saturday	
22	Abraham Lincoln	1809	2	12	February 12, 1809	73,293	200	Sunday	
23	Andrew Johnson	1808	12	29	December 29, 1808	73,338	200	Thursday	
24	Ulysses S. Grant	1822	4	27	April 27, 1822	68,471	187	Saturday	
25	Rutherford B. Hayes	1822	10	4	October 4, 1822	68,311	187	Friday	
26	James A. Garfield	1831	11	19	November 19, 1831	64,978	177	Saturday	
27	Chester A. Arthur	1829	10	5	October 5, 1829	65,753	180	Monday	
28	Grover Cleveland	1837	3	18	March 18, 1837	63,032	172	Saturday	
29	Benjamin Harrison	1833	8	20	August 20, 1833	64,338	176	Tuesday	
30	William McKinley	1843	1	29	January 29, 1843	60,889	166	Sunday	
31	Theodore Roosevelt	1858	10	27	October 27, 1858	55,139	150	Wednesday	
32	William Howard Taft	1857	9	15	September 15, 1857	55,546	152	Tuesday	
33	Woodrow Wilson	1856	12	28	December 28, 1856	55,807	152	Sunday	
34	Warren G. Harding	1865	11	2	November 2, 1865	52,576	143	Thursday	
35	Calvin Coolidge	1892	7	4	July 4, 1892	58,148	137	Thursday	

Figure 10-8: The Extended Date functions used in formulas.

The functions are surprisingly simple. For example, here's the listing for the XDATE function:

```
Function XDATE(y, m, d, Optional fmt As String) As String
    If IsMissing(fmt) Then fmt = "Short Date"
    XDATE = Format(DateSerial(y, m, d), fmt)
End Function
```

The arguments for XDATE are

- **y**: A four-digit year in the range 0100 to 9999
- **m**: A month number (1-12)
- **d**: A day number (1-31)
- **fmt**: (Optional) A date format string

If the `fmt` argument is omitted, the date is displayed using the system's *short date* setting (as specified in the Windows Control Panel).

If the `m` or `d` argument exceeds a valid number, it rolls over into the next year or month. For example, if you specify a month of 13, it's interpreted as January of the next year.



On the CD

The VBA code for the Extended Data functions is available on the companion CD-ROM. The filename is `extended date function.xlsm`. The CD also contains some documentation for these functions in a Word document named `extended date functions help.docx`.

Debugging Functions

When you're using a formula in a worksheet to test a Function procedure, VBA runtime errors don't appear in the all-too-familiar, pop-up error box. If an error occurs, the formula simply returns an error value (`#VALUE!`). Luckily, the lack of a pop-up error message doesn't present a problem for debugging functions because you have several possible workarounds:

- **Place `MsgBox` functions at strategic locations to monitor the value of specific variables.** Message boxes in Function procedures *do* pop up when the procedure is executed. But make sure that you have only one formula in the worksheet that uses your function, or message boxes will appear for each formula that is evaluated, which is a repetition that will quickly become annoying.
- **Test the procedure by calling it from a Sub procedure, not from a worksheet formula.** Runtime errors are displayed in the usual manner, and you can either fix the problem (if you know it) or jump right into the Debugger.
- **Set a breakpoint in the function and then step through the function.** You then can access all the standard VBA debugging tools. To set a breakpoint, move the cursor to the statement at which you want to pause execution and then choose `Debug→Toggle Breakpoint` (or press F9). When the function is executing, press F8 to step through the procedure line-by-line.
- **Use one or more temporary `Debug.Print` statements in your code to write values to the VBE Immediate window.** For example, if you want to monitor a value inside of a loop, use something like the following routine:

```
Function VowelCount(r) As Long
    Dim Count As Long
    Dim i As Long
    Dim Ch As String * 1
    Count = 0
    For i = 1 To Len(r)
        Ch = UCase(Mid(r, i, 1))
        If Ch Like "[AEIOU]" Then
            Count = Count + 1
            Debug.Print Ch, i
        End If
    Next i
End Function
```

```

Next i
VowelCount = Count
End Function

```

In this case, the values of two variables, `Ch` and `i`, are printed to the Immediate window whenever the `Debug.Print` statement is encountered. Figure 10-9 shows the result when the function has an argument of `Tucson Arizona`.

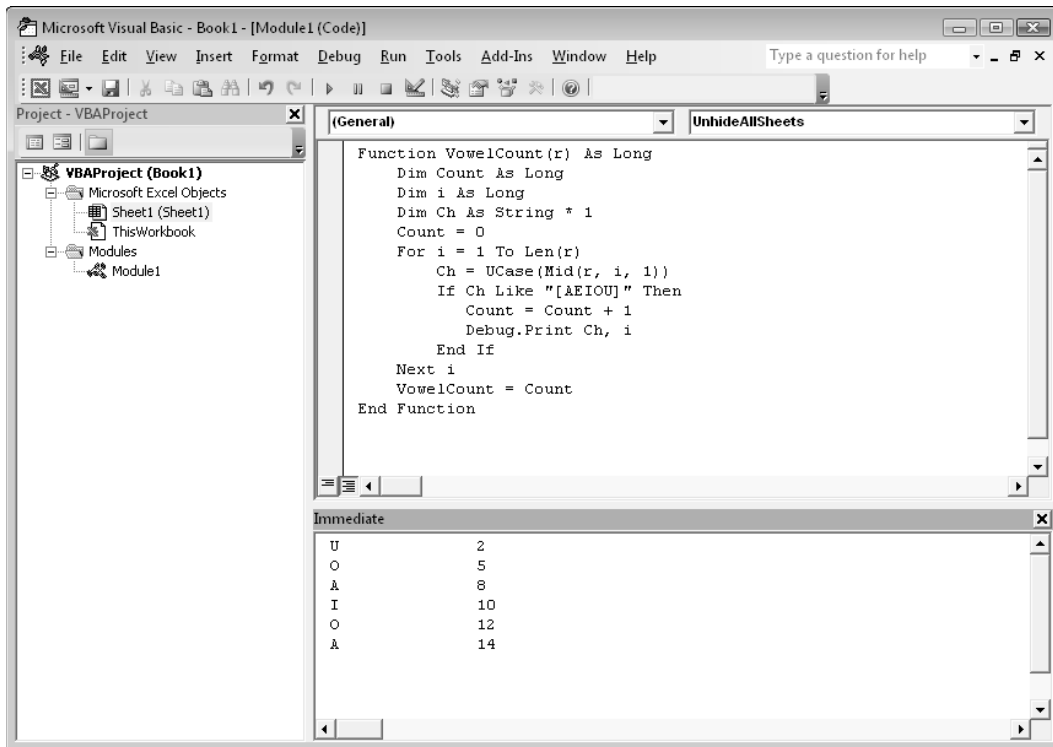


Figure 10-9: Use the Immediate window to display results while a function is running.

Dealing with the Insert Function Dialog Box

Excel's Insert Function dialog box is a handy tool. When you're creating a worksheet formula, this tool lets you select a particular worksheet function from a list of functions. These functions are grouped into various categories to make locating a particular function easier. When you select a function and click OK, the Function Arguments dialog box appears to help insert the function's arguments. Figure 10-10 shows both of these dialog boxes.

The Insert Function dialog box also displays your custom worksheet functions. By default, custom functions are listed under the User Defined category. The Function Arguments dialog box prompts you for a custom function's arguments.

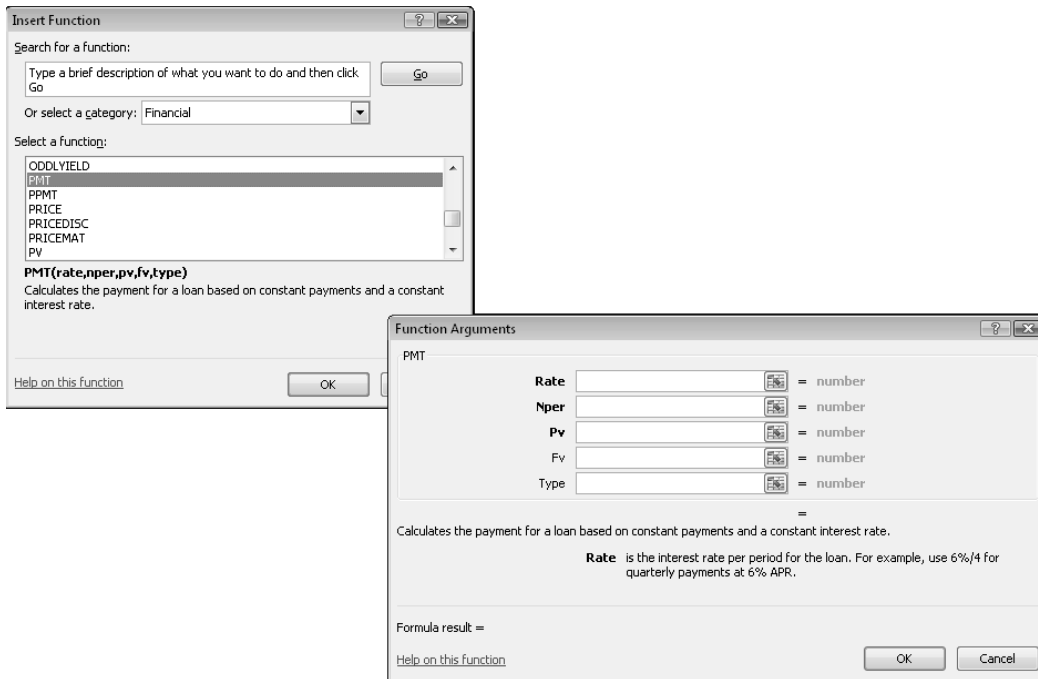


Figure 10-10: The Insert Function dialog box makes it easy to enter a function into a formula, and the Function Arguments dialog box prompts for the arguments.

The Insert Function dialog box enables you to search for a function by keyword. Unfortunately, you can't use this search feature to locate custom functions created in VBA.



Note

Custom Function procedures defined with the `Private` keyword don't appear in the Insert Function dialog box. If you develop a function that's intended to be used only in your other VBA procedures, you should declare it by using the `Private` keyword. However, declaring the function as `Private` doesn't prevent it from being used in a worksheet formula. It just prevents the function from displaying in the Insert Function dialog box.

Using the MacroOptions method

You can use the `MacroOptions` method of the `Application` object to make your functions appear just like built-in functions. Specifically, this method enables you to:

- Provide a description of the function
- Specify a function category
- Provide descriptions for the function arguments.

Following is an example of a procedure that uses the `MacroOptions` method to provide information about a function.

```
Sub DescribeFunction()  
    Dim FuncName As String  
    Dim FuncDesc As String  
    Dim FuncCat As Long  
    Dim Arg1Desc As String, Arg2Desc As String  
  
    FuncName = "DrawOne"  
    FuncDesc = "Displays the contents of a random cell from a range"  
    FuncCat = 5 'Lookup & Reference  
    Arg1Desc = "The range that contains the values"  
    Arg2Desc = "(Optional) If False or missing, a new cell is not "  
    Arg2Desc = Arg2Desc & "selected when recalculated. If True, a "  
    Arg2Desc = Arg2Desc & "new cell is selected when recalculated."  
  
    Application.MacroOptions _  
        Macro:=FuncName, _  
        Description:=FuncDesc, _  
        Category:=FuncCat, _  
        ArgumentDescriptions:=Array(Arg1Desc, Arg2Desc) End Sub
```

This procedure uses variables to store the various information, and the variables are used as arguments for the `MacroOptions` method. The function is assigned to function category 5 (Lookup & Reference). Notice that descriptions for the two arguments are indicated by using an array as the last argument for the `MacroOptions` method.



New Feature

The ability to provide argument descriptions is new to Excel 2010. If the workbook is opened in an early version of Excel, however, the arguments won't display the descriptions.

Figure 10-11 shows the Insert Function and Function Arguments dialog boxes after executing this procedure.

You need to execute the `DescribeFunction` procedure only one time. After doing so, the information assigned to the function is stored in the workbook. You can also omit arguments. For example, if you don't need the arguments to have descriptions, just omit the `ArgumentDescriptions` argument.



Cross-Ref

For information on creating a custom help topic accessible from the Insert Function dialog box, refer to Chapter 24.

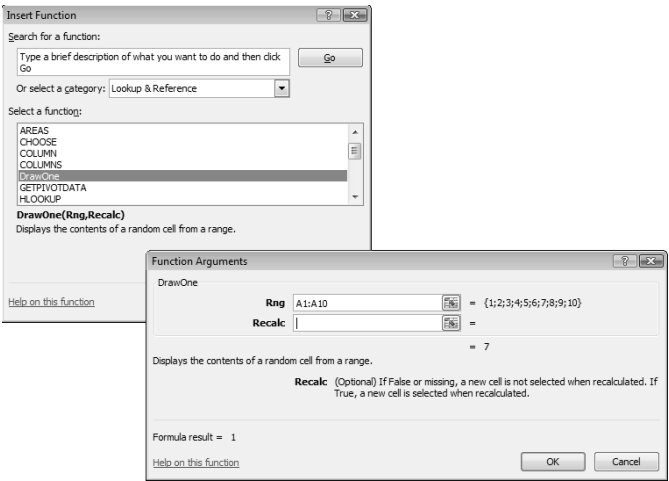


Figure 10-11: The Insert Function and Function Arguments dialog boxes for a custom function.

Specifying a function category

If you don't use the `MacroOptions` method to specify a different category, your custom worksheet functions appear in the User Defined category in the Insert Function dialog box. You may prefer to assign your function to a different category. Assigning a function to a category also causes it to appear in the drop-down controls in the Formulas→Function Library group on the Ribbon.

Table 10-1 lists the category numbers that you can use for the `Category` argument for the `MacroOptions` method. Notice that a few of these categories (10 through 13) aren't normally displayed in the Insert Function dialog box. If you assign your function to one of these categories, the category will appear in the dialog box.

Table 10-1: Function Categories

Category Number	Category Name
0	All (no specific category)
1	Financial
2	Date & Time
3	Math & Trig
4	Statistical
5	Lookup & Reference
6	Database
7	Text
8	Logical
9	Information

continued

Table 10-1: Function Categories

Category Number	Category Name
12	Macro Control
13	DDE/External
14	User Defined
15	Engineering
16	Cube
17	Compatibility*

*The Compatibility category is new to Excel 2010.

You can also create custom function categories. Instead of using a number for the `Category` argument for `MacroOptions`, use a text string. The statement that follows creates a new function category named VBA Functions, and assigns the `Commission` function to this category:

```
Application.MacroOptions Macro:="Commission", Category:="VBA Functions"
```

Adding a function description manually

As an alternative to using the `MacroOptions` method to provide a function description, you can use the Macro dialog box.



Note

If you don't provide a description for your custom function, the Insert Function dialog box displays the following text: No help available.

Follow these steps to provide a description for a custom function:

1. Create your function in the VBE.
2. Activate Excel, making sure that the workbook that contains the function is the active workbook.
3. Choose Developer→Code→Macros (or press Alt+F8).
The Macro dialog box lists available procedures, but your functions won't be in the list.
4. Type the name of your function in the Macro Name box.
5. Click the Options button to display the Macro Options dialog box.
6. Enter the function description in the Description box (see Figure 10-12).
The Shortcut Key field is irrelevant for functions.

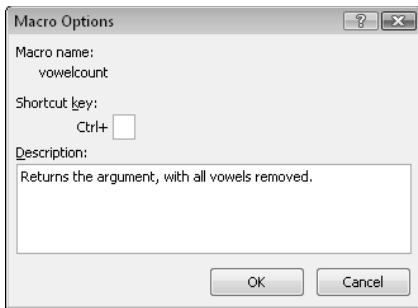


Figure 10-12: Provide a function description in the Macro Options dialog box.

7. Click OK and then click Cancel.

After you perform the preceding steps, the Insert Function dialog box displays the description that you entered in Step 6 when the function is selected.

When you use the Insert Function dialog box to enter a function, the Function Arguments dialog box is displayed after you click OK. For built-in functions, the Function Arguments dialog box displays a description for each of the function's arguments. Unfortunately, you can't provide such descriptions for custom function arguments.

Using Add-ins to Store Custom Functions

You may prefer to store frequently used custom functions in an add-in file. A primary advantage is that you can use those functions in any workbook.

In addition, you can use the functions in formulas without a filename qualifier. Assume that you have a custom function named `ZapSpaces`, and that it's stored in `Myfuncs.xlsm`. To use this function in a formula in a workbook other than `Myfuncs.xlsm`, you need to enter the following formula:

```
=Myfuncs.xlsm!ZapSpaces (A1:C12)
```

If you create an add-in from `Myfuncs.xlsm` and the add-in is loaded, you can omit the file reference and enter a formula such as the following:

```
=ZapSpaces (A1:C12)
```



Cross-Ref

I discuss add-ins in Chapter 21.

**Caution**

A potential problem with using add-ins to store custom functions is that your workbook is dependent on the add-in file. If you need to share your workbook with a colleague, you also need to share a copy of the add-in that contains the functions.

Using the Windows API

VBA can borrow methods from other files that have nothing to do with Excel or VBA — for example, the Dynamic Link Library (DLL) files that Windows and other software use. As a result, you can do things with VBA that would otherwise be outside the language's scope.

The *Windows Application Programming Interface* (API) is a set of functions available to Windows programmers. When you call a Windows function from VBA, you're accessing the Windows API. Many of the Windows resources used by Windows programmers are available in *DLLs*, which store programs and functions and are linked at runtime rather than at compile time.

64-bit Excel and API functions



Excel 2010 adds a new challenge to using Windows API functions in your code because Excel 2010 is also available in a 64-bit version. If you want your code to be compatible with the 32-bit versions (including Excel 2007) and 64-bit version of Excel 2010, you need to declare your API functions twice, using compiler directives to ensure that the correct declaration is used.

For example, the following declaration works with 32-bit Excel versions, but causes a compile error with 64-bit Excel 2010:

```
Declare Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

In many cases, making the declaration compatible with 64-bit Excel is as simple as adding the word `PtrSafe` after the `Declare` keyword. The following declaration is compatible with both 32-bit Excel 2010 and 64-bit Excel 2010:

```
Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

However, the code will fail in Excel 2007 (and earlier versions) because the `PtrSafe` keyword is not recognized.

In Chapter 26, I describe how to make API function declarations compatible with all versions of 32-bit Excel and 64-bit Excel 2010.

Windows API examples

Before you can use a Windows API function, you must declare the function at the top of your code module. If the code module is for a `UserForm`, `Sheet`, or `ThisWorkbook`, you must declare the API function as `Private`.

An API function must be declared precisely. The declaration statement tells VBA:

- Which API function you're using
- In which library the API function is located
- The API function's arguments

After you declare an API function, you can use it in your VBA code.

Determining the Windows directory

This section contains an example of an API function that displays the name of the Windows directory — something that's not possible using standard VBA statements. This code won't work with Excel 2007.

Here's the API function declaration:

```
Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

This function, which has two arguments, returns the name of the directory in which Windows is installed. After calling the function, the Windows directory is contained in `lpBuffer`, and the length of the directory string is contained in `nSize`.

After inserting the `Declare` statement at the top of your module, you can access the function by calling the `GetWindowsDirectoryA` function. The following is an example of calling the function and displaying the result in a message box:

```
Sub ShowWindowsDir()  
    Dim WinPath As String * 255  
    Dim WinDir As String  
    WinPath = Space(255)  
    WinDir = Left(WinPath, GetWindowsDirectoryA _  
        (WinPath, Len(WinPath)))  
    MsgBox WinDir, vbInformation, "Windows Directory"  
End Sub
```

Executing the `ShowWindowsDir` procedure displays a message box with the Windows directory.

Often, you'll want to create a *wrapper* for API functions. In other words, you create your own function that uses the API function. This greatly simplifies using the API function. Here's an example of a wrapper VBA function:

```
Function WindowsDir() As String
'   Returns the Windows directory
Dim WinPath As String * 255
WinPath = Space(255)
WindowsDir = Left(WinPath, GetWindowsDirectoryA _
    (WinPath, Len(WinPath)))
End Function
```

After declaring this function, you can call it from another procedure:

```
MsgBox WindowsDir()
```

You can even use the function in a worksheet formula:

```
=WindowsDir()
```



On the CD

This example is available on the companion CD-ROM. The filename is `windows directory.xlsm`, and the API function declaration is compatible with Excel 2007 and later.

The reason for using API calls is to perform actions that would otherwise be impossible (or at least very difficult). If your application needs to find the path of the Windows directory, you could search all day and not find a function in Excel or VBA to do the trick. But knowing how to access the Windows API may solve your problem.



Caution

When you work with API calls, system crashes during testing aren't uncommon, so save your work often.

Detecting the Shift key

Here's another example: Suppose that you've written a VBA macro that will be executed by clicking a button on a worksheet. Furthermore, suppose that you want the macro to perform differently if the user presses the Shift key when the button is clicked. VBA doesn't provide a way to detect whether the Shift key is pressed. But you can use the `GetKeyState` API function to find out. The `GetKeyState` function tells you whether a particular key is pressed. It takes a single argument, `nVirtKey`, which represents the code for the key that you're interested in.

The following code demonstrates how to detect whether the Shift key is pressed when the `Button_Click` event handler procedure is executed. Notice that I define a constant for the

Shift key (using a hexadecimal value) and then use this constant as the argument for `GetKeyState`. If `GetKeyState` returns a value less than zero, it means that the Shift key was pressed; otherwise, the Shift key wasn't pressed. This code isn't compatible with Excel 2007.

```
Declare PtrSafe Function GetKeyState Lib "user32" _
    (ByVal nVirtKey As Long) As Integer
Sub Button_Click()
    Const VK_SHIFT As Integer = &H10
    If GetKeyState(VK_SHIFT) < 0 Then
        MsgBox "Shift is pressed"
    Else
        MsgBox "Shift is not pressed"
    End If
End Sub
```



On the CD

A workbook named `key_press.xlsm` on the companion CD-ROM demonstrates how to detect the following keys (as well as any combinations): Ctrl, Shift, and Alt. The declarations in this file aren't compatible with 64-bit Excel. The API function declaration in this workbook is compatible with Excel 2007 and later.

Learning more about API functions

Working with the Windows API functions can be tricky. Many programming reference books list the declarations for common API calls and often provide examples. Usually, you can simply copy the declarations and use the functions without really understanding the details. In reality (at least the reality that I've seen), most Excel programmers take a cookbook approach to API functions. The Internet has dozens of examples that you can copy and paste and that work quite reliably.



Cross-Ref

Chapter 11 has several additional examples of using Windows API functions.



On the CD

The companion CD-ROM includes a file named `win32api.txt`, which is a text file that contains Windows API declarations and constants. You can open this file with a text editor and copy the appropriate declarations to a VBA module.

VBA Programming Examples and Techniques

In This Chapter

- Using VBA to work with ranges
- Using VBA to work with workbooks and sheets
- Creating custom functions for use in your VBA procedures and in worksheet formulas
- Trying miscellaneous VBA tricks and techniques
- Using Windows Application Programming Interface (API) functions

Learning by Example

I believe that learning programming concepts is accelerated by a heavy emphasis on examples. And based on the feedback that I've received from readers of previous editions of this book, I have plenty of company. VBA programmers especially benefit from a hands-on approach. A well-thought-out example usually communicates a concept much better than a description of the underlying theory. I decided, therefore, not to write a reference book that painstakingly describes every nuance of VBA. Rather, I prepared numerous examples to demonstrate useful Excel programming techniques.

The previous chapters in this part provide enough information to get you started. The Help system provides all the details that I left out. In this chapter, I pick up the pace and present examples that solve practical problems while furthering your knowledge of VBA.

I've categorized this chapter's examples into six groups:

- Working with ranges
- Working with workbooks and sheets
- VBA techniques

- Functions that are useful in your VBA procedures
- Functions that you can use in worksheet formulas
- Windows API calls



Cross-Ref

Subsequent chapters in this book present additional feature-specific examples: charts, pivot tables, events, UserForms, and so on.

Working with Ranges

The examples in this section demonstrate how to manipulate worksheet ranges with VBA.

Specifically, I provide examples of copying a range, moving a range, selecting a range, identifying types of information in a range, prompting for a cell value, determining the first empty cell in a column, pausing a macro to allow the user to select a range, counting cells in a range, looping through the cells in a range, and several other commonly used range-related operations.

Copying a range

Excel's macro recorder is useful not so much for generating usable code, but for discovering the names of relevant objects, methods, and properties. The code that's generated by the macro recorder isn't always the most efficient, but it can usually provide you with several clues.

For example, recording a simple copy-and-paste operation generates five lines of VBA code:

```
Sub Macro1()  
    Range("A1").Select  
    Selection.Copy  
    Range("B1").Select  
    ActiveSheet.Paste  
    Application.CutCopyMode = False  
End Sub
```



Using the examples in this chapter

Not all the examples in this chapter are intended to be stand-alone programs. They are, however, set up as usable procedures that you can adapt for your own applications.

I urge you to follow along on your computer as you read this chapter. Better yet, modify the examples and see what happens. I guarantee that this hands-on experience will help you more than reading a reference book.

Notice that the generated code selects cell A1, copies it, and then selects cell B1 and performs the paste operation. But in VBA, you don't need to select an object to work with it. You would never learn this important point by mimicking the preceding recorded macro code, where two statements incorporate the `Select` method. You can replace this procedure with the following much simpler routine, which doesn't select any cells. It also takes advantage of the fact that the `Copy` method can use an argument that represents the destination for the copied range.

```
Sub CopyRange()  
    Range("A1").Copy Range("B1")  
End Sub
```

Both of these macros assume that a worksheet is active and that the operation takes place on the active worksheet. To copy a range to a different worksheet or workbook, simply qualify the range reference for the destination. The following example copies a range from `Sheet1` in `File1.xlsx` to `Sheet2` in `File2.xlsx`. Because the references are fully qualified, this example works regardless of which workbook is active.

```
Sub CopyRange2()  
    Workbooks("File1.xlsx").Sheets("Sheet1").Range("A1").Copy _  
        Workbooks("File2.xlsx").Sheets("Sheet2").Range("A1")  
End Sub
```

Another way to approach this task is to use object variables to represent the ranges, as shown in the code that follows:

```
Sub CopyRange3()  
    Dim Rng1 As Range, Rng2 As Range  
    Set Rng1 = Workbooks("File1.xlsx").Sheets("Sheet1").Range("A1")  
    Set Rng2 = Workbooks("File2.xlsx").Sheets("Sheet2").Range("A1")  
    Rng1.Copy Rng2  
End Sub
```

As you might expect, copying isn't limited to one single cell at a time. The following procedure, for example, copies a large range. Notice that the destination consists of only a single cell (which represents the upper-left cell for the destination). Using a single cell for the destination works just like it does when you copy and paste a range manually in Excel.

```
Sub CopyRange4()  
    Range("A1:C800").Copy Range("D1")  
End Sub
```

Moving a range

The VBA instructions for moving a range are very similar to those for copying a range, as the following example demonstrates. The difference is that you use the `Cut` method instead of the `Copy` method. Note that you need to specify only the upper-left cell for the destination range.

The following example moves 18 cells (in A1:C6) to a new location, beginning at cell H1:

```
Sub MoveRange1()  
    Range("A1:C6").Cut Range("H1")  
End Sub
```

Copying a variably sized range

In many cases, you need to copy a range of cells, but you don't know the exact row and column dimensions of the range. For example, you might have a workbook that tracks weekly sales, and the number of rows changes weekly when you add new data.

Figure 11-1 shows a common type of worksheet. This range consists of several rows, and the number of rows changes each week. Because you don't know the exact range address at any given time, writing a macro to copy the range requires additional coding.

	A	B	C	D
1	Week	Total Sales	New Customers	
2	1	21,093	45	
3	2	25,375	49	
4	3	26,180	38	
5	4	25,564	32	
6	5	29,325	22	
7	6	23,069	23	
8	7	24,281	53	
9				

Figure 11-1: The number of rows in the data range changes every week.

The following macro demonstrates how to copy this range from `Sheet1` to `Sheet2` (beginning at cell A1). It uses the `CurrentRegion` property, which returns a `Range` object that corresponds to the block of cells around a particular cell (in this case, A1).

```
Sub CopyCurrentRegion2()  
    Range("A1").CurrentRegion.Copy Sheets("Sheet2").Range("A1")  
End Sub
```



Note

Using the `CurrentRegion` property is equivalent to choosing the **Home**→**Editing**→**Find & Select**→**Go To Special** command and selecting the **Current Region** option (or by using the **Ctrl+Shift+*** shortcut). To see how `CurrentRegion` selection works, record your actions while you issue that command. Generally, the `CurrentRegion` property setting consists of a rectangular block of cells surrounded by one or more blank rows or columns.

If the range to be copied is a table (specified using **Insert**→**Tables**→**Table**), you can use code like this (which assumes the table is named `Table1`):

```
Sub CopyTable()  
    Range("Table1[#All]").Copy Sheets("Sheet2").Range("A1") End Sub
```



Tips for working with ranges

When you work with ranges, keep the following points in mind:

- Your code doesn't need to select a range in order to work with it.
- You can't select a range that's not on the active worksheet. So if your code *does* select a range, its worksheet must be active. You can use the `Activate` method of the `Worksheets` collection to activate a particular sheet.
- Remember that the macro recorder doesn't always generate the most efficient code. Often, you can create your macro by using the recorder and then edit the code to make it more efficient.
- Using named ranges in your VBA code is a good idea. For example, referring to `Range("Total")` is better than `Range("D45")`. In the latter case, if you add a row above row 45, the cell address will change. You would then need to modify the macro so that it uses the correct range address (D46).
- If you rely on the macro recorder when selecting ranges, make sure that you record the macro using relative references. Use the **Developer**→**Code**→**Use Relative References** control to toggle this setting.
- When running a macro that works on each cell in the current range selection, the user might select entire columns or rows. In most cases, you don't want to loop through every cell in the selection. Your macro should create a subset of the selection consisting of only the nonblank cells. See "Looping through a selected range efficiently," later in this chapter.
- Excel allows multiple selections. For example, you can select a range, press **Ctrl**, and select another range. You can test for multiple selections in your macro and take appropriate action. See "Determining the type of selected range," later in this chapter.

Selecting or otherwise identifying various types of ranges

Much of the work that you'll do in VBA will involve working with ranges — either selecting a range or identifying a range so that you can do something with the cells.

In addition to the `CurrentRegion` property (which I discussed earlier), you should also be aware of the `End` method of the `Range` object. The `End` method takes one argument, which determines the direction in which the selection is extended. The following statement selects a range from the active cell to the last non-empty cell:

```
Range(ActiveCell, ActiveCell.End(xlDown)).Select
```

Here's a similar example that uses a specific cell as the starting point:

```
Range(Range("A2"), Range("A2").End(xlDown)).Select
```

As you might expect, three other constants simulate key combinations in the other directions: `xlUp`, `xlToLeft`, and `xlToRight`.



Caution

Be careful when using the `End` method with the `ActiveCell` property. If the active cell is at the perimeter of a range or if the range contains one or more empty cells, the `End` method may not produce the desired results.



Cross-Ref

The companion CD-ROM includes a workbook that demonstrates several common types of range selections. When you open this workbook, named `range selections.xlsm`, the code adds a new menu item to the shortcut menu that appears when you right-click a cell: `Selection Demo`. This menu contains commands that enable the user to make various types of selections, as shown in Figure 11-2.

The following macro is in the example workbook. The `SelectCurrentRegion` macro simulates pressing `Ctrl+Shift+*`.

```
Sub SelectCurrentRegion()  
    ActiveCell.CurrentRegion.Select  
End Sub
```

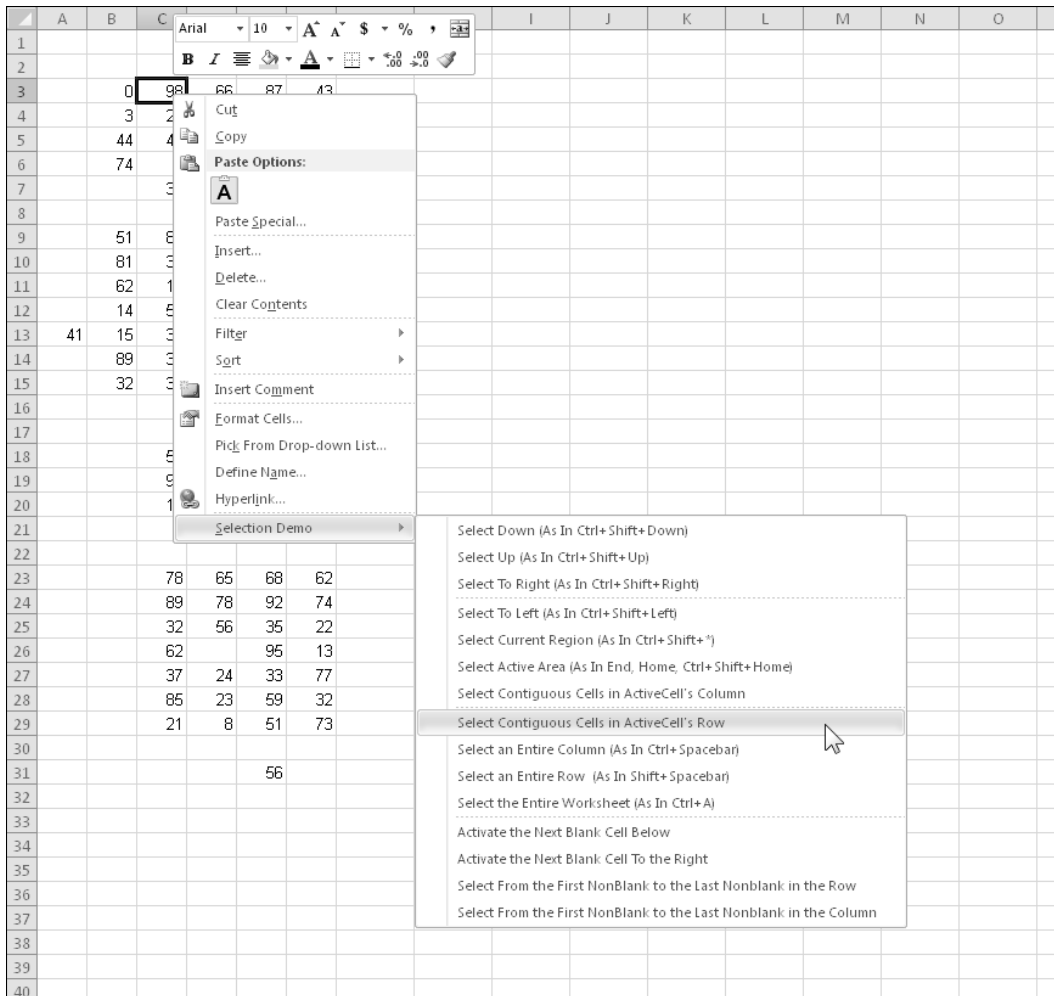



Figure 11-2: This workbook uses a custom shortcut menu to demonstrate how to select variably sized ranges by using VBA.

Often, you won't want to actually select the cells. Rather, you'll want to work with them in some way (for example, format them). You can easily adapt the cell-selecting procedures. The following procedure was adapted from `SelectCurrentRegion`. This procedure doesn't select cells; it applies formatting to the range that's defined as the current region around the active cell. You can also adapt the other procedures in the example workbook in this manner.

```
Sub FormatCurrentRegion()
    ActiveCell.CurrentRegion.Font.Bold = True
End Sub
```

Prompting for a cell value

The following procedure demonstrates how to ask the user for a value and then insert it into cell A1 of the active worksheet:

```
Sub GetValue1()  
    Range("A1").Value = InputBox("Enter the value")  
End Sub
```

Figure 11-3 shows how the input box looks.



Figure 11-3: The InputBox function gets a value from the user to be inserted into a cell.

This procedure has a problem, however. If the user clicks the Cancel button in the input box, the procedure deletes any data already in the cell. The following modification takes no action if the Cancel button is clicked:

```
Sub GetValue2()  
    Dim UserEntry As Variant  
    UserEntry = InputBox("Enter the value")  
    If UserEntry <> "" Then Range("A1").Value = UserEntry  
End Sub
```

In many cases, you'll need to validate the user's entry in the input box. For example, you may require a number between 1 and 12. The following example demonstrates one way to validate the user's entry. In this example, an invalid entry is ignored, and the input box is displayed again. This cycle keeps repeating until the user enters a valid number or clicks Cancel.

```
Sub GetValue3()  
    Dim UserEntry As Variant  
    Dim Msg As String  
    Const MinVal As Integer = 1  
    Const MaxVal As Integer = 12  
    Msg = "Enter a value between " & MinVal & " and " & MaxVal  
    Do  
        UserEntry = InputBox(Msg)  
        If UserEntry = "" Then Exit Sub  
        If IsNumeric(UserEntry) Then  
            If UserEntry >= MinVal And UserEntry <= MaxVal Then Exit Do  
        End If  
    Loop
```

```

End If
Msg = "Your previous entry was INVALID."
Msg = Msg & vbCrLf
Msg = Msg & "Enter a value between " & MinVal & " and " & MaxVal
Loop
ActiveSheet.Range("A1").Value = UserEntry
End Sub

```

As you can see in Figure 11-4, the code also changes the message displayed if the user makes an invalid entry.



Cross-Ref

The three `GetValue` procedures are available on the companion CD-ROM. The filename is `inputbox demo.xlsm`.

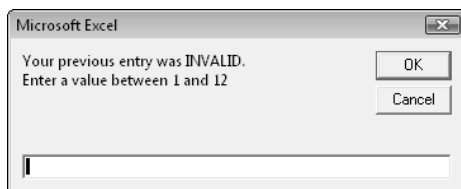


Figure 11-4: Validate a user's entry with the VBA `InputBox` function.

Entering a value in the next empty cell

A common requirement is to enter a value into the next empty cell in a column or row. The following example prompts the user for a name and a value and then enters the data into the next empty row (see Figure 11-5).

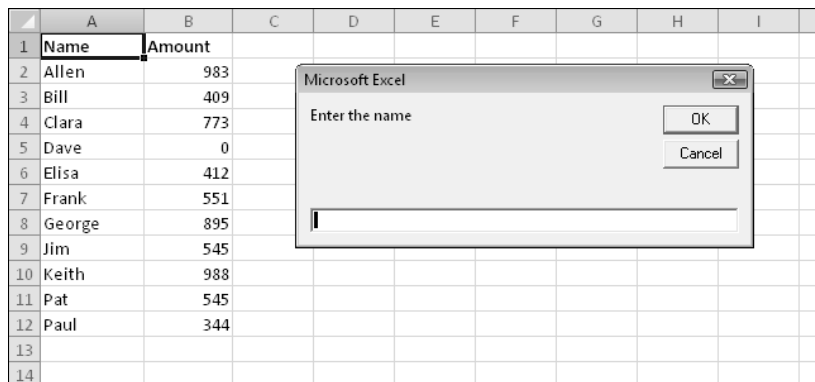


Figure 11-5: A macro for inserting data into the next empty row in a worksheet.

```
Sub GetData()  
    Dim NextRow As Long  
    Dim Entry1 As String, Entry2 As String  
    Do  
        'Determine next empty row  
        NextRow = Cells(Rows.Count, 1).End(xlUp).Row + 1  
  
        ' Prompt for the data  
        Entry1 = InputBox("Enter the name")  
        If Entry1 = "" Then Exit Sub  
        Entry2 = InputBox("Enter the amount")  
        If Entry2 = "" Then Exit Sub  
  
        ' Write the data  
        Cells(NextRow, 1) = Entry1  
        Cells(NextRow, 2) = Entry2  
    Loop  
End Sub
```

To keep things simple, this procedure doesn't perform any validation. Notice that the loop continues indefinitely. I use `Exit Sub` statements to get out of the loop when the user clicks Cancel in the input box.



Cross-Ref

The `GetData` procedure is available on the companion CD-ROM. The filename is `next empty cell.xlsm`.

Notice the statement that determines the value of the `NextRow` variable. If you don't understand how this statement works, try the manual equivalent: Activate the last cell in column A (cell A1048576 in an Excel 2010 workbook), press `End`, and then press the up-arrow key. At this point, the last nonblank cell in column A will be selected. The `Row` property returns this row number, and it's incremented by 1 in order to get the row of the cell below it (the next empty row). Rather than hard-code the last cell in column A, I used `Rows.Count` so that this procedure will work with previous versions of Excel (which have fewer rows).

Note that this technique of selecting the next empty cell has a slight glitch. If the column is completely empty, it will calculate row 2 as the next empty row. Writing additional code to account for this possibility would be fairly easy to do.

Pausing a macro to get a user-selected range

In some situations, you may need an interactive macro. For example, you can create a macro that pauses while the user specifies a range of cells. The procedure in this section describes how to do this with Excel's `InputBox` method.



Note

Don't confuse Excel's `InputBox` method with VBA's `InputBox` function. Although these two items have the same name, they're not the same.

The Sub procedure that follows demonstrates how to pause a macro and let the user select a range. The code then inserts a formula into each cell of the specified range.

```
Sub GetUserRange()
    Dim UserRange As Range

    Prompt = "Select a range for the random numbers."
    Title = "Select a range"

    ' Display the Input Box
    On Error Resume Next
    Set UserRange = Application.InputBox( _
        Prompt:=Prompt, _
        Title:=Title, _
        Default:=ActiveCell.Address, _
        Type:=8) 'Range selection
    On Error GoTo 0

    ' Was the Input Box canceled?
    If UserRange Is Nothing Then
        MsgBox "Canceled."
    Else
        UserRange.Formula = "=RAND()"
    End If
End Sub
```

The input box is shown in Figure 11-6.

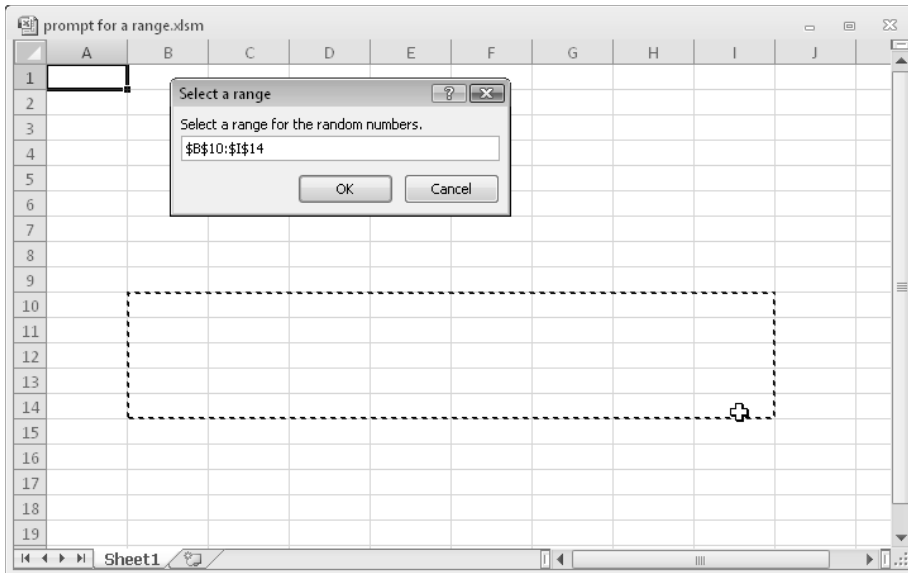


Figure 11-6: Use an input box to pause a macro.



Cross-Ref

This example, named `prompt for a range.xlsm`, is available on the companion CD-ROM.

Specifying a `Type` argument of 8 for the `InputBox` method is the key to this procedure. Also, note the use of `On Error Resume Next`. This statement ignores the error that occurs if the user clicks the Cancel button. If so, the `UserRange` object variable isn't defined. This example displays a message box with the text `Canceled`. If the user clicks OK, the macro continues. Using `On Error GoTo 0` resumes normal error handling.

By the way, you don't need to check for a valid range selection. Excel takes care of this task for you.



Caution

Make sure that screen updating isn't turned off when you use the `InputBox` method to select a range. Otherwise, you won't be able to make a worksheet selection. Use the `ScreenUpdating` property of the `Application` object to control screen updating while a macro is running.

Counting selected cells

You can create a macro that works with the range of cells selected by the user. Use the `Count` property of the `Range` object to determine how many cells are contained in a range selection (or any range, for that matter). For example, the following statement displays a message box that contains the number of cells in the current selection:

```
MsgBox Selection.Count
```



Caution

With the larger worksheet size in recent versions of Excel 2010, the `Count` property can generate an error. The `Count` property uses the `Long` data type, so the largest value that it can store is 2,147,483,647. For example, if the user selects 2,048 complete columns (2,147,483,648 cells), the `Count` property generates an error. Fortunately, Microsoft added a new property beginning with Excel 2007: `CountLarge`. `CountLarge` uses the `Double` data type, which can handle values up to 1.79×10^{308} .

Bottom line? In the vast majority of situations, the `Count` property will work fine. If there's a chance that you may need to count more cells (such as all cells in a worksheet), use `CountLarge` instead of `Count`.

If the active sheet contains a range named `data`, the following statement assigns the number of cells in the `data` range to a variable named `CellCount`:

```
CellCount = Range("data").Count
```

You can also determine how many rows or columns are contained in a range. The following expression calculates the number of columns in the currently selected range:

```
Selection.Columns.Count
```

And, of course, you can also use the `Rows` property to determine the number of rows in a range. The following statement counts the number of rows in a range named `data` and assigns the number to a variable named `RowCount`:

```
RowCount = Range("data").Rows.Count
```

Determining the type of selected range

Excel supports several types of range selections:

- A single cell
- A contiguous range of cells
- One or more entire columns
- One or more entire rows
- The entire worksheet
- Any combination of the preceding (that is, a multiple selection)

As a result, when your VBA procedure processes a user-selected range, you can't make any presumptions about what that range might be. For example, the range selection might consist of two areas, say `A1:A10` and `C1:C10`. (To make a multiple selection, press `Ctrl` while you select the ranges with your mouse.)

In the case of a multiple range selection, the `Range` object comprises separate areas. To determine whether a selection is a multiple selection, use the `Areas` method, which returns an `Areas` collection. This collection represents all the ranges within a multiple range selection.

You can use an expression like the following to determine whether a selected range has multiple areas:

```
NumAreas = Selection.Areas.Count
```

If the `NumAreas` variable contains a value greater than 1, the selection is a multiple selection.

Following is a function named `AreaType`, which returns a text string that describes the type of range selection.

```
Function AreaType(RangeArea As Range) As String
'   Returns the type of a range in an area
  Select Case True
    Case RangeArea.Cells.CountLarge = 1
      AreaType = "Cell"
    Case RangeArea.CountLarge = Cells.CountLarge
      AreaType = "Worksheet"
    Case RangeArea.Rows.Count = Cells.Rows.Count
      AreaType = "Column"
    Case RangeArea.Columns.Count = Cells.Columns.Count
      AreaType = "Row"
    Case Else
      AreaType = "Block"
  End Select
End Function
```

This function accepts a `Range` object as its argument and returns one of five strings that describe the area: `Cell`, `Worksheet`, `Column`, `Row`, or `Block`. The function uses a `Select Case` construct to determine which of five comparison expressions is `True`. For example, if the range consists of a single cell, the function returns `Cell`. If the number of cells in the range is equal to the number of cells in the worksheet, it returns `Worksheet`. If the number of rows in the range equals the number of rows in the worksheet, it returns `Column`. If the number of columns in the range equals the number of columns in the worksheet, the function returns `Row`. If none of the `Case` expressions is `True`, the function returns `Block`.

Notice that I used the `CountLarge` property when counting cells. As I noted previously in this chapter, the number of selected cells could potentially exceed the limit of the `Count` property.



Cross-Ref

This example is available on the companion CD-ROM in a file named `about range selection.xlsm`. The workbook contains a procedure (named `RangeDescription`) that uses the `AreaType` function to display a message box that describes the current range selection. Figure 11-7 shows an example. Understanding how this routine works will give you a good foundation for working with `Range` objects.



Note

You might be surprised to discover that Excel allows multiple selections to be identical. For example, if you hold down `Ctrl` and click five times in cell `A1`, the selection will have five identical areas. The `RangeDescription` procedure takes this possibility into account, and doesn't count the same cell multiple times.

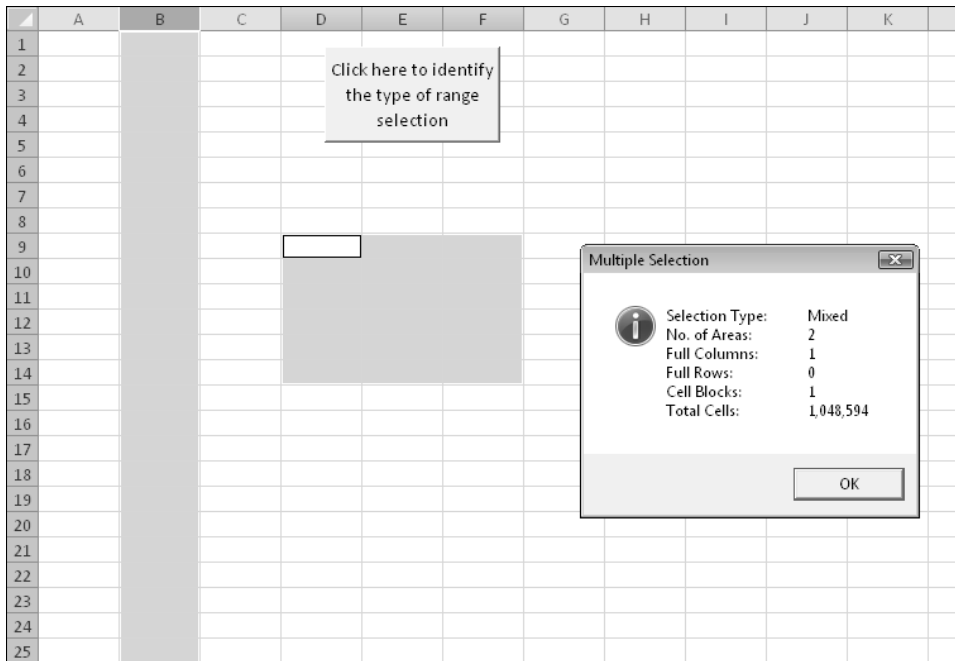


Figure 11-7: A VBA procedure analyzes the currently selected range.

Looping through a selected range efficiently

A common task is to create a macro that evaluates each cell in a range and performs an operation if the cell meets a certain criterion. The procedure that follows is an example of such a macro. The `ColorNegative` procedure sets the cell's background color to red for cells that contain a negative value. For non-negative value cells, it sets the background color to none.



This example is for educational purposes only. Using Excel's conditional formatting is a much better approach.

```
Sub ColorNegative()
' Makes negative cells red
Dim cell As Range
If TypeName(Selection) <> "Range" Then Exit Sub
Application.ScreenUpdating = False
For Each cell In Selection
    If cell.Value < 0 Then
        cell.Interior.Color = RGB(255, 0, 0)
    Else
        cell.Interior.Color = xlNone
    End If
Next cell
End Sub
```

The `ColorNegative` procedure certainly works, but it has a serious flaw. For example, what if the used area on the worksheet were small, but the user selects an entire column? Or ten columns? Or the entire worksheet? You don't need to process all those empty cells, and the user would probably give up long before your code churns through all those cells.

A better solution (`ColorNegative2`) follows. In this revised procedure, I create a `Range` object variable, `WorkRange`, which consists of the intersection of the selected range and the worksheet's used range. Figure 11-8 shows an example; the entire column D is selected (1,048,576 cells). The worksheet's used range, however, consists of the range B2:I16. Therefore, the intersection of these ranges is D2:D16, which is a much smaller range than the original selection. The time difference between processing 15 cells versus processing 1,048,576 cells is significant.

	A	B	C	D	E	F	G	H	I
1									
2		-5	0	-7	3	-3	7	-6	-9
3		-5	-6	-6	-10	-1	10	9	-10
4		-2	5	1	4	-3	3	-8	-3
5		1	8	-3	-8	1	8	8	6
6		0	-4	-3	3	-1	7	5	2
7		-10	4	1	8	1	-8	7	9
8		5	-4	-1	7	10	-1	8	-3
9		1	4	1	-8	-2	-1	-6	8
10		-8	-3	10	-1	7	6	7	9
11		0	-2	-2	-1	9	7	7	7
12		10	4	7	6	10	-10	10	4
13		-5	-1	9	7	0	8	6	9
14		3	-4	10	-10	9	-9	2	-4
15		4	9	0	8	4	7	-1	-4
16		0	1	9	-9	2	7	-7	0
17									
18									
19									

Figure 11-8: Using the intersection of the used range and the selected range results in fewer cells to process.

```
Sub ColorNegative2()
' Makes negative cells red
Dim WorkRange As Range
Dim cell As Range
If TypeName(Selection) <> "Range" Then Exit Sub
Application.ScreenUpdating = False
Set WorkRange = Application.Intersect(Selection, _
    ActiveSheet.UsedRange)
For Each cell In WorkRange
    If cell.Value < 0 Then
        cell.Interior.Color = RGB(255, 0, 0)
    Else
        cell.Interior.Color = xlNone
    End If
Next cell
End Sub
```

The `ColorNegative2` procedure is an improvement, but it's still not as efficient as it could be because it processes empty cells. A third revision, `ColorNegative3`, is quite a bit longer, but it's much more efficient. I use the `SpecialCells` method to generate two subsets of the selection: One subset (`ConstantCells`) includes only the cells with numeric constants; the other subset (`FormulaCells`) includes only the cells with numeric formulas. The code processes the cells in these subsets by using two `For Each-Next` constructs. The net effect: Only nonblank, nontext cells are evaluated, thus speeding up the macro considerably.

```
Sub ColorNegative3()
'   Makes negative cells red
    Dim FormulaCells As Range, ConstantCells As Range
    Dim cell As Range
    If TypeName(Selection) <> "Range" Then Exit Sub
    Application.ScreenUpdating = False

'   Create subsets of original selection
    On Error Resume Next
    Set FormulaCells = Selection.SpecialCells(xlFormulas, xlNumbers)
    Set ConstantCells = Selection.SpecialCells(xlConstants, xlNumbers)
    On Error GoTo 0
'   Process the formula cells
    If Not FormulaCells Is Nothing Then
        For Each cell In FormulaCells
            If cell.Value < 0 Then
                cell.Interior.Color = RGB(255, 0, 0)
            Else
                cell.Interior.Color = xlNone
            End If
        Next cell
    End If
'   Process the constant cells
    If Not ConstantCells Is Nothing Then
        For Each cell In ConstantCells
            If cell.Value < 0 Then
                cell.Interior.Color = RGB(255, 0, 0)
            Else
                cell.Interior.Color = xlNone
            End If
        Next cell
    End If
End Sub
```



Note

The `On Error` statement is necessary because the `SpecialCells` method generates an error if no cells qualify.



Cross-Ref

A workbook that contains the three `ColorNegative` procedures is available on the companion CD-ROM. The file is named `efficient looping.xlsm`.

Deleting all empty rows

The following procedure deletes all empty rows in the active worksheet. This routine is fast and efficient because it doesn't check all rows. It checks only the rows in the used range, which is determined by using the `UsedRange` property of the `Worksheet` object.

```
Sub DeleteEmptyRows()  
    Dim LastRow As Long  
    Dim r As Long  
    Dim Counter As Long  
    Application.ScreenUpdating = False  
    LastRow = ActiveSheet.UsedRange.Rows.Count + _  
        ActiveSheet.UsedRange.Rows(1).Row - 1  
    For r = LastRow To 1 Step -1  
        If Application.WorksheetFunction.CountA(Rows(r)) = 0 Then  
            Rows(r).Delete  
            Counter = Counter + 1  
        End If  
    Next r  
    Application.ScreenUpdating = True  
    MsgBox Counter & " empty rows were deleted."  
End Sub
```

The first step is to determine the last used row and then assign this row number to the `LastRow` variable. This calculation isn't as simple as you might think because the used range may or may not begin in row 1. Therefore, `LastRow` is calculated by determining the number of rows in the used range, adding the first row number in the used range, and subtracting 1.

The procedure uses Excel's `COUNTA` worksheet function to determine whether a row is empty. If this function returns 0 for a particular row, the row is empty. Notice that the procedure works on the rows from bottom to top and also uses a negative step value in the `For-Next` loop. This negative step value is necessary because deleting rows causes all subsequent rows to move up in the worksheet. If the looping occurred from top to bottom, the counter within the loop wouldn't be accurate after a row is deleted.

The macro uses another variable, `Counter`, to keep track of how many rows were deleted. This number is displayed in a message box when the procedure ends.



Cross-Ref

A workbook that contains this example is available on the companion CD-ROM in a file named `delete empty rows.xlsm`.

Duplicating rows a variable number of times

The example in this section demonstrates how to use VBA to create duplicates of a row. Figure 11-9 shows a worksheet for an office raffle. Column A contains the name, and column B contains the number of tickets purchased by each person. Column C contains a random number (generated

by the RAND function). The winner will be determined by sorting the data based on column 3 (the highest random number wins).

	A	B	C	D
1	Name	No. Tickets	Random	
2	Alan	1	0.07987701	
3	Barbara	2	0.99031952	
4	Charlie	1	0.60364364	
5	Dave	5	0.90840464	
6	Frank	3	0.91514996	
7	Gilda	1	0.90027277	
8	Hubert	1	0.1048423	
9	Inez	2	0.0910841	
10	Mark	1	0.50256856	
11	Norah	10	0.97290029	
12	Penelope	2	0.14995557	
13	Rance	1	0.05694515	
14	Wendy	2	0.30601043	
15				

Figure 11-9: The goal is to duplicate rows based on the value in column B.

The goal is to duplicate the rows so that each person will have a row for each ticket purchased. For example, Barbara purchased two tickets, so she should have two rows. The procedure to insert the new rows is shown here:

```
Sub DupeRows()
    Dim cell As Range
    ' 1st cell with number of tickets
    Set cell = Range("B2")
    Do While Not IsEmpty(cell)
        If cell > 1 Then
            Range(cell.Offset(1, 0), cell.Offset(cell.Value - 1, _
                0)).EntireRow.Insert
            Range(cell, cell.Offset(cell.Value - 1, 1)).EntireRow.FillDown
        End If
        Set cell = cell.Offset(cell.Value, 0)
    Loop
End Sub
```

The `cell` object variable is initialized to cell B2, the first cell that has a number. The loop inserts new rows and then copies the row using the `FillDown` method. The `cell` variable is incremented to the next person, and the loop continues until an empty cell is encountered. Figure 11-10 shows the worksheet after running this procedure.



Cross-Ref

A workbook that contains this example is available on the companion CD-ROM. The file is named `duplicate rows.xlsm`.

	A	B	C	D
1	Name	No. Tickets	Random	
2	Alan	1	0.68771157	
3	Barbara	2	0.74151011	
4	Barbara	2	0.85520705	
5	Charlie	1	0.73332976	
6	Dave	5	0.99957885	
7	Dave	5	0.71642623	
8	Dave	5	0.32573479	
9	Dave	5	0.95313647	
10	Dave	5	0.09885253	
11	Frank	3	0.38696819	
12	Frank	3	0.40951989	
13	Frank	3	0.01047686	
14	Gilda	1	0.73986656	
15	Hubert	1	0.31302036	
16	Inez	2	0.09629546	
17	Inez	2	0.7406352	
18	Mark	1	0.10237242	
19	Norah	10	0.61515667	
20	Norah	10	0.37511779	
21	Norah	10	0.3017492	
22	Norah	10	0.03892754	
23	Norah	10	0.88545176	
24	Norah	10	0.30386286	
25	Norah	10	0.2008295	
26	Norah	10	0.57932419	
27	Norah	10	0.04228009	
28	Norah	10	0.47085364	
29	Penelope	2	0.78530293	
30	Penelope	2	0.80008606	
31	Rance	1	0.87725432	
32	Wendy	2	0.55074661	
33	Wendy	2	0.4916796	
34				

Figure 11-10: New rows were added, according to the value in column B.

Determining whether a range is contained in another range

The following `InRange` function accepts two arguments, both `Range` objects. The function returns `True` if the first range is contained in the second range.

```
Function InRange(rng1, rng2) As Boolean
' Returns True if rng1 is a subset of rng2
InRange = False
If rng1.Parent.Parent.Name = rng2.Parent.Parent.Name Then
    If rng1.Parent.Name = rng2.Parent.Name Then
        If Union(rng1, rng2).Address = rng2.Address Then
            InRange = True
        End If
    End If
End If
End Function
```

The `InRange` function may appear a bit more complex than it needs to be because the code needs to ensure that the two ranges are in the same worksheet and workbook. Notice that the procedure uses the `Parent` property, which returns an object's container object. For example, the following expression returns the name of the worksheet for the `rng1` object reference:

```
rng1.Parent.Name
```

The following expression returns the name of the workbook for `rng1`:

```
rng1.Parent.Parent.Name
```

VBA's `Union` function returns a `Range` object that represents the union of two `Range` objects. The union consists of all the cells from both ranges. If the address of the union of the two ranges is the same as the address of the second range, the first range is contained within the second range.



Cross-Ref

A workbook that contains this function is available on the companion CD-ROM in a file named `inrange function.xlsm`.

Determining a cell's data type

Excel provides a number of built-in functions that can help determine the type of data contained in a cell. These include `ISTEXT`, `ISLOGICAL`, and `ISERROR`. In addition, VBA includes functions such as `IsEmpty`, `IsDate`, and `IsNumeric`.

The following function, named `CellType`, accepts a range argument and returns a string (Blank, Text, Logical, Error, Date, Time, or Number) that describes the data type of the upper-left cell in the range. You can use this function in a worksheet formula or from another VBA procedure.

```
Function CellType(Rng) As String
' Returns the cell type of the upper left
' cell in a range
Dim TheCell As Range
Set TheCell = Rng.Range("A1")
Select Case True
    Case IsEmpty(TheCell)
        CellType = "Blank"
    Case Application.IsText(TheCell)
        CellType = "Text"
    Case Application.IsLogical(TheCell)
        CellType = "Logical"
    Case Application.IsErr(TheCell)
        CellType = "Error"
```

```

    Case IsDate(TheCell)
        CellType = "Date"
    Case InStr(1, TheCell.Text, ":") <> 0
        CellType = "Time"
    Case IsNumeric(TheCell)
        CellType = "Number"
End Select
End Function

```

Notice the use of the `Set TheCell` statement. The `CellType` function accepts a range argument of any size, but this statement causes it to operate on only the upper-left cell in the range (which is represented by the `TheCell` variable).



Cross-Ref

A workbook that contains this function is available on the companion CD-ROM. The file is named `celltype function.xlsm`.

Reading and writing ranges

Many VBA tasks involve transferring values either from an array to a range or from a range to an array. Excel reads from ranges much faster than it writes to ranges because the latter operation involves the calculation engine. The `WriteReadRange` procedure that follows demonstrates the relative speeds of writing and reading a range.

This procedure creates an array and then uses `For-Next` loops to write the array to a range and then read the range back into the array. It calculates the time required for each operation by using the Excel `Timer` function.

```

Sub WriteReadRange()
    Dim MyArray()
    Dim Time1 As Double
    Dim NumElements As Long, i As Long
    Dim WriteTime As String, ReadTime As String
    Dim Msg As String
    NumElements = 60000
    ReDim MyArray(1 To NumElements)

    ' Fill the array
    For i = 1 To NumElements
        MyArray(i) = i
    Next i

    ' Write the array to a range
    Time1 = Timer
    For i = 1 To NumElements
        Cells(i, 1) = MyArray(i)
    Next i

```



```

WriteTime = Format(Timer - Time1, "00:00")

' Read the range into the array
Time1 = Timer
For i = 1 To NumElements
    MyArray(i) = Cells(i, 1)
Next i
ReadTime = Format(Timer - Time1, "00:00")

' Show results
Msg = "Write: " & WriteTime
Msg = Msg & vbCrLf
Msg = Msg & "Read: " & ReadTime
MsgBox Msg, vbOKOnly, NumElements & " Elements"
End Sub

```

On my system, it took 58 seconds to write a 60,000-element array to a range, but it took less than 1 second to read the range into an array.

A better way to write to a range

The example in the preceding section uses a `For-Next` loop to transfer the contents of an array to a worksheet range. In this section, I demonstrate a more efficient way to accomplish this.

Start with the example that follows, which illustrates the most obvious (but not the most efficient) way to fill a range. This example uses a `For-Next` loop to insert its values in a range.

```

Sub LoopFillRange()
' Fill a range by looping through cells
Dim CellsDown As Long, CellsAcross As Integer
Dim CurrRow As Long, CurrCol As Integer
Dim StartTime As Double
Dim CurrVal As Long

' Get the dimensions
CellsDown = InputBox("How many cells down?")
If CellsDown = 0 Then Exit Sub
CellsAcross = InputBox("How many cells across?")
If CellsAcross = 0 Then Exit Sub

' Record starting time
StartTime = Timer

' Loop through cells and insert values
CurrVal = 1
Application.ScreenUpdating = False
For CurrRow = 1 To CellsDown
    For CurrCol = 1 To CellsAcross
        ActiveCell.Offset(CurrRow - 1, _
            CurrCol - 1).Value = CurrVal
    Next CurrCol
Next CurrRow

```

```

        CurrVal = CurrVal + 1
    Next CurrCol
Next CurrRow

' Display elapsed time
Application.ScreenUpdating = True
MsgBox Format(Timer - StartTime, "00.00") & " seconds"
End Sub

```

The example that follows demonstrates a much faster way to produce the same result. This code inserts the values into an array and then uses a single statement to transfer the contents of an array to the range.

```

Sub ArrayFillRange()
' Fill a range by transferring an array
Dim CellsDown As Long, CellsAcross As Integer
Dim i As Long, j As Integer
Dim StartTime As Double
Dim TempArray() As Long
Dim TheRange As Range
Dim CurrVal As Long
' Get the dimensions
CellsDown = InputBox("How many cells down?")
If CellsDown = 0 Then Exit Sub
CellsAcross = InputBox("How many cells across?")
If CellsAcross = 0 Then Exit Sub
' Record starting time
StartTime = Timer
' Redimension temporary array
ReDim TempArray(1 To CellsDown, 1 To CellsAcross)
' Set worksheet range
Set TheRange = ActiveCell.Range(Cells(1, 1), _
    Cells(CellsDown, CellsAcross))
' Fill the temporary array
CurrVal = 0
Application.ScreenUpdating = False
For i = 1 To CellsDown
    For j = 1 To CellsAcross
        TempArray(i, j) = CurrVal + 1
        CurrVal = CurrVal + 1
    Next j
Next i
' Transfer temporary array to worksheet
TheRange.Value = TempArray
' Display elapsed time
Application.ScreenUpdating = True
MsgBox Format(Timer - StartTime, "00.00") & " seconds"
End Sub

```

On my system, using the loop method to fill a 1000 x 250-cell range (250,000 cells) took 10.05 seconds. The array transfer method took only 00.18 seconds to generate the same results — more than 50 times faster! The moral of this story? If you need to transfer large amounts of data to a worksheet, avoid looping whenever possible.



Note

The timing results are highly dependent on the presence of formulas. Generally, you'll get faster transfer times if no workbooks are open that contain formulas, or if you set the calculation mode to Manual.



Cross-Ref

A workbook that contains the `WriteReadRange`, `LoopFillRange`, and `ArrayFillRange` procedures is available on the companion CD-ROM. The file is named `loop vs array fill range.xlsm`.

Transferring one-dimensional arrays

The example in the preceding section involves a two-dimensional array, which works out nicely for row-and-column-based worksheets.

When transferring a one-dimensional array to a range, the range must be horizontal — that is, one row with multiple *columns*. If you need the data in a vertical range instead, you must first transpose the array to make it vertical. You can use Excel's `TRANSPOSE` function to do this. The following example transfers a 100-element array to a vertical worksheet range (A1:A100):

```
Range("A1:A100").Value = Application.WorksheetFunction.Transpose(MyArray)
```



Caution

Excel's `TRANSPOSE` function doesn't work with arrays that exceed 65,536 elements.

Transferring a range to a variant array

This section discusses yet another way to work with worksheet data in VBA. The following example transfers a range of cells to a two-dimensional variant array. Then message boxes display the upper bounds for each dimension of the variant array.

```
Sub RangeToVariant()  
    Dim x As Variant  
    x = Range("A1:L600").Value  
    MsgBox UBound(x, 1)  
    MsgBox UBound(x, 2)  
End Sub
```

In this example, the first message box displays 600 (the number of rows in the original range), and the second message box displays 12 (the number of columns). You'll find that transferring the range data to a variant array is virtually instantaneous.

The following example reads a range (named `data`) into a variant array, performs a simple multiplication operation on each element in the array, and then transfers the variant array back to the range:

```
Sub RangeToVariant2()
    Dim x As Variant
    Dim r As Long, c As Integer
    ' Read the data into the variant
    x = Range("data").Value

    ' Loop through the variant array
    For r = 1 To UBound(x, 1)
        For c = 1 To UBound(x, 2)
            ' Multiply by 2
            x(r, c) = x(r, c) * 2
        Next c
    Next r
    ' Transfer the variant back to the sheet
    Range("data") = x
End Sub
```

You'll find that this procedure runs amazingly fast. Working with 30,000 cells took less than one second.



Cross-Ref

A workbook that contains this example is available on the companion CD-ROM. The file is named `variant transfer.xlsm`.

Selecting cells by value

The example in this section demonstrates how to select cells based on their value. Oddly, Excel doesn't provide a direct way to perform this operation. My `SelectByValue` procedure follows. In this example, the code selects cells that contain a negative value, but you can easily change the code to select cells based on other criteria.

```
Sub SelectByValue()
    Dim Cell As Object
    Dim FoundCells As Range
    Dim WorkRange As Range

    If TypeName(Selection) <> "Range" Then Exit Sub

    ' Check all or selection?
```

```

If Selection.CountLarge = 1 Then
    Set WorkRange = ActiveSheet.UsedRange
Else
    Set WorkRange = Application.Intersect(Selection, ActiveSheet.UsedRange)
End If

' Reduce the search to numeric cells only
On Error Resume Next
Set WorkRange = WorkRange.SpecialCells(xlConstants, xlNumbers)
If WorkRange Is Nothing Then Exit Sub
On Error GoTo 0

' Loop through each cell, add to the FoundCells range if it qualifies
For Each Cell In WorkRange
    If Cell.Value < 0 Then
        If FoundCells Is Nothing Then
            Set FoundCells = Cell
        Else
            Set FoundCells = Union(FoundCells, Cell)
        End If
    End If
Next Cell
' Show message, or select the cells
If FoundCells Is Nothing Then
    MsgBox "No cells qualify."
Else
    FoundCells.Select
End If
End Sub

```

The procedure starts by checking the selection. If it's a single cell, then the entire worksheet is searched. If the selection is at least two cells, then only the selected range is searched. The range to be searched is further refined by using the `SpecialCells` method to create a `Range` object that consists only of the numeric constants.

The code within the `For-Next` loop examines the cell's value. If it meets the criterion (less than 0), then the cell is added to the `FoundCells` `Range` object by using the `Union` method. Note that you can't use the `Union` method for the first cell. If the `FoundCells` range contains no cells, attempting to use the `Union` method will generate an error. Therefore, the code checks whether `FoundCells` is `Nothing`.

When the loop ends, the `FoundCells` object will consist of the cells that meet the criterion (or will be `Nothing` if no cells were found). If no cells are found, a message box appears. Otherwise, the cells are selected.



Cross-Ref

This example is available on the companion CD-ROM. The file is named `select by value.xlsm`.

Copying a noncontiguous range

If you've ever attempted to copy a noncontiguous range selection, you discovered that Excel doesn't support such an operation. Attempting to do so brings up an error message: *That command cannot be used on multiple selections*.

An exception is when you attempt to copy a multiple selection that consists of entire rows or columns. Excel *does* allow that operation.

When you encounter a limitation in Excel, you can often circumvent it by creating a macro. The example in this section is a VBA procedure that allows you to copy a multiple selection to another location.

```
Sub CopyMultipleSelection()
    Dim SelAreas() As Range
    Dim PasteRange As Range
    Dim UpperLeft As Range
    Dim NumAreas As Long, i As Long
    Dim TopRow As Long, LeftCol As Long
    Dim RowOffset As Long, ColOffset As Long

    If TypeName(Selection) <> "Range" Then Exit Sub

    ' Store the areas as separate Range objects
    NumAreas = Selection.Areas.Count
    ReDim SelAreas(1 To NumAreas)
    For i = 1 To NumAreas
        Set SelAreas(i) = Selection.Areas(i)
    Next

    ' Determine the upper-left cell in the multiple selection
    TopRow = ActiveSheet.Rows.Count
    LeftCol = ActiveSheet.Columns.Count
    For i = 1 To NumAreas
        If SelAreas(i).Row < TopRow Then TopRow = SelAreas(i).Row
        If SelAreas(i).Column < LeftCol Then LeftCol = SelAreas(i).Column
    Next
    Set UpperLeft = Cells(TopRow, LeftCol)

    ' Get the paste address
    On Error Resume Next
    Set PasteRange = Application.InputBox _
        (Prompt:="Specify the upper-left cell for the paste range:", _
        Title:="Copy Multiple Selection", _
        Type:=8)
    On Error GoTo 0

    ' Exit if canceled
    If TypeName(PasteRange) <> "Range" Then Exit Sub

    ' Make sure only the upper-left cell is used
```

```

Set PasteRange = PasteRange.Range("A1")

' Copy and paste each area
For i = 1 To NumAreas
    RowOffset = SelAreas(i).Row - TopRow
    ColOffset = SelAreas(i).Column - LeftCol
    SelAreas(i).Copy PasteRange.Offset(RowOffset, ColOffset)
Next i
End Sub

```

Figure 11-11 shows the prompt to select the destination location.



Cross-Ref

The companion CD-ROM contains a workbook with this example, plus another version that warns the user if data will be overwritten. The file is named `copy multiple selection.xlsm`.

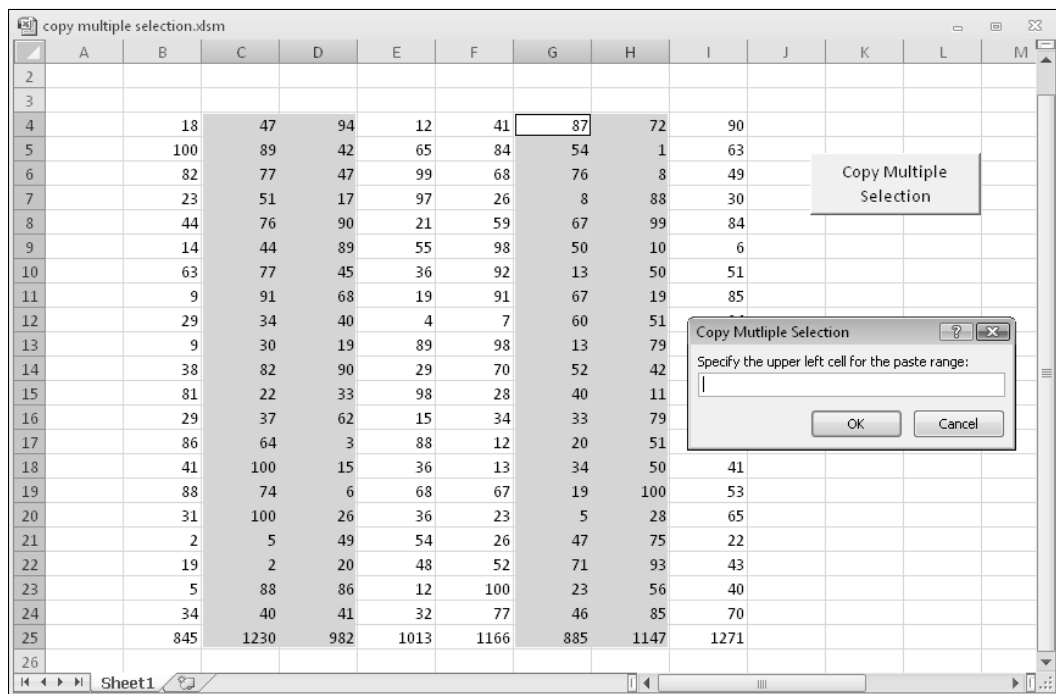


Figure 11-11: Using Excel's `InputBox` method to prompt for a cell location.

Working with Workbooks and Sheets

The examples in this section demonstrate various ways to use VBA to work with workbooks and worksheets.

Saving all workbooks

The following procedure loops through all workbooks in the `Workbooks` collection and saves each file that has been saved previously:

```
Public Sub SaveAllWorkbooks()  
    Dim Book As Workbook  
    For Each Book In Workbooks  
        If Book.Path <> "" Then Book.Save  
    Next Book  
End Sub
```

Notice the use of the `Path` property. If a workbook's `Path` property is empty, the file has never been saved (it's a newly created workbook). This procedure ignores such workbooks and saves only the workbooks that have a non-empty `Path` property.

Saving and closing all workbooks

The following procedure loops through the `Workbooks` collection. The code saves and closes all workbooks.

```
Sub CloseAllWorkbooks()  
    Dim Book As Workbook  
    For Each Book In Workbooks  
        If Book.Name <> ThisWorkbook.Name Then  
            Book.Close savechanges:=True  
        End If  
    Next Book  
    ThisWorkbook.Close savechanges:=True  
End Sub
```

The procedure uses an `If` statement within the `For-Next` loop to determine whether the workbook is the workbook that contains the code. This statement is necessary because closing the workbook that contains the procedure would end the code, and subsequent workbooks wouldn't be affected. After all the other workbooks are closed, the workbook that contains the code closes itself.

Hiding all but the selection

The example in this section hides all rows and columns in a worksheet except those in the current range selection. Figure 11-12 shows an example.

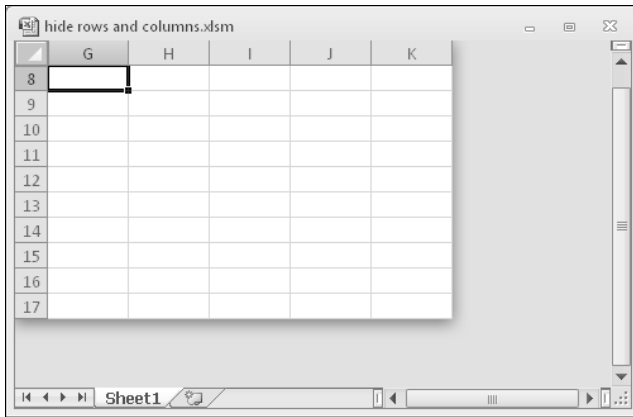


Figure 11-12: All rows and columns are hidden, except for a range (G8:K17).

```
Sub HideRowsAndColumns()
    Dim row1 As Long, row2 As Long
    Dim col1 As Long, col2 As Long

    If TypeName(Selection) <> "Range" Then Exit Sub

    ' If last row or last column is hidden, unhide all and quit
    If Rows(Rows.Count).EntireRow.Hidden Or _
        Columns(Columns.Count).EntireColumn.Hidden Then
        Cells.EntireColumn.Hidden = False
        Cells.EntireRow.Hidden = False
        Exit Sub
    End If

    row1 = Selection.Rows(1).Row
    row2 = row1 + Selection.Rows.Count - 1
    col1 = Selection.Columns(1).Column
    col2 = col1 + Selection.Columns.Count - 1

    Application.ScreenUpdating = False
    On Error Resume Next
    ' Hide rows
    Range(Cells(1, 1), Cells(row1 - 1, 1)).EntireRow.Hidden = True
    Range(Cells(row2 + 1, 1), Cells(Rows.Count, 1)).EntireRow.Hidden = True
    ' Hide columns
    Range(Cells(1, 1), Cells(1, col1 - 1)).EntireColumn.Hidden = True
    Range(Cells(1, col2 + 1), Cells(1, Columns.Count)).EntireColumn.Hidden = True
End Sub
```

If the range selection consists of a noncontiguous range, the first area is used as the basis for hiding rows and columns.



Cross-Ref

A workbook with this example is available on the companion CD-ROM. The file is named `hide rows and columns.xlsm`.

Synchronizing worksheets

If you use multisheet workbooks, you probably know that Excel can't synchronize the sheets in a workbook. In other words, there is no automatic way to force all sheets to have the same selected range and upper-left cell. The VBA macro that follows uses the active worksheet as a base and then performs the following on all other worksheets in the workbook:

- Selects the same range as the active sheet.
- Makes the upper-left cell the same as the active sheet.

Following is the listing for the procedure:

```
Sub SynchSheets()
'   Duplicates the active sheet's active cell and upper left cell
'   Across all worksheets
'   If TypeName(ActiveSheet) <> "Worksheet" Then Exit Sub
'   Dim UserSheet As Worksheet, sht As Worksheet
'   Dim TopRow As Long, LeftCol As Integer
'   Dim UserSel As String

'   Application.ScreenUpdating = False
'   Remember the current sheet
'   Set UserSheet = ActiveSheet

'   Store info from the active sheet
'   TopRow = ActiveWindow.ScrollRow
'   LeftCol = ActiveWindow.ScrollColumn
'   UserSel = ActiveWindow.RangeSelection.Address

'   Loop through the worksheets
'   For Each sht In ActiveWorkbook.Worksheets
'       If sht.Visible Then 'skip hidden sheets
'           sht.Activate
'           Range(UserSel).Select
'           ActiveWindow.ScrollRow = TopRow
'           ActiveWindow.ScrollColumn = LeftCol
'       End If
'   Next sht

'   Restore the original position
'   UserSheet.Activate
'   Application.ScreenUpdating = True
End Sub
```



A workbook with this example is available on the companion CD-ROM in a file named `synchronize sheets.xlsm`.

VBA Techniques

The examples in this section illustrate common VBA techniques that you might be able to adapt to your own projects.

Toggling a Boolean property

A *Boolean property* is one that is either `True` or `False`. The easiest way to toggle a Boolean property is to use the `Not` operator, as shown in the following example, which toggles the `WrapText` property of a selection.

```
Sub ToggleWrapText()  
    ' Toggles text wrap alignment for selected cells  
    If TypeName(Selection) = "Range" Then  
        Selection.WrapText = Not ActiveCell.WrapText  
    End If  
End Sub
```

You can modify this procedure to toggle other Boolean properties.

Note that the active cell is used as the basis for toggling. When a range is selected and the property values in the cells are inconsistent (for example, some cells are bold, and others are not), it's considered *mixed*, and Excel uses the active cell to determine how to toggle. If the active cell is bold, for example, all cells in the selection are made not bold when you click the Bold button. This simple procedure mimics the way Excel works, which is usually the best practice.

Note also that this procedure uses the `TypeName` function to check whether the selection is a range. If the selection isn't a range, nothing happens.

You can use the `Not` operator to toggle many other properties. For example, to toggle the display of row and column borders in a worksheet, use the following code:

```
ActiveWindow.DisplayHeadings = Not ActiveWindow.DisplayHeadings
```

To toggle the display of gridlines in the active worksheet, use the following code:

```
ActiveWindow.DisplayGridlines = Not ActiveWindow.DisplayGridlines
```

Determining the number of printed pages

If you need to determine the number of printed pages for a worksheet printout, you can use Excel's Print Preview feature and view the page count displayed at the bottom of the screen. The VBA procedure that follows calculates the number of printed pages for the active sheet by counting the number of horizontal and vertical page breaks:

```
Sub PageCount()  
    MsgBox (ActiveSheet.HPageBreaks.Count + 1) * _  
        (ActiveSheet.VPageBreaks.Count + 1) & " pages"  
End Sub
```

The following VBA procedure loops through all worksheets in the active workbook and displays the total number of printed pages, as shown in Figure 11-13:

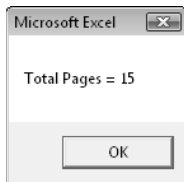


Figure 11-13: Using VBA to count the number of printed pages in a workbook.

```
Sub ShowPageCount()  
    Dim PageCount As Integer  
    Dim sht As Worksheet  
    PageCount = 0  
    For Each sht In Worksheets  
        PageCount = PageCount + (sht.HPageBreaks.Count + 1) * _  
            (sht.VPageBreaks.Count + 1)  
    Next sht  
    MsgBox "Total printed pages = " & PageCount  
End Sub
```



Cross-Ref

A workbook that contains this example is on the companion CD-ROM in a file named `page count.xlsm`.

Displaying the date and time

If you understand the serial number system that Excel uses to store dates and times, you won't have any problems using dates and times in your VBA procedures.

The `DateAndTime` procedure displays a message box with the current date and time, as depicted in Figure 11-14. This example also displays a personalized message in the message box title bar.



Figure 11-14: A message box displaying the date and time.

The procedure uses the `Date` function as an argument for the `Format` function. The result is a string with a nicely formatted date. I used the same technique to get a nicely formatted time.

```
Sub DateAndTime()
    Dim TheDate As String, TheTime As String
    Dim Greeting As String
    Dim FullName As String, FirstName As String
    Dim SpaceInName As Long
    TheDate = Format(Date, "Long Date")
    TheTime = Format(Time, "Medium Time")
    ' Determine greeting based on time
    Select Case Time
        Case Is < TimeValue("12:00"): Greeting = "Good Morning, "
        Case Is >= TimeValue("17:00"): Greeting = "Good Evening, "
        Case Else: Greeting = "Good Afternoon, "
    End Select
    ' Append user's first name to greeting
    FullName = Application.UserName
    SpaceInName = InStr(1, FullName, " ", 1)

    ' Handle situation when name has no space
    If SpaceInName = 0 Then SpaceInName = Len(FullName)
    FirstName = Left(FullName, SpaceInName)
    Greeting = Greeting & FirstName
    ' Show the message
    MsgBox TheDate & vbCrLf & vbCrLf & "It's " & TheTime, vbOKOnly, Greeting
End Sub
```

In the preceding example, I used named formats (`Long Date` and `Medium Time`) to ensure that the macro will work properly regardless of the user's international settings. You can, however, use other formats. For example, to display the date in `mm/dd/yy` format, you can use a statement like the following:

```
TheDate = Format(Date, "mm/dd/yy")
```

I used a `Select Case` construct to base the greeting displayed in the message box's title bar on the time of day. VBA time values work just as they do in Excel. If the time is less than .5 (noon), it's morning. If it's greater than .7083 (5 p.m.), it's evening. Otherwise, it's afternoon. I took the easy way out and used VBA's `TimeValue` function, which returns a time value from a string.

The next series of statements determines the user's first name, as recorded in the General tab in Excel's Options dialog box. I used VBA's `InStr` function to locate the first space in the user's name. When I first wrote this procedure, I didn't consider a username that has no space. So when I ran this procedure on a machine with a username of *Nobody*, the code failed — which goes to show you that I can't think of everything, and even the simplest procedures can run aground. (By the way, if the user's name is left blank, Excel always substitutes the name *User*.) The solution to this problem was to use the length of the full name for the `SpaceInName` variable so that the `Left` function extracts the full name.

The `MsgBox` function concatenates the date and time but uses the built-in `vbCrLf` constant to insert a line break between them. `vbOKOnly` is a predefined constant that returns 0, causing the message box to appear with only an OK button. The final argument is the `Greeting`, constructed earlier in the procedure.



Cross-Ref

The `DateAndTime` procedure is available on the companion CD-ROM in a file named `date and time.xlsm`.

Getting a list of fonts

If you need to get a list of all installed fonts, you'll find that Excel doesn't provide a direct way to retrieve that information. The technique described here takes advantage of the fact that (for compatibility purposes) Excel 2010 still supports the old `CommandBar` properties and methods. These properties and methods were used in pre-Excel 2007 versions to work with toolbars and menus.

The `ShowInstalledFonts` macro displays a list of the installed fonts in column A of the active worksheet. It creates a temporary toolbar (a `CommandBar` object), adds the `Font` control, and reads the font names from that control. The temporary toolbar is then deleted.

```
Sub ShowInstalledFonts()
    Dim FontList As CommandBarControl
    Dim TempBar As CommandBar
    Dim i As Long

    ' Create temporary CommandBar
    Set TempBar = Application.CommandBars.Add
    Set FontList = TempBar.Controls.Add(ID:=1728)

    ' Put the fonts into column A
    Range("A:A").ClearContents
    For i = 0 To FontList.ListCount - 1
        Cells(i + 1, 1) = FontList.List(i + 1)
    
```

```
Next i

' Delete temporary CommandBar
TempBar.Delete
End Sub
```



Tip

As an option, you can display each font name in the actual font (as shown in Figure 11-15). To do so, add this statement inside the `For-Next` loop:

```
Cells(i+1,1).Font.Name = FontList.List(i+1)
```

Be aware, however, that using many fonts in a workbook can eat up lots of system resources, and it could even crash your system.



Cross-Ref

This procedure is available on the companion CD-ROM. The file is named `list fonts.xlsm`.

	A	B
22	Batang	
23	BatangChe	
24	Bauhaus 93	
25	BAVEUSE	
26	Bean Town	
27	Bell MT	
28	Berlin Sans FB	
29	Berlin Sans FB Demi	
30	Bernard MT Condensed	
31	Beryllium	
32	BIONDI	
33	<i>Blackadder JTC</i>	
34	Blue Highway	
35	Blue Highway Condensed	
36	BLUE HIGHWAY D TYPE	
37	Blue Highway Linocut	
38	Bodoni MT	
39	Bodoni MT Black	
40	Bodoni MT Condensed	
41	Bodoni MT Poster Compressed	
42	Book Antiqua	
43	Bookman Old Style	
44	ŷ / / 7 - - - - - 8 9 = 4 3 8 = 7 9 = 0	

Figure 11-15: Listing font names in the actual fonts.

Sorting an array

Although Excel has a built-in command to sort worksheet ranges, VBA doesn't offer a method to sort arrays. One viable (but cumbersome) workaround is to transfer your array to a worksheet range, sort it by using Excel's commands, and then return the result to your array. But if speed is essential, it's better to write a sorting routine in VBA.

In this section, I cover four different sorting techniques:

- *Worksheet sort* transfers an array to a worksheet range, sorts it, and transfers it back to the array. This procedure accepts an array as its only argument.
- *Bubble sort* is a simple sorting technique (also used in the Chapter 9 sheet-sorting example). Although easy to program, the bubble-sorting algorithm tends to be rather slow, especially when the number of elements is large.
- *Quick sort* is a much faster sorting routine than bubble sort, but it is also more difficult to understand. This technique works only with `Integer` and `Long` data types.
- *Counting sort* is lightning fast, but also difficult to understand. Like the quick sort, this technique works only with `Integer` and `Long` data types.



Cross-Ref

The companion CD-ROM includes a workbook application (named `sorting demo.xlsx`) that demonstrates these sorting methods. This workbook is useful for comparing the techniques with arrays of varying sizes. However, you can also copy the procedures and use them in your code.

Figure 11-16 shows the dialog box for this project. I tested the sorting procedures with seven different array sizes, ranging from 100 to 100,000 elements. The arrays contained random numbers (of type `Long`).

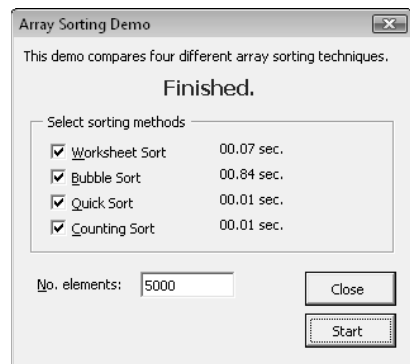


Figure 11-16: Comparing the time required to perform sorts of various array sizes.

Table 11-1 shows the results of my tests. A 0.00 entry means that the sort was virtually instantaneous (less than .01 second).

Table 11-1: Sorting Times (in Seconds) for Four Sort Algorithms Using Randomly Filled Arrays

Array Elements	Excel Worksheet Sort	VBA Bubble Sort	VBA Quick Sort	VBA Counting Sort
100	0.04	0.00	0.00	0.02
500	0.02	0.01	0.00	0.01
1,000	0.03	0.03	0.00	0.00
5,000	0.07	0.84	0.01	0.01
10,000	0.09	3.41	0.01	0.01
50,000	0.43	79.95	0.07	0.02
100,000	0.78	301.90	0.14	0.04

The worksheet sort algorithm is amazingly fast, especially when you consider that the values are transferred to the sheet, sorted, and then transferred back to the array.

The bubble sort algorithm is reasonably fast with small arrays, but for larger arrays (more than 10,000 elements), forget it. The quick sort and counting sort algorithms are blazingly fast, but they're limited to `Integer` and `Long` data types.

Processing a series of files

One common use for macros is to perform repetitive tasks. The example in this section demonstrates how to execute a macro on several different files stored on disk. This example — which may help you set up your own routine for this type of task — prompts the user for a file specification and then processes all matching files. In this case, processing consists of importing the file and entering a series of summary formulas that describe the data in the file.

```
Sub BatchProcess()
    Dim FileSpec As String
    Dim i As Integer
    Dim FileName As String
    Dim FileList() As String
    Dim FoundFiles As Integer
    ' Specify path and file spec
    FileSpec = ThisWorkbook.Path & "\" & "text???.txt"
    FileName = Dir(FileSpec)

    ' Was a file found?
    If FileName <> "" Then
        FoundFiles = 1
        ReDim Preserve FileList(1 To FoundFiles)
        FileList(FoundFiles) = FileName
    Else
        MsgBox "No files were found that match " & FileSpec
    End Sub
```

```

End If

' Get other filenames
Do
    FileName = Dir
    If FileName = "" Then Exit Do
    FoundFiles = FoundFiles + 1
    ReDim Preserve FileList(1 To FoundFiles)
    FileList(FoundFiles) = FileName & "*"
Loop
' Loop through the files and process them
For i = 1 To FoundFiles
    Call ProcessFiles(FileList(i))
Next i
End Sub

```



Cross-Ref

This example, named `batch processing.xlsm`, is on the companion CD-ROM. It uses three additional files (also on the CD): `text01.txt`, `text02.txt`, and `text03.txt`.

You'll need to modify the routine to import other text files.

The matching filenames are stored in an array named `FoundFiles`, and the procedure uses a `For-Next` loop to process the files. Within the loop, the processing is done by calling the `ProcessFiles` procedure, which follows. This simple procedure uses the `OpenText` method to import the file and then inserts five formulas. You may, of course, substitute your own routine in place of this one:

```

Sub ProcessFiles(FileName As String)
' Import the file
Workbooks.OpenText FileName:=FileName, _
    Origin:=xlWindows, _
    StartRow:=1, _
    DataType:=xlFixedWidth, _
    FieldInfo:= _
        Array(Array(0, 1), Array(3, 1), Array(12, 1))
' Enter summary formulas
Range("D1").Value = "A"
Range("D2").Value = "B"
Range("D3").Value = "C"
Range("E1:E3").Formula = "=COUNTIF(B:B,D1)"
Range("F1:F3").Formula = "=SUMIF(B:B,D1,C:C)"
End Sub

```



Cross-Ref

For more information about working with files using VBA, refer to Chapter 27.

Some Useful Functions for Use in Your Code

In this section, I present some custom utility functions that you may find useful in your own applications and that may provide inspiration for creating similar functions. These functions are most useful when called from another VBA procedure. Therefore, they're declared by using the `Private` keyword and thus won't appear in Excel's Insert Function dialog box.



Cross-Ref

The examples in this section are available on the companion CD-ROM. The file is named `VBA utility functions.xlsm`.

The FileExists function

This function takes one argument (a path with filename) and returns `True` if the file exists:

```
Private Function FileExists(fname) As Boolean
'   Returns TRUE if the file exists
    FileExists = (Dir(fname) <> "")
End Function
```

The FileNameOnly function

This function accepts one argument (a path with filename) and returns only the filename. In other words, it strips out the path.

```
Private Function FileNameOnly(pname) As String
'   Returns the filename from a path/filename string
    Dim temp As Variant
    length = Len(pname)
    temp = Split(pname, Application.PathSeparator)
    FileNameOnly = temp(UBound(temp))
End Function
```

The function uses the VBA `Split` function, which accepts a string (that includes delimiter characters), and returns a variant array that contains the elements between the delimiter characters. In this case the `temp` variable contains an array that consists of each text string between the `Application.PathSeparator` (usually a backslash character). For another example of the `Split` function, see “Extracting the nth element from a string,” later in this chapter.

If the argument is `c:\excel files\2010\backup\budget.xlsx`, the function returns the string `budget.xlsx`.

The `FileNameOnly` function works with any path and filename (even if the file *does not* exist). If the file exists, the following function is a simpler way to strip off the path and return only the filename:

```
Private Function FileNameOnly2(pname) As String
    FileNameOnly2 = Dir(pname)
End Function
```

The PathExists function

This function accepts one argument (a path) and returns `True` if the path exists:

```
Private Function PathExists(pname) As Boolean
' Returns TRUE if the path exists
If Dir(pname, vbDirectory) = "" Then
    PathExists = False
Else
    PathExists = (GetAttr(pname) And vbDirectory) = vbDirectory
End If
End Function
```

The RangeNameExists function

This function accepts a single argument (a range name) and returns `True` if the range name exists in the active workbook:

```
Private Function RangeNameExists(nname) As Boolean
' Returns TRUE if the range name exists
Dim n As Name
RangeNameExists = False
For Each n In ActiveWorkbook.Names
    If UCase(n.Name) = UCase(nname) Then
        RangeNameExists = True
        Exit Function
    End If
Next n
End Function
```

Another way to write this function follows. This version attempts to create an object variable using the name. If doing so generates an error, then the name doesn't exist.

```
Private Function RangeNameExists2(nname) As Boolean
'   Returns TRUE if the range name exists
    Dim n As Range
    On Error Resume Next
    Set n = Range(nname)
    If Err.Number = 0 Then RangeNameExists2 = True _
        Else RangeNameExists2 = False
End Function
```



Testing for membership in a collection

The following function procedure is a generic function that you can use to determine whether an object is a member of a collection:

```
Private Function IsInCollection(Coln As Object, _
    Item As String) As Boolean
    Dim Obj As Object
    On Error Resume Next
    Set Obj = Coln(Item)
    IsInCollection = Not Obj Is Nothing
End Function
```

This function accepts two arguments: the collection (an object) and the item (a string) that might or might not be a member of the collection. The function attempts to create an object variable that represents the item in the collection. If the attempt is successful, the function returns `True`; otherwise, it returns `False`.

You can use the `IsInCollection` function in place of three other functions listed in this chapter: `RangeNameExists`, `SheetExists`, and `WorkbookIsOpen`. To determine whether a range named `Data` exists in the active workbook, call the `IsInCollection` function with this statement:

```
MsgBox IsInCollection(ActiveWorkbook.Names, "Data")
```

To determine whether a workbook named `Budget` is open, use this statement:

```
MsgBox IsInCollection(Workbooks, "budget.xlsx")
```

To determine whether the active workbook contains a sheet named `Sheet1`, use this statement:

```
MsgBox IsInCollection(ActiveWorkbook.Worksheets, "Sheet1")
```

The SheetExists function

This function accepts one argument (a worksheet name) and returns `True` if the worksheet exists in the active workbook:

```
Private Function SheetExists(sname) As Boolean
' Returns TRUE if sheet exists in the active workbook
Dim x As Object
On Error Resume Next
Set x = ActiveWorkbook.Sheets(sname)
If Err.Number = 0 Then SheetExists = True _
    Else SheetExists = False
End Function
```

The WorkbookIsOpen function

This function accepts one argument (a workbook name) and returns `True` if the workbook is open:

```
Private Function WorkbookIsOpen(wbname) As Boolean
' Returns TRUE if the workbook is open
Dim x As Workbook
On Error Resume Next
Set x = Workbooks(wbname)
If Err.Number = 0 Then WorkbookIsOpen = True _
    Else WorkbookIsOpen = False
End Function
```

Retrieving a value from a closed workbook

VBA doesn't include a method to retrieve a value from a closed workbook file. You can, however, take advantage of Excel's ability to work with linked files. This section contains a custom VBA function (`GetValue`, which follows) that retrieves a value from a closed workbook. It does so by calling an *XLM macro*, which is an old-style macro used in versions prior to Excel 5. Fortunately, Excel still supports this old macro system.

```
Private Function GetValue(path, file, sheet, ref)
' Retrieves a value from a closed workbook
Dim arg As String
' Make sure the file exists
If Right(path, 1) <> "\" Then path = path & "\"
If Dir(path & file) = "" Then
    GetValue = "File Not Found"
Exit Function
End If
```

```

' Create the argument
arg = "'" & path & "[" & file & "]" & sheet & "!" & _
    Range(ref).Range("A1").Address(, , xlR1C1)
' Execute an XLM macro
GetValue = ExecuteExcel4Macro(arg)
End Function

```

The GetValue function takes four arguments:

- path: The drive and path to the closed file (for example, "d:\files")
- file: The workbook name (for example, "budget.xlsx")
- sheet: The worksheet name (for example, "Sheet1")
- ref: The cell reference (for example, "C4")

The following Sub procedure demonstrates how to use the GetValue function. It displays the value in cell A1 in Sheet1 of a file named 2010budget.xlsx, located in the XLFiles\Budget directory on drive C.

```

Sub TestGetValue()
    Dim p As String, f As String
    Dim s As String, a As String
    p = "c:\XLFiles\Budget"
    f = "2010budget.xlsx"
    s = "Sheet1"
    a = "A1"
    MsgBox GetValue(p, f, s, a)
End Sub

```

Another example follows. This procedure reads 1,200 values (100 rows and 12 columns) from a closed file and then places the values into the active worksheet.

```

Sub TestGetValue2()
    Dim p As String, f As String
    Dim s As String, a As String
    Dim r As Long, c As Long
    p = "c:\XLFiles\Budget"
    f = "2010Budget.xlsx"
    s = "Sheet1"
    Application.ScreenUpdating = False
    For r = 1 To 100
        For c = 1 To 12
            a = Cells(r, c).Address
            Cells(r, c) = GetValue(p, f, s, a)
        Next c
    Next r
End Sub

```

**Note**

The `GetValue` function doesn't work if used in a worksheet formula. Actually, there is no need to use this function in a formula. You can simply create a link formula to retrieve a value from a closed file.

**Cross-Ref**

This example is available on the companion CD-ROM. The file is named `value` from a closed workbook.xlsm. The example uses a file named `myworkbook.xlsx` for the closed file.

Some Useful Worksheet Functions

The examples in this section are custom functions that you can use in worksheet formulas. Remember, you must define these `Function` procedures in a VBA module (not a code module associated with `ThisWorkbook`, a `Sheet`, or a `UserForm`).

**Cross-Ref**

The examples in this section are available on the companion CD-ROM in a file named `worksheet functions.xlsm`.

Returning cell formatting information

This section contains a number of custom functions that return information about a cell's formatting. These functions are useful if you need to sort data based on formatting (for example, sort in such a way that all bold cells are together).

**Caution**

You'll find that these functions aren't always updated automatically. This is because changing formatting, for example, doesn't trigger Excel's recalculation engine. To force a global recalculation (and update all the custom functions), press **Ctrl+Alt+F9**.

Alternatively, you can add the following statement to your function:

```
Application.Volatile
```

When this statement is present, then pressing **F9** will recalculate the function.

The following function returns `TRUE` if its single-cell argument has bold formatting. If a range is passed as the argument, the function uses the upper-left cell of the range.

```
Function IsBold(cell) As Boolean
' Returns TRUE if cell is bold
IsBold = cell.Range("A1").Font.Bold
End Function
```


Note that this function works only with explicitly applied formatting. It doesn't work for formatting applied using conditional formatting. Excel 2010 introduced a new object, `DisplayFormat`. This object takes conditional formatting into account. Here's the `IsBold` function rewritten so that it also works with bold formatting applied as a result of conditional formatting:

```
Function IsBold(cell) As Boolean
' Returns TRUE if cell is bold, even if from conditional formatting
  IsBold = cell.Range("A1").DisplayFormat.Font.Bold
End Function
```

The following function returns `TRUE` if its single-cell argument has italic formatting:

```
Function IsItalic(cell) As Boolean
' Returns TRUE if cell is italic
  IsItalic = cell.Range("A1").Font.Italic
End Function
```

Both of the preceding functions will return an error if the cell has mixed formatting — for example, if only *some* characters are bold. The following function returns `TRUE` only if all characters in the cell are bold:

```
Function AllBold(cell) As Boolean
' Returns TRUE if all characters in cell are bold
  If IsNull(cell.Font.Bold) Then
    AllBold = False
  Else
    AllBold = cell.Font.Bold
  End If
End Function
```

You can simplify the `AllBold` function as follows:

```
Function AllBold (cell) As Boolean
' Returns TRUE if all characters in cell are bold
  AllBold = Not IsNull(cell.Font.Bold)
End Function
```

The `FillColor` function returns an integer that corresponds to the color index of the cell's interior. The actual color depends on the workbook theme that's applied. If the cell's interior isn't filled, the function returns `-4142`.

This function doesn't work with fill colors applied in tables (created with `Insert→Tables→Table`) or pivot tables. You need to use the `DisplayFormat` object to detect that type of fill color, as I described previously.

```
Function FillColor(cell) As Integer
'   Returns an integer corresponding to
'   cell's interior color
    FillColor = cell.Range("A1").Interior.ColorIndex
End Function
```

A talking worksheet

The `SayIt` function uses Excel's text-to-speech generator to “speak” its argument (which can be literal text or a cell reference).

```
Function SayIt(txt)
    Application.Speech.Speak (txt)
    SayIt = txt
End Function
```

This function has some amusing possibilities, but it can also be useful. For example, use the function in a formula like this:

```
=IF(SUM(A:A)>25000,SayIt("Goal Reached"))
```

If the sum of the values in column A exceeds 25,000, you'll hear the synthesized voice tell you that the goal has been reached. You can also use the `Speak` method at the end of a lengthy procedure. That way, you can do something else, and you'll get an audible notice when the procedure ends.

Displaying the date when a file was saved or printed

An Excel workbook contains several built-in document properties, accessible from the `BuiltinDocumentProperties` property of the `Workbook` object. The following function returns the date and time that the workbook was last saved:

```
Function LastSaved()
    Application.Volatile
    LastSaved = ThisWorkbook. _
        BuiltinDocumentProperties("Last Save Time")
End Function
```

The date and time returned by this function are the same date and time that appear in the Related Dates section of Backstage View when you choose **File**→**Info**. Note that the `AutoSave` feature also affects this value. In other words, the “Last Save Time” is not necessarily the last time the file was saved by the *user*.

The following function is similar to `LastSaved`, but it returns the date and time when the workbook was last printed or previewed. If the workbook has never been printed or previewed, the function returns a `#VALUE` error.

```
Function LastPrinted()  
    Application.Volatile  
    LastPrinted = ThisWorkbook. _  
        BuiltinDocumentProperties("Last Print Date")  
End Function
```

If you use these functions in a formula, you might need to force a recalculation (by pressing F9) to get the current values of these properties.



Note

Quite a few additional built-in properties are available, but Excel doesn't use all of them. For example, attempting to access the `Number of Bytes` property will generate an error. For a list of all built-in properties, consult the Help system.

The preceding `LastSaved` and `LastPrinted` functions are designed to be stored in the workbook in which they're used. In some cases, you may want to store the function in a different workbook (for example, `personal.xlsb`) or in an add-in. Because these functions reference `ThisWorkbook`, they won't work correctly. Following are more general-purpose versions of these functions. These functions use `Application.Caller`, which returns a `Range` object that represents the cell that calls the function. The use of `Parent.Parent` returns the workbook (that is, the parent of the parent of the `Range` object — a `Workbook` object). This topic is explained further in the next section.

```
Function LastSaved2()  
    Application.Volatile  
    LastSaved2 = Application.Caller.Parent.Parent. _  
        BuiltinDocumentProperties("Last Save Time")  
End Function
```

Understanding object parents

As you know, Excel's object model is a hierarchy: Objects are contained in other objects. At the top of the hierarchy is the `Application` object. Excel contains other objects, and these objects contain other objects, and so on. The following hierarchy depicts how a `Range` object fits into this scheme:

- Application object
 - Workbook object
 - Worksheet object
 - Range object

In the lingo of object-oriented programming, a `Range` object's parent is the `Worksheet` object that contains it. A `Worksheet` object's parent is the `Workbook` object that contains the worksheet, and a `Workbook` object's parent is the `Application` object.

How can you put this information to use? Examine the `SheetName` VBA function that follows. This function accepts a single argument (a range) and returns the name of the worksheet that contains the range. It uses the `Parent` property of the `Range` object. The `Parent` property returns an object: the object that contains the `Range` object.

```
Function SheetName(ref) As String
    SheetName = ref.Parent.Name
End Function
```

The next function, `WorkbookName`, returns the name of the workbook for a particular cell. Notice that it uses the `Parent` property twice. the first `Parent` property returns a `Worksheet` object, and the second `Parent` property returns a `Workbook` object.

```
Function WorkbookName(ref) As String
    WorkbookName = ref.Parent.Parent.Name
End Function
```

The `AppName` function that follows carries this exercise to the next logical level, accessing the `Parent` property three times (the parent of the parent of the parent). This function returns the name of the `Application` object for a particular cell. It will, of course, always return `Microsoft Excel`.

```
Function AppName(ref) As String
    AppName = ref.Parent.Parent.Parent.Name
End Function
```

Counting cells between two values

The following function, named `CountBetween`, returns the number of values in a range (first argument) that fall between values represented by the second and third arguments:

```
Function CountBetween(InRange, num1, num2) As Long
'   Counts number of values between num1 and num2
With Application.WorksheetFunction
    If num1 <= num2 Then
        CountBetween = .CountIfs(InRange, ">=" & num1, _
            InRange, "<=" & num2)
    Else
        CountBetween = .CountIfs(InRange, ">=" & num2, _
```

```
        InRange, "<=" & num1)  
    End If  
End With  
End Function
```

Note that this function uses Excel's COUNTIFS function. In fact, the `CountBetween` function is essentially a wrapper that can simplify your formulas.



COUNTIFS was introduced in Excel 2007. Therefore, this function won't work with previous versions of Excel.

Following is an example formula that uses the `CountBetween` function. The formula returns the number of cells in A1:A100 that are greater than or equal to 10 and less than or equal to 20.

```
=CountBetween(A1:A100,10,20)
```

The function accepts the two numeric argument in either order. So, this formula is equivalent to the previous formula:

```
=CountBetween(A1:A100,20,10)
```

Using this VBA function is simpler than entering the following (somewhat confusing) formula:

```
=COUNTIFS(A1:A100,">=10",A1:A100,"<=20")
```

Determining the last non-empty cell in a column or row

In this section, I present two useful functions: `LastInColumn` returns the contents of the last non-empty cell in a column; `LastInRow` returns the contents of the last non-empty cell in a row. Each function accepts a range as its single argument. The range argument can be a complete column (for `LastInColumn`) or a complete row (for `LastInRow`). If the supplied argument isn't a complete column or row, the function uses the column or row of the upper-left cell in the range. For example, the following formula returns the last value in column B:

```
=LastInColumn(B5)
```

The following formula returns the last value in row 7:

```
=LastInRow(C7:D9)
```

The `LastInColumn` function follows:

```
Function LastInColumn(rng As Range)
' Returns the contents of the last non-empty cell in a column
Dim LastCell As Range
Application.Volatile
With rng.Parent
    With .Cells(.Rows.Count, rng.Column)
        If Not IsEmpty(.Value) Then
            LastInColumn = .Value
        ElseIf IsEmpty(.End(xlUp)) Then
            LastInColumn = ""
        Else
            LastInColumn = .End(xlUp).Value
        End If
    End With
End With
End Function
```

This function is rather complicated, so here are a few points that may help you understand it:

- `Application.Volatile` causes the function to be executed whenever the sheet is calculated.
- `Rows.Count` returns the number of rows in the worksheet. I used the `Count` property, rather than hard-coding the value, because not all worksheets have the same number of rows.
- `rng.Column` returns the column number of the upper-left cell in the `rng` argument.
- Using `rng.Parent` causes the function to work properly even if the `rng` argument refers to a different sheet or workbook.
- The `End` method (with the `xlUp` argument) is equivalent to activating the last cell in a column, pressing `End`, and then pressing the up-arrow key.
- The `IsEmpty` function checks whether the cell is empty. If so, it returns an empty string. Without this statement, an empty cell would be returned as 0.

The `LastInRow` function follows. This function is very similar to the `LastInColumn` function.

```
Function LastInRow(rng As Range)
' Returns the contents of the last non-empty cell in a row
Application.Volatile
With rng.Parent
    With .Cells(rng.Row, .Columns.Count)
        If Not IsEmpty(.Value) Then
            LastInRow = .Value
        ElseIf IsEmpty(.End(xlToLeft)) Then
```

```

        LastInRow = " "
    Else
        LastInRow = .End(xlToLeft).Value
    End If
End With
End With
End Function

```

Does a string match a pattern?

The `IsLike` function is very simple (but also very useful). This function returns `TRUE` if a text string matches a specified pattern.

This function, which follows, is remarkably simple. As you can see, the function is essentially a wrapper that lets you take advantage of VBA's powerful `Like` operator in your formulas.

```

Function IsLike(text As String, pattern As String) As Boolean
'   Returns true if the first argument is like the second
    IsLike = text Like pattern
End Function

```

This `IsLike` function takes two arguments:

- `text`: A text string or a reference to a cell that contains a text string
- `pattern`: A string that contains wildcard characters according to the following list:

Character(s) in Pattern	Matches in Text
?	Any single character
*	Zero or more characters
#	Any single digit (0-9)
[charlist]	Any single character in charlist
[!charlist]	Any single character not in charlist

The following formula returns `TRUE` because `*` matches any number of characters. It returns `TRUE` if the first argument is any text that begins with `g`.

```
=IsLike("guitar", "g*")
```

The following formula returns `TRUE` because `?` matches any single character. If the first argument were `"Unit12"`, the function would return `FALSE`.

```
=IsLike("Unit1", "Unit?")
```

The next formula returns `TRUE` because the first argument is a single character in the second argument.

```
=ISLIKE("a", "[aeiou] ")
```

The following formula returns `TRUE` if cell A1 contains *a, e, i, o, u, A, E, I, O, or U*. Using the `UPPER` function for the arguments makes the formula not case-sensitive.

```
=IsLike(UPPER(A1), UPPER("[aeiou] "))
```

The following formula returns `TRUE` if cell A1 contains a value that begins with 1 and has exactly three digits (that is, any integer between 100 and 199).

```
=IsLike(A1, "1###")
```

Extracting the nth element from a string

`ExtractElement` is a custom worksheet function (which you can also call from a VBA procedure) that extracts an element from a text string. For example, if a cell contains the following text, you can use the `ExtractElement` function to extract any of the substrings between the hyphens.

```
123-456-789-0133-8844
```

The following formula, for example, returns 0133, which is the fourth element in the string. The string uses a hyphen (-) as the separator.

```
=ExtractElement("123-456-789-0133-8844", 4, "-")
```

The `ExtractElement` function uses three arguments:

- **Txt:** The text string from which you're extracting. It can be a literal string or a cell reference.
- **n:** An integer that represents the element to extract.
- **Separator:** A single character used as the separator.



Note

If you specify a space as the `Separator` character, multiple spaces are treated as a single space, which is almost always what you want. If `n` exceeds the number of elements in the string, the function returns an empty string.

The VBA code for the `ExtractElement` function follows:

```
Function ExtractElement(Txt, n, Separator) As String
' Returns the nth element of a text string, where the
' elements are separated by a specified separator character
Dim AllElements As Variant
AllElements = Split(Txt, Separator)
ExtractElement = AllElements(n - 1)
End Function
```

This function uses VBA’s `Split` function, which returns a variant array that contains each element of the text string. This array begins with 0 (not 1), so using `n - 1` references the desired element.

Spelling out a number

The `SPELLDOLLARS` function returns a number spelled out in text — as on a check. For example, the following formula returns the string *One hundred twenty-three and 45/100 dollars*:

```
=SPELLDOLLARS (123.45)
```

Figure 11-17 shows some additional examples of the `SPELLDOLLARS` function. Column C contains formulas that use the function. For example, the formula in C1 is

```
=SPELLDOLLARS (A1)
```

Note that negative numbers are spelled out and enclosed in parentheses.

	A	B	C	D	E	F	G	H	I	J
1	32		Thirty-Two and 00/100 Dollars							
2	37.56		Thirty-Seven and 56/100 Dollars							
3	-32		(Thirty-Two and 00/100 Dollars)							
4	-26.44		(Twenty-Six and 44/100 Dollars)							
5	-4		(Four and 00/100 Dollars)							
6	1.87341		One and 87/100 Dollars							
7	1.56		One and 56/100 Dollars							
8	1		One and 00/100 Dollars							
9	6.56		Six and 56/100 Dollars							
10	12.12		Twelve and 12/100 Dollars							
11	1000000		One Million and 00/100 Dollars							
12	10000000000		Ten Billion and 00/100 Dollars							
13	1111111111		One Billion One Hundred Eleven Million One Hundred Eleven Thousand One Hundred Eleven and 00/100 Dollars							
14										

Figure 11-17: Examples of the `SPELLDOLLARS` function.



On the CD

The `SPELLDOLLARS` function is too lengthy to list here, but you can view the complete listing in worksheet `function.xlsm` on the companion CD-ROM.

A multifunctional function

This example describes a technique that may be helpful in some situations: making a single worksheet function act like multiple functions. For example, the following VBA listing is for a custom function called `StatFunction`. It takes two arguments: the range (`rng`) and the operation (`op`). Depending on the value of `op`, the function returns a value computed using any of the following worksheet functions: `AVERAGE`, `COUNT`, `MAX`, `MEDIAN`, `MIN`, `MODE`, `STDEV`, `SUM`, or `VAR`.

For example, you can use this function in your worksheet as follows:

```
=StatFunction(B1:B24,A24)
```

The result of the formula depends on the contents of cell A24, which should be a string such as `Average`, `Count`, `Max`, and so on. You can adapt this technique for other types of functions.

```
Function StatFunction(rng, op)
    Select Case UCase(op)
        Case "SUM"
            StatFunction = WorksheetFunction.Sum(rng)
        Case "AVERAGE"
            StatFunction = WorksheetFunction.Average(rng)
        Case "MEDIAN"
            StatFunction = WorksheetFunction.Median(rng)
        Case "MODE"
            StatFunction = WorksheetFunction.Mode(rng)
        Case "COUNT"
            StatFunction = WorksheetFunction.Count(rng)
        Case "MAX"
            StatFunction = WorksheetFunction.Max(rng)
        Case "MIN"
            StatFunction = WorksheetFunction.Min(rng)
        Case "VAR"
            StatFunction = WorksheetFunction.Var(rng)
        Case "STDEV"
            StatFunction = WorksheetFunction.StDev(rng)
        Case Else
            StatFunction = CVErr(xlErrNA)
    End Select
End Function
```

The SheetOffset function

You probably know that Excel's support for 3-D workbooks is limited. For example, if you need to refer to a different worksheet in a workbook, you must include the worksheet's name in your formula. Adding the worksheet name isn't a big problem . . . until you attempt to copy the formula across other worksheets. The copied formulas continue to refer to the original worksheet name, and the sheet references aren't adjusted as they would be in a true 3-D workbook.

The example discussed in this section is a VBA function (named `SheetOffset`) that enables you to address worksheets in a relative manner. For example, you can refer to cell A1 on the previous worksheet by using this formula:

```
=SheetOffset(-1,A1)
```

The first argument represents the relative sheet, and it can be positive, negative, or zero. The second argument must be a reference to a single cell. You can copy this formula to other sheets, and the relative referencing will be in effect in all the copied formulas.

The VBA code for the `SheetOffset` function follows:

```
Function SheetOffset(Offset As Long, Optional Cell As Variant)
' Returns cell contents at Ref, in sheet offset
Dim WksIndex As Long, WksNum As Long
Dim wks As Worksheet
Application.Volatile
If IsMissing(Cell) Then Set Cell = Application.Caller
WksNum = 1
For Each wks In Application.Caller.Parent.Parent.Worksheets
    If Application.Caller.Parent.Name = wks.Name Then
        SheetOffset = Worksheets(WksNum + Offset).Range(Cell(1).Address)
        Exit Function
    Else
        WksNum = WksNum + 1
    End If
Next wks
End Function
```

Returning the maximum value across all worksheets

If you need to determine the maximum value in cell B1 across a number of worksheets, you would use a formula such as this:

```
=MAX(Sheet1:Sheet4!B1)
```

This formula returns the maximum value in cell B1 for Sheet1, Sheet4, and all the sheets in between.

But what if you add a new sheet (Sheet5) after Sheet4? Your formula won't adjust automatically, so you need to edit the formula to include the new sheet reference:

```
=MAX(Sheet1:Sheet5!B1)
```

The `MaxAllSheets` function, which follows, accepts a single-cell argument and returns the maximum value in that cell across all worksheets in the workbook. The formula that follows, for example, returns the maximum value in cell B1 for all sheets in the workbook:

```
=MaxAllSheets(B1)
```

If you add a new sheet, you don't need to edit the formula:

```
Function MaxAllSheets(cell)
    Dim MaxVal As Double
    Dim Addr As String
    Dim Wksht As Object
    Application.Volatile
    Addr = cell.Range("A1").Address
    MaxVal = -9.9E+307
    For Each Wksht In cell.Parent.Parent.Worksheets
        If Wksht.Name = cell.Parent.Name And _
            Addr = Application.Caller.Address Then
            ' avoid circular reference
        Else
            If IsNumeric(Wksht.Range(Addr)) Then
                If Wksht.Range(Addr) > MaxVal Then _
                    MaxVal = Wksht.Range(Addr).Value
            End If
        End If
    Next Wksht
    If MaxVal = -9.9E+307 Then MaxVal = 0
    MaxAllSheets = MaxVal
End Function
```

The `For Each` statement uses the following expression to access the workbook:

```
cell.Parent.Parent.Worksheets
```

The parent of the cell is a worksheet, and the parent of the worksheet is the workbook. Therefore, the `For Each-Next` loop cycles among all worksheets in the workbook. The first `If` statement

inside the loop performs a check to see whether the cell being checked is the cell that contains the function. If so, that cell is ignored to avoid a circular reference error.



You can easily modify this function to perform other cross-worksheet calculations, such as minimum, average, sum, and so on.

Returning an array of nonduplicated random integers

The function in this section, `RandomIntegers`, returns an array of nonduplicated integers. The function is intended to be used in a multicell array formula.

```
{=RandomIntegers() }
```

Select a range and then enter the formula by pressing Ctrl+Shift+Enter. The formula returns an array of nonduplicated integers, arranged randomly. For example, if you enter the formula into a 50-cell range, the formulas will return nonduplicated integers from 1 to 50.

The code for `RandomIntegers` follows:

```
Function RandomIntegers()
    Dim FuncRange As Range
    Dim V() As Variant, ValArray() As Variant
    Dim CellCount As Double
    Dim i As Integer, j As Integer
    Dim r As Integer, c As Integer
    Dim Temp1 As Variant, Temp2 As Variant
    Dim RCount As Integer, CCount As Integer

    ' Create Range object
    Set FuncRange = Application.Caller
    ' Return an error if FuncRange is too large
    CellCount = FuncRange.Count
    If CellCount > 1000 Then
        RandomIntegers = CVErr(xlErrNA)
        Exit Function
    End If

    ' Assign variables
    RCount = FuncRange.Rows.Count
    CCount = FuncRange.Columns.Count
    ReDim V(1 To RCount, 1 To CCount)
    ReDim ValArray(1 To 2, 1 To CellCount)
    ' Fill array with random numbers
    ' and consecutive integers
    For i = 1 To CellCount
        ValArray(1, i) = Rnd
        ValArray(2, i) = i
    Next i
End Function
```

```

Next i
' Sort ValArray by the random number dimension
For i = 1 To CellCount
    For j = i + 1 To CellCount
        If ValArray(1, i) > ValArray(1, j) Then
            Temp1 = ValArray(1, j)
            Temp2 = ValArray(2, j)
            ValArray(1, j) = ValArray(1, i)
            ValArray(2, j) = ValArray(2, i)
            ValArray(1, i) = Temp1
            ValArray(2, i) = Temp2
        End If
    Next j
Next i

' Put the randomized values into the V array
i = 0
For r = 1 To RCount
    For c = 1 To CCount
        i = i + 1
        V(r, c) = ValArray(2, i)
    Next c
Next r
RandomIntegers = V
End Function

```

Randomizing a range

The `RangeRandomize` function, which follows, accepts a range argument and returns an array that consists of the input range — in random order:

```

Function RangeRandomize(rng)
    Dim V() As Variant, ValArray() As Variant
    Dim CellCount As Double
    Dim i As Integer, j As Integer
    Dim r As Integer, c As Integer
    Dim Temp1 As Variant, Temp2 As Variant
    Dim RCount As Integer, CCount As Integer

' Return an error if rng is too large
CellCount = rng.Count
If CellCount > 1000 Then
    RangeRandomize = CVErr(xlErrNA)
    Exit Function
End If

' Assign variables

```

```

RCount = rng.Rows.Count
CCount = rng.Columns.Count
ReDim V(1 To RCount, 1 To CCount)
ReDim ValArray(1 To 2, 1 To CellCount)
' Fill ValArray with random numbers
' and values from rng
For i = 1 To CellCount
    ValArray(1, i) = Rnd
    ValArray(2, i) = rng(i)
Next i
' Sort ValArray by the random number dimension
For i = 1 To CellCount
    For j = i + 1 To CellCount
        If ValArray(1, i) > ValArray(1, j) Then
            Temp1 = ValArray(1, j)
            Temp2 = ValArray(2, j)
            ValArray(1, j) = ValArray(1, i)
            ValArray(2, j) = ValArray(2, i)
            ValArray(1, i) = Temp1
            ValArray(2, i) = Temp2
        End If
    Next j
Next i

' Put the randomized values into the V array
i = 0
For r = 1 To RCount
    For c = 1 To CCount
        i = i + 1
        V(r, c) = ValArray(2, i)
    Next c
Next r
RangeRandomize = V
End Function

```

The code is very similar to that for the `RandomIntegers` function.

Figure 11-18 shows the function in use. The array formula in B2:B11 is:

```
{= RangeRandomize(A2:A11)}
```

This formula returns the contents of A2:A11, but in random order.

	A	B	C	D
1	Original	Randomized		
2	Aardvark	Kangaroo		
3	Baboon	Fox		
4	Cat	Hippo		
5	Dog	Cat		
6	Elephant	Iguana		
7	Fox	Lemur		
8	Giraffe	Javelina		
9	Hippo	Baboon		
10	Iguana	Aardvark		
11	Javelina	Elephant		
12	Kangaroo	Giraffe		
13	Lemur	Dog		
14				
15				

Figure 11-18: The RangeRandomize function returns the contents of a range, in random order.

Windows API Calls

VBA has the capability to use functions that are stored in Dynamic Link Libraries (DLLs). The examples in this section use common Windows API calls to DLLs.



Note

For simplicity, the API function declarations presented in this section work in Excel 2010 only (both the 32-bit and 64-bit versions). However, the example files on the CD-ROM use compiler directives so they will work with previous versions of Excel.

Determining file associations

In Windows, many file types are associated with a particular application. This association makes it possible to double-click the file to load it into its associated application.

The following function, named `GetExecutable`, uses a Windows API call to get the full path to the application associated with a particular file. For example, your system has many files with a `.txt` extension — one named `Readme.txt` is probably in your Windows directory right now. You can use the `GetExecutable` function to determine the full path of the application that opens when the file is double-clicked.



Note

Windows API declarations must appear at the top of your VBA module.

```
Private Declare PtrSafe Function FindExecutableA Lib "shell32.dll" _
    (ByVal lpFile As String, ByVal lpDirectory As String, _
    ByVal lpResult As String) As Long
```



```
Function GetExecutable(strFile As String) As String
    Dim strPath As String
    Dim intLen As Integer
    strPath = Space(255)
    intLen = FindExecutableA(strFile, "\", strPath)
    GetExecutable = Trim(strPath)
End Function
```

Figure 11-19 shows the result of calling the `GetExecutable` function, with an argument of the filename for an MP3 audio file. The function returns the full path of the application that's associated with the file.

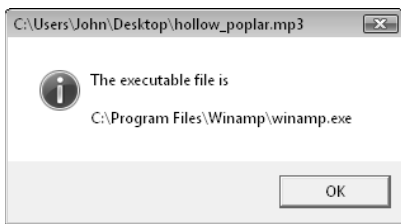


Figure 11-19: Determining the path and name of the application associated with a particular file.



Cross-Ref

This example is available on the companion CD-ROM. The filename is `file association.xlsm`.

Determining disk drive information

VBA doesn't have a way to directly get information about disk drives. But with the assistance of three API functions, you can get just about all the information you need.

Figure 11-20 shows the output from a VBA procedure that identifies all connected drives, determines the drive type, and calculates total space, used space, and free space.

The code is rather lengthy, so I don't list it here, but the interested reader should be able to figure it out by examining the code on the CD-ROM.



Cross-Ref

This example is available on the companion CD-ROM in a file named `drive information.xlsm`.

	B	C	D	E	F	G	
7							
8							
9							
		Drive	Type	Total Bytes	Used Bytes	Free Bytes	
10		C:\	Fixed	239,210,590,208	149,441,699,840	89,768,890,368	
11		D:\	Fixed	10,737,414,144	3,737,821,184	6,999,592,960	
12		E:\	CD-ROM	47,415,296	47,415,296		
13		F:\	CD-ROM				
14		G:\	Fixed	300,009,586,688	271,551,561,728	28,458,024,960	
15		H:\	Fixed	300,009,586,688	289,034,698,752	10,974,887,936	
16		I:\	Removable				
17		J:\	Removable				
18		K:\	Removable	3,956,801,536	804,945,920	3,151,855,616	
19		L:\	Removable				
20		Z:\	Remote	239,210,590,208	149,441,699,840	89,768,890,368	
21							
22							
23							

Figure 11-20: Using Windows API functions to get disk drive information.

Determining default printer information

The example in this section uses a Windows API function to return information about the active printer. The information is contained in a single text string. The example parses the string and displays the information in a more readable format.

```
Private Declare PtrSafe Function GetProfileStringA Lib "kernel32" _
    (ByVal lpAppName As String, ByVal lpKeyName As String, _
    ByVal lpDefault As String, ByVal lpReturnedString As _
    String, ByVal nSize As Long) As Long

Sub DefaultPrinterInfo()
    Dim strLPT As String * 255
    Dim Result As String
    Call GetProfileStringA _
        ("Windows", "Device", "", strLPT, 254)

    Result = Application.Trim(strLPT)
    ResultLength = Len(Result)
    Comma1 = InStr(1, Result, ",", 1)
    Comma2 = InStr(Comma1 + 1, Result, ",", 1)
    ' Gets printer's name
    Printer = Left(Result, Comma1 - 1)
    ' Gets driver
    Driver = Mid(Result, Comma1 + 1, Comma2 - Comma1 - 1)
    ' Gets last part of device line
    Port = Right(Result, ResultLength - Comma2)
    ' Build message
    Msg = "Printer:" & Chr(9) & Printer & Chr(13)
    Msg = Msg & "Driver:" & Chr(9) & Driver & Chr(13)
    Msg = Msg & "Port:" & Chr(9) & Port
    ' Display message
    MsgBox Msg, vbInformation, "Default Printer Information"
End Sub
```

**Note**

The `ActivePrinter` property of the `Application` object returns the name of the active printer (and lets you change it), but there's no direct way to determine what printer driver or port is being used. That's why this function may be useful.

Figure 11-21 shows a sample message box returned by this procedure.

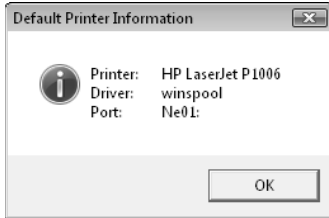


Figure 11-21: Getting information about the active printer by using a Windows API call.

**Cross-Ref**

This example is available on the companion CD-ROM. The filename is `printer info.xlsm`.

Determining video display information

The example in this section uses Windows API calls to determine a system's current video mode for the primary display monitor. If your application needs to display a certain amount of information on one screen, knowing the display size helps you scale the text accordingly. In addition, the code determines the number of monitors. If more than one monitor is installed, the procedure reports the virtual screen size.

```
Declare PtrSafe Function GetSystemMetrics Lib "user32" _
    (ByVal nIndex As Long) As Long
Public Const SM_CMONITORS = 80
Public Const SM_CXSCREEN = 0
Public Const SM_CYSCREEN = 1
Public Const SM_CXVIRTUALSCREEN = 78
Public Const SM_CYVIRTUALSCREEN = 79

Sub DisplayVideoInfo()
    Dim numMonitors As Long
    Dim vidWidth As Long, vidHeight As Long
    Dim virtWidth As Long, virtHeight As Long
    Dim Msg As String

    numMonitors = GetSystemMetrics(SM_CMONITORS)
    vidWidth = GetSystemMetrics(SM_CXSCREEN)
    vidHeight = GetSystemMetrics(SM_CYSCREEN)
    virtWidth = GetSystemMetrics(SM_CXVIRTUALSCREEN)
    virtHeight = GetSystemMetrics(SM_CYVIRTUALSCREEN)
```

```

If numMonitors > 1 Then
    Msg = numMonitors & " display monitors" & vbCrLf
    Msg = Msg & "Virtual screen: " & virtWidth & " X "
    Msg = Msg & virtHeight & vbCrLf & vbCrLf
    Msg = Msg & "The video mode on the primary display is: "
    Msg = Msg & vidWidth & " X " & vidHeight
Else
    Msg = Msg & "The video display mode: "
    Msg = Msg & vidWidth & " X " & vidHeight
End If
MsgBox Msg
End Sub

```

Figure 11-22 shows the message box returned by this procedure when running on a dual-monitor system.

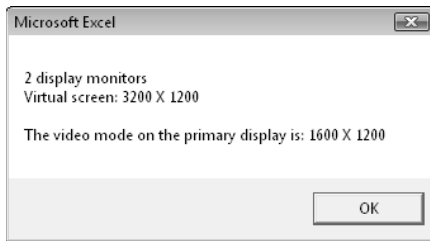


Figure 11-22: Using a Windows API call to determine the video display mode.



Cross-Ref

This example is available on the companion CD-ROM. The filename is `video mode.xlsx`.

Adding sound to your applications

The example in this section adds some sound capability to Excel. Specifically, it enables your application to play WAV or MIDI files. For example, you might like to play a short sound clip when a dialog box is displayed. Or maybe not. In any case, if you want Excel to play WAV or MIDI files, this section has what you need.



Cross-Ref

The examples in this section are available on the companion CD-ROM in a file named `sound.xlsx`.

Playing a WAV file

The following example contains the API function declaration plus a simple procedure to play a sound file called `sound.wav`, which is presumed to be in the same directory as the workbook:

```
Private Declare Function PlaySound Lib "winmm.dll" _
    Alias "PlaySoundA" (ByVal lpzName As String, _
    ByVal hModule As Long, ByVal dwFlags As Long) As Long
Const SND_SYNC = &H0
Const SND_ASYNC = &H1
Const SND_FILENAME = &H20000

Sub PlayWAV()
    WAVFile = "sound.wav"
    WAVFile = ThisWorkbook.Path & "\" & WAVFile
    Call PlaySound(WAVFile, 0&, SND_ASYNC Or SND_FILENAME)
End Sub
```

In the preceding example, the WAV file is played asynchronously. This means that execution continues while the sound is playing. To stop code execution while the sound is playing, use this statement instead:

```
Call PlaySound(WAVFile, 0&, SND_SYNC Or SND_FILENAME)
```

Playing a MIDI file

If the sound file is a MIDI file, you'll need to use a different API call. The `PlayMIDI` procedure starts playing a MIDI file. Executing the `StopMIDI` procedure stops playing the MIDI file. This example uses a file named `xfiles.mid`.

```
Private Declare Function mciExecute Lib "winmm.dll" _
    (ByVal lpstrCommand As String) As Long

Sub PlayMIDI()
    MIDIFile = "xfiles.mid"
    MIDIFile = ThisWorkbook.Path & "\" & MIDIFile
    mciExecute ("play " & MIDIFile)
End Sub

Sub StopMIDI()
    MIDIFile = "xfiles.mid"
    MIDIFile = ThisWorkbook.Path & "\" & MIDIFile
    mciExecute ("stop " & MIDIFile)
End Sub
```

Playing sound from a worksheet function

The `Alarm` function, which follows, is designed to be used in a worksheet formula. It uses a Windows API function to play a sound file when a cell meets a certain condition.

```

Declare Function PlaySound Lib "winmm.dll" _
    Alias "PlaySoundA" (ByVal lpszName As String, _
        ByVal hModule As Long, ByVal dwFlags As Long) As Long
Function Alarm(Cell, Condition)
    Dim WAVFile As String
    Const SND_ASYNC = &H1
    Const SND_FILENAME = &H20000
    If Evaluate(Cell.Value & Condition) Then
        WAVFile = ThisWorkbook.Path & "\sound.wav"
        Call PlaySound(WAVFile, 0&, SND_ASYNC Or SND_FILENAME)
        Alarm = True
    Else
        Alarm = False
    End If
End Function

```

The `Alarm` function accepts two arguments: a cell reference and a condition (expressed as a string). The following formula, for example, uses the `Alarm` function to play a WAV file when the value in cell B13 is greater than or equal to 1000.

```
=ALARM(B13, ">=1000")
```

The function uses VBA's `Evaluate` function to determine whether the cell's value matches the specified criterion. When the criterion is met (and the alarm has sounded), the function returns `True`; otherwise, it returns `False`.



On the CD

The examples in this section are available on the companion CD-ROM in a file named `sound.xlsm`.



Cross-Ref

The `SayIt` function, presented earlier in this chapter, is a much simpler way to use sound in a function.

Reading from and writing to the Registry

Most Windows applications use the Windows Registry database to store settings. (See Chapter 4 for some additional information about the Registry.) Your VBA procedures can read values from the Registry and write new values to the Registry. Doing so requires the following Windows API declarations:

```

Private Declare PtrSafe Function RegOpenKeyA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sSubKey As String, _
        ByRef hkeyResult As Long) As Long
Private Declare PtrSafe Function RegCloseKey Lib "ADVAPI32.DLL" _

```

```

    (ByVal hKey As Long) As Long
Private Declare PtrSafe Function RegSetValueExA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sValueName As String, _

    ByVal dwReserved As Long, ByVal dwType As Long, _
    ByVal sValue As String, ByVal dwSize As Long) As Long
Private Declare PtrSafe Function RegCreateKeyA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sSubKey As String, _
    ByRef hkeyResult As Long) As Long
Private Declare PtrSafe Function RegQueryValueExA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sValueName As String, _
    ByVal dwReserved As Long, ByRef lValueType As Long, _
    ByVal sValue As String, ByRef lResultLen As Long) As Long

```



Cross-Ref

I developed two wrapper functions that simplify the task of working with the Registry: `GetRegistry` and `WriteRegistry`. These functions are available on the companion CD-ROM in a file named `windows registry.xlsm`. This workbook includes a procedure that demonstrates reading from the Registry and writing to the Registry.

Reading from the Registry

The `GetRegistry` function returns a setting from the specified location in the Registry. It takes three arguments:

- **RootKey:** A string that represents the branch of the Registry to address. This string can be one of the following:
 - `HKEY_CLASSES_ROOT`
 - `HKEY_CURRENT_USER`
 - `HKEY_LOCAL_MACHINE`
 - `HKEY_USERS`
 - `HKEY_CURRENT_CONFIG`
- **Path:** The full path of the Registry category being addressed.
- **RegEntry:** The name of the setting to retrieve.

Here's an example. If you'd like to find which graphic file, if any, is being used for the desktop wallpaper, you can call `GetRegistry` as follows. (Notice that the arguments aren't case-sensitive.)

```

RootKey = "hkey_current_user"
Path = "Control Panel\Desktop"
RegEntry = "Wallpaper"
MsgBox GetRegistry(RootKey, Path, RegEntry), _
    vbInformation, Path & "\RegEntry"

```

The message box will display the path and filename of the graphic file (or an empty string if wallpaper isn't used).

Writing to the Registry

The `WriteRegistry` function writes a value to the Registry at a specified location. If the operation is successful, the function returns `True`; otherwise, it returns `False`. `WriteRegistry` takes the following arguments (all of which are strings):

- **RootKey:** A string that represents the branch of the Registry to address. This string may be one of the following:
 - `HKEY_CLASSES_ROOT`
 - `HKEY_CURRENT_USER`
 - `HKEY_LOCAL_MACHINE`
 - `HKEY_USERS`
 - `HKEY_CURRENT_CONFIG`
- **Path:** The full path in the Registry. If the path doesn't exist, it is created.
- **RegEntry:** The name of the Registry category to which the value will be written. If it doesn't exist, it is added.
- **RegVal:** The value that you're writing.

Here's an example that writes a value representing the time and date Excel was started to the Registry. The information is written in the area that stores Excel's settings.

```
Sub Workbook_Open()  
    RootKey = "hkey_current_user"  
    Path = "software\microsoft\office\14.0\excel\LastStarted"  
    RegEntry = "DateTime"  
    RegVal = Now()  
    If WriteRegistry(RootKey, Path, RegEntry, RegVal) Then  
        msg = RegVal & " has been stored in the registry."  
        Else msg = "An error occurred"  
    End If  
    MsgBox msg  
End Sub
```

If you store this routine in the `ThisWorkbook` module in your personal macro workbook, the setting is automatically updated whenever you start Excel.



An easier way to access the Registry

If you want to use the Windows Registry to store and retrieve settings for your Excel applications, you don't have to bother with the Windows API calls. Rather, you can use VBA's `GetSetting` and `SaveSetting` functions.

These two functions are described in the Help system, so I won't cover the details here. However, it's important to understand that these functions work only with the following key name:

`HKEY_CURRENT_USER\Software\VB and VBA Program Settings`

In other words, you can't use these functions to access *any* key in the registry. Rather, these functions are most useful for storing information about your Excel application that you need to maintain between sessions.

Working with UserForms

CHAPTER 12

Custom Dialog Box Alternatives

CHAPTER 13

Introducing UserForms

CHAPTER 14

UserForm Examples

CHAPTER 15

Advanced UserForm Techniques

Custom Dialog Box Alternatives

In This Chapter

- Using an input box to get user input
- Using a message box to display messages or get a simple response
- Selecting a file from a dialog box
- Selecting a directory
- Displaying Excel's built-in dialog boxes

Before You Create That UserForm . . .

Dialog boxes are, perhaps, the most important user interface element in Windows programs. Virtually every Windows program uses them, and most users have a good understanding of how they work. Excel developers implement custom dialog boxes by creating UserForms. However, VBA provides the means to display some built-in dialog boxes, with minimal programming required.

Before I get into the nitty-gritty of creating UserForms (beginning with Chapter 13), you might find it helpful to understand some of Excel's built-in tools that display dialog boxes. The sections that follow describe various dialog boxes that you can display without creating a UserForm.

Using an Input Box

An *input box* is a simple dialog box that allows the user to make a single entry. For example, you can use an input box to let the user enter text or a number or even select a range. You can generate an `InputBox` in two ways: by using a VBA function and by using a method of the `Application` object.

The VBA InputBox function

The syntax for VBA's `InputBox` function is

```
InputBox(prompt[,title][,default][,xpos][,ypos][,helpfile, context])
```

- `prompt`: Required. The text displayed in the `InputBox`.
- `title`: Optional. The caption of the `InputBox` window.
- `default`: Optional. The default value to be displayed in the dialog box.
- `xpos, ypos`: Optional. The screen coordinates of the upper-left corner of the window.
- `helpfile, context`: Optional. The help file and help topic.

The `InputBox` function prompts the user for a single piece of information. The function always returns a string, so your code may need to convert the results to a value.

The prompt may consist of up to 1,024 characters. In addition, you can provide a title for the dialog box and a default value and specify its position on the screen. You can also specify a custom Help topic; if you do, the input box includes a Help button.

The following example, which generates the dialog box shown in Figure 12-1, uses the VBA `InputBox` function to ask the user for his full name. The code then extracts the first name and displays a greeting in a message box.

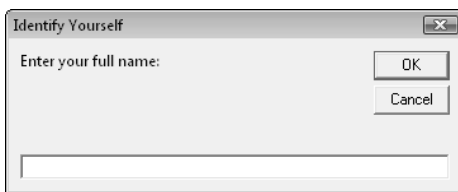


Figure 12-1: VBA's `InputBox` function at work.

```
Sub GetName()
    Dim UserName As String
    Dim FirstSpace As Integer
    Do Until UserName <> ""
        UserName = InputBox("Enter your full name: ", _
            "Identify Yourself")
    Loop
    FirstSpace = InStr(UserName, " ")
    If FirstSpace <> 0 Then
        UserName = Left(UserName, FirstSpace - 1)
    End If
    MsgBox "Hello " & UserName
End Sub
```

Notice that this `InputBox` function is written in a `Do Until` loop to ensure that something is entered when the input box appears. If the user clicks Cancel or doesn't enter any text, `UserName` contains an empty string, and the input box reappears. The procedure then attempts to extract the first name by searching for the first space character (by using the `InStr` function) and then using the `Left` function to extract all characters before the first space. If a space character isn't found, the entire name is used as entered.

As I mentioned, the `InputBox` function always returns a string. If the string returned by the `InputBox` function looks like a number, you can convert it to a value by using VBA's `Val` function. Or you can use Excel's `InputBox` method, which I describe in the next section.

Figure 12-2 shows another example of the VBA `InputBox` function. The user is asked to fill in the missing word. This example also illustrates the use of named arguments. The prompt text is retrieved from a worksheet cell and is assigned to a variable (`p`).

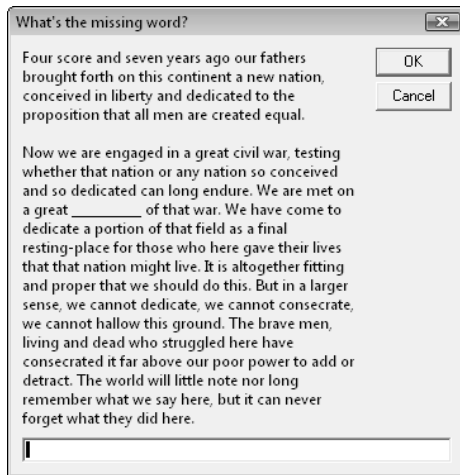


Figure 12-2: Using VBA's `InputBox` function with a long prompt.

```
Sub GetWord()
    Dim TheWord As String
    Dim p As String
    Dim t As String
    p = Range("A1")
    t = "What's the missing word?"
    TheWord = InputBox(prompt:=p, Title:=t)
    If UCase(TheWord) = "BATTLEFIELD" Then
        MsgBox "Correct."
    Else
        MsgBox "That is incorrect."
    End If
End Sub
```



The two examples in this section are available on the companion CD-ROM. The file is named `VBA inputbox.xlsm`.

The Excel InputBox method

Using Excel's `InputBox` method offers three advantages over VBA's `InputBox` function:

- You can specify the data type returned.
- The user can specify a worksheet range by dragging in the worksheet.
- Input validation is performed automatically.

The syntax for the Excel `InputBox` method is

```
InputBox(Prompt [,Title][,Default][,Left][,Top][,HelpFile, HelpContextID]
[,Type])
```

- **Prompt:** Required. The text displayed in the input box.
- **Title:** Optional. The caption in the input box window.
- **Default:** Optional. The default value to be returned by the function if the user enters nothing.
- **Left, Top:** Optional. The screen coordinates of the upper-left corner of the window.
- **HelpFile, HelpContextID:** Optional. The Help file and Help topic.
- **Type:** Optional. A code for the data type returned, as listed in Table 12-1.

Table 12-1: Codes to Determine the Data Type Returned by Excel's `Inputbox` Method

Code	Meaning
0	A formula
1	A number
2	A string (text)
4	A logical value (True or False)
8	A cell reference, as a range object
16	An error value, such as #N/A
64	An array of values

Excel's `InputBox` method is quite versatile. To allow more than one data type to be returned, use the sum of the pertinent codes. For example, to display an input box that can accept text or numbers, set `type` equal to 3 (that is, 1 + 2, or *number* plus *text*). If you use 8 for the `type` argument, the user can enter a cell or range address (or a named cell or range) manually or point to a range in the worksheet.

The `EraseRange` procedure, which follows, uses the `InputBox` method to allow the user to select a range to erase (see Figure 12-3). The user can either type the range address manually or use the mouse to select the range in the sheet.

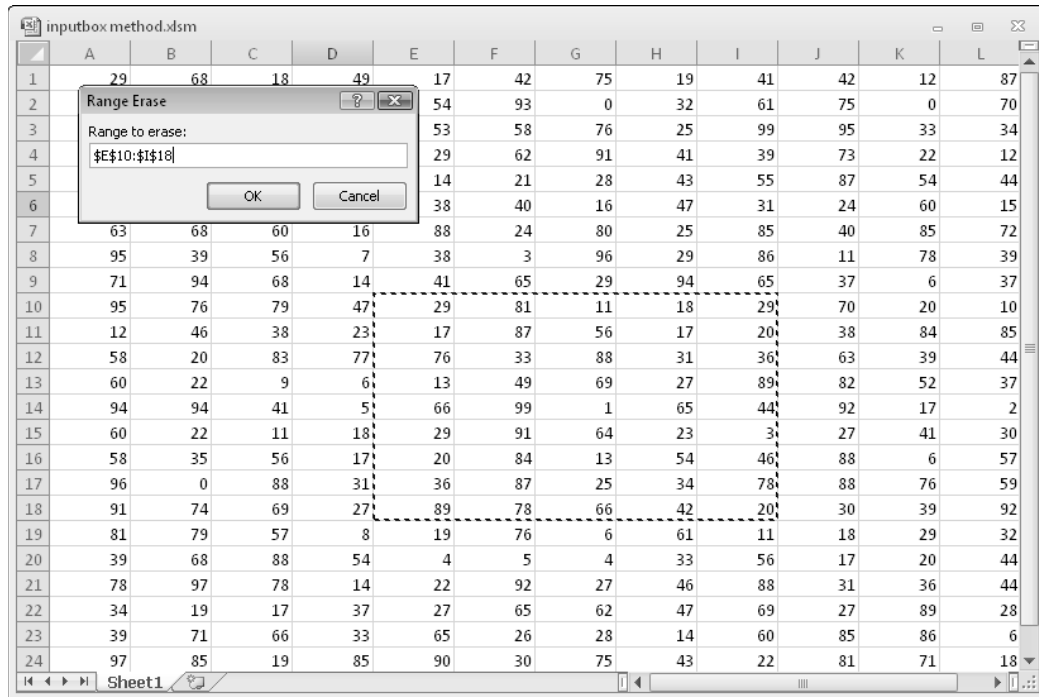


Figure 12-3: Using the `InputBox` method to specify a range.

The `InputBox` method with a `type` argument of 8 returns a `Range` object (note the `Set` keyword). This range is then erased (by using the `Clear` method). The default value displayed in the input box is the current selection's address. The `On Error` statement ends the procedure if the input box is canceled.

```
Sub EraseRange()  
    Dim UserRange As Range  
    On Error GoTo Canceled  
    Set UserRange = Application.InputBox _  
        (Prompt:="Range to erase:", _  
        Title:="Range Erase", _  
        Default:=Selection.Address, _  
        Type:=8)  
    UserRange.Clear  
End Sub
```

```
UserRange.Clear
UserRange.Select
Canceled:
End Sub
```



On the CD

This example is available on the companion CD-ROM in a file named `inputbox method.xlsm`.

Yet another advantage of using Excel's `InputBox` method is that Excel performs input validation automatically. In the `GetRange` example, if you enter something other than a range address, Excel displays an informative message and lets the user try again (see Figure 12-4).



Figure 12-4: Excel's `InputBox` method performs validation automatically.

The VBA `MsgBox` Function

VBA's `MsgBox` function is an easy way to display a message to the user or to get a simple response (such as OK or Cancel). I use the `MsgBox` function in many of the examples in this book as a way to display a variable's value.

The official syntax for `MsgBox` is as follows:

```
MsgBox(prompt[,buttons][,title][,helpfile, context])
```

- **prompt:** Required. The text displayed in the message box.
- **buttons:** Optional. A numeric expression that determines which buttons and icon are displayed in the message box. See Table 12-2.
- **title:** Optional. The caption in the message box window.
- **helpfile, context:** Optional. The helpfile and Help topic.

You can easily customize your message boxes because of the flexibility of the `buttons` argument. (Table 12-2 lists the many constants that you can use for this argument.) You can specify which buttons to display, whether an icon appears, and which button is the default.

Table 12-2: Constants Used for Buttons in the MsgBox Function

Constant	Value	Description
vbOKOnly	0	Display OK button only.
vbOKCancel	1	Display OK and Cancel buttons.
vbAbortRetryIgnore	2	Display Abort, Retry, and Ignore buttons.
vbYesNoCancel	3	Display Yes, No, and Cancel buttons.
vbYesNo	4	Display Yes and No buttons.
vbRetryCancel	5	Display Retry and Cancel buttons.
vbCritical	16	Display Critical Message icon.
vbQuestion	32	Display Warning Query icon.
vbExclamation	48	Display Warning Message icon.
vbInformation	64	Display Information Message icon.
vbDefaultButton1	0	First button is default.
vbDefaultButton2	256	Second button is default.
vbDefaultButton3	512	Third button is default.
vbDefaultButton4	768	Fourth button is default.
vbSystemModal	4096	All applications are suspended until the user responds to the message box (might not work under all conditions).
vbMsgBoxHelpButton	16384	Display a Help button. However, there is no way to display any help if the button is clicked.

You can use the `MsgBox` function by itself (to simply display a message) or assign its result to a variable. When you use the `MsgBox` function to return a result, the value represents the button clicked by the user. The following example displays a message and an OK button, but doesn't return a result:

```
Sub MsgBoxDemo()
    MsgBox "Macro finished with no errors."
End Sub
```

To get a response from a message box, you can assign the results of the `MsgBox` function to a variable. In the following code, I use some built-in constants (described in Table 12-3) to make it easier to work with the values returned by `MsgBox`:

```
Sub GetAnswer()
    Dim Ans As Integer
    Ans = MsgBox("Continue?", vbYesNo)
    Select Case Ans
        Case vbYes
            ...[code if Ans is Yes]...
    End Select
End Sub
```

```

        Case vbNo
    '        ...[code if Ans is No]...
    End Select
End Sub

```

Table 12-3: Constants Used for MsgBox Return Value

Constant	Value	Button Clicked
vbOK	1	OK
vbCancel	2	Cancel
vbAbort	3	Abort
vbRetry	4	Retry
vbIgnore	5	Ignore
vbYes	6	Yes
vbNo	7	No

The variable returned by the `MsgBox` function is an `Integer` data type. Actually, you don't even need to use a variable to utilize the result of a message box. The following procedure is another way of coding the `GetAnswer` procedure:

```

Sub GetAnswer2()
    If MsgBox("Continue?", vbYesNo) = vbYes Then
    '        ...[code if Ans is Yes]...
    Else
    '        ...[code if Ans is No]...
    End If
End Sub

```

The following function example uses a combination of constants to display a message box with a Yes button, a No button, and a question mark icon; the second button is designated as the default button (see Figure 12-5). For simplicity, I assigned these constants to the `Config` variable.

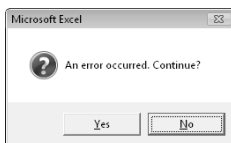


Figure 12-5: The buttons argument of the `MsgBox` function determines which buttons appear.

```
Private Function ContinueProcedure() As Boolean
    Dim Config As Integer
    Dim Ans As Integer
    Config = vbYesNo + vbQuestion + vbDefaultButton2
    Ans = MsgBox("An error occurred. Continue?", Config)
    If Ans = vbYes Then ContinueProcedure = True _
        Else ContinueProcedure = False
End Function
```

You can call the `ContinueProcedure` function from another procedure. For example, the following statement calls the `ContinueProcedure` function (which displays the message box). If the function returns `False` (that is, the user selects No), the procedure ends. Otherwise, the next statement would be executed.

```
If Not ContinueProcedure() Then Exit Sub
```

The width of the message box depends on your video resolution. If you'd like to force a line break in the message, use the `vbCrLf` (or `vbNewLine`) constant in the text. The following example displays the message in three lines. Figure 12-6 shows how it looks.

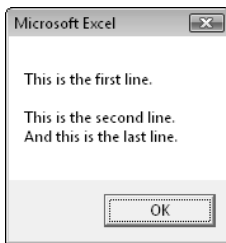


Figure 12-6: Splitting a message into multiple lines.

```
Sub MultiLine()
    Dim Msg As String
    Msg = "This is the first line." & vbCrLf & vbCrLf
    Msg = Msg & "This is the second line." & vbCrLf
    Msg = Msg & "And this is the last line."
    MsgBox Msg
End Sub
```

You can also insert a tab character by using the `vbTab` constant. The following procedure uses a message box to display the values in a 13 x 3 range of cells in A1:C13 (see Figure 12-7). It separates the columns by using a `vbTab` constant and inserts a new line by using the `vbCrLf` constant. The `MsgBox` function accepts a maximum string length of 1,023 characters, which will limit the number of cells that you can display. Also, note that the tab stops are fixed, so if a cell contains more than 11 characters, the columns won't be aligned.

	A	B	C	D	E	F	G	H	I	J	K	L
1	1,524	2,405	2,166	1,622	1,826	2,347						
2	1,192	1,727	1,456	1,328	2,574	1,501						
3	2,552	3,139	2,873	2,473	1,691	1,374						
4	2,571	2,026	2,943	2,972	2,889	2,017						
5	2,223	2,504	2,638	1,428	2,911	1,489						
6	2,249	1,021	1,514	1,544	2,814	2,006						
7	2,585	2,730	1,620	2,454	1,706	2,985						
8	2,328	1,662	2,731	2,831	1,246	1,277						
9	1,054	1,001	3,087	2,324	1,894	2,825						
10	1,756	2,965	1,240	3,111	3,038	1,804						
11	2,858	3,195	2,850	1,177	1,803	1,433						
12	2,682	1,114	2,821	1,788	2,569	2,856						
13	3,169	2,010	3,037	1,571	1,989	2,959						
14	1,817	2,417	1,647	2,987	2,872	2,297						
15	1,263	1,154	3,116	1,541	1,303	2,914						
16	2,670	1,472	2,709	1,595	1,523	2,646						
17	3,176	3,054	1,472	2,711	1,577	2,455						
18	2,036	2,518	2,658	1,259	1,600	1,979						
19	3,162	1,725	1,003	2,082	1,717	2,023						
20	1,474	2,146	2,460	1,610	2,415	2,315						
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

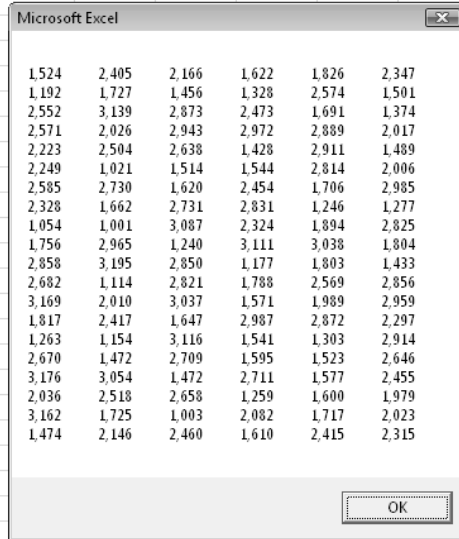


Figure 12-7: This message box displays text with tabs and line breaks.

```

Sub ShowRange()
    Dim Msg As String
    Dim r As Integer, c As Integer
    Msg = ""
    For r = 1 To 12
        For c = 1 To 3
            Msg = Msg & Cells(r, c).Text
            If c <> 3 Then Msg = Msg & vbTab
        Next c
        Msg = Msg & vbCrLf
    Next r
    MsgBox Msg
End Sub

```



Cross-Ref

Chapter 15 includes a UserForm example that emulates the MsgBox function.

The Excel GetOpenFilename Method

If your application needs to ask the user for a filename, you can use the `InputBox` function. But this approach is tedious and error-prone because the user must type the filename (with no browsing ability). A better approach is to use the `GetOpenFilename` method of the `Application` object, which ensures that your application gets a valid filename (as well as its complete path).

This method displays the normal Open dialog box, but it does *not* actually open the file specified. Rather, the method returns a string that contains the path and filename selected by the user. Then you can write code to do whatever you want with the filename.

The syntax for the `GetOpenFilename` method is as follows (all arguments are optional):

```
Application.GetOpenFilename(FileFilter, FilterIndex, Title, ButtonText, MultiSelect)
```

- `FileFilter`: Optional. A string specifying file-filtering criteria.
- `FilterIndex`: Optional. The index number of the default file-filtering criteria.
- `Title`: Optional. The title of the dialog box. If omitted, the title is `Open`.
- `ButtonText`: For Macintosh only.
- `MultiSelect`: Optional. If `True`, you can select multiple filenames. The default value is `False`.

The `FileFilter` argument determines what file types appear in the dialog box's Files of Type drop-down list. The argument consists of pairs of file filter strings followed by the wildcard file filter specification, with each part and each pair separated by commas. If omitted, this argument defaults to the following:

```
"All Files (*.*) , *.*"
```

Notice that the first part of this string (`All Files (*.*)`) is the text displayed in the Files of Type drop-down list. The second part (`*.*`) actually determines which files are displayed.

The following instruction assigns a string to a variable named `Filt`. You can then use this string as a `FileFilter` argument for the `GetOpenFilename` method. In this case, the dialog box will allow the user to select from four different file types (plus an All Files option). Notice that I used VBA's line continuation sequence to set up the `Filt` variable; doing so makes it much easier to work with this rather complicated argument.

```
Filt = "Text Files (*.txt),*.txt," & _  
      "Lotus Files (*.prn),*.prn," & _  
      "Comma Separated Files (*.csv),*.csv," & _  
      "ASCII Files (*.asc),*.asc," & _  
      "All Files (*.*) , *.*"
```

The `FilterIndex` argument specifies which `FileFilter` is the default, and the `Title` argument is text that is displayed in the title bar. If the `MultiSelect` argument is `True`, the user can select multiple files, all of which are returned in an array.

The following example prompts the user for a filename. It defines five file filters.

```
Sub GetImportFileName()
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim Title As String
    Dim FileName As Variant

    ' Set up list of file filters
    Filt = "Text Files (*.txt),*.txt," & _
        "Lotus Files (*.prn),*.prn," & _
        "Comma Separated Files (*.csv),*.csv," & _
        "ASCII Files (*.asc),*.asc," & _
        "All Files (*.*),*.*"
    ' Display *.* by default
    FilterIndex = 5
    ' Set the dialog box caption
    Title = "Select a File to Import"
    ' Get the file name
    FileName = Application.GetOpenFilename _
        (FileFilter:=Filt, _
        FilterIndex:=FilterIndex, _
        Title:=Title)
    ' Exit if dialog box canceled
    If FileName = False Then
        MsgBox "No file was selected."
        Exit Sub
    End If

    ' Display full path and name of the file
    MsgBox "You selected " & FileName
End Sub
```

Figure 12-8 shows the dialog box that appears when this procedure is executed and the user selects the Comma Separated Files filter.

	A	B	C	D	E	F	G	H
1	Month	Region 1	Region 2					
2	Jan	\$15,873	\$28,322					
3	Feb	\$16,056	\$28,810					
4	Mar	\$15,784	\$28,153					
5	Apr	\$16,857	\$28,026					
6	May	\$17,470	\$28,683					
7	Jun	\$18,640	\$29,520					
8	Jul	\$17,894	\$30,106					
9	Aug	\$17,164	\$29,840					
10	Sep	\$16,617	\$30,267					
11	Oct	\$17,366	\$30,595					
12	Nov	\$16,825	\$31,368					
13	Dec	\$16,249	\$31,648					
14								
15								
16								
17								
18								
19								
20								

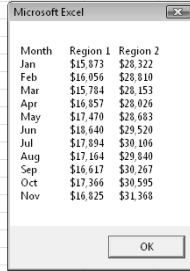


Figure 12-8: The `GetOpenFilename` method displays a dialog box used to specify a file.

The following example is similar to the previous example. The difference is that the user can press `Ctrl` or `Shift` and select multiple files when the dialog box is displayed. Notice that I check for the `Cancel` button click by determining whether `FileName` is an array. If the user doesn't click `Cancel`, the result is an array that consists of at least one element. In this example, a list of the selected files is displayed in a message box.

```
Sub GetImportFileName2()
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim FileName As Variant
    Dim Title As String
    Dim i As Integer
    Dim Msg As String
    ' Set up list of file filters
    Filt = "Text Files (*.txt),*.txt," & _
        "Lotus Files (*.prn),*.prn," & _
        "Comma Separated Files (*.csv),*.csv," & _
        "ASCII Files (*.asc),*.asc," & _
        "All Files (*.*),*.*"
    ' Display *.* by default
    FilterIndex = 5
    ' Set the dialog box caption
    Title = "Select a File to Import"
    ' Get the file name
```

```
FileName = Application.GetOpenFilename _  
    (FileFilter:=Filt, _  
    FilterIndex:=FilterIndex, _  
    Title:=Title, _  
    MultiSelect:=True)  
' Exit if dialog box canceled  
If Not IsArray(FileName) Then  
    MsgBox "No file was selected."  
    Exit Sub  
End If  
  
' Display full path and name of the files  
For i = LBound(FileName) To UBound(FileName)  
    Msg = Msg & FileName(i) & vbCrLf  
Next i  
MsgBox "You selected:" & vbCrLf & Msg  
End Sub
```

The `FileName` variable is defined as a variant (not a string, as in the previous examples). I use variant because `FileName` can potentially hold an array rather than a single filename.



On the CD

The two examples in this section are available on the companion CD-ROM. The filename is prompt for `file.xlsm`.

The Excel `GetSaveAsFilename` Method

The `GetSaveAsFilename` method is very similar to the `GetOpenFilename` method. It displays a Save As dialog box and lets the user select (or specify) a file. It returns a filename and path but doesn't take any action. Like the `GetOpenFilename` method, all of the `GetSaveAsFilename` method's arguments are optional.

The syntax for this method is

```
Application.GetSaveAsFilename(InitialFilename, FileFilter, FilterIndex,  
    Title, ButtonText)
```

The arguments are

- `InitialFilename`: Optional. Specifies the suggested filename.
- `FileFilter`: Optional. A string specifying file-filtering criteria.
- `FilterIndex`: Optional. The index number of the default file-filtering criteria.
- `Title`: Optional. The title of the dialog box.
- `ButtonText`: For Macintosh only.

Prompting for a Directory

If you need to get a filename, the simplest solution is to use the `GetOpenFileName` method, as I describe earlier. But if you need to get a directory name only (no file), you can use Excel's `FileDialog` object.

The following procedure displays a dialog box (see Figure 12-9) that allows the user to select a directory. The selected directory name (or `Canceled`) is then displayed by using the `MsgBox` function.

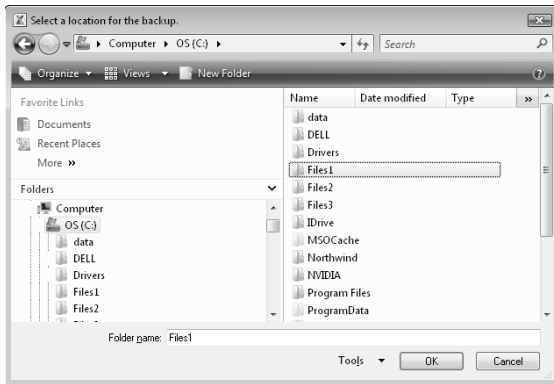


Figure 12-9: Using the `FileDialog` object to select a directory.

```
Sub GetAFolder ()
    With Application.FileDialog(msoFileDialogFolderPicker)
        .InitialFileName = Application.DefaultFilePath & "\"
        .Title = "Select a location for the backup"
        .Show
        If .SelectedItems.Count = 0 Then
            MsgBox "Canceled"
        Else
            MsgBox .SelectedItems(1)
        End If
    End With
End Sub
```

The `FileDialog` object lets you specify the starting directory by specifying a value for the `InitialFileName` property. In this example, the code uses Excel's default file path as the starting directory.

Displaying Excel's Built-In Dialog Boxes

Code that you write in VBA can execute many of Excel's Ribbon commands. And, if the command normally leads to a dialog box, your code can "make choices" in the dialog box (although the dialog box itself isn't displayed). For example, the following VBA statement is equivalent to

choosing the Home→Editing→Find & Select→Go To command, specifying range A1:C3, and clicking OK. But the Go To dialog box never appears (which is what you want).

```
Application.Goto Reference:=Range("A1:C3")
```

In some cases, however, you may want to display one of Excel's built-in dialog boxes so that the end user can make the choices. You can do so by writing code that executes a Ribbon command.



Note

Using the `Dialogs` collection of the `Application` object is another way to display an Excel dialog box. However, Microsoft has not kept this feature up-to-date, so I don't even discuss it. The method I describe in this section is a much better solution.

In previous versions of Excel, programmers created custom menus and toolbars by using the `CommandBar` object. In Excel 2007 and Excel 2010, the `CommandBar` object is still available, but it doesn't work like it has in the past.



Cross-Ref

Refer to Chapter 22 for more information about the `CommandBar` object.

The `CommandBar` object has also been enhanced, beginning with Excel 2007. You can use the `CommandBar` object to execute Ribbon commands using VBA. Many of the Ribbon commands display a dialog box. For example, the following statement displays the Unhide dialog box (see Figure 12-10):

```
Application.CommandBars.ExecuteMso("SheetUnhide")
```

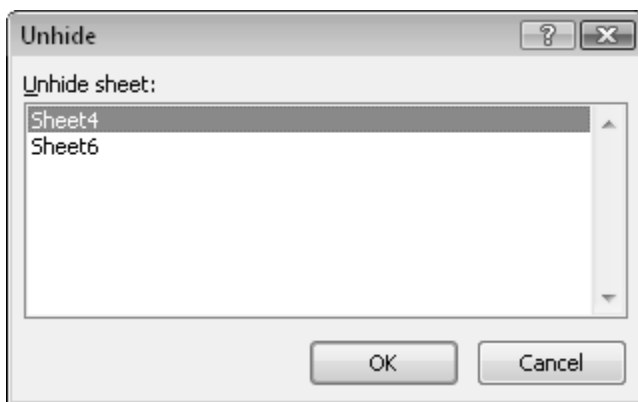


Figure 12-10: This dialog box was displayed with a VBA statement.

The `ExecuteMso` method accepts one argument, an `idMso` parameter that represents a Ribbon control. Unfortunately, these parameters aren't listed in the Help system.



On the CD

The companion CD-ROM contains a file, `ribbon control names.xlsx`, that lists all the Excel Ribbon command parameter names. You'll need to experiment with the items listed in this workbook. Many of them execute the command immediately (no dialog box). And most will generate an error if they're issued in an incorrect context. For example, Excel displays an error if your code executes the `FunctionWizard` command when a chart is selected.

Following is another example. This statement, when executed, displays the Font tab of the Format Cells dialog box (see Figure 12-11):

```
Application.CommandBars.ExecuteMso("FormatCellsFontDialog")
```

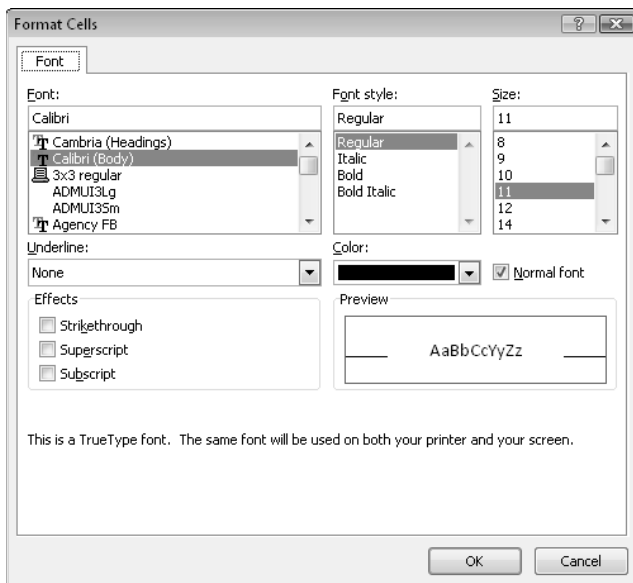


Figure 12-11: Using the `ExecuteMso` method to display a dialog box.



Executing an old menu item directly

Another technique to display a built-in dialog box requires knowledge of the pre-Excel 2007 toolbars (officially known as `CommandBar` objects). Although Excel no longer uses `CommandBar` objects, they're still supported for compatibility.

The following statement, for example, is equivalent to selecting the **Format**→**Sheet**→**Unhide** command in the Excel 2003 menu:

```
Application.CommandBars("Worksheet Menu Bar")._
    Controls("Format").Controls("Sheet")._
    Controls("Unhide...").Execute
```

This statement, when executed, displays the Unhide dialog box. Notice that the menu item captions must match exactly (including the ellipsis after **Unhide**).

Here's another example. This statement displays the Format Cells dialog box:

```
Application.CommandBars("Worksheet Menu Bar")._
    Controls("Format").Controls("Cells...").Execute
```

It's probably not a good idea to rely on `CommandBar` objects because they may be removed from a future version of Excel.

Displaying a Data Form

Many people use Excel to manage lists in which the information is arranged in rows. Excel offers a simple way to work with this type of data through the use of a built-in data entry form that Excel can create automatically. This data form works with either a normal range of data or a range that has been designated as a table (by using the **Insert**→**Tables**→**Table** command). Figure 12-12 shows an example of a data form in use.

Making the data form accessible

For some reason, the command to access the data form isn't in the Excel Ribbon. To access the data form from Excel's user interface, you must add it to your Quick Access toolbar or to the Ribbon. Following are instructions to add this command to the Quick Access toolbar:

1. Right-click the Quick Access toolbar and select **Customize Quick Access Toolbar**.
The Quick Access Toolbar panel of the Excel Options dialog box appears.
2. In the **Choose Commands From** drop-down list, select **Commands Not in the Ribbon**.

3. In the list box on the left, select Form.
4. Click the Add button to add the selected command to your Quick Access toolbar.
5. Click OK to close the Excel Options dialog box.

After performing these steps, a new icon will appear on your Quick Access toolbar.

The screenshot shows an Excel worksheet with a table of real estate data. A data entry form is overlaid on the table, displaying the details for the selected row (Agent: Randolph). The form includes fields for Agent, Date Listed, Area, List Price, Bedrooms, Baths, SqFt, Type, Pool, Sold, and Per Sq Ft. The form is titled 'Sheet1' and has a 'New' button at the top right. The table data is as follows:

	Agent	Date Listed	Area	List Price	Bedrooms	Baths	SqFt	Type	Pool	Sold	Per Sq Ft
2	Adams	10/28/2009	Central	\$199,000	3	2.5	1,510	Condo	FALSE	FALSE	\$132
3	Adams	9/7/2009	Central	\$214,500	4	2.5	1,862	Single Family	TRUE	FALSE	\$115
4	Adams	5/17/2009	Central	\$265,000	4	3	1,905	Single Family	FALSE	FALSE	\$139
5	Adams	8/7/2009	Central	\$268,500	4	2.5	1,911	Single Family	FALSE	FALSE	\$141
6	Adams	2/25/2009					1,552	Single Family	TRUE	TRUE	\$176
7	Adams	8/20/2009					2,800	Single Family	TRUE	FALSE	\$111
8	Adams	2/3/2009					1,752	Single Family	FALSE	TRUE	\$186
9	Jenkins	2/17/2009					4,696	Single Family	TRUE	FALSE	\$256
10	Romero	4/23/2009					4,800	Single Family	FALSE	FALSE	\$166
11	Hamilton	3/15/2009					2,414	Single Family	TRUE	FALSE	\$176
12	Randolph	5/13/2009					2,444	Single Family	TRUE	TRUE	\$166
13	Adams	5/10/2009					2,207	Single Family	TRUE	TRUE	\$95
14	Shasta	4/12/2009					2,620	Single Family	FALSE	FALSE	\$152
15	Kelly	6/28/2009					1,971	Single Family	FALSE	FALSE	\$198
16	Shasta	9/5/2009					3,109	Single Family	FALSE	FALSE	\$125
17	Adams	6/25/2009					2,468	Condo	FALSE	FALSE	\$154
18	Adams	2/27/2009					2,354	Condo	FALSE	TRUE	\$161
19	Robinson	4/18/2009					3,000	Single Family	FALSE	TRUE	\$126
20	Barnes	7/15/2009					1,800	Single Family	FALSE	FALSE	\$116
21	Bennet	5/31/2009					2,041	Single Family	FALSE	TRUE	\$112
22	Bennet	5/28/2009					1,940	Single Family	TRUE	FALSE	\$283
23	Shasta	8/3/2009					3,927	Single Family	FALSE	FALSE	\$95
24	Lang	5/22/2009	N. County	\$369,900	3	2.5	2,030	Condo	TRUE	FALSE	\$182
25	Romero	2/16/2009	N. County	\$369,900	4	3	1,988	Condo	FALSE	TRUE	\$186
26	Bennet	7/15/2009	S. County	\$229,900	3	2.5	1,580	Single Family	TRUE	FALSE	\$146
27	Chung	7/27/2009	Central	\$236,900	3	2	1,700	Single Family	FALSE	FALSE	\$139
28	Chung	9/15/2009	Central	\$339,900	4	2	2,238	Single Family	FALSE	FALSE	\$152
29	Chung	5/10/2009	Central	\$375,000	4	3	2,467	Single Family	TRUE	FALSE	\$152
30	Chung	4/10/2009	S. County	\$205,000	3	2.5	2,001	Single Family	TRUE	FALSE	\$102
31	Chung	8/22/2009	S. County	\$229,500	4	2.5	2,284	Condo	FALSE	FALSE	\$100

Figure 12-12: Some users prefer to use Excel's built-in data form for data-entry tasks.

To use a data entry form, you must arrange your data so that Excel can recognize it as a table. Start by entering headings for the columns in the first row of your data entry range. Select any cell in the table and click the Form button on your Quick Access toolbar. Excel then displays a dialog box customized to your data. You can use the Tab key to move between the text boxes and supply information. If a cell contains a formula, the formula result appears as text (not as an edit box). In other words, you can't modify formulas from the data entry form.

When you complete the data form, click the New button. Excel enters the data into a row in the worksheet and clears the dialog box for the next row of data.

Displaying a data form by using VBA

Use the `ShowDataForm` method to display Excel's data form. The only requirement is that the active cell must be within a range. The following code activates cell A1 (which is in a table) and then displays the data form:

```
Sub DisplayDataForm()  
    Range("A1").Select  
    ActiveSheet.ShowDataForm  
End Sub
```



On the CD

A workbook with this example is available on the companion CD-ROM. The file is named `data form example.xlsm`.

Introducing UserForms

In This Chapter

- Creating, showing, and unloading UserForms
- Exploring the UserForm controls available to you
- Setting the properties of UserForm controls
- Controlling UserForms with VBA procedures
- Creating a UserForm
- Introducing the types of events relevant to UserForms and controls
- Customizing your control Toolbox
- Going over a handy checklist for creating UserForms

How Excel Handles Custom Dialog Boxes

Excel makes creating custom dialog boxes for your applications relatively easy. In fact, you can duplicate the look and feel of many of Excel's dialog boxes.

Excel developers have always had the ability to create custom dialog boxes for their applications. Beginning with Excel 97, things changed substantially — UserForms replaced the clunky old dialog sheets. UserForms are *much* easier to work with, and they offer many additional capabilities. Even though UserForms haven't been upgraded over the years, you'll find that this feature works well and is very flexible.

A custom dialog box is created on a UserForm, and you access UserForms in the Visual Basic Editor (VBE).

Following is the typical sequence that you'll follow when you create a UserForm:

1. Insert a new UserForm into your workbook's VB Project.
2. Add controls to the UserForm.
3. Adjust some of the properties of the controls that you added.
4. Write event-handler procedures for the controls.
These procedures, which are located in the code window for the UserForm, are executed when various events (such as a button click) occur.
5. Write a procedure that will display the UserForm.
This procedure will be located in a VBA module (not in the code module for the UserForm).
6. Add a way to make it easy for the user to execute the procedure you created in Step 5.
You can add a button to a worksheet, a Ribbon command, and so on.

Inserting a New UserForm

To insert a new UserForm, activate the VBE (press Alt+F11), select your workbook's project from the Project window, and then choose Insert→UserForm. UserForms have default names like UserForm1, UserForm2, and so on.



You can change the name of a UserForm to make it easier to identify. Select the form and use the Properties window to change the Name property. (Press F4 if the Properties window isn't displayed.) Figure 13-1 shows the Properties window when an empty UserForm is selected.

A workbook can have any number of UserForms, and each UserForm holds a single custom dialog box.

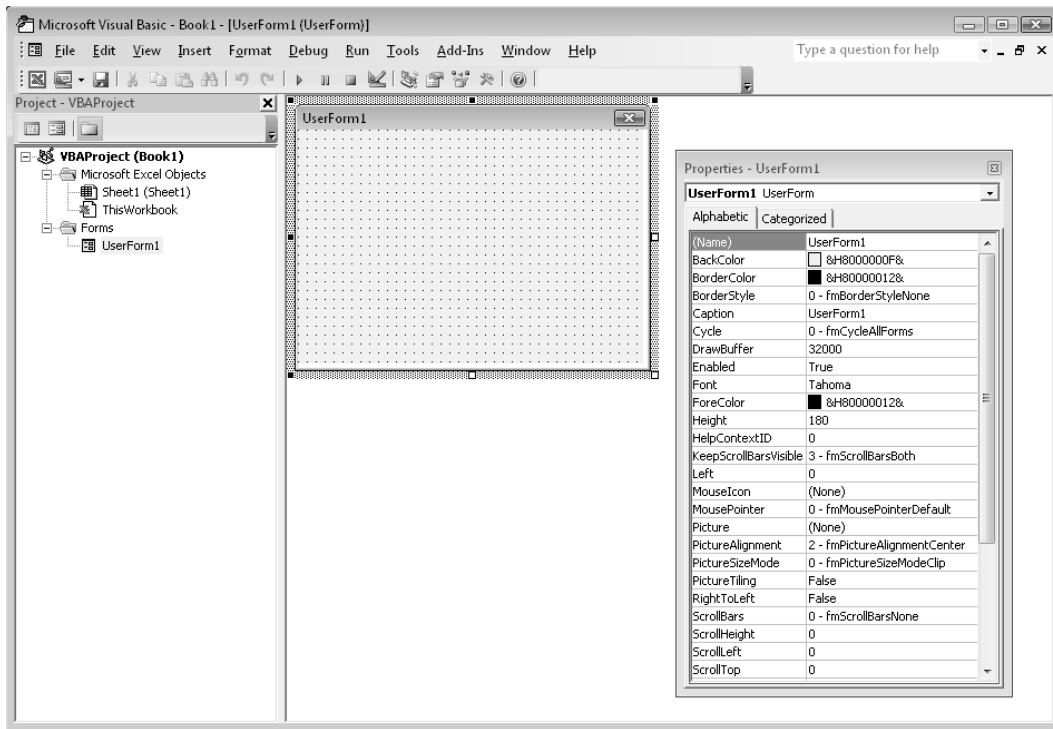


Figure 13-1: The Properties window for an empty UserForm.

Adding Controls to a UserForm

To add controls to a UserForm, use the Toolbox. (The VBE doesn't have menu commands that add controls.) If the Toolbox isn't displayed, choose View→Toolbox. Figure 13-2 shows the Toolbox. The Toolbox is a floating window, so you can move it to a convenient location.

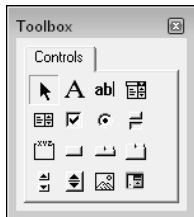


Figure 13-2: Use the Toolbox to add controls to a UserForm.

Click the Toolbox button that corresponds to the control that you want to add and then click inside the dialog box to create the control (using its default size). Or you can click the control and then drag in the dialog box to specify the dimensions for the control.

When you add a new control, it's assigned a name that combines the control type with the numeric sequence for that type of control. For example, if you add a `CommandButton` control to an empty UserForm, it's named `CommandButton1`. If you then add a second `CommandButton` control, it's named `CommandButton2`.

**Tip**

Renaming all the controls that you'll be manipulating with your VBA code is a good idea. Doing so lets you refer to meaningful names (such as `ProductListBox`) rather than generic names (such as `ListBox1`). To change the name of a control, use the Properties window in the VBE. Just select the object and change the `Name` property.

Toolbox Controls

In the sections that follow, I briefly describe the controls available to you in the Toolbox.

**On the CD**

Figure 13-3 shows a UserForm with one of each control. This workbook, named `all userform controls.xlsm`, is available on the companion CD-ROM.

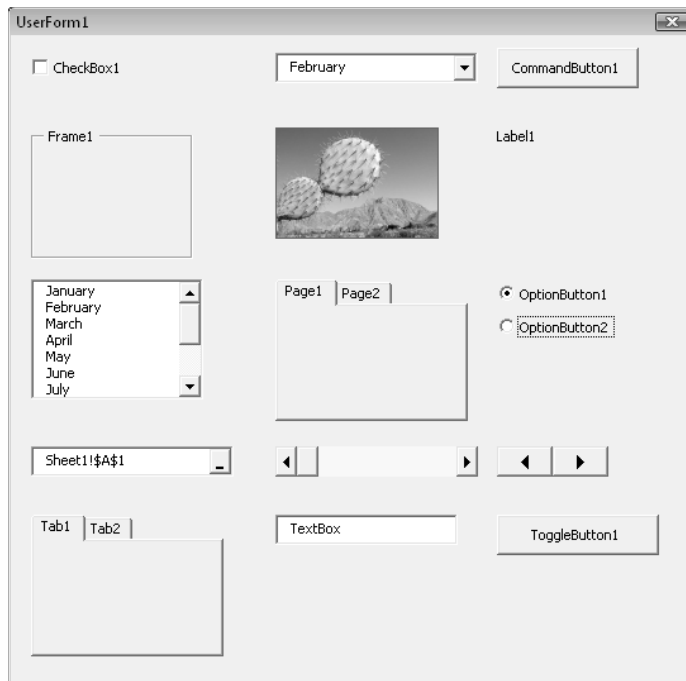


Figure 13-3: This UserForm has one of each of the 15 controls.



Your UserForms can also use other ActiveX controls. See “Customizing the Toolbox,” later in this chapter.

Tip

CheckBox

A `CheckBox` control is useful for getting a binary choice: yes or no, true or false, on or off, and so on. When a `CheckBox` is checked, it has a value of `True`; when it's not checked, the `CheckBox` value is `False`.

ComboBox

A `ComboBox` control presents a list of items in a drop-down box and displays only one item at a time. Unlike a `Listbox` control, you can set up a `ComboBox` to allow the user to enter a value that doesn't appear in the list of items.

CommandButton

Every dialog box that you create will probably have at least one `CommandButton` control. Usually, your UserForms will have one `CommandButton` labeled OK and another labeled Cancel.

Frame

A `Frame` control is used to enclose other controls. You enclose controls either for aesthetic purposes or to logically group a set of controls. A frame is particularly useful when the dialog box contains more than one set of `OptionButton` controls.

Image

You can use an `Image` control to display a graphic image, which can come from a file or can be pasted from the Clipboard. You may want to use an `Image` control to display your company's logo in a dialog box. The graphics image is stored in the workbook. That way, if you distribute your workbook to someone else, you don't have to include a copy of the graphics file.



Caution

Some graphics files are very large, and using such images can make your workbook increase dramatically in size. For best results, use graphics sparingly or use small graphics files.

Label

A `Label` control simply displays text in your dialog box.

ListBox

The `ListBox` control presents a list of items, and the user can select an item (or multiple items). `ListBox` controls are very flexible. For example, you can specify a worksheet range that holds the `ListBox` items, and this range can consist of multiple columns. Or you can fill the `ListBox` with items by using VBA.

MultiPage

A `MultiPage` control lets you create tabbed dialog boxes, like the Format Cells dialog box. By default, a `MultiPage` control has two pages, but you can add any number of additional pages.

OptionButton

`OptionButton` controls are useful when the user needs to select one item from a small number of choices. `OptionButtons` are always used in groups of at least two. When one `OptionButton` is selected, the other `OptionButtons` in its group are deselected.

If your UserForm contains more than one set of `OptionButtons`, the `OptionButtons` in each set must share a unique `GroupName` property value. Otherwise, all `OptionButtons` become part of the same set. Alternatively, you can enclose the `OptionButtons` in a `Frame` control, which automatically groups the `OptionButtons` contained in the frame.

RefEdit

The `RefEdit` control is used when you need to let the user select a range in a worksheet. This control accepts a typed range address or a range address generated by pointing to the range in a worksheet.

ScrollBar

The `ScrollBar` control is similar to a `SpinButton` control. The difference is that the user can drag the `ScrollBar` button to change the control's value in larger increments. The `ScrollBar` control is most useful for selecting a value that extends across a wide range of possible values.

SpinButton

The `SpinButton` control lets the user select a value by clicking either of two arrows: one to increase the value and the other to decrease the value. A `SpinButton` is often used in conjunction with a `TextBox` control or `Label` control, which displays the current value of the `SpinButton`. A `SpinButton` can be oriented horizontally or vertically.

TabStrip

A `TabStrip` control is similar to a `MultiPage` control, but it's not as easy to use. A `TabStrip` control, unlike a `MultiPage` control, doesn't serve as a container for other objects. Generally, you'll find that the `MultiPage` control is much more versatile.

TextBox

A `TextBox` control lets the user type text or a value.



Using controls on a worksheet

You can embed many of the UserForm controls directly into a worksheet. You can access these controls by using Excel's Developer→Controls→Insert command. Adding such controls to a worksheet requires much less effort than creating a UserForm. In addition, you may not have to create any macros because you can link a control to a worksheet cell. For example, if you insert a `CheckBox` control on a worksheet, you can link it to a particular cell by setting its `LinkedCell` property. When the `CheckBox` is checked, the linked cell displays `TRUE`. When the `CheckBox` is unchecked, the linked cell displays `FALSE`.

The accompanying figure shows a worksheet that contains some ActiveX controls. This workbook, named `activex worksheet controls.xlsx`, is available on the companion CD-ROM. The workbook uses linked cells and contains no macros.

Adding controls to a worksheet can be a bit confusing because controls can come from two sources:

- **Form controls:** These controls are insertable objects.
- **ActiveX controls:** These controls are a subset of those that are available for use on UserForms.

You can use the controls from either of these sources, but it's important that you understand the distinctions between them. The Form controls work much differently than the ActiveX controls.

When you add an ActiveX control to a worksheet, Excel goes into *design mode*. In this mode, you can adjust the properties of any controls on your worksheet, add or edit event-handler procedures for the control, or change its size or position. To display the Properties window for an ActiveX control, use the Developer→Controls→Properties command.

For simple buttons, I often use the `Button` control from the Form controls because it lets me attach any macro to it. If I use a `CommandButton` control from the ActiveX controls, clicking it will execute its event-handler procedure (for example, `CommandButton1_Click`) in the code module for the `Sheet` object — you can't attach just any macro to it.

When Excel is in design mode, you can't try out the controls. To test the controls, you must exit design mode by clicking the Developer→Controls→Design mode button (which is a toggle).

ToggleButton

A `ToggleButton` control has two states: on and off. Clicking the button toggles between these two states, and the button changes its appearance. Its value is either `True` (pressed) or `False` (not pressed). I never use this control because I think a `CheckBox` is much clearer.

Adjusting UserForm Controls

After you place a control in a UserForm, you can move and resize the control by using standard mouse techniques.



Tip

You can select multiple controls by Shift-clicking or by clicking and dragging to lasso a group of controls.

A UserForm can contain vertical and horizontal gridlines (displayed as dots) that help you align the controls that you add. When you add or move a control, it *snaps* to the grid to help you line up the controls. If you don't like to see these gridlines, you can turn them off by choosing **Tools**→**Options** in the VBE. In the Options dialog box, select the General tab and set your desired options in the Form Grid Settings section.

The Format menu in the VBE window provides several commands to help you precisely align and space the controls in a dialog box. Before you use these commands, select the controls that you want to work with. These commands work just as you'd expect, so I don't explain them here. Figure 13-4 shows a dialog box with several `OptionButton` controls about to be aligned. Figure 13-5 shows the controls after being aligned and assigned equal vertical spacing.



Tip

When you select multiple controls, the last control that you select appears with white handles rather than the normal black handles. The control with the white handles is used as the basis for sizing or positioning.

Adjusting a Control's Properties

Every control has a number of properties that determine how the control looks and behaves. You can change a control's properties, as follows:

- **At design time** when you're developing the UserForm. You use the Properties window to make design time changes.
- **During runtime** when the UserForm is being displayed for the user. You use VBA instructions to change a control's properties at runtime.

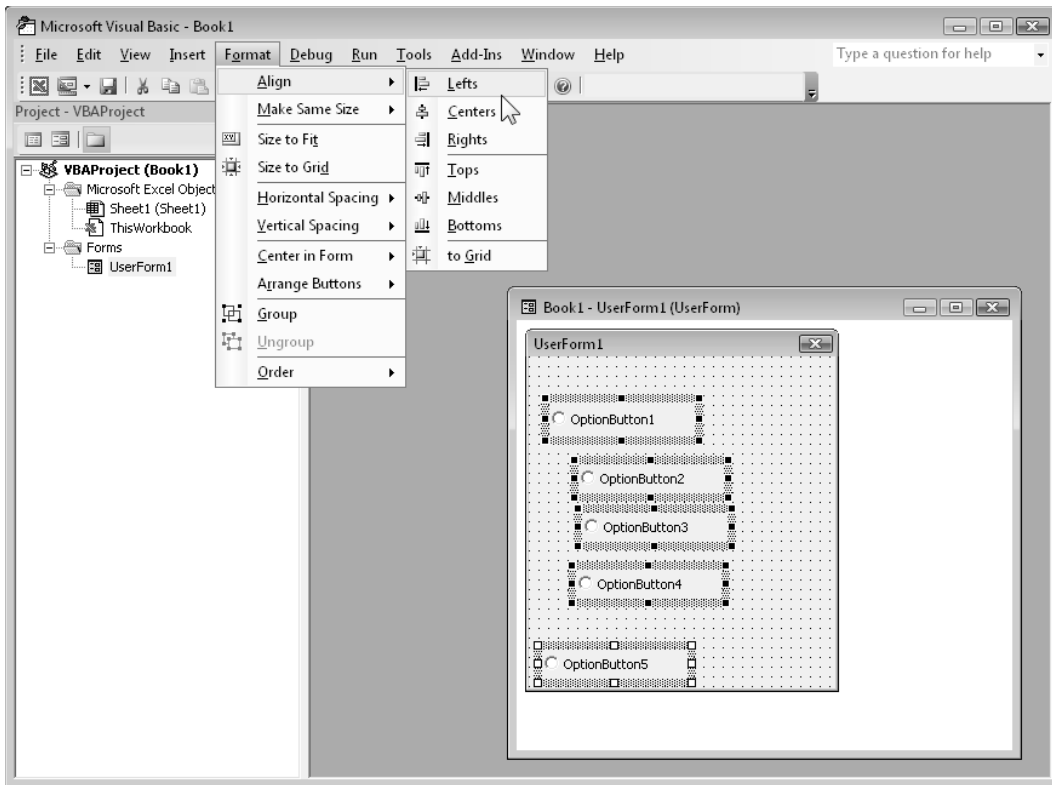


Figure 13-4: Use the Format→Align command to change the alignment of controls.

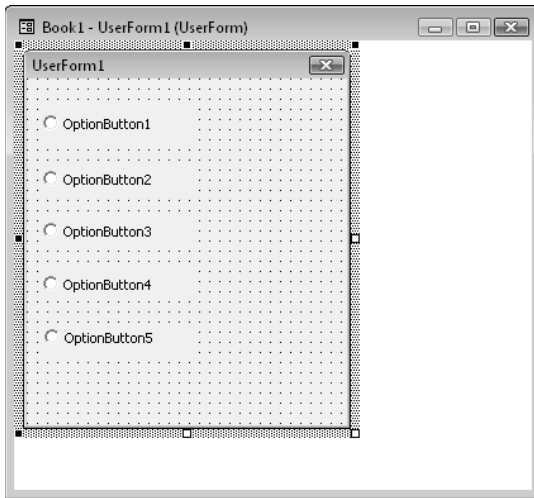


Figure 13-5: The OptionButton controls, aligned and evenly spaced.

Using the Properties window

In the VBE, the Properties window adjusts to display the properties of the selected item (which can be a control or the UserForm itself). In addition, you can select a control from the drop-down list at the top of the Properties window. Figure 13-6 shows the Properties window for an `OptionButton` control.

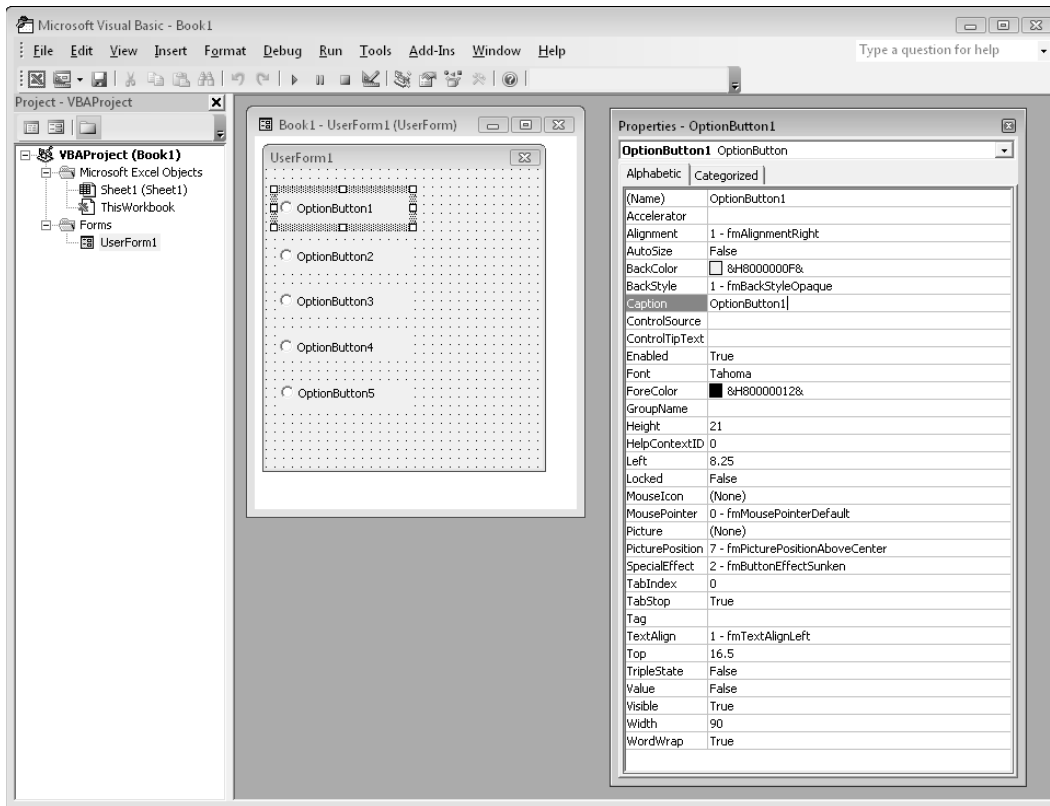


Figure 13-6: The Properties window for an `OptionButton` control.



Note

The Properties window has two tabs. The **Alphabetic** tab displays the properties for the selected object in alphabetical order. The **Categorized** tab displays them grouped into logical categories. Both tabs contain the same properties but in a different order.

To change a property, just click it and specify the new property. Some properties can take on a finite number of values, selectable from a list. If so, the Properties window will display a button with a downward-pointing arrow when that property is selected. Click the button, and you'll be able to select the property's value from the list. For example, the `TextAlign` property can have any of the following values: 1 - `fmTextAlignLeft`, 2 - `fmTextAlignCenter`, or 3 - `fmTextAlignRight`.

A few properties (for example, `Font` and `Picture`) display a small button with an ellipsis when selected. Click the button to display a dialog box associated with the property.

The Image control `Picture` property is worth mentioning because you can either select a graphic file that contains the image or paste an image from the Clipboard. When pasting an image, first copy it to the Clipboard; then select the `Picture` property for the Image control, and press Ctrl+V to paste the Clipboard contents.



If you select two or more controls at once, the Properties window displays only the properties that are common to the selected controls.



The UserForm itself has many properties that you can adjust. Some of these properties are then used as defaults for controls that you add to the UserForm. For example, if you change the UserForm `Font` property, all controls added to the UserForm will use that font. Note, however, that controls already on the UserForm aren't affected.

Common properties

Although each control has its own unique set of properties, many controls have some common properties. For example, every control has a `Name` property and properties that determine its size and position (`Height`, `Width`, `Left`, and `Right`).

If you're going to manipulate a control by using VBA, it's an excellent idea to provide a meaningful name for the control. For example, the first `OptionButton` that you add to a UserForm has a default name of `OptionButton1`. You refer to this object in your code with a statement such as the following:

```
OptionButton1.Value = True
```

But if you give the `OptionButton` a more meaningful name (such as `obLandscape`), you can use a statement such as this one:

```
obLandscape.Value = True
```



Many people find it helpful to use a name that also identifies the type of object. In the preceding example, I use `ob` as the prefix to identify the control as an `OptionButton`. I'm not aware of any standard prefixes, so feel free to invent your own.

You can adjust the properties of several controls at once. For example, you might have several `OptionButtons` that you want left-aligned. You can simply select all the `OptionButtons` and then change the `Left` property in the Properties box. All the selected controls will then take on that new `Left` property value.

The best way to learn about the various properties for a control is to use the Help system. Simply click on a property in the Property window and press F1. Figure 13-7 shows an example of the type of help provided for a property.

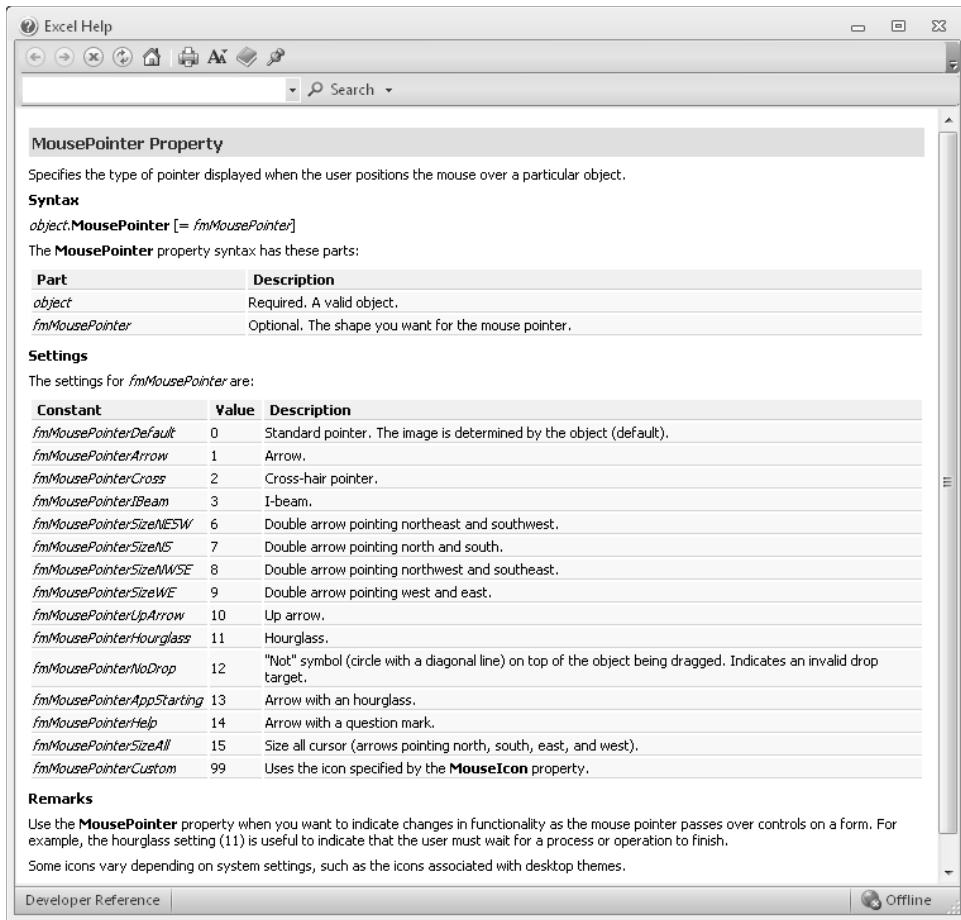


Figure 13-7: The Help system provides information about each property for every control.

Accommodating keyboard users

Many users prefer to navigate through a dialog box by using the keyboard: The Tab and Shift+Tab keystrokes cycle through the controls, and pressing a *hot key* (an underlined letter) operates the control. To make sure that your dialog box works properly for keyboard users, you must be mindful of two issues: tab order and accelerator keys.

Changing the tab order of controls

The *tab order* determines the sequence in which the controls are activated when the user presses Tab or Shift+Tab. It also determines which control has the initial *focus*. If a user is entering text into a `TextBox` control, for example, the `TextBox` has the focus. If the user clicks an `OptionButton`, the `OptionButton` has the focus. The control that's first in the tab order has the focus when a dialog box is first displayed.

To set the tab order of your controls, choose **View→Tab Order**. You can also right-click the UserForm and choose **Tab Order** from the shortcut menu. In either case, Excel displays the **Tab Order** dialog box, as shown in Figure 13-8. The **Tab Order** dialog box lists all the controls, the sequence of which corresponds to the order in which controls pass the focus between each other in the UserForm. To move a control, select it and click the arrow keys up or down. You can choose more than one control (click while pressing **Shift** or **Ctrl**) and move them all at once.

Alternatively, you can set an individual control's position in the tab order via the **Properties** window. The first control in the tab order has a **TabIndex** property of 0. Changing the **TabIndex** property for a control may also affect the **TabIndex** property of other controls. These adjustments are made automatically to ensure that no control has a **TabIndex** greater than the number of controls. If you want to remove a control from the tab order, set its **TabStop** property to **False**.

**Note**

Some controls, such as **Frame** and **MultiPage**, act as containers for other controls. The controls inside a container have their own tab order. To set the tab order for a group of **OptionButtons** inside a **Frame** control, select the **Frame** control before you choose the **View→Tab Order** command.

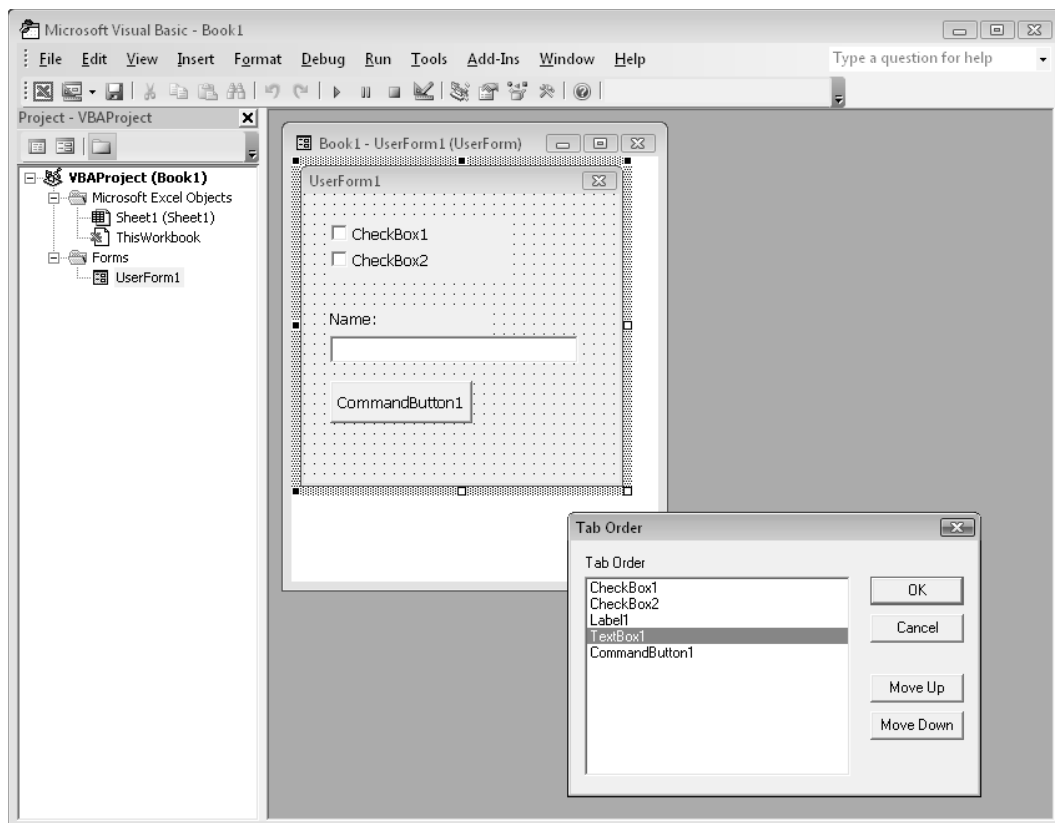


Figure 13-8: Use the **Tab Order** dialog box to specify the tab order of the controls.



Testing a UserForm

You'll usually want to test your UserForm while you're developing it. You can test a UserForm in three ways without actually calling it from a VBA procedure:

- Choose the Run→Run Sub/UserForm command.
- Press F5.
- Click the Run Sub/UserForm button on the Standard toolbar.

These three techniques all trigger the UserForm's `Initialize` event. When a dialog box is displayed in this test mode, you can try out the tab order and the accelerator keys.

Setting hot keys

You can assign an accelerator key, or hot key, to most dialog box controls. An accelerator key allows the user to access the control by pressing Alt+ the hot key. Use the `Accelerator` property in the Properties window for this purpose.



Tip

Some controls, such as a `TextBox`, don't have an `Accelerator` property because they don't display a caption. You still can allow direct keyboard access to these controls by using a `Label` control. Assign an accelerator key to the `Label` and put it before the `TextBox` in the tab order.

Displaying a UserForm

To display a UserForm from VBA, you create a procedure that uses the `Show` method of the `UserForm` object. If your UserForm is named `UserForm1`, the following procedure displays the dialog box on that form:

```
Sub ShowForm()  
    UserForm1.Show  
End Sub
```

This procedure must be located in a standard VBA module and not in the code module for the UserForm.

When the UserForm is displayed, it remains visible on-screen until it's dismissed. Usually, you'll add a `CommandButton` control to the UserForm that executes a procedure that dismisses the UserForm. The procedure can either unload the UserForm (with the `Unload` command) or hide the UserForm (with the `Hide` method of the `UserForm` object). This concept will become clearer as you work through various examples in this and subsequent chapters.

Displaying a modeless UserForm

By default, UserForms are displayed modally. This means that the UserForm must be dismissed before the user can do anything in the worksheet. You can also display a modeless UserForm. When a modeless UserForm is displayed, the user can continue working in Excel, and the UserForm remains visible. To display a modeless UserForm, use the following syntax:

```
UserForm1.Show vbModeless
```

Displaying a UserForm based on a variable

In some cases, you may have several UserForms, and your code makes a decision regarding which of them to display. If the name of the UserForm is stored as a string variable, you can use the `Add` method to add the UserForm to the `UserForms` collection and then use the `Show` method of the `UserForms` collection. Here's an example that assigns the name of a UserForm to the `MyForm` variable and then displays the UserForm:

```
MyForm = "UserForm1"  
UserForms.Add(MyForm).Show
```

Loading a UserForm

VBA also has a `Load` statement. Loading a UserForm loads it into memory, but it's not visible until you use the `Show` method. To load a UserForm, use a statement like this:

```
Load UserForm1
```

If you have a complex UserForm, you might want to load it into memory before it's needed so that it will appear more quickly when you use the `Show` method. In the majority of situations, however, you don't need to use the `Load` statement.

About event-handler procedures

After the UserForm is displayed, the user interacts with it — selecting an item from a `ListBox`, clicking a `CommandButton`, and so on. In official terminology, the user causes an *event* to occur. For example, clicking a `CommandButton` causes the `Click` event for the `CommandButton`. You need to write procedures that execute when these events occur. These procedures are sometimes known as *event-handler* procedures.

**Note**

Event-handler procedures must be located in the Code window for the UserForm. However, your event-handler procedure can call another procedure that's located in a standard VBA module.

Your VBA code can change the properties of the controls while the UserForm is displayed (that is, at runtime). For example, you could assign to a `Listbox` control a procedure that changes the text in a `Label` when an item is selected. This type of manipulation will become clearer later in this chapter.

Closing a UserForm

To close a UserForm, use the `Unload` command, as shown in this example:

```
Unload UserForm1
```

Or, if the code is located in the code module for the UserForm, you can use the following:

```
Unload Me
```

In this case, the keyword `Me` refers to the UserForm. Using `Me` rather than the UserForm's name eliminates the need to modify your code if you change the name of the UserForm.

Normally, your VBA code should include the `Unload` command after the UserForm has performed its actions. For example, your UserForm may have a `CommandButton` that serves as an OK button. Clicking this button executes a macro. One of the statements in the macro will unload the UserForm. The UserForm remains visible on the screen until the macro that contains the `Unload` statement finishes.

When a UserForm is unloaded, its controls are reset to their original values. In other words, your code won't be able to access the user's choices after the UserForm is unloaded. If the user's choice must be used later on (after the UserForm is unloaded), you need to store the value in a `Public` variable, declared in a standard VBA module. Or you could store the value in a worksheet cell, or even in the Windows registry.

**Note**

A UserForm is automatically unloaded when the user clicks the Close button (the X in the UserForm title bar). This action also triggers a `UserForm QueryClose` event, followed by a `UserForm Terminate` event.

UserForms also have a `Hide` method. When you invoke this method, the UserForm disappears, but it remains loaded in memory, so your code can still access the various properties of the controls. Here's an example of a statement that hides a UserForm:

```
UserForm1.Hide
```

Or, if the code is in the code module for the UserForm, you can use the following:

```
Me.Hide
```

If for some reason you'd like your UserForm to disappear immediately while its macro is executing, use the `Hide` method at the top of the procedure. For example, in the following procedure, the UserForm disappears immediately when `CommandButton1` is clicked. The last statement in the procedure unloads the UserForm.

```
Private Sub CommandButton1_Click()  
    Me.Hide  
    Application.ScreenUpdating = True  
    For r = 1 To 10000  
        Cells(r, 1) = r  
    Next r  
    Unload Me  
End Sub
```

In this example, I set `ScreenUpdating` to `True` to force Excel to hide the UserForm completely. Without that statement, the UserForm may actually remain visible.



Cross-Ref

In Chapter 15, I describe how to display a progress indicator, which takes advantage of the fact that a UserForm remains visible while the macro executes.

Creating a UserForm: An Example

If you've never created a UserForm, you might want to walk through the example in this section. The example includes step-by-step instructions for creating a simple dialog box and developing a VBA procedure to support the dialog box.

This example uses a UserForm to obtain two pieces of information: a person's name and sex. The dialog box uses a `TextBox` control to get the name and three `OptionButtons` to get the sex (Male, Female, or Unknown). The information collected in the dialog box is then sent to the next blank row in a worksheet.

Creating the UserForm

Figure 13-9 shows the completed UserForm for this example. For best results, start with a new workbook with only one worksheet in it. Then follow these steps:

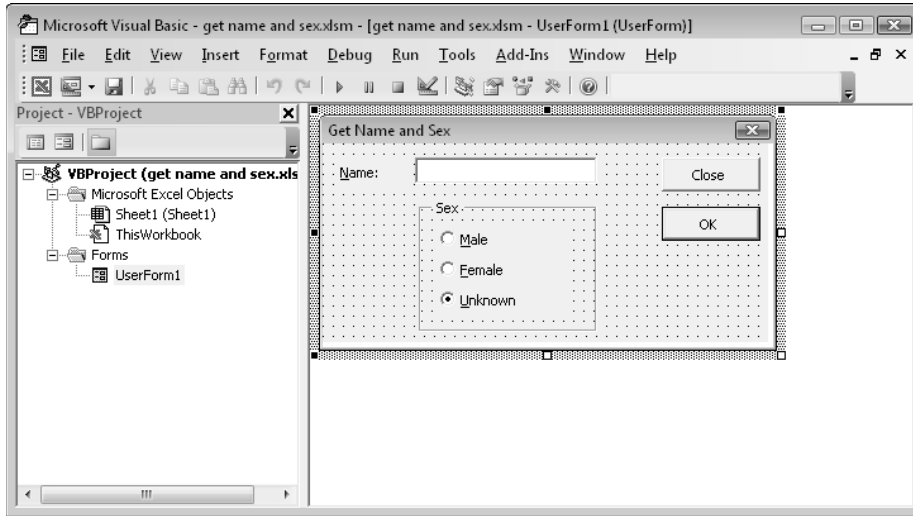


Figure 13-9: This dialog box asks the user to enter a name and a sex.

1. Press Alt+F11 to activate the VBE.
2. In the Project window, select the workbook's project and choose Insert→UserForm to add an empty UserForm.
The UserForm's `Caption` property will have its default value: `UserForm1`.
3. Use the Properties window to change the UserForm's `Caption` property to `Get Name and Sex`.
(If the Properties window isn't visible, press F4.)
4. Add a `Label` control and adjust the properties as follows:

Property	Value
Accelerator	N
Caption	Name :
TabIndex	0

5. Add a `TextBox` control and adjust the properties as follows:

Property	Value
Name	TextName
TabIndex	1

6. Add a `Frame` control and adjust the properties as follows:

Property	Value
Caption	Sex
TabIndex	2

7. Add an `OptionButton` control inside the frame and adjust the properties as follows:

Property	Value
Accelerator	M
Caption	Male
Name	OptionMale
TabIndex	0

8. Add another `OptionButton` control inside the frame and adjust the properties as follows:

Property	Value
Accelerator	F
Caption	Female
Name	OptionFemale
TabIndex	1

9. Add yet another `OptionButton` control inside the `Frame` and adjust the properties as follows:

Property	Value
Accelerator	U
Caption	Unknown
Name	OptionUnknown
TabIndex	2
Value	True

10. Add a `CommandButton` control *outside* the `Frame` and adjust the properties as follows:

Property	Value
Caption	OK
Default	True
Name	OKButton
TabIndex	3

11. Add another `CommandButton` control and adjust the properties as follows:

Property	Value
Caption	Close
Cancel	True
Name	CloseButton
TabIndex	4



Tip

When you're creating several controls that are similar, you may find it easier to copy an existing control rather than create a new one. To copy a control, press **Ctrl** while you drag the control to make a new copy of it. Then adjust the properties on the copied control.

Writing code to display the dialog box

Next, you add an `ActiveX CommandButton` to the worksheet. This button will execute a procedure that displays the `UserForm`. Here's how:

1. Activate Excel.
(**Alt+F11** is the shortcut key combination.)
2. Choose **Developer**→**Controls**→**Insert** and click `CommandButton` from the `ActiveX Controls` section.
3. Drag in the worksheet to create the button.
If you like, you can change the caption for the worksheet `CommandButton`. To do so, right-click the button and choose `CommandButton Object`→**Edit** from the shortcut menu. You can then edit the text that appears on the `CommandButton`. To change other properties of the object, right-click and choose `Properties`. Then make the changes in the `Properties` box.
4. Double-click the `CommandButton`.
This step activates the `VBE`. More specifically, the code module for the worksheet will be displayed, with an empty event-handler procedure for the worksheet's `CommandButton`.
5. Enter a single statement in the `CommandButton1_Click` procedure (see Figure 13-10).
This short procedure uses the `Show` method of an object (`UserForm1`) to display the `UserForm`.

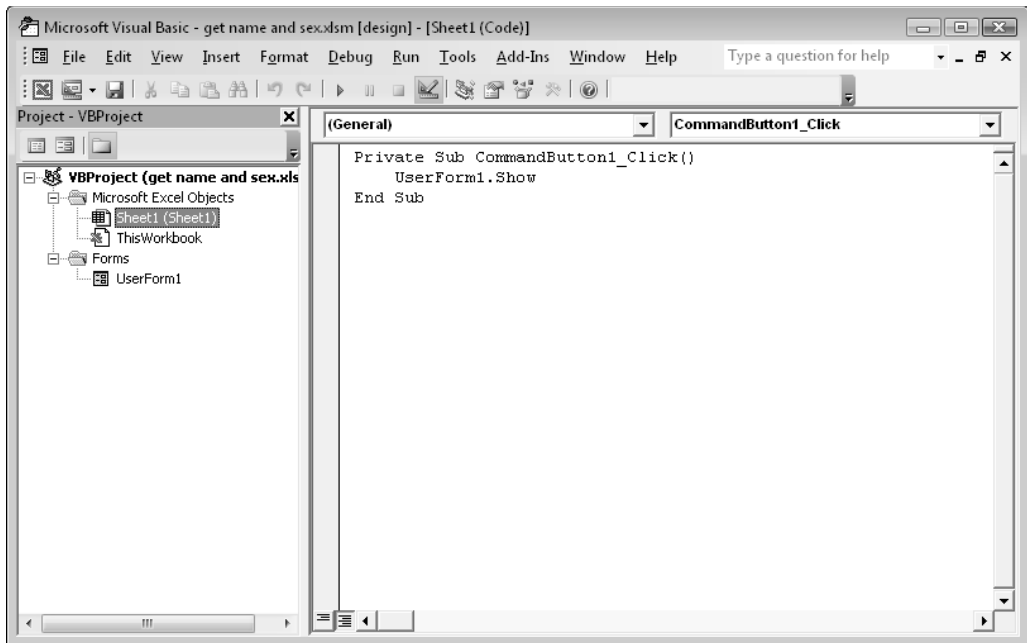


Figure 13-10: The CommandButton1_Click procedure is executed when the button on the worksheet is clicked.

Testing the dialog box

The next step is to re-activate Excel and try out the procedure that displays the dialog box.



Note

When you click the CommandButton on the worksheet, you'll find that nothing happens. Rather, the button is selected. That's because Excel is still in design mode — which happens automatically when you insert an ActiveX control. To exit design mode, click the **Developer→Controls→Design Mode** button. To make any changes to your CommandButton, you'll need to put Excel back into design mode.

When you exit design mode, clicking the button will display the UserForm (see Figure 13-11).

When the dialog box is displayed, enter some text into the text box and click OK. Nothing happens — which is understandable because you haven't yet created an event-handler procedure for the OK button.



Note

Click the X (Close) button in the UserForm title bar to dismiss the dialog box.

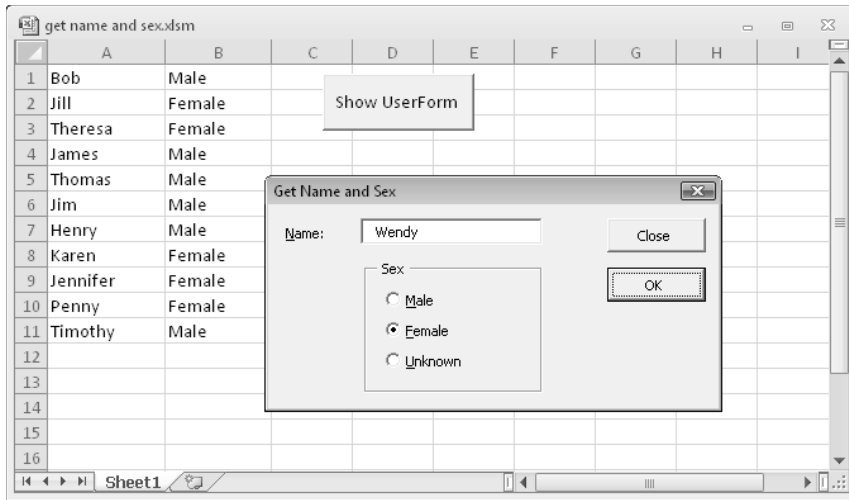


Figure 13-11: The CommandButton's Click event procedure displays the UserForm.

Adding event-handler procedures

In this section, I explain how to write the procedures that will handle the events that occur when the UserForm is displayed. To continue the example, do the following:

1. Press Alt+F11 to activate the VBE.
2. Make sure that the UserForm is displayed and double-click the CommandButton captioned Close.

This step activates the Code window for the UserForm and inserts an empty procedure named `CloseButton_Click`. Notice that this procedure consists of the object's name, an underscore character, and the event that it handles.

3. Modify the procedure as follows.

(This is the event handler for the `CloseButton`'s `Click` event.)

```
Private Sub CloseButton_Click()
    Unload UserForm1
End Sub
```

This procedure, which is executed when the user clicks the Close button, simply unloads the UserForm.

4. Press Shift+F7 to redisplay `UserForm1` (or click the View Object icon at the top of the Project Explorer window).

5. Double-click the OK button and enter the following procedure.

(This is the event handler for the OKButton's Click event.)

```
Private Sub OKButton_Click()
    Dim NextRow As Long
    ' Make sure Sheet1 is active
    Sheets("Sheet1").Activate
    ' Determine the next empty row
    NextRow = _
        Application.WorksheetFunction.CountA(Range("A:A")) + 1
    ' Transfer the name
    Cells(NextRow, 1) = TextName.Text

    ' Transfer the sex
    If OptionMale Then Cells(NextRow, 2) = "Male"
    If OptionFemale Then Cells(NextRow, 2) = "Female"
    If OptionUnknown Then Cells(NextRow, 2) = "Unknown"

    ' Clear the controls for the next entry
    TextName.Text = ""
    OptionUnknown = True
    TextName.SetFocus
End Sub
```

6. Activate Excel and click the CommandButton again to display the UserForm and then re-run the procedure again.

You'll find that the UserForm controls now function correctly. You can use them to add new names to the list in the worksheet.

Here's how the `OKButton_Click` procedure works: First, the procedure makes sure that the proper worksheet (`Sheet1`) is active. It then uses Excel's `COUNTA` function to determine the next blank cell in column A. Next, it transfers the text from the `TextBox` control to column A. It then uses a series of `If` statements to determine which `OptionButton` was selected and writes the appropriate text (Male, Female, or Unknown) to column B. Finally, the dialog box is reset to make it ready for the next entry. Notice that clicking OK doesn't close the dialog box. To end data entry (and unload the UserForm), click the Close button.

Validating the data

Play around with this example some more, and you'll find that it has a small problem: It doesn't ensure that the user actually enters a name into the text box. To make sure that the user enters a name, insert the following code in the `OKButton_Click` procedure, before the text is transferred to the worksheet. It ensures that the user enters a name (well, at least some text) in the `TextBox`. If the `TextBox` is empty, a message appears, and the focus is set to the `TextBox` so that the user can try again. The `Exit Sub` statement ends the procedure with no further action.

```
' Make sure a name is entered
If TextName.Text = "" Then
    MsgBox "You must enter a name."
    TextName.SetFocus
Exit Sub
End If
```

The finished dialog box

After making all these modifications, you'll find that the dialog box works flawlessly. (Don't forget to test the hot keys.) In real life, you'd probably need to collect more information than just name and sex. However, the same basic principles apply. You just need to deal with more UserForm controls.



On the CD

A workbook with this example is available on the companion CD-ROM in a file named `get name and sex.xlsm`.

Understanding UserForm Events

Each UserForm control (as well as the UserForm itself) is designed to respond to certain types of events, and a user or Excel can trigger these events. For example, clicking a `CommandButton` generates a `Click` event for the `CommandButton`. You can write code that is executed when a particular event occurs.

Some actions generate multiple events. For example, clicking the upward arrow of a `SpinButton` control generates a `SpinUp` event and also a `Change` event. When a UserForm is displayed by using the `Show` method, Excel generates an `Initialize` event and an `Activate` event for the UserForm. (Actually, the `Initialize` event occurs when the UserForm is loaded into memory and before it's actually displayed.)



Cross-Ref

Excel also supports events associated with a `Sheet` object, `Chart` objects, and the `ThisWorkbook` object. I discuss these types of events in Chapter 18.

Learning about events

To find out which events are supported by a particular control, do the following:

1. Add a control to a UserForm.
2. Double-click the control to activate the code module for the UserForm.
The VBE will insert an empty event-handler procedure for the default event for the control.

3. Click the drop-down list in the upper-right corner of the module window, and you'll see a complete list of events for the control.

Figure 13-12 shows the list of events for a `CheckBox` control.



Figure 13-12: The event list for a `CheckBox` control.

4. Select an event from the list, and the VBE will create an empty event-handler procedure for you.



Note

To find out specific details about an event, consult the Help system. The Help system also lists the events available for each control. When you locate an event for an object, make sure that the Help system table of contents is displayed. Then you can see a list of all other events for the object.



Caution

Event-handler procedures incorporate the name of the object in the procedure's name. Therefore, if you change the name of a control, you'll also need to make the appropriate changes to the control's event-handler procedure(s). The name changes aren't performed automatically! To make things easy on yourself, it's a good idea to provide names for your controls before you begin creating event-handler procedures.

UserForm events

Several events are associated with showing and unloading a UserForm:

- **Initialize:** Occurs before a UserForm is loaded or shown but doesn't occur if the UserForm was previously hidden.
- **Activate:** Occurs when a UserForm is shown.

- **Deactivate:** Occurs when a UserForm is deactivated but doesn't occur if the form is hidden.
- **QueryClose:** Occurs before a UserForm is unloaded.
- **Terminate:** Occurs after the UserForm is unloaded.



Note

Often, it's critical that you choose the appropriate event for your event-handler procedure and that you understand the order in which the events occur. Using the `Show` method invokes the `Initialize` and `Activate` events (in that order). Using the `Load` command invokes only the `Initialize` event. Using the `Unload` command triggers the `QueryClose` and `Terminate` events (in that order). Using the `Hide` method doesn't trigger either of these events.



On the CD

The companion CD-ROM contains a workbook (named `userform events.xlsm`) that monitors all these events and displays a message box when an event occurs. If you're confused about UserForm events, studying the code in this example should clear things up.

SpinButton events

To help clarify the concept of events, this section takes a close look at the events associated with a `SpinButton` control. Some of these events are associated with other controls, and some are unique to the `SpinButton` control.



On the CD

The companion CD-ROM contains a workbook that demonstrates the sequence of events that occur for a `SpinButton` and the UserForm that contains it. The workbook, named `spinbutton events.xlsm`, contains a series of event-handler routines — one for each `SpinButton` and `UserForm` event. Each of these routines simply displays a message box that tells you the event that just fired.

Table 13-1 lists all the events for the `SpinButton` control.

Table 13-1: SpinButton Events

Event	Description
<code>AfterUpdate</code>	Occurs after the control is changed through the user interface.
<code>BeforeDragOver</code>	Occurs when a drag-and-drop operation is in progress.
<code>BeforeDropOrPaste</code>	Occurs when the user is about to drop or paste data onto the control.
<code>BeforeUpdate</code>	Occurs before the control is changed.
<code>Change</code>	Occurs when the <code>Value</code> property changes.
<code>Enter</code>	Occurs before the control actually receives the focus from a control on the same UserForm.

Event	Description
Error	Occurs when the control detects an error and can't return the error information to a calling program.
Exit	Occurs immediately before a control loses the focus to another control on the same form.
KeyDown	Occurs when the user presses a key and the object has the focus.
KeyPress	Occurs when the user presses any key that produces a typeable character.
KeyUp	Occurs when the user releases a key and the object has the focus.
SpinDown	Occurs when the user clicks the lower (or left) SpinButton arrow.
SpinUp	Occurs when the user clicks the upper (or right) SpinButton arrow.

A user can operate a `SpinButton` control by clicking it with the mouse or (if the control has the focus) by using the up-arrow and down-arrow keys.

Mouse-initiated events

When the user clicks the upper SpinButton arrow, the following events occur in this precise order:

1. `Enter` (triggered only if the `SpinButton` did not already have the focus)
2. `Change`
3. `SpinUp`

Keyboard-initiated events

The user can also press `Tab` to set the focus to the `SpinButton` and then use the arrow keys to increment or decrement the control. If so, the following events occur (in this order):

1. `Enter`
2. `KeyDown`
3. `Change`
4. `SpinUp` (or `SpinDown`)
5. `KeyUp`

What about changes via code?

The `SpinButton` control can also be changed by VBA code — which also triggers the appropriate event(s). For example, the following statement sets the `SpinButton1.Value` property to 0 and also triggers the `Change` event for the `SpinButton` control — but only if the `SpinButton` value was not already 0:

```
SpinButton1.Value = 0
```

You might think that you could disable events by setting the `EnableEvents` property of the `Application` object to `False`. Unfortunately, this property applies only to events that involve true Excel objects: `Workbooks`, `Worksheets`, and `Charts`.

Pairing a SpinButton with a TextBox

A `SpinButton` has a `Value` property, but this control doesn't have a caption in which to display its value. In many cases, however, you'll want the user to see the `SpinButton` value. And sometimes you'll want the user to be able to change the `SpinButton` value directly instead of clicking the `SpinButton` repeatedly.

The solution is to pair a `SpinButton` with a `TextBox`, which enables the user to specify a value either by typing it into the `TextBox` directly or by clicking the `SpinButton` to increment or decrement the value in the `TextBox`.

Figure 13-13 shows a simple example. The `SpinButton`'s `Min` property is 1, and its `Max` property is 100. Therefore, clicking the `SpinButton`'s arrows will change its value to an integer between 1 and 100.

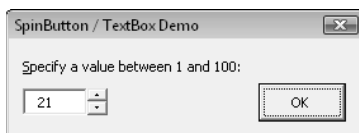


Figure 13-13: This `SpinButton` is paired with a `TextBox`.



On the CD

This workbook is available on the companion CD-ROM. The file is named `spinbutton` and `textbox.xlsm`.

The code required to link a `SpinButton` with a `TextBox` is relatively simple. It's basically a matter of writing event-handler procedures to ensure that the `SpinButton`'s `Value` property is always in sync with the `TextBox`'s `Text` property.

The following procedure is executed whenever the `SpinButton`'s `Change` event is triggered. That is, the procedure is executed when the user clicks the `SpinButton` or changes its value by pressing the up arrow or down arrow.

```
Private Sub SpinButton1_Change()  
    TextBox1.Text = SpinButton1.Value  
End Sub
```

The procedure simply assigns the `SpinButton`'s `Value` to the `Text` property of the `TextBox` control. Here, the controls have their default names (`SpinButton1` and `TextBox1`). If the user enters a value directly into the `TextBox`, its `Change` event is triggered, and the following procedure is executed:

```
Private Sub TextBox1_Change()
    NewVal = Val(TextBox1.Text)
    If NewVal >= SpinButton1.Min And _
        NewVal <= SpinButton1.Max Then _
        SpinButton1.Value = NewVal
End Sub
```

This procedure starts by using VBA's `Val` function to convert the text in the `TextBox` to a value. (If the `TextBox` contains non-numeric text, the `Val` function returns 0.) The next statement determines whether the value is within the proper range for the `SpinButton`. If so, the `SpinButton`'s `Value` property is set to the value entered in the `TextBox`.



About the Tag property

Every UserForm and control has a `Tag` property. This property doesn't represent anything specific, and, by default, is empty. You can use the `Tag` property to store information for your own use.

For example, you may have a series of `TextBox` controls in a UserForm. The user may be required to enter text into some but not all of them. You can use the `Tag` property to identify (for your own use) which fields are required. In this case, you can set the `Tag` property to a string such as `Required`. Then when you write code to validate the user's entries, you can refer to the `Tag` property.

The following example is a function that examines all `TextBox` controls on `UserForm1` and returns the number of required `TextBox` controls that are empty:

```
Function EmptyCount()
    Dim ctl As Control
    EmptyCount = 0
    For Each ctl In UserForm1.Controls
        If TypeName(ctl) = "TextBox" Then
            If ctl.Tag = "Required" Then
                If ctl.Text = "" Then
                    EmptyCount = EmptyCount + 1
                End If
            End If
        End If
    Next ctl
End Function
```

As you work with UserForms, you'll probably think of other uses for the `Tag` property.

The example is set up so that clicking the OK button (which is named `OKButton`) transfers the `SpinButton`'s value to the active cell. The event handler for this `CommandButton`'s `Click` event is as follows:

```
Private Sub OKButton_Click()  
    ' Enter the value into the active cell  
    If CStr(SpinButton1.Value) = TextBox1.Text Then  
        ActiveCell = SpinButton1.Value  
        Unload Me  
    Else  
        MsgBox "Invalid entry.", vbCritical  
        TextBox1.SetFocus  
        TextBox1.SelStart = 0  
        TextBox1.SelLength = Len(TextBox1.Text)  
    End If  
End Sub
```

This procedure does one final check: It makes sure that the text entered in the `TextBox` matches the `SpinButton`'s value. This check is necessary in the case of an invalid entry. For example, if the user enters `3r` into the `TextBox`, the `SpinButton`'s value would not be changed, and the result placed in the active cell would not be what the user intended. Notice that the `SpinButton`'s `Value` property is converted to a string by using the `CStr` function. This conversion ensures that the comparison won't generate an error if a value is compared with text. If the `SpinButton`'s value doesn't match the `TextBox`'s contents, a message box is displayed. Notice that the focus is set to the `TextBox` object, and the contents are selected (by using the `SelStart` and `SelLength` properties). This setup makes it very easy for the user to correct the entry.

Referencing UserForm Controls

When working with controls on a UserForm, the VBA code is usually contained in the code window for the UserForm. You can also refer to UserForm controls from a general VBA module. To do so, you need to qualify the reference to the control by specifying the UserForm name. For example, consider the following procedure, which is located in a VBA module. It simply displays the UserForm named `UserForm1`.

```
Sub GetData()  
    UserForm1.Show  
End Sub
```

Assume that `UserForm1` contains a text box (named `TextBox1`), and you want to provide a default value for the text box. You could modify the procedure as follows:

```
Sub GetData()  
    UserForm1.TextBox1.Value = "John Doe"  
    UserForm1.Show  
End Sub
```

Another way to set the default value is to take advantage of the UserForm's `Initialize` event. You can write code in the `UserForm_Initialize` procedure, which is located in the code module for the UserForm. Here's an example:

```
Private Sub UserForm_Initialize()  
    TextBox1.Value = "John Doe"  
End Sub
```

Notice that when the control is referenced in the code module for the UserForm, you don't need to qualify the references with the UserForm name. However, qualifying references to controls does have an advantage: You'll then be able to take advantage of the Auto List Members feature, which lets you choose the control names from a drop-down list.



Understanding the controls collection

The controls on a UserForm make up a collection. For example, the following statement displays the number of controls on `UserForm1`:

```
MsgBox UserForm1.Controls.Count
```

VBA does *not* maintain a collection of each control type. For example, there is no collection of `CommandButton` controls. However, you can determine the type of control by using the `TypeName` function. The following procedure uses a `For Each` structure to loop through the `Controls` collection and then displays the number of `CommandButton` controls on `UserForm1`:

```
Sub CountButtons()  
    Dim cbCount As Integer  
    Dim ctl as Control  
    cbCount = 0  
    For Each ctl In UserForm1.Controls  
        If TypeName(ctl) = "CommandButton" Then _  
            cbCount = cbCount + 1  
    Next ctl  
    MsgBox cbCount  
End Sub
```



Rather than use the actual name of the UserForm, it's preferable to use `Me`. Then, if you change the name of the UserForm, you won't need to replace the references in your code.

Customizing the Toolbox

When a UserForm is active in the VBE, the Toolbox displays the controls that you can add to the UserForm. If the Toolbox isn't visible, choose **View**→**Toolbox** to display it. This section describes ways to customize the Toolbox.

Adding new pages to the Toolbox

The Toolbox initially contains a single tab. Right-click this tab and select **New Page** to add a new tab to the Toolbox. You can also change the text displayed on the tab by selecting **Rename** from the shortcut menu.

Customizing or combining controls

A very handy feature lets you customize a control and then save it for future use. You can, for example, create a `CommandButton` control that's set up to serve as an OK button. Set the following properties to customize the `CommandButton`: `Width`, `Height`, `Caption`, `Default`, and `Name`. Then drag the customized `CommandButton` to the Toolbox to create a new control. Right-click the new control to rename it or change its icon.

You can also create a new Toolbox entry that consists of multiple controls. For example, you can create two `CommandButtons` that represent a UserForm's OK and Cancel buttons. Customize them as you like and then select them both and drag them to the Toolbox. Then, you can use this new Toolbox control to add two customized buttons in one fell swoop.

This type of customization also works with controls that act as containers. For example, create a `Frame` control and add four customized `OptionButtons`, neatly spaced and aligned. Then drag the `Frame` to the Toolbox to create a customized `Frame` control.

To help identify customized controls, right-click the control and select **Customize xxx** from the shortcut menu (where `xxx` is the control's name). You see a new dialog box that lets you change the `ToolTip` text, edit the icon, or load a new icon image from a file.



You may want to place your customized controls on a separate page in the Toolbox. This lets you export the entire page so that you can share it with other Excel users. To export a Toolbox page, right-click the tab and select **Export Page**.



On the CD

The companion CD-ROM contains a pag file (named `newcontrols.pag`) that contains some customized controls. You can import this file as a new page in your Toolbox.

Right-click a tab and select Import Page. Then locate the pag file. Your Toolbox will resemble Figure 13-14. The new controls include an exclamation point image, a “critical” red x image, a question mark image, an information image, OK and Cancel buttons, a Frame with four `OptionButton` controls, a `TextBox`, a `Spinner`, and six `CheckBox` controls.

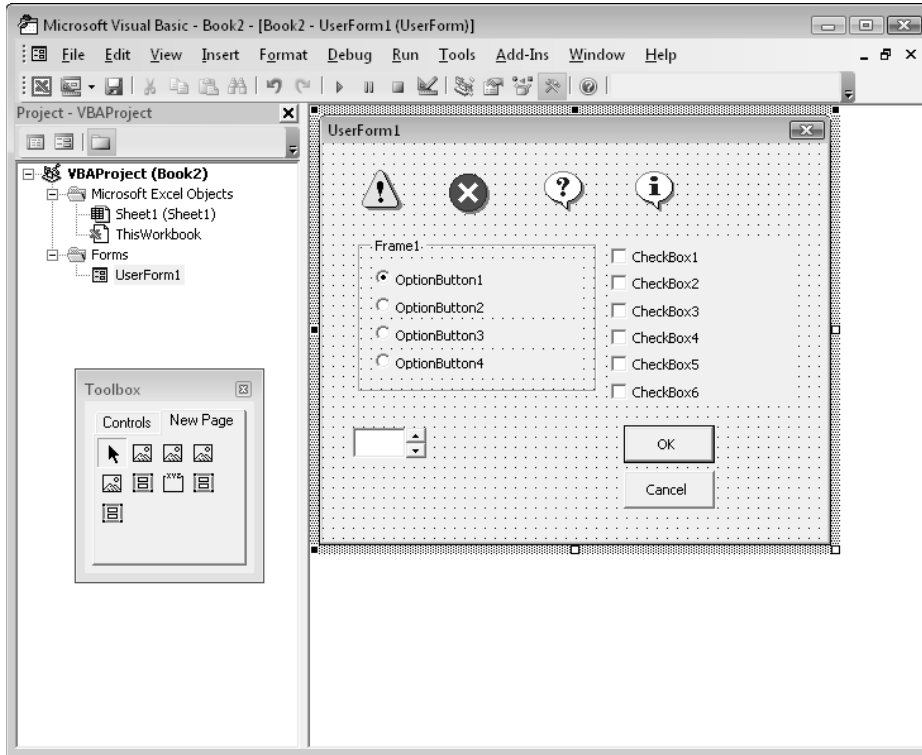


Figure 13-14: The Toolbox, with a new page of controls.

Adding new ActiveX controls

UserForms can use other ActiveX controls developed by Microsoft or other vendors. To add an additional ActiveX control to the Toolbox, right-click the Toolbox and select Additional Controls. You see the dialog box shown in Figure 13-15.

The Additional Controls dialog box lists all ActiveX controls that are installed on your system. Select the control(s) that you want to add and then click OK to add an icon for each selected control.

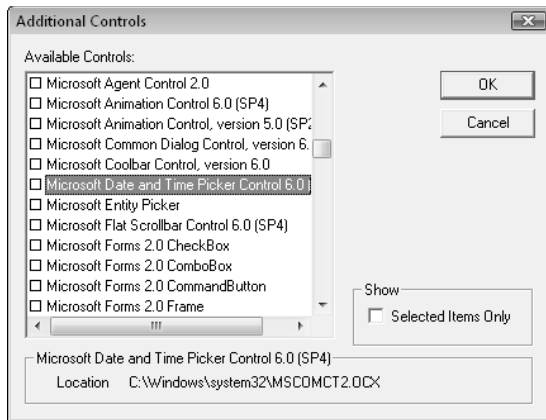


Figure 13-15: The Additional Controls dialog box lets you add other ActiveX controls.



Caution

Not all ActiveX controls that are installed on your system will work in Excel UserForms. In fact, most of them probably won't work. Also, some controls require a license in order to use them in an application. If you (or the users of your application) aren't licensed to use a particular control, an error will occur.

Creating UserForm Templates

You may find that when you design a new UserForm, you tend to add the same controls each time. For example, every UserForm might have two CommandButtons that serve as OK and Cancel buttons. In the previous section, I describe how to create a new control that combines these two (customized) buttons into a single control. Another option is to create your UserForm template and then export it so that you can import it into other projects. An advantage is that the event-handler code for the controls is stored with the template.

Start by creating a UserForm that contains all the controls and customizations that you'd need to reuse in other projects. Then make sure that the UserForm is selected and choose File→Export File (or press Ctrl+E). You'll be prompted for a filename.

Then, when you start your next project, choose File→Import File to load the saved UserForm.



Emulating Excel's dialog boxes

The look and feel of Windows dialog boxes differs from program to program. When developing applications for Excel, it's best to try to mimic Excel's dialog box style whenever possible.

In fact, a good way to learn how to create effective dialog boxes is to try to copy one of Excel's dialog boxes down to the smallest detail. For example, make sure that you get all the hot keys defined and be sure that the tab order is the same. To re-create one of Excel's dialog boxes, you need to test it under various circumstances and see how it behaves. I guarantee that your analysis of Excel's dialog boxes will improve your own dialog boxes.

You'll find that it's impossible to duplicate some of Excel's dialog boxes.

A UserForm Checklist

Before you unleash a UserForm on end users, be sure that everything is working correctly. The following checklist should help you identify potential problems:

- Are similar controls the same size?
- Are the controls evenly spaced?
- Is the dialog box too overwhelming? If so, you may want to group the controls by using a `MultiPage` control.
- Can every control be accessed with a hot key?
- Are any of the hot keys duplicated?
- Is the tab order set correctly?
- Will your VBA code take appropriate action if the user presses Esc or clicks the Close button on the UserForm?
- Are there any misspellings in the text?
- Does the dialog box have an appropriate caption?
- Will the dialog box display properly at all video resolutions?
- Are the controls grouped logically (by function)?
- Do `ScrollBar` and `SpinButton` controls allow valid values only?
- Does the UserForm use any controls that might not be installed on every system?
- Are `ListBoxes` set properly (Single, Multi, or Extended)? See Chapter 14 for details on `Listbox` controls.

UserForm Examples

In This Chapter

- Using a UserForm for a simple menu
- Selecting ranges from a UserForm
- Using a UserForm as a splash screen
- Changing the size of a UserForm while it's displayed
- Zooming and scrolling a sheet from a UserForm
- Understanding various techniques that involve a `ListBox` control
- Using an external control
- Using the `MultiPage` control
- Animating a `Label` control

Creating a UserForm “Menu”

Sometimes, you might want to use a UserForm as a type of menu. In other words, the UserForm presents some options, and the user makes a choice. This section presents two ways to do this: using `CommandButtons` or using a `ListBox`.



Cross-Ref

Chapter 15 contains additional examples of more advanced UserForm techniques.

Using CommandButtons in a UserForm

Figure 14-1 shows an example of a UserForm that uses `CommandButton` controls as a simple menu. Setting up this sort of UserForm is easy, and the code behind the UserForm is straightforward. Each `CommandButton` has its own event-handler procedure. For example, the following procedure is executed when `CommandButton1` is clicked:

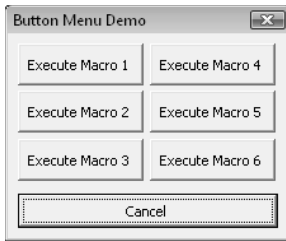


Figure 14-1: This dialog box uses CommandButtons as a menu.

```
Private Sub CommandButton1_Click()
    Me.Hide
    Call Macro1
    Unload Me
End Sub
```

This procedure hides the UserForm, calls `Macro1`, and then closes the UserForm. The other buttons have similar event-handler procedures.

Using a ListBox in a UserForm

Figure 14-2 shows another example that uses a `ListBox` as a menu. Before the UserForm is displayed, its `Initialize` event-handler procedure is called. This procedure, which follows, uses the `AddItem` method to add six items to the `ListBox`:

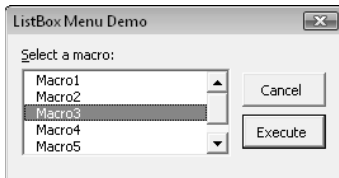


Figure 14-2: This dialog box uses a `ListBox` as a menu.

```
Private Sub UserForm_Initialize()
    With ListBox1
        .AddItem "Macro1"
        .AddItem "Macro2"
        .AddItem "Macro3"
        .AddItem "Macro4"
        .AddItem "Macro5"
        .AddItem "Macro6"
    End With
End Sub
```

The Execute button also has a procedure to handle its Click event:

```
Private Sub ExecuteButton_Click()  
    Select Case ListBox1.ListIndex  
        Case -1  
            MsgBox "Select a macro from the list."  
            Exit Sub  
        Case 0: Call Macro1  
        Case 1: Call Macro2  
        Case 2: Call Macro3  
        Case 3: Call Macro4  
        Case 4: Call Macro5  
        Case 5: Call Macro6  
    End Select  
    Unload Me  
End Sub
```

This procedure accesses the `ListIndex` property of the `ListBox` to determine which item is selected. The procedure uses a `Select Case` structure to execute the appropriate macro. If the `ListIndex` is `-1`, nothing is selected in the `ListBox`, and the user sees a message.

In addition, this UserForm has a procedure to handle the double-click event for the `ListBox`. Double-clicking an item in the `ListBox` executes the corresponding macro.



On the CD

The two examples in this section are available on the companion CD-ROM. The filename is `userform menus.xlsm`.



Cross-Ref

Chapter 15 shows a similar example in which you can use a UserForm to simulate a toolbar.

Selecting Ranges from a UserForm

Many of Excel's built-in dialog boxes allow the user to specify a range. For example, the Goal Seek dialog box (displayed by choosing `Data→Data Tools→What-If Analysis→Goal Seek`) asks the user to select two single-cell ranges. The user can either type the range addresses (or names) directly or use the mouse to point and click in a sheet to make a range selection.

Your UserForms can also provide this type of functionality, thanks to the `RefEdit` control. The `RefEdit` control doesn't look exactly like the range selection control used in Excel's built-in dialog boxes, but it works in a similar manner. If the user clicks the small button on the right side of the control, the dialog box disappears temporarily, and a small range selector is displayed — which is exactly what happens with Excel's built-in dialog boxes.



Note

Unfortunately, the `RefEdit` control has a few quirks that still haven't been fixed. You'll find that this control doesn't allow the user to use shortcut range selection keys (for example, pressing `End`, followed by `Shift+↓` will not select cells to the end of the column). In addition, after clicking the small button on the right side of the control (to temporarily hide the dialog box), you're limited to mouse selections only. You can't use the keyboard at all to make a selection.

Figure 14-3 shows a UserForm that contains a `RefEdit` control. This dialog box enables the user to perform a simple mathematical operation on all nonformula (and non-empty) cells in the selected range. The operation that's performed corresponds to the selected `OptionButton`.



On the CD

This example is available on the companion CD-ROM in a file named `range selection demo.xlsm`.

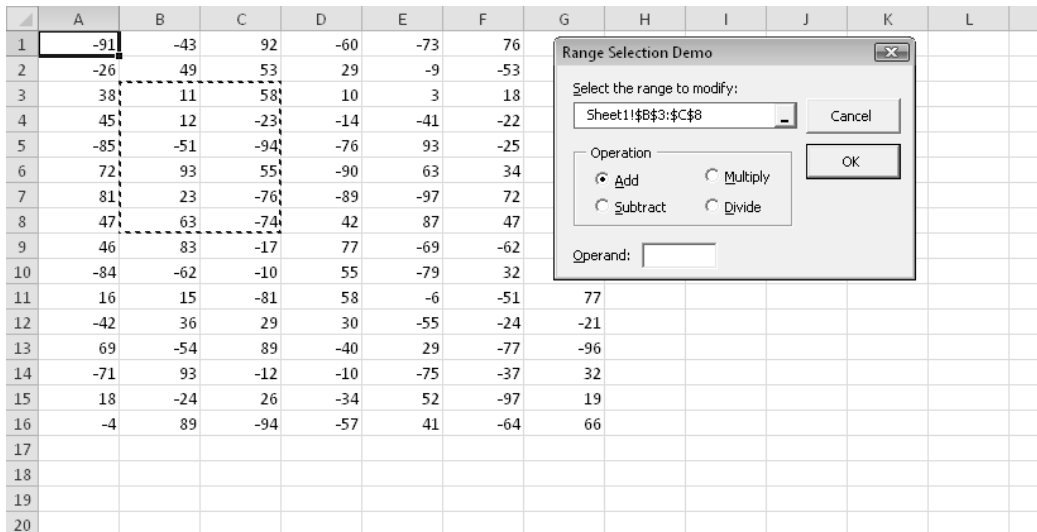


Figure 14-3: The `RefEdit` control shown here allows the user to select a range.

Following are a few things to keep in mind when using a `RefEdit` control:

- The `RefEdit` control returns a text string that represents a range address. You can convert this string to a `Range` object by using a statement such as

```
Set UserRange = Range(RefEdit1.Text)
```

- Initializing the `RefEdit` control to display the current range selection is good practice. You can do so in the `UserForm_Initialize` procedure by using a statement such as

```
RefEdit1.Text = ActiveWindow.RangeSelection.Address
```


- For best results, avoid using a `RefEdit` control inside of a `Frame` or a `MultiPage` control. Doing so may cause Excel to crash.
- Don't assume that `RefEdit` will always return a valid range address. Pointing to a range isn't the only way to get text into this control. The user can type any text and can also edit or delete the displayed text. Therefore, you need to make sure that the range is valid. The following code is an example of a way to check for a valid range. If an invalid range is detected, the user is given a message, and focus is set to the `RefEdit` control so that the user can try again.

```
On Error Resume Next
Set UserRange = Range(RefEdit1.Text)
If Err.Number <> 0 Then
    MsgBox "Invalid range selected"
    RefEdit1.SetFocus
    Exit Sub
End If
On Error GoTo 0
```

- The user can also click the worksheet tabs while selecting a range with the `RefEdit` control. Therefore, you can't assume that the selection is on the active sheet. However, if a different sheet is selected, the range address is preceded by a sheet name. For example:

```
Sheet2!$A$1:$C$4
```

- If you need to get a single cell selection from the user, you can pick out the upper-left cell of a selected range by using a statement such as

```
Set OneCell = Range(RefEdit1.Text).Range("A1")
```



Cross-Ref

As I discuss in Chapter 12, you can also use Excel's `InputBox` method to allow the user to select a range.

Creating a Splash Screen

Some developers like to display some introductory information when the application is opened. This display is commonly known as a *splash screen*. You're undoubtedly familiar with Excel's splash screen, which appears for a few seconds when Excel is loading.

You can create a splash screen for your Excel application with a UserForm. This example is essentially a UserForm that displays automatically and then dismisses itself after five seconds.



On the CD

The companion CD-ROM contains a workbook that demonstrates this procedure. The file is named `splash screen.xlsm`.

Follow these instructions to create a splash screen for your project:

1. Create your workbook.
2. Activate the Visual Basic Editor (VBE) and insert a new UserForm into the project.

The code in this example assumes that this form is named `UserForm1`.

3. Place any controls that you like on `UserForm1`.

For example, you may want to insert an `Image` control that has your company's logo. Figure 14-4 shows an example.

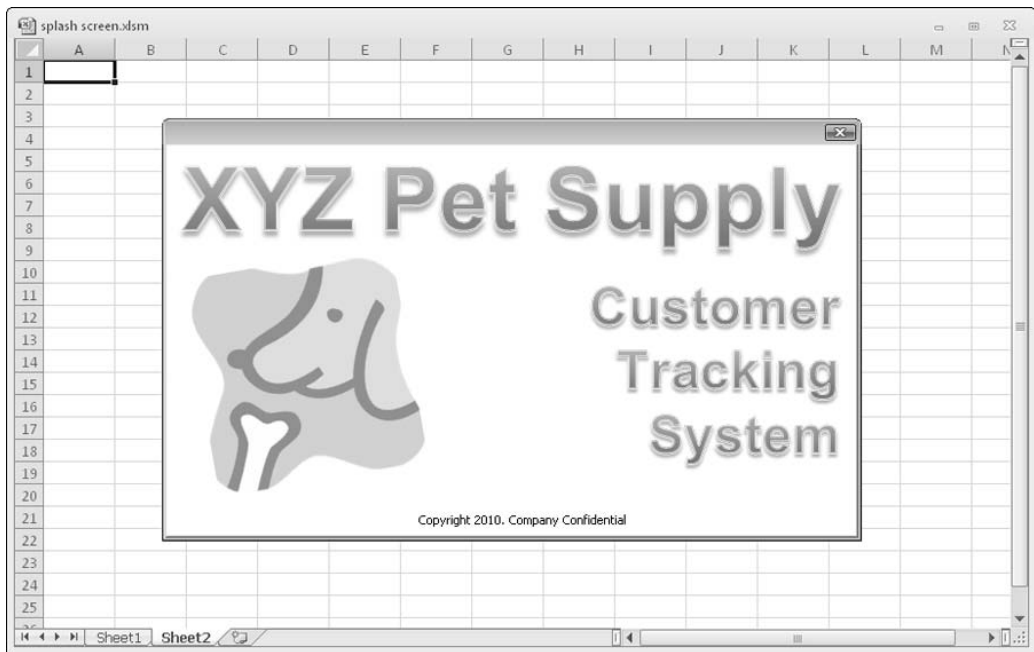


Figure 14-4: This splash screen is displayed briefly when the workbook is opened.

4. Insert the following procedure into the code module for the `ThisWorkbook` object:

```
Private Sub Workbook_Open()
    UserForm1.Show
End Sub
```

5. Insert the following procedure into the code module for `UserForm1`.

For a delay other than five seconds, change the argument for the `TimeValue` function.

```
Private Sub UserForm_Activate()
    Application.OnTime Now + _
        TimeValue("00:00:05"), "KillTheForm"
End Sub
```

6. Insert the following procedure into a general VBA module:

```
Private Sub KillTheForm()  
    Unload UserForm1  
End Sub
```

When the workbook is opened, the `Workbook_Open` procedure is executed. The procedure in Step 4 displays the UserForm. At that time, the UserForm's `Activate` event occurs, which triggers the `UserForm_Activate` procedure (see Step 5). This procedure uses the `OnTime` method of the `Application` object to execute a procedure named `KillTheForm` at a particular time. In this case, the time is five seconds after the activation event. The `KillTheForm` procedure simply unloads the UserForm.

7. As an option, you can add a small `CommandButton` named `CancelButton`, set its `Cancel` property to `True`, and insert the following event-handler procedure in the UserForm's code module:

```
Private Sub CancelButton_Click()  
    Unload Me  
End Sub
```

Doing so lets the user cancel the splash screen before the time has expired by pressing `Esc`. In the example, I placed this small button behind another object so that it's not visible.



Caution

Keep in mind that the splash screen isn't displayed until the workbook is entirely loaded. In other words, if you'd like to display the splash screen to give the user something to look at while the workbook is loading, this technique won't fill the bill.



Tip

If your application needs to run some VBA procedures at start-up, you can display the UserForm *modeless* so that the code will continue running while the UserForm is displayed. To do so, change the `Workbook_Open` procedure as follows:

```
Private Sub Workbook_Open()  
    UserForm1.Show vbModeless  
    ' other code goes here  
End Sub
```

Disabling a UserForm's Close Button

When a UserForm is displayed, clicking the Close button (the X in the upper-right corner) will unload the form. You might have a situation in which you don't want the Close button to unload the form. For example, you might require that the UserForm be closed only by clicking a particular `CommandButton`.

Although you can't actually disable the Close button, you can prevent the user from closing a UserForm by clicking it. You can do so by monitoring the UserForm's `QueryClose` event.

The following procedure, which is located in the code module for the UserForm, is executed before the form is closed (that is, when the `QueryClose` event occurs):

```
Private Sub UserForm_QueryClose _  
    (Cancel As Integer, CloseMode As Integer)  
    If CloseMode = vbFormControlMenu Then  
        MsgBox "Click the OK button to close the form."  
        Cancel = True  
    End If  
End Sub
```

The `UserForm_QueryClose` procedure uses two arguments. The `CloseMode` argument contains a value that indicates the cause of the `QueryClose` event. If `CloseMode` is equal to `vbFormControlMenu` (a built-in constant), that means that the user clicked the Close button. If a message is displayed, the `Cancel` argument is set to `True`, and the form isn't actually closed.



On the CD

The example in this section is available on the companion CD-ROM in a file named `queryclose demo.xlsm`.



Note

Keep in mind that a user can press **Ctrl+Break** to break out of the macro. In this example, pressing **Ctrl+Break** while the UserForm is displayed causes the UserForm to be dismissed. To prevent this occurrence, execute the following statement prior to displaying the UserForm:

```
Application.EnableCancelKey = xlDisabled
```

Make sure that your application is debugged before you add this statement. Otherwise, you'll find that it's impossible to break out of an accidental endless loop.

Changing a UserForm's Size

Many applications use dialog boxes that change their own size. For example, Excel's Find and Replace dialog box (displayed when you choose **Home**→**Editing**→**Find & Select**→**Replace**) increases its height when the user clicks the Options button.

The example in this section demonstrates how to get a UserForm to change its size dynamically. Changing a dialog box's size is done by altering the `Width` or `Height` property of the UserForm object.



Cross-Ref

Refer to Chapter 15 for an example that allows the user to change the UserForm's size by dragging the lower-right corner.

Figure 14-5 shows the dialog box as it is first displayed, and Figure 14-6 shows it after the user clicks the Options button. Notice that the button's caption changes, depending on the size of the UserForm.

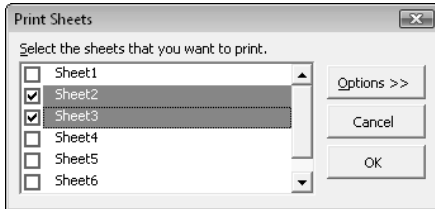


Figure 14-5: A sample dialog box in its standard mode.

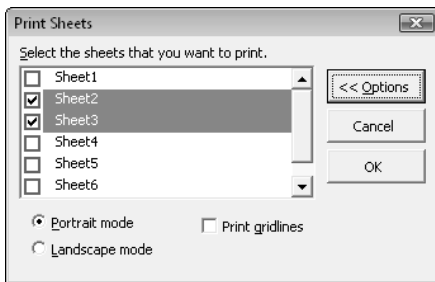


Figure 14-6: The same dialog box enlarged to show some options.

While you're creating the UserForm, set it to its largest size to enable you to work with the controls. Then use the `UserForm_Initialize` procedure to set it to its default (smaller) size.

The code uses two constants, defined at the top of the module:

```
Const SmallSize As Integer = 124
Const LargeSize As Integer = 164
```

This example displays a list of worksheets in the active workbook and lets the user select which sheets to print. Following is the event handler that's executed when the CommandButton named `OptionsButton` is clicked:

```
Private Sub OptionsButton_Click()
    If OptionsButton.Caption = "Options >>" Then
        Me.Height = LargeSize
        OptionsButton.Caption = "<< Options"
```

```

Else
    Me.Height = SmallSize
    OptionsButton.Caption = "Options >>"
End If
End Sub

```

This procedure examines the `Caption` of the `CommandButton` and sets the `UserForm`'s `Height` property accordingly.



Note

When controls aren't displayed because they're outside the visible portion of the `UserForm`, the accelerator keys for such controls continue to function. In this example, the user can press the `Alt+L` hot key (to select the Landscape mode option) even if that option isn't visible. To block access to nondisplayed controls, you can write code to disable the controls when they aren't displayed.



On the CD

The example in this section is available on the companion CD-ROM. The file is named `change userform size.xlsm`.

Zooming and Scrolling a Sheet from a UserForm

The example in this section demonstrates how to use `ScrollBar` controls to allow sheet scrolling and zooming while a dialog box is displayed. Figure 14-7 shows how the example dialog box is set up. When the `UserForm` is displayed, the user can adjust the worksheet's zoom factor (from 10% to 400%) by using the `ScrollBar` at the top. The two `ScrollBar`s in the bottom section of the dialog box allow the user to scroll the worksheet horizontally and vertically.



On the CD

This example, named `zoom and scroll sheet.xlsm`, is available on the companion CD-ROM.

If you look at the code for this example, you'll see that it's remarkably simple. The controls are initialized in the `UserForm_Initialize` procedure, which follows:

```

Private Sub UserForm_Initialize()
    LabelZoom.Caption = ActiveWindow.Zoom & "%"
'    Zoom
    With ScrollBarZoom
        .Min = 10
        .Max = 400
        .SmallChange = 1
    End With
End Sub

```

```

        .LargeChange = 10
        .Value = ActiveWindow.Zoom
    End With

    ' Horizontally scrolling
    With ScrollBarColumns
        .Min = 1
        .Max = ActiveSheet.UsedRange.Columns.Count
        .Value = ActiveWindow.ScrollColumn
        .LargeChange = 25
        .SmallChange = 1
    End With

    ' Vertically scrolling
    With ScrollBarRows
        .Min = 1
        .Max = ActiveSheet.UsedRange.Rows.Count
        .Value = ActiveWindow.ScrollRow
        .LargeChange = 25
        .SmallChange = 1
    End With
End Sub

```

	A	B	C	D	E
1587	273	133	107	279	
1588	320	124	498	331	
1589	178		33	452	
1590	56		1	140	
1591	122		8	209	
1592	311		4	170	
1593	309	11	390	7	
1594	487	108	473	362	
1595	99	360	213	393	

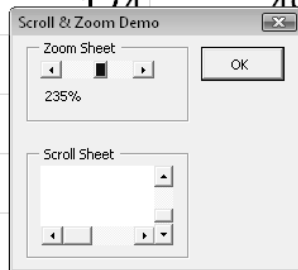


Figure 14-7: Here, `ScrollBar` controls allow zooming and scrolling of the worksheet.

This procedure sets various properties of the `ScrollBar` controls by using values based on the active window.

When the `ScrollBarZoom` control is used, the `ScrollBarZoom_Change` procedure (which follows) is executed. This procedure sets the `ScrollBar` control's `Value` to the `ActiveWindow`'s `Zoom` property value. It also changes a label to display the current zoom factor.

```
Private Sub ScrollBarZoom_Change()  
    With ActiveWindow  
        .Zoom = ScrollBarZoom.Value  
        LabelZoom = .Zoom & "%"  
    End With  
End Sub
```

Worksheet scrolling is accomplished by the two procedures that follow. These procedures set the `ScrollRow` or `ScrollColumns` property of the `ActiveWindow` object equal to the appropriate `ScrollBar` control value.

```
Private Sub ScrollBarColumns_Change()  
    ActiveWindow.ScrollColumn = ScrollBarColumns.Value  
End Sub  
  
Private Sub ScrollBarRows_Change()  
    ActiveWindow.ScrollRow = ScrollBarRows.Value  
End Sub
```



Tip

Rather than use the `Change` event in the preceding procedures, you can use the `Scroll` event. The difference is that the event is triggered when the `ScrollBars` are dragged — resulting in smooth zooming and scrolling. To use the `Scroll` event, just make the `Change` part of the procedure name `Scroll`.

ListBox Techniques

The `ListBox` control is extremely versatile, but it can be a bit tricky to work with. This section contains a number of examples that demonstrate common techniques that involve the `ListBox` control.



Note

In most cases, the techniques described in this section also work with a `ComboBox` control.

Following are a few points to keep in mind when working with `ListBox` controls. Examples in the sections that follow demonstrate many of these points:

- You can retrieve the items in a `ListBox` from a range of cells (specified by the `RowSource` property), or you can add them by using VBA code (using the `AddItem` method).
- You can set up a `ListBox` to allow a single selection or a multiple selection. You use the `MultiSelect` property to specify the type of selection allowed.
- If a `ListBox` isn't set up for a multiple selection, you can link the value of the `ListBox` to a worksheet cell by using the `ControlSource` property.
- You can display a `ListBox` with no items selected (the `ListIndex` property will be `-1`). However, after an item is selected, the user can't deselect all items. The exception is if the `MultiSelect` property is `True`.
- A `ListBox` can contain multiple columns (controlled by the `ColumnCount` property) and even a descriptive header (controlled by the `ColumnHeads` property).
- The vertical height of a `ListBox` displayed in a UserForm window isn't always the same as the vertical height when the UserForm is actually displayed.
- You can display the items in a `ListBox` either as check boxes (if multiple selection is allowed) or as option buttons (if a single selection is allowed). The display type is controlled by the `ListStyle` property.

For complete details on the properties and methods for a `ListBox` control, consult the Help system.

Adding items to a `ListBox` control

Before displaying a UserForm that uses a `ListBox` control, you need to fill the `ListBox` with items. You can fill a `ListBox` at design time using items stored in a worksheet range, or at runtime using VBA to add the items to the `ListBox`.

The two examples in this section presume that

- You have a UserForm named `UserForm1`.
- This UserForm contains a `ListBox` control named `ListBox1`.
- The workbook contains a sheet named `Sheet1`, and range `A1:A12` contains the items to be displayed in the `ListBox`.

Adding items to a `ListBox` at design time

To add items to a `ListBox` at design time, the `ListBox` items must be stored in a worksheet range. Use the `RowSource` property to specify the range that contains the `ListBox` items. Figure 14-8 shows the Properties window for a `ListBox` control. The `RowSource` property is set to `Sheet1!A1:A12`. When the UserForm is displayed, the `ListBox` will contain the 12 items in this

range. The items appear in the ListBox at design time as soon as you specify the range for the RowSource property.

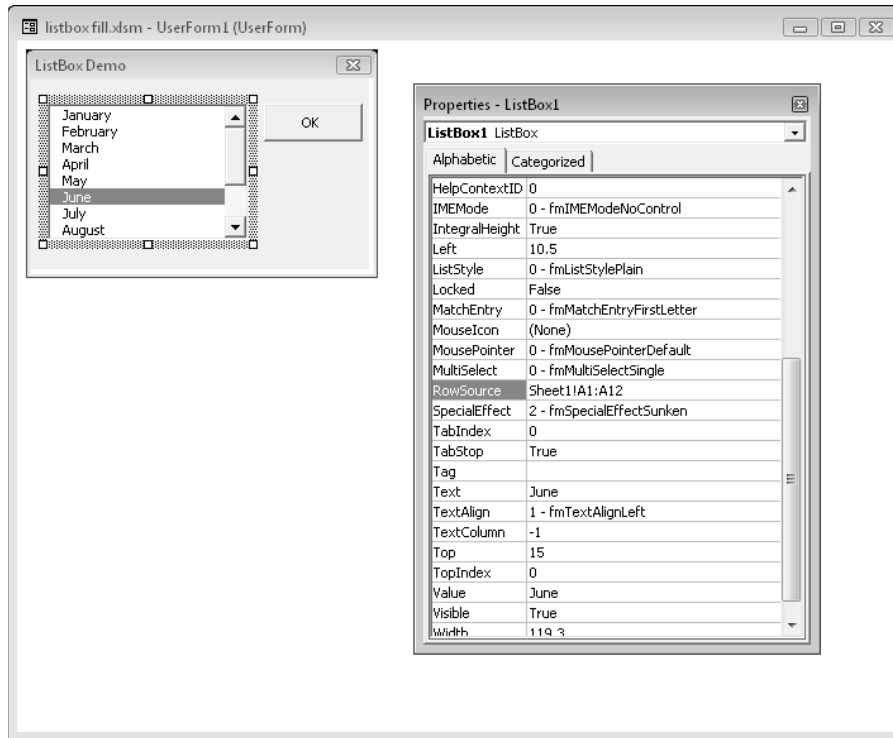


Figure 14-8: Setting the RowSource property at design time.



Caution

In most cases, you'll want to include the worksheet name when you specify the RowSource property; otherwise, the ListBox will use the specified range on the active worksheet. In some cases, you may need to fully qualify the range by including the workbook name. For example:

```
[budget.xlsx]Sheet1!A1:A12
```

A better practice is to define a name for the range and use that name in your code. This habit will ensure that the proper range is used even if rows above the range are added or deleted.

Adding items to a ListBox at runtime

To add ListBox items at runtime, you have two choices:

- Set the RowSource property to a range address by using code.
- Write code that uses the AddItem method to add the ListBox items.

As you might expect, you can set the `RowSource` property via code rather than with the Properties window. For example, the following procedure sets the `RowSource` property for a `ListBox` before displaying the UserForm. In this case, the items consist of the cell entries in a range named `Categories` on the `Budget` worksheet.

```
UserForm1.ListBox1.RowSource = "Budget!Categories"  
UserForm1.Show
```

If the `ListBox` items aren't contained in a worksheet range, you can write VBA code to fill the `ListBox` before the dialog box appears. The following procedure fills the `ListBox` with the names of the months by using the `AddItem` method.

```
Sub ShowUserForm2()  
' Fill the list box  
With UserForm1.ListBox1  
    .RowSource=""  
    .AddItem "January"  
    .AddItem "February"  
    .AddItem "March"  
    .AddItem "April"  
    .AddItem "May"  
    .AddItem "June"  
    .AddItem "July"  
    .AddItem "August"  
    .AddItem "September"  
    .AddItem "October"  
    .AddItem "November"  
    .AddItem "December"  
End With  
UserForm1.Show  
End Sub
```

**Caution**

In the preceding code, notice that I set the `RowSource` property to an empty string. This setting is to avoid a potential error that occurs if the Properties window has a non-empty `RowSource` setting. If you try to add items to a `ListBox` that has a non-null `RowSource` setting, you'll get a "permission denied" error.

You can also use the `AddItem` method to retrieve `ListBox` items from a range. Here's an example that fills a `ListBox` with the contents of `A1:A12` on `Sheet1`.

```
For Row = 1 To 12  
    UserForm1.ListBox1.AddItem Sheets("Sheet1").Cells(Row, 1)  
Next Row
```

Using the `List` property is even simpler. The statement that follows has the same effect as the preceding `For Next` loop.

```
UserForm1.ListBox1.List = Application.Transpose(Sheets("Sheet1"). _  
    Range("A1:A12"))
```

Note that I used the `Transpose` function because the `List` property expects a horizontal array and the range is in a column rather than a row.

You can also use the `List` property if your data is stored in a one-dimensional array. For example, assume that you have an array named `MyList` that contains 50 elements. The following statement will create a 50-item list in `ListBox1`:

```
UserForm1.ListBox1.List = MyList
```



On the CD

The examples in this section are available on the companion CD-ROM. The file is named `listbox fill.xlsm`.

Adding only unique items to a ListBox

In some cases, you may need to fill a `ListBox` with *unique* (nonduplicated) items from a list. For example, assume that you have a worksheet that contains customer data. One of the columns might contain the state (see Figure 14-9). You'd like to fill a `ListBox` with the state names of your customers, but you don't want to include duplicate state names.

One technique involves using a `Collection` object. After creating a new `Collection` object, you can add items to the object with the following syntax:

```
object.Add item, key, before, after
```

The `key` argument, if used, must be a unique text string that specifies a separate key that you can use to access a member of the collection. The important word here is *unique*. If you attempt to add a non-unique key to a collection, an error occurs, and the item isn't added. You can take advantage of this situation and use it to create a collection that consists only of unique items.

The following procedure starts by declaring a new `Collection` object named `NoDuples`. It assumes that a range named `Data` contains a list of items, some of which may be duplicated.

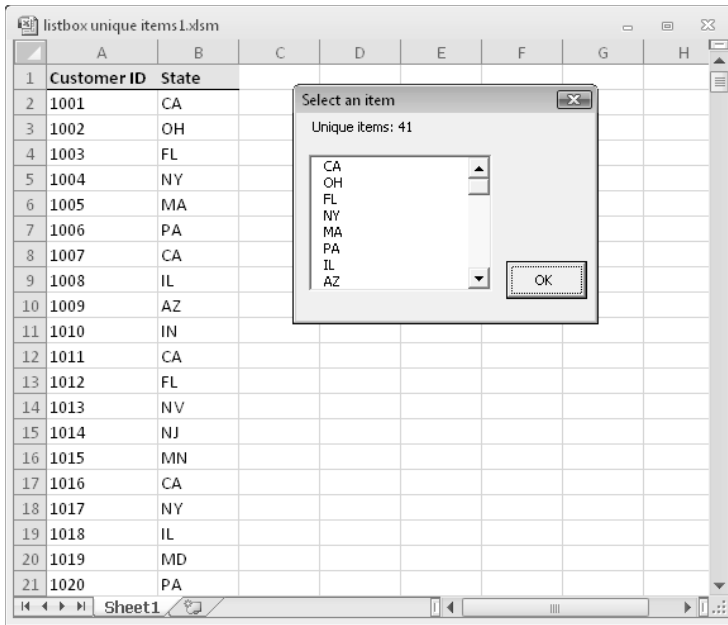


Figure 14-9: A Collection object is used to fill a ListBox with the unique items from column B.

The code loops through the cells in the range and attempts to add the cell's value to the `NoDups` collection. It also uses the cell's value (converted to a string) for the key argument. Using the `On Error Resume Next` statement causes VBA to ignore the error that occurs if the key isn't unique. When an error occurs, the item isn't added to the collection — which is just what you want. The procedure then transfers the items in the `NoDups` collection to the `ListBox`. The UserForm also contains a label that displays the number of unique items.

```
Sub RemoveDuplicates1()
    Dim AllCells As Range, Cell As Range
    Dim NoDups As New Collection

    On Error Resume Next
    For Each Cell In Range("State")
        NoDups.Add Cell.Value, CStr(Cell.Value)
    Next Cell
    On Error GoTo 0
    ' Add the non-duplicated items to a ListBox
    For Each Item In NoDups
        UserForm1.ListBox1.AddItem Item
    Next Item
    ' Display the count
    UserForm1.Label1.Caption = _
        "Unique items: " & NoDups.Count
    ' Show the UserForm
    UserForm1.Show
End Sub
```



On the CD

This example, named `listbox unique items1.xlsm`, is available on the companion CD-ROM. A workbook named `listbox unique items2.xlsm` has a slightly more sophisticated version of this technique and displays the items sorted.

Determining the selected item in a ListBox

The examples in the preceding sections merely display a UserForm with a ListBox filled with various items. These procedures omit a key point: how to determine which item or items were selected by the user.



Note

This discussion assumes a single-selection `ListBox` object — one whose `MultiSelect` property is set to `0`.

To determine which item was selected, access the `ListBox`'s `Value` property. The statement that follows, for example, displays the text of the selected item in `ListBox1`.

```
MsgBox ListBox1.Value
```

If no item is selected, this statement will generate an error.

If you need to know the position of the selected item in the list (rather than the content of that item), you can access the `ListBox`'s `ListIndex` property. The following example uses a message box to display the item number of the selected `ListBox` item:

```
MsgBox "You selected item #" & ListBox1.ListIndex
```

If no item is selected, the `ListIndex` property will return `-1`.



Note

The numbering of items in a `ListBox` begins with `0` — not `1`. Therefore, the `ListIndex` of the first item is `0`, and the `ListIndex` of the last item is equivalent to the value of the `ListCount` property less `1`.

Determining multiple selections in a ListBox

A `ListBox`'s `MultiSelect` property can be any of three values:

- `0` (`fmMultiSelectSingle`): Only one item can be selected. This setting is the default.
- `1` (`fmMultiSelectMulti`): Pressing the spacebar or clicking selects or deselects an item in the list.
- `2` (`fmMultiSelectExtended`): Shift-clicking extends the selection from the previously selected item to the current item. You can also use Shift and one of the arrow keys to extend the selected items.

If the `ListBox` allows multiple selections (that is, if its `MultiSelect` property is either 1 or 2), trying to access the `ListIndex` or `Value` property will result in an error. Instead, you need to use the `Selected` property, which returns an array whose first item has an index of 0. For example, the following statement displays `True` if the first item in the `ListBox` list is selected:

```
MsgBox ListBox1.Selected(0)
```



On the CD

The companion CD-ROM contains a workbook that demonstrates how to identify the selected item(s) in a `ListBox`. It works for single-selection and multiple-selection `ListBoxes`. The file is named `listbox selected items.xlsm`.

The following code, from the example workbook on the CD-ROM, loops through each item in the `ListBox`. If the item was selected, it appends the item's text to a variable called `Msg`. Finally, the names of all the selected items are displayed in a message box.

```
Private Sub OKButton_Click()  
    Msg = ""  
    For i = 0 To ListBox1.ListCount - 1  
        If ListBox1.Selected(i) Then _  
            Msg = Msg & ListBox1.List(i) & vbCrLf  
    Next i  
    MsgBox "You selected: " & vbCrLf & Msg  
    Unload Me  
End Sub
```

Figure 14-10 shows the result when multiple `ListBox` items are selected.

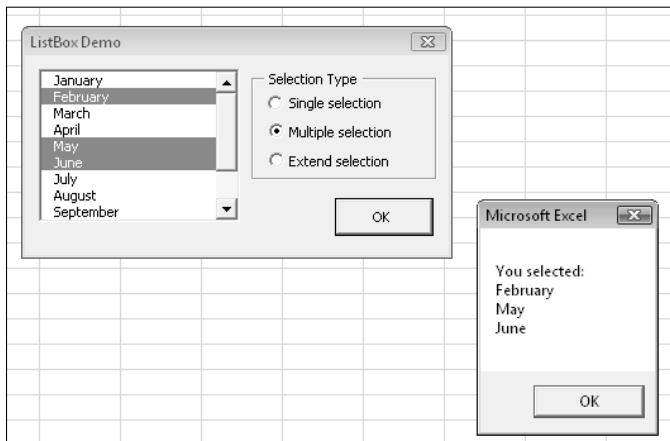


Figure 14-10: This message box displays a list of items selected in a `ListBox`.

Multiple lists in a single ListBox

This example demonstrates how to create a ListBox in which the contents change depending on the user's selection from a group of OptionButtons.

Figure 14-11 shows the UserForm. The ListBox gets its items from a worksheet range. The procedures that handle the Click event for the OptionButton controls simply set the ListBox's RowSource property to a different range. One of these procedures follows:

```
Private Sub obMonths_Click()
    ListBox1.RowSource = "Sheet1!Months"
End Sub
```

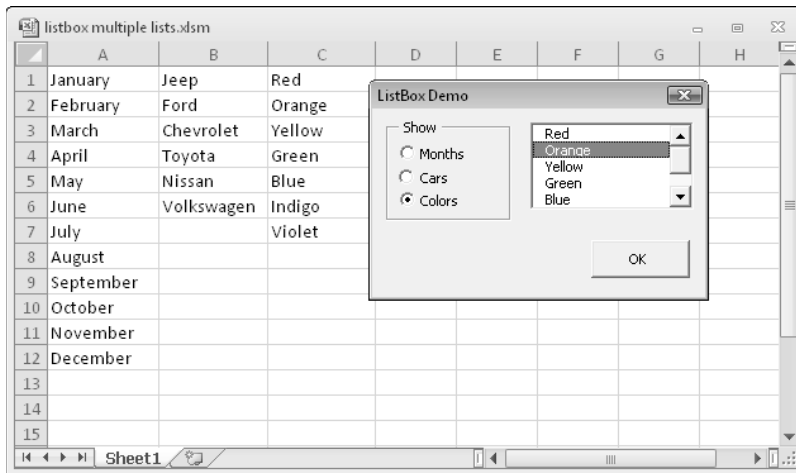


Figure 14-11: The contents of this ListBox depend on the OptionButton selected.

Clicking the OptionButton named `obMonths` changes the `RowSource` property of the ListBox to use a range named `Months` on `Sheet1`.



On the CD

This example, named `listbox multiple lists.xlsm`, is available on the companion CD-ROM.

ListBox item transfer

Some applications require a user to select several items from a list. It's often useful to create a new list of the selected items and display the new list in another ListBox. For an example of this situation, check out the Quick Access Toolbar tab of the Excel Options dialog box.

Figure 14-12 shows a dialog box with two ListBoxes. The Add button adds the item selected in the left ListBox to the right ListBox. The Remove button removes the selected item from the list on the right. A check box determines the behavior when a duplicate item is added to the list: Namely, if the Allow Duplicates check box isn't marked, a message box appears if the user attempts to add an item that's already on the list.

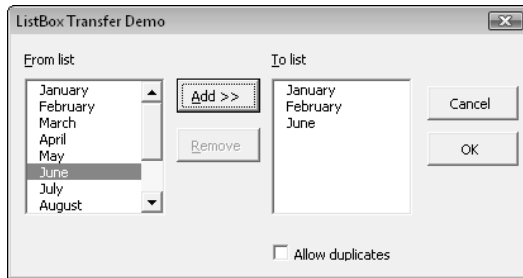


Figure 14-12: Building a list from another list.

The code for this example is relatively simple. Here's the procedure that is executed when the user clicks the Add button:

```
Private Sub AddButton_Click()
    If ListBox1.ListIndex = -1 Then Exit Sub
    If Not cbDuplicates Then
        ' See if item already exists
        For i = 0 To ListBox2.ListCount - 1
            If ListBox1.Value = ListBox2.List(i) Then
                Beep
                Exit Sub
            End If
        Next i
    End If
    ListBox2.AddItem ListBox1.Value
End Sub
```

The code for the Remove button is even simpler:

```
Private Sub RemoveButton_Click()
    If ListBox2.ListIndex = -1 Then Exit Sub
    ListBox2.RemoveItem ListBox2.ListIndex
End Sub
```

Notice that both of these routines check to make sure that an item is actually selected. If the ListBox's `ListIndex` property is `-1`, no items are selected, and the procedure ends.

This example has two additional procedures that control whether the Remove button is enabled or disabled. These events are triggered when the `ListBox` is entered (either via a keystroke or a mouse click). The net effect is that the Remove button is enabled only when the user is working in `ListBox2`.

```
Private Sub ListBox1_Enter()  
    RemoveButton.Enabled = False  
End Sub  
  
Private Sub ListBox2_Enter()  
    RemoveButton.Enabled = True  
End Sub
```



On the CD

This example, named `listbox item transfer.xlsm`, is available on the companion CD-ROM.

Moving items in a ListBox

Often, the order of items in a list is important. The example in this section demonstrates how to allow the user to move items up or down in a `ListBox`. The VBE uses this type of technique to let you control the tab order of the items in a UserForm. (Right-click a UserForm and choose Tab Order from the shortcut menu.)

Figure 14-13 shows a dialog box that contains a `ListBox` and two `CommandButtons`. Clicking the Move Up button moves the selected item up in the `ListBox`; clicking the Move Down button moves the selected item down.



On the CD

This example, named `listbox move items.xlsm`, is available on the companion CD-ROM.

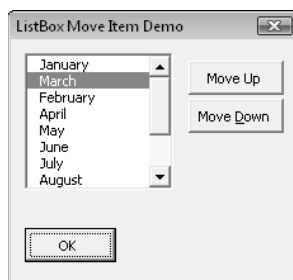


Figure 14-13: The buttons allow the user to move items up or down in the `ListBox`.

The event-handler procedures for the two CommandButtons follow:

```
Private Sub MoveUpButton_Click()  
    Dim NumItems As Integer, i As Integer, ItemNum As Integer  
    Dim TempItem As String, TempList()  
    If ListBox1.ListIndex <= 0 Then Exit Sub  
    NumItems = ListBox1.ListCount  
    Dim TempList()  
    ReDim TempList(0 To NumItems - 1)  
    ' Fill array with list box items  
    For i = 0 To NumItems - 1  
        TempList(i) = ListBox1.List(i)  
    Next i  
    ' Selected item  
    ItemNum = ListBox1.ListIndex  
    ' Exchange items  
    TempItem = TempList(ItemNum)  
    TempList(ItemNum) = TempList(ItemNum - 1)  
    TempList(ItemNum - 1) = TempItem  
    ListBox1.List = TempList  
    ' Change the list index  
    ListBox1.ListIndex = ItemNum - 1  
End Sub  
  
Private Sub MoveDownButton_Click()  
    Dim NumItems As Integer, i As Integer, ItemNum As Integer  
    Dim TempItem As String, TempList()  
    If ListBox1.ListIndex = ListBox1.ListCount - 1 Then Exit Sub  
    NumItems = ListBox1.ListCount  
    Dim TempList()  
    ReDim TempList(0 To NumItems - 1)  
    ' Fill array with list box items  
    For i = 0 To NumItems - 1  
        TempList(i) = ListBox1.List(i)  
    Next i  
    ' Selected item  
    ItemNum = ListBox1.ListIndex  
    ' Exchange items  
    TempItem = TempList(ItemNum)  
    TempList(ItemNum) = TempList(ItemNum + 1)  
    TempList(ItemNum + 1) = TempItem  
    ListBox1.List = TempList  
    ' Change the list index  
    ListBox1.ListIndex = ItemNum + 1  
End Sub
```

Working with multicolumn ListBox controls

A normal ListBox has a single column for its contained items. You can, however, create a ListBox that displays multiple columns and (optionally) column headers. Figure 14-14 shows an example of a multicolumn ListBox that gets its data from a worksheet range.



This example, named `listbox multicolumn1.xlsm`, is available on the companion CD-ROM.

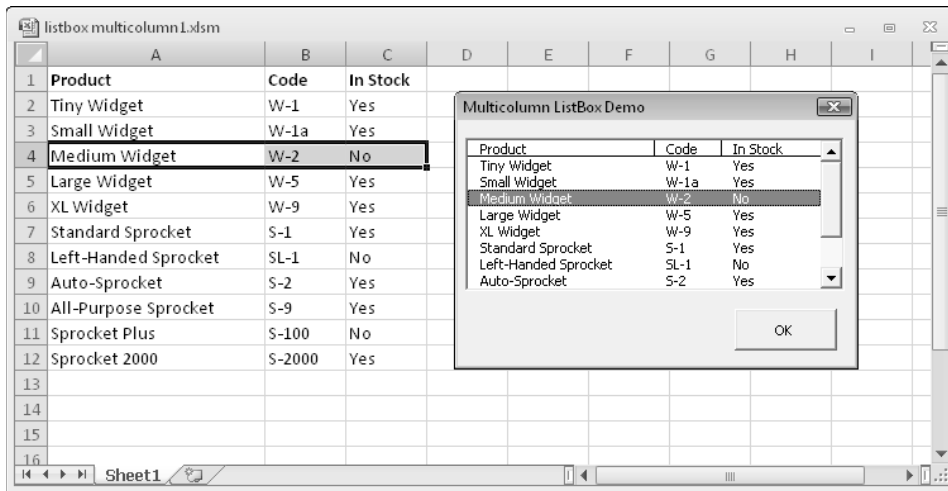


Figure 14-14: This ListBox displays a three-column list with column headers.

To set up a multicolumn ListBox that uses data stored in a worksheet range, follow these steps:

1. Make sure that the ListBox's `ColumnCount` property is set to the correct number of columns.
2. Specify the correct multicolumn range in the Excel worksheet as the ListBox's `RowSource` property.
3. If you want to display column headers, set the `ColumnHeads` property to `True`.
Do not include the column headings on the worksheet in the range setting for the `RowSource` property. VBA will instead automatically use the row directly above the first row of the `RowSource` range.
4. Adjust the column widths by assigning a series of values, specified in *points* ($\frac{1}{2}$ of one inch) and separated by semicolons, to the `ColumnWidths` property.

For example, for a three-column list box, the `ColumnWidths` property might be set to the following text string:

```
110 pt;40 pt;30 pt
```

5. Specify the appropriate column as the `BoundColumn` property.

The bound column specifies which column is referenced when an instruction polls the `ListBox`'s `Value` property.

To fill a `ListBox` with multicolumn data without using a range, you first create a two-dimensional array and then assign the array to the `ListBox`'s `List` property. The following statements demonstrate this using a 12-row x 2-column array named `Data`. The two-column `ListBox` shows the month names in column 1 and the number of the days in the month in column 2 (see Figure 14-15). Notice that the procedure sets the `ColumnCount` property to 2.

```
Private Sub UserForm_Initialize()
'   Fill the list box
Dim Data(1 To 12, 1 To 2)
For i = 1 To 12
    Data(i, 1) = Format(DateSerial(2010, i, 1), "mmmm")
Next i
For i = 1 To 12
    Data(i, 2) = Day(DateSerial(2010, i + 1, 1) - 1)
Next i
ListBox1.ColumnCount = 2
ListBox1.List = Data
End Sub
```



On the CD

This example is available on the companion CD-ROM. The file is named `listbox multicolumn2.xlsm`.



Note

There appears to be no way to specify column headers for the `ColumnHeads` property when the list source is a VBA array.

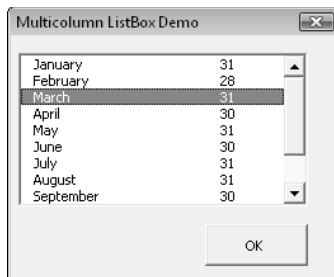


Figure 14-15: A two-column `ListBox` filled with data stored in an array.

Using a ListBox to select worksheet rows

The example in this section displays a ListBox that consists of the entire used range of the active worksheet (see Figure 14-16). The user can select multiple items in the ListBox. Clicking the All button selects all items, and clicking the None button deselects all items. Clicking OK selects those corresponding rows in the worksheet. You can, of course, select multiple noncontiguous rows directly in the worksheet by pressing Ctrl while you click the row borders. However, you might find that selecting rows is easier when using this method.



On the CD

This example, named `listbox select rows.xlsm`, is available on the companion CD-ROM.

Selecting multiple items is possible because the ListBox's `MultiSelect` property is set to `1 - fmMultiSelectMulti`. The check boxes on each item are displayed because the ListBox's `ListStyle` property is set to `1 - fmListStyleOption`.

The UserForm's `Initialize` procedure follows. This procedure creates a Range object named `rng` that consists of the active sheet's used range. Additional code sets the ListBox's `ColumnCount` and `RowSource` properties and adjusts the `ColumnWidths` property so that the ListBox columns are proportional to the column widths in the worksheet.

```
Private Sub UserForm_Initialize()
    Dim ColCnt As Integer
    Dim rng As Range
    Dim cw As String
    Dim c As Integer
    ColCnt = ActiveSheet.UsedRange.Columns.Count
    Set rng = ActiveSheet.UsedRange
    With ListBox1
        .ColumnCount = ColCnt
        .RowSource = rng.Address
        cw = ""
        For c = 1 To .ColumnCount
            cw = cw & rng.Columns(c).Width & ";"
        Next c
        .ColumnWidths = cw
        .ListIndex = 0
    End With
End Sub
```

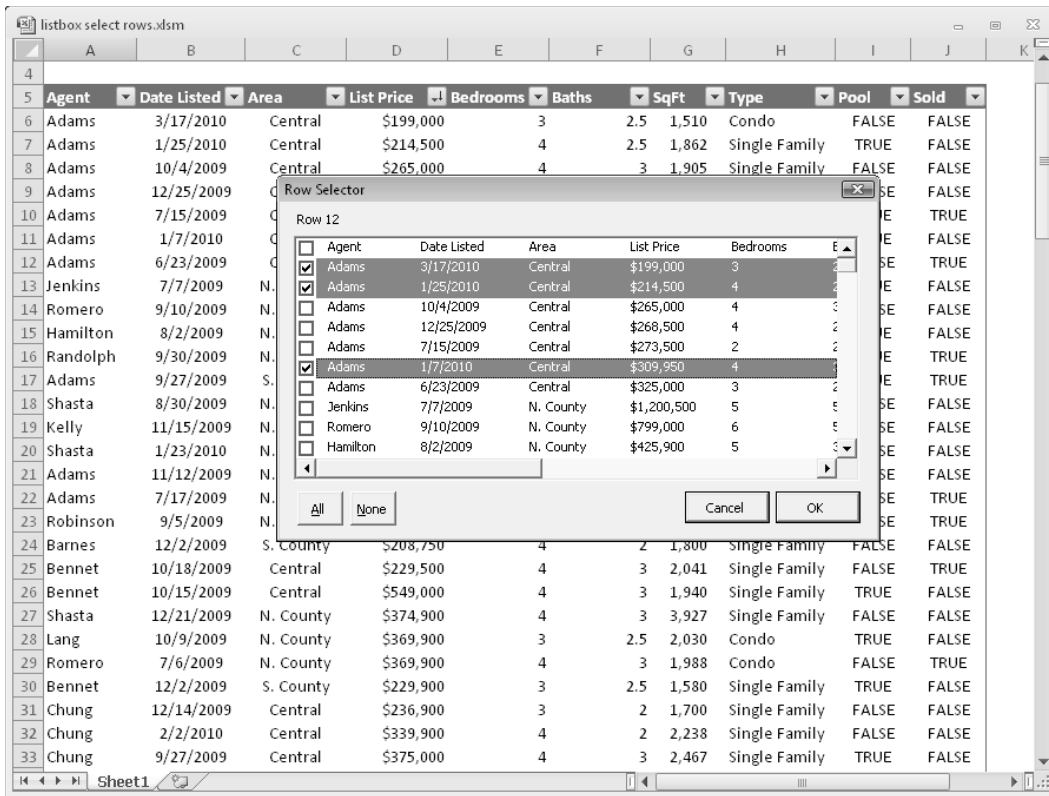


Figure 14-16: This ListBox makes selecting rows in a worksheet easy.

The All and None buttons (named `SelectAllButton` and `SelectNoneButton`, respectively) have simple event-handler procedures as follows:

```
Private Sub SelectAllButton_Click()
    Dim r As Integer
    For r = 0 To ListBox1.ListCount - 1
        ListBox1.Selected(r) = True
    Next r
End Sub

Private Sub SelectNoneButton_Click()
    Dim r As Integer
    For r = 0 To ListBox1.ListCount - 1
        ListBox1.Selected(r) = False
    Next r
End Sub
```

The `OKButton_Click` procedure follows. This procedure creates a `Range` object named `RowRange` that consists of the rows that correspond to the selected items in the `ListBox`. To determine whether a row was selected, the code examines the `Selected` property of the `ListBox` control. Notice that it uses the `Union` function to add ranges to the `RowRange` object.

```
Private Sub OKButton_Click()
    Dim RowRange As Range
    Dim RowCnt As Integer, r As Integer
    RowCnt = 0
    For r = 0 To ListBox1.ListCount - 1
        If ListBox1.Selected(r) Then
            RowCnt = RowCnt + 1
            If RowCnt = 1 Then
                Set RowRange = ActiveSheet.UsedRange.Rows(r + 1)
            Else
                Set RowRange = _
                    Union(RowRange, ActiveSheet.UsedRange.Rows(r + 1))
            End If
        End If
    Next r
    If Not RowRange Is Nothing Then RowRange.Select
    Unload Me
End Sub
```



On the CD

This example is available on the companion CD-ROM. The file is named `listbox select rows.xlsm`.

Using a ListBox to activate a sheet

The example in this section is just as useful as it is instructive. This example uses a multicolumn `ListBox` to display a list of sheets within the active workbook. The columns represent

- The sheet's name
- The type of sheet (worksheet, chart, or Excel 5/95 dialog sheet)
- The number of nonempty cells in the sheet
- Whether the sheet is visible

Figure 14-17 shows an example of the dialog box.

The code in the `UserForm_Initialize` procedure (which follows) creates a two-dimensional array and collects the information by looping through the sheets in the active workbook. It then transfers this array to the `ListBox`.

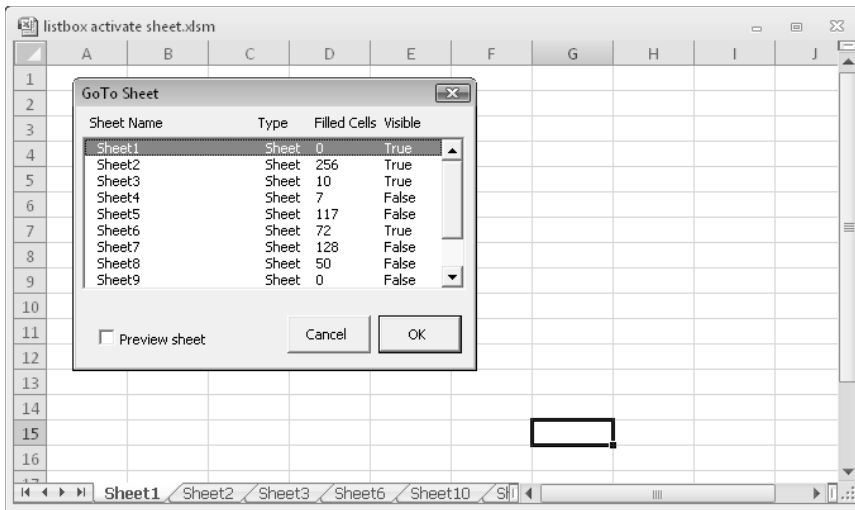


Figure 14-17: This dialog box lets the user activate a sheet.

```
Public OriginalSheet As Object
Private Sub UserForm_Initialize()
    Dim SheetData() As String, Sht As Object
    Dim ShtCnt As Integer, ShtNum As Integer, ListPos As Integer
    Set OriginalSheet = ActiveSheet
    ShtCnt = ActiveWorkbook.Sheets.Count
    ReDim SheetData(1 To ShtCnt, 1 To 4)
    ShtNum = 1
    For Each Sht In ActiveWorkbook.Sheets
        If Sht.Name = ActiveSheet.Name Then _
            ListPos = ShtNum - 1
        SheetData(ShtNum, 1) = Sht.Name
        Select Case TypeName(Sht)
            Case "Worksheet"
                SheetData(ShtNum, 2) = "Sheet"
                SheetData(ShtNum, 3) = _
                    Application.CountA(Sht.Cells)
            Case "Chart"
                SheetData(ShtNum, 2) = "Chart"
                SheetData(ShtNum, 3) = "N/A"
            Case "DialogSheet"
                SheetData(ShtNum, 2) = "Dialog"
                SheetData(ShtNum, 3) = "N/A"
        End Select
        If Sht.Visible Then
            SheetData(ShtNum, 4) = "True"
        Else
            SheetData(ShtNum, 4) = "False"
        End If
    Next Sht
End Sub
```

```

        ShtNum = ShtNum + 1
    Next Sht
    With ListBox1
        .ColumnWidths = "100 pt;30 pt;40 pt;50 pt"
        .List = SheetData
        .ListIndex = ListPos
    End With
End Sub

```

The `ListBox1_Click` procedure follows:

```

Private Sub ListBox1_Click()
    If cbPreview Then _
        Sheets(ListBox1.Value).Activate
End Sub

```

The value of the `CheckBox` control (named `cbPreview`) determines whether the selected sheet is previewed when the user clicks an item in the `ListBox`.

Clicking the `OK` button (named `OKButton`) executes the `OKButton_Click` procedure, which follows:

```

Private Sub OKButton_Click()
    Dim UserSheet As Object
    Set UserSheet = Sheets(ListBox1.Value)
    If UserSheet.Visible Then
        UserSheet.Activate
    Else
        If MsgBox("Unhide sheet?", _
            vbQuestion + vbYesNoCancel) = vbYes Then
            UserSheet.Visible = True
            UserSheet.Activate
        Else
            OriginalSheet.Activate
        End If
    End If
    Unload Me
End Sub

```

The `OKButton_Click` procedure creates an object variable that represents the selected sheet. If the sheet is visible, it's activated. If it's not visible, the user is presented with a message box asking whether it should be unhidden. If the user responds in the affirmative, the sheet is unhidden and activated. Otherwise, the original sheet (stored in a public object variable named `OriginalSheet`) is activated.

Double-clicking an item in the `ListBox` has the same result as clicking the `OK` button. The `ListBox1_DblClick` procedure, which follows, simply calls the `OKButton_Click` procedure.

```
Private Sub ListBox1_DblClick(ByVal Cancel As MSForms.ReturnBoolean)
    Call OKButton_Click
End Sub
```



On the CD

This example is available on the companion CD-ROM. The file is named `listbox activate sheet.xlsm`.

Using the MultiPage Control in a UserForm

The `MultiPage` control is useful for UserForms that must display many controls. The `MultiPage` control lets you group the choices and place each group on a separate tab.

Figure 14-18 shows an example of a UserForm that contains a `MultiPage` control. In this case, the control has three pages, each with its own tab.



On the CD

This example is available on the companion CD-ROM. The file is named `multipage control demo.xlsm`.

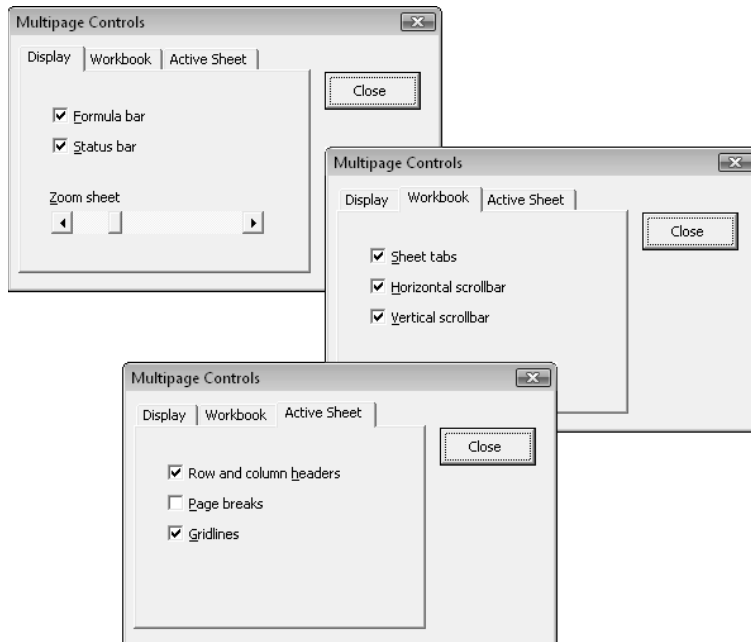


Figure 14-18: `MultiPage` groups your controls on pages, making them accessible from a tab.



Note

The Toolbox also contains a control named `TabStrip`, which resembles a `MultiPage` control. However, unlike the `MultiPage` control, the `TabStrip` control isn't a container for other objects. The `MultiPage` control is much more versatile, and I've never had a need to actually use the `TabStrip` control.

Using a `MultiPage` control can be a bit tricky. The following are some things to keep in mind when using this control:

- The tab (or page) that's displayed up front is determined by the control's `Value` property. A value of 0 displays the first tab, a value of 1 displays the second tab, and so on.
- By default, a `MultiPage` control has two pages. To add a new page in the VBE, right-click a tab and select `New Page` from the shortcut menu.
- When you're working with a `MultiPage` control, just click a tab to set the properties for that particular page. The Properties window will display the properties that you can adjust.
- You may find it difficult to select the actual `MultiPage` control because clicking the control selects a page within the control. To select the control itself, click its border. Or, you can use the `Tab` key to cycle among all the controls. Yet another option is to select the `MultiPage` control from the drop-down list in the Properties window.
- If your `MultiPage` control has lots of tabs, you can set its `MultiRow` property to `True` to display the tabs in more than one row.
- If you prefer, you can display buttons instead of tabs. Just change the `Style` property to 1. If the `Style` property value is 2, the `MultiPage` control won't display tabs or buttons.
- The `TabOrientation` property determines the location of the tabs on the `MultiPage` control.
- For each page, you can set a transition effect by changing the `TransitionEffect` property. For example, clicking a tab can cause the new page to push the former page out of the way. Use the `TransitionPeriod` property to set the speed of the transition effect.

Using an External Control

The example in this section uses the Windows Media Player control. Although this control isn't an Excel control (it's installed with Windows), it works fine in a UserForm.

To make this control available, add a UserForm to a workbook and follow these steps:

1. Activate the VBE.
2. Right-click the Toolbox and choose `Additional Controls`.
Choose `View→Toolbox` if the Toolbox isn't visible.

3. In the Additional Controls dialog box, scroll down and place a check mark next to Windows Media Player.
4. Click OK.

Your Toolbox will display a new control.

Figure 14-19 shows the `Windows Media Player` control in a UserForm, along with the Property window. The `URL` property represents the media item being played (music or video). If the item is on your hard drive, the `URL` property will contain the full path along with the filename.

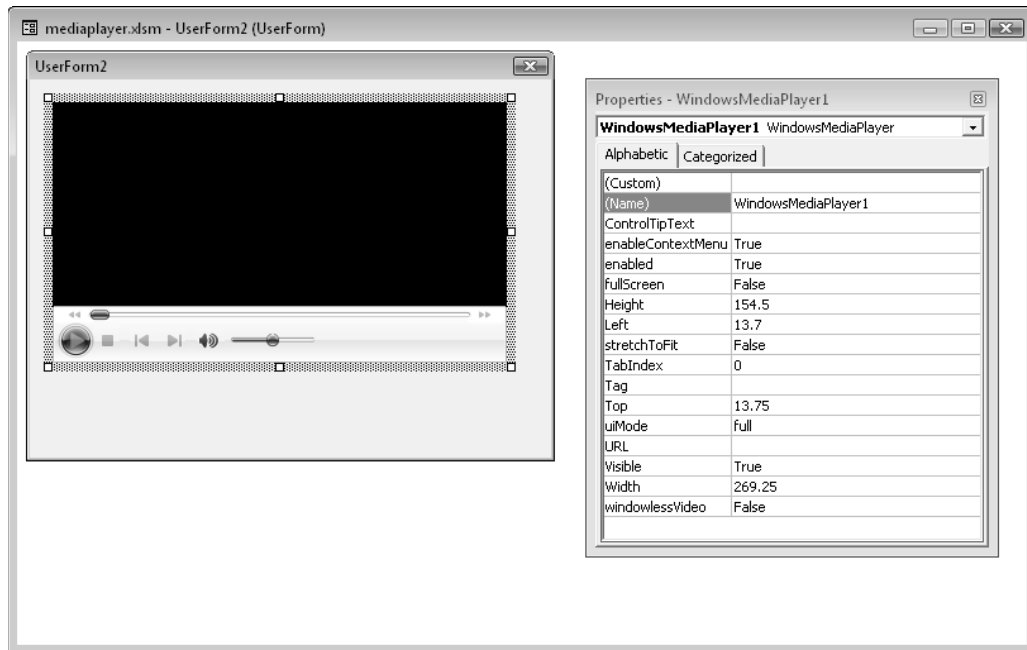


Figure 14-19: The Date and Time Picker control in a UserForm.

Figure 14-20 shows this control being used. I reduced the height of the `Windows Media Player` control to hide the video display. I added a `ListBox`, which is filled with MP3 audio file-names. Clicking the Play button plays the selected file. Clicking the Close button stops the sound and closes the UserForm. This UserForm is displayed modeless, so the user can continue working when the dialog box is displayed.



On the CD

This example is available on the companion CD-ROM. The file is named `mediaplayer.xlsm`, and it's in a separate directory that includes some public domain MP3 sound effect files.

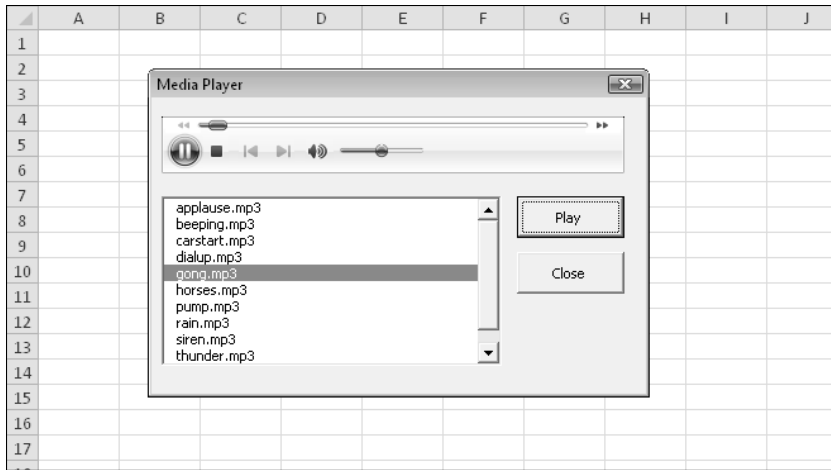


Figure 14-20: The Windows Media Player control.

This example was incredibly easy to create. The `UserForm_Initialize` procedure adds the MP3 filenames to the `ListBox`. To keep things simple, it reads the files that are in the same directory as the workbook. A more versatile approach is to let the user select a directory.

```
Private Sub UserForm_Initialize()
    Dim FileName As String
    ' Fill listbox with MP3 files
    FileName = Dir(ThisWorkbook.Path & "\*.mp3", vbNormal)
    Do While Len(FileName) > 0
        ListBox1.AddItem FileName
        FileName = Dir()
    Loop
    ListBox1.ListIndex = 0
End Sub
```



Cross-Ref

See Chapter 27 for more information about using the `Dir` command.

The `PlayButton_Click` event-handler code consists of a single statement, which assigns the selected filename to the `URL` property of the `WindowsMediaPlayer1` object.

```
Private Sub PlayButton_Click()
    ' URL property loads track, and starts player
    WindowsMediaPlayer1.URL = _
        ThisWorkbook.Path & "\" & ListBox1.List(ListBox1.ListIndex)
End Sub
```

You can probably think of lots of enhancements for this simple application.

Animating a Label

The final example in this chapter demonstrates how to animate a `Label` control. The UserForm shown in Figure 14-21 is an interactive random number generator.

Two `TextBox` controls hold the lower and upper values for the random number. A `Label` control initially displays four question marks, but the text is animated to show random numbers when the user clicks the Start button. The Start button changes to a Stop button, and clicking it again stops the animation and displays the random number. Figure 14-22 shows the dialog box displaying a random number between 1 and 10,000.

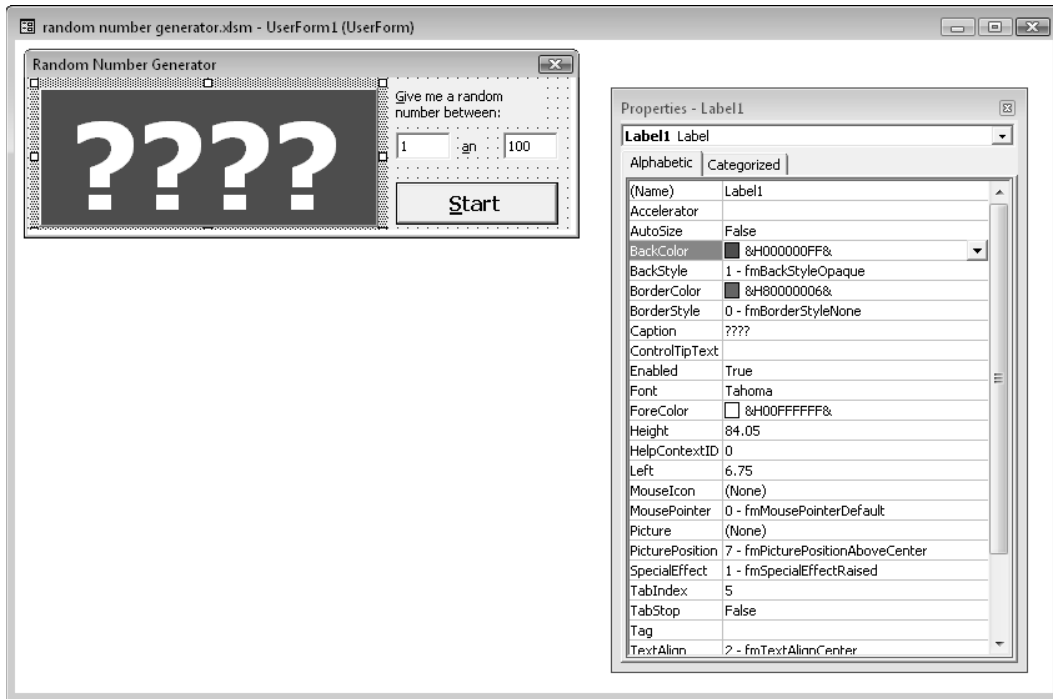


Figure 14-21: Generating a random number.



Figure 14-22: A random number has been chosen.

The code that's attached to the button is as follows:

```
Dim Stopped As Boolean
Private Sub StartStopButton_Click()
    Dim Low As Double, Hi As Double

    If StartStopButton.Caption = "Start" Then
        ' validate low and hi values
        If Not IsNumeric(TextBox1.Text) Then
            MsgBox "Non-numeric starting value.", vbInformation
            With TextBox1
                .SelStart = 0
                .SelLength = Len(.Text)
                .SetFocus
            End With
            Exit Sub
        End If

        If Not IsNumeric(TextBox2.Text) Then
            MsgBox "Non-numeric ending value.", vbInformation
            With TextBox2
                .SelStart = 0
                .SelLength = Len(.Text)
                .SetFocus
            End With
            Exit Sub
        End If

        ' Make sure they aren't in the wrong order
        Low = Application.Min(Val(TextBox1.Text), Val(TextBox2.Text))
        Hi = Application.Max(Val(TextBox1.Text), Val(TextBox2.Text))

        ' Adjust font size, if necessary
        Select Case Application.Max(Len(TextBox1.Text), Len(TextBox2.Text))
            Case Is < 5: Label1.Font.Size = 72
            Case 5: Label1.Font.Size = 60
            Case 6: Label1.Font.Size = 48
            Case Else: Label1.Font.Size = 36
        End Select

        StartStopButton.Caption = "Stop"
        Stopped = False
        Randomize
        Do Until Stopped
            Label1.Caption = Int((Hi - Low + 1) * Rnd + Low)
            DoEvents ' Causes the animation
        Loop
    Else
        Stopped = True
    End If
End Sub
```



```
        StartStopButton.Caption = "Start"  
    End If  
End Sub
```

Because the button serves two purposes (starting and stopping), the procedure uses a public variable, `Stopped`, to keep track of the state. The first part of the procedure consists of two `If-Then` structures to validate the contents of the `TextBox` controls. Two more statements ensure that the low value is in fact less than the high value. The next section adjusts the `Label` control's font size, based on the maximum value. The `Do Until` loop is responsible for generating and displaying the random numbers. Notice the `DoEvents` statement. This statement causes Excel to "yield" to the operating system. Without the statement, the `Label` control wouldn't display each random number as it's generated. In other words, the `DoEvents` statement is what makes the animation possible.

The UserForm also contains a `CommandButton` that serves as a Cancel button. This control is positioned off the UserForm so that it's not visible. This `CommandButton` has its `Cancel` property set to `True`, so pressing `Esc` is equivalent to clicking the button. Its click event-handler procedure simply sets the `Stopped` variable to `True` and unloads the UserForm:

```
Private Sub CancelButton_Click()  
    Stopped = True  
    Unload Me  
End Sub
```



On the CD

This example, named `random number generator.xlsm`, is available on the companion CD-ROM.

Advanced UserForm Techniques

In This Chapter

- Using modeless UserForms
- Displaying a progress indicator
- Creating a *wizard* — an interactive series of dialog boxes
- Creating a function that emulates VBA's `MsgBox` function
- Allowing users to move UserForm controls
- Displaying a UserForm with no title bar
- Simulating a toolbar with a Userform
- Allowing users to resize a UserForm
- Handling multiple controls with a single event handler
- Using a dialog box to select a color
- Displaying a chart in a UserForm
- Using an Enhanced Data Form
- Creating a moving tile puzzle

A Modeless Dialog Box

Most dialog boxes that you encounter are *modal* dialog boxes, which you must dismiss from the screen before the user can do anything with the underlying application. Some dialog boxes, however, are *modeless*, which means the user can continue to work in the application while the dialog box is displayed.

To display a modeless UserForm, use a statement such as

```
UserForm1.Show vbModeless
```

The word `vbModeless` is a built-in constant that has a value of 0. Therefore, the following statement works identically:

```
UserForm1.Show 0
```

Figure 15-1 shows a modeless dialog box that displays information about the active cell. When the dialog box is displayed, the user is free to move the cell cursor, activate other sheets, and perform other Excel actions. The information displayed in the dialog box changes when the active cell changes.

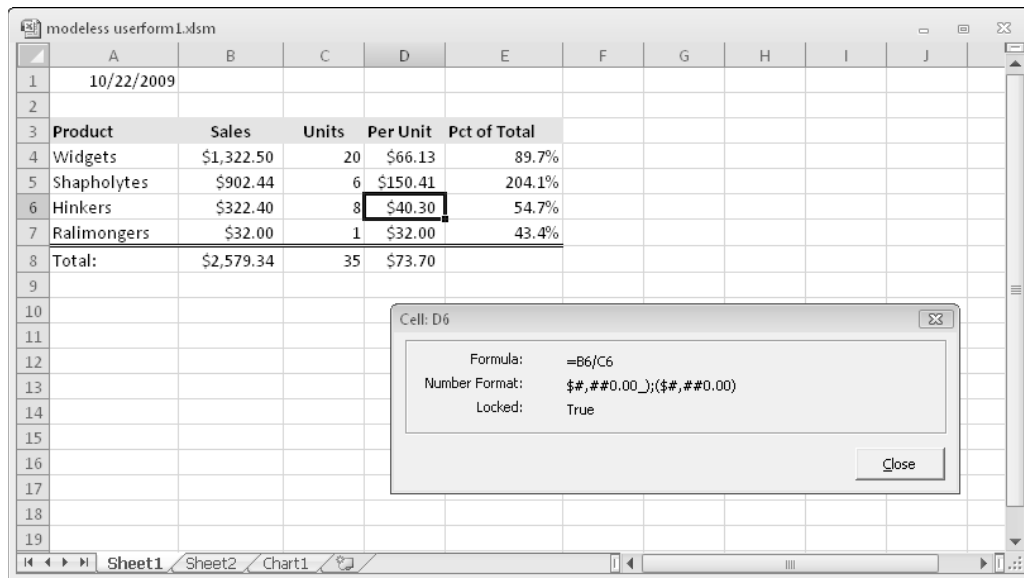


Figure 15-1: This modeless dialog box remains visible while the user continues working.



On the CD

This example, named `modeless userform1.xlsm`, is available on the companion CD-ROM.

The key is determining when to update the information in the dialog box. To do so, the example monitors two workbook events: `SheetSelectionChange` and `SheetActivate`. These event-handler procedures are located in the code module for the `ThisWorkbook` object.

**Cross-Ref**

Refer to Chapter 19 for additional information about events.

The event-handler procedures follow:

```
Private Sub Workbook_SheetSelectionChange _
    (ByVal Sh As Object, ByVal Target As Range)
    Call UpdateBox
End Sub

Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    Call UpdateBox
End Sub
```

The two previous procedures call the UpdateBox procedure, which follows:

```
Sub UpdateBox()
    With UserForm1
        ' Make sure a worksheet is active
        If TypeName(ActiveSheet) <> "Worksheet" Then
            .lblFormula.Caption = "N/A"
            .lblNumFormat.Caption = "N/A"
            .lblLocked.Caption = "N/A"
            Exit Sub
        End If

        .Caption = "Cell: " & ActiveCell.Address(False, False)
        ' Formula
        If ActiveCell.HasFormula Then
            .lblFormula.Caption = ActiveCell.Formula
        Else
            .lblFormula.Caption = "(none)"
        End If
        ' Number format
        .lblNumFormat.Caption = ActiveCell.NumberFormat
        ' Locked
        .lblLocked.Caption = ActiveCell.Locked
    End With
End Sub
```

The UpdateBox procedure changes the UserForm's caption to show the active cell's address; then it updates the three Label controls (lblFormula, lblNumFormat, and lblLocked).

Following are a few points to help you understand how this example works:

- The UserForm is displayed modeless so that you can still access the worksheet while it's displayed.
- Code at the top of the procedure checks to make sure that the active sheet is a worksheet. If the sheet isn't a worksheet, the `Label` controls are assigned the text `N/A`.
- The workbook monitors the active cell by using a `Selection_Change` event (which is located in the `ThisWorkbook` code module).
- The information is displayed in `Label` controls on the UserForm.

Figure 15-2 shows a more sophisticated version of this example. This version displays quite a bit of additional information about the selected cell. Long-time Excel users might notice the similarity to the Info window — a handy feature that was removed from Excel several versions ago. The code is too lengthy to display here, but you can view the well-commented code in the example workbook.

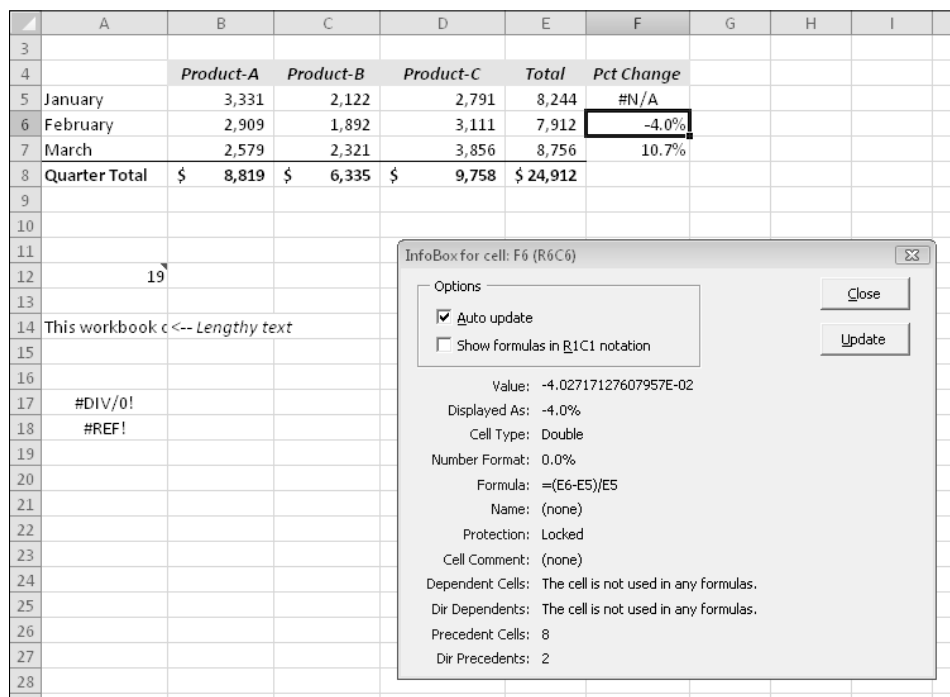


Figure 15-2: This modeless UserForm displays various information about the active cell.



On the CD

This example, named `modeless userform2.xlsm`, is available on the companion CD-ROM.

Following are some key points about this more sophisticated version:

- The UserForm has a check box (Auto Update). When this check box is selected, the UserForm is updated automatically. When Auto Update isn't turned on, the user can use the Update button to refresh the information.
- The workbook uses a class module to monitor two events for all open workbooks: the `SheetSelectionChange` event and the `SheetActivate` event. As a result, the code to display the information about the current cell is executed automatically whenever these events occur in any workbook (assuming that the Auto Update option is in effect). Some actions (such as changing a cell's number format) do not trigger either of these events. Therefore, the UserForm also contains an Update button.



Cross-Ref

Refer to Chapter 29 for more information about class modules.

- The counts displayed for the cell precedents and dependents fields include cells in the active sheet only. This is a limitation of the `Precedents` and `Dependents` properties.
- Because the length of the information will vary, VBA code is used to size and vertically space the labels — and also change the height of the UserForm if necessary.

Displaying a Progress Indicator

One of the most common requests among Excel developers involves progress indicators. A *progress indicator* is a graphical thermometer-type display that shows the progress of a task, such as a lengthy macro.

In this section, I describe how to create three types of progress indicators for

- A macro that's not initiated by a UserForm (a stand-alone progress indicator).
- A macro that is initiated by a UserForm. In this case, the UserForm uses a `MultiPage` control that displays the progress indicator while the macro is running.
- A macro that is initiated by a UserForm. In this case, the UserForm increases in height while the macro is running, and the progress indicator appears at the bottom of the dialog box.

Using a progress indicator requires that your code is able to gauge how far along your macro might be in completing its given task. How you do this will vary, depending on the macro. For example, if your macro writes data to cells and you know the number of cells that will be written to, it's a simple matter to write code that calculates the percent completed. Even if you can't accurately gauge the progress of a macro, it's a good idea to give the user some indication that the macro is still running and Excel hasn't crashed.



Displaying progress in the status bar

A simple way to display the progress of a macro is to use Excel's status bar. The advantage is that a status bar is very easy to program. However, the disadvantage is that most users aren't accustomed to watching the status bar and prefer a more visual display.

To write text to the status bar, use a statement such as

```
Application.StatusBar = "Please wait..."
```

You can, of course, update the status bar while your macro progresses. For example, if you have a variable named `Pct` that represents the percent completed, you can write code that periodically executes a statement such as this:

```
Application.StatusBar = "Processing... " & Pct & "% Completed"
```

When your macro finishes, you must reset the status bar to its normal state with the following statement:

```
Application.StatusBar = False
```

If you don't reset the status bar, the final message will continue to display.



Caution

A progress indicator will slow down your macro a bit because of the extra overhead of having to update it. If speed is absolutely critical, you might prefer to forgo using a progress indicator.

Creating a stand-alone progress indicator

This section describes how to set up a stand-alone progress indicator — that is, one that isn't initiated by displaying a UserForm — to display the progress of a macro. The macro simply clears the worksheet and writes 20,000 random numbers to a range of cells:

```
Sub GenerateRandomNumbers()
' Inserts random numbers on the active worksheet
Const RowMax As Long = 500
Const ColMax As Long = 40
Dim r As Long, c As Long
If TypeName(ActiveSheet) <> "Worksheet" Then Exit Sub
Cells.Clear
For r = 1 To RowMax
    For c = 1 To ColMax
        Cells(r, c) = Int(Rnd * 1000)
    Next c
Next r
End Sub
```


After you make a few modifications to this macro (described in the next section), the UserForm, shown in Figure 15-3, displays the progress.

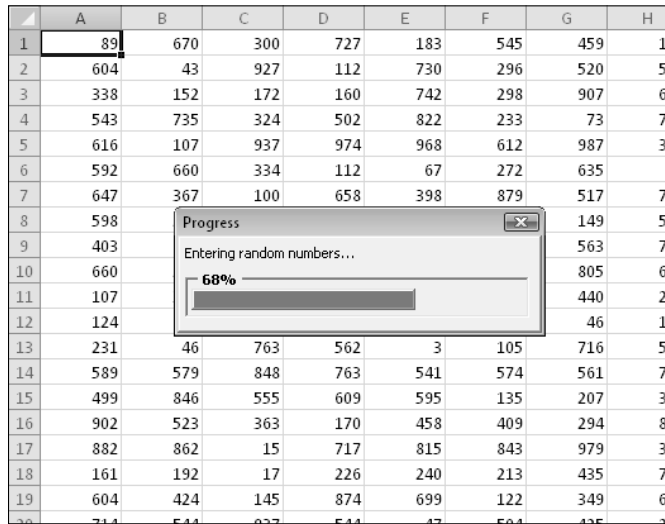


Figure 15-3: A UserForm displays the progress of a macro.



This example, named `progress indicator1.xlsm`, is available on the companion CD-ROM.

Building the stand-alone progress indicator UserForm

Follow these steps to create the UserForm that will be used to display the progress of your task:

1. Insert a new UserForm and change its `Caption` property setting to `Progress`.
2. Add a `Frame` control and name it `FrameProgress`.
3. Add a `Label` control inside the `Frame`, name it `LabelProgress`, remove the label's caption, and make its background color (`BackColor` property) something that will stand out.

The label's size and placement don't matter for now.

4. Add another label above the frame to describe what's going on (optional).
In this example, the label reads, *Entering random numbers. . .*
5. Adjust the UserForm and controls so that they look something like Figure 15-4.

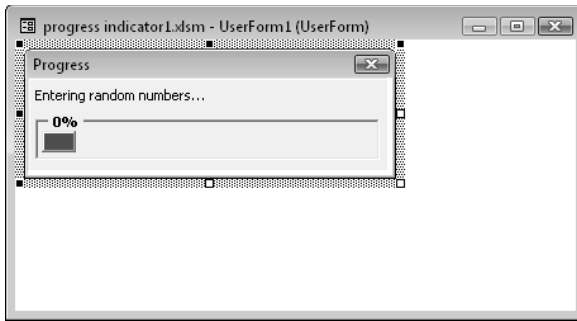


Figure 15-4: This UserForm will serve as a progress indicator.

You can, of course, apply any other type of formatting to the controls. For example, I changed the `SpecialEffect` property for the `Frame` control to make it “sunken.”

Creating the event-handler procedures for the stand-alone progress indicator

The trick here involves running a procedure automatically when the UserForm is displayed. One option is to use the `Initialize` event. However, this event occurs *before* the UserForm is actually displayed, so it’s not appropriate. The `Activate` event, on the other hand, is triggered when the UserForm is displayed, so it’s perfect for this application.

Insert the following procedure in the code window for the UserForm. This procedure simply calls a procedure named `GenerateRandomNumbers` when the UserForm is displayed. This procedure, which is stored in a VBA module, is the actual macro that runs while the progress indicator is displayed.

```
Private Sub UserForm_Activate()  
    Call GenerateRandomNumbers  
End Sub
```

The modified version of the `GenerateRandomNumber` procedure (which was presented earlier) follows. Notice that additional code keeps track of the progress and stores it in a variable named `PctDone`.

```
Sub GenerateRandomNumbers()  
    ' Inserts random numbers on the active worksheet  
    Dim Counter As Long  
    Const RowMax As Long = 500  
    Const ColMax As Long = 40  
    Dim r As Integer, c As Long  
    Dim PctDone As Double  
  
    If TypeName(ActiveSheet) <> "Worksheet" Then Exit Sub  
    Cells.Clear  
    Counter = 1
```

```

For r = 1 To RowMax
    For c = 1 To ColMax
        Cells(r, c) = Int(Rnd * 1000)
        Counter = Counter + 1
    Next c
    PctDone = Counter / (RowMax * ColMax)
    Call UpdateProgress(PctDone)
Next r
Unload UserForm1
End Sub

```

The `GenerateRandomNumbers` procedure contains two loops. Within the inner loop is a call to the `UpdateProgress` procedure, which takes one argument (the `PctDone` variable, which represents the progress of the macro). `PctDone` will contain a value between 0 and 100.

```

Sub UpdateProgress(Pct)
    With UserForm1
        .FrameProgress.Caption = Format(Pct, "0%")
        .LabelProgress.Width = Pct * (.FrameProgress.Width - 10)
        .Repaint
    End With
End Sub

```

Creating the start-up procedure for a stand-alone progress indicator

All that's missing is a procedure to display the UserForm. Enter the following procedure in a VBA module:

```

Sub ShowUserForm()
    With UserForm1
        .LabelProgress.Width = 0
        .Show
    End With
End Sub

```



Tip

An additional accoutrement is to make the progress bar color match the workbook's current theme. To do so, just add this statement to the `ShowUserForm` procedure:

```

.LabelProgress.BackColor = ActiveWorkbook.Theme. _
    ThemeColorScheme.Colors(msoThemeAccent1)

```

How the stand-alone progress indicator works

When you execute the `ShowUserForm` procedure, the `Label` object's width is set to 0. Then the `Show` method of the `UserForm1` object displays the UserForm (which is the progress indicator). When the UserForm is displayed, its `Activate` event is triggered, which executes the `GenerateRandomNumbers` procedure. The `GenerateRandomNumbers` procedure contains code that calls the `UpdateProgress` procedure every time the `r` loop counter variable changes. Notice that the `UpdateProgress` procedure uses the `Repaint` method of the `UserForm` object. Without this statement, the changes to the label would not be updated. Before the `GenerateRandomNumbers` procedure ends, the last statement unloads the UserForm.

To customize this technique, you need to figure out how to determine the percentage completed and assign it to the `PctDone` variable. This calculation will vary, depending on your application. If your code runs in a loop (as in this example), determining the percentage completed is easy. If your code is not in a loop, you might need to estimate the progress completed at various points in your code.

Showing a progress indicator by using a MultiPage control

In the preceding example, a UserForm didn't initiate the macro. In many cases, your lengthy macro is kicked off when the user clicks the OK button on a UserForm. The technique that I describe in this section is a better solution and assumes the following:

- Your project is completed and debugged.
- Your project uses a UserForm (without a `MultiPage` control) to initiate a lengthy macro.
- You have a way to gauge the progress of your macro.



On the CD

The companion CD-ROM contains an example that demonstrates this technique. The file is named `progress indicator2.xlsm`.

Like the previous example, this one enters random numbers into a worksheet. The difference here is that the application contains a UserForm that allows the user to specify the number of rows and columns for the random numbers (see Figure 15-5).

Modifying your UserForm for a progress indicator with a MultiPage control

This step assumes that you have a UserForm all set up. You'll add a `MultiPage` control. The first page of the `MultiPage` control will contain all your original UserForm controls. The second page will contain the controls that display the progress indicator. When the macro begins executing, VBA code will change the `Value` property of the `MultiPage` control. This will effectively hide the original controls and display the progress indicator.

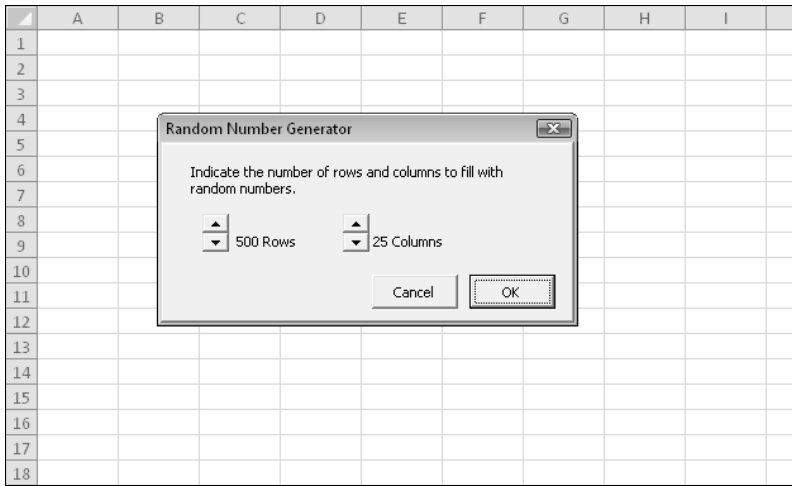


Figure 15-5: The user specifies the number of rows and columns for the random numbers.

The first step is to add a `MultiPage` control to your UserForm. Then move all the existing controls on the UserForm and paste them to `Page1` of the `MultiPage` control.

Next, activate `Page2` of the `MultiPage` control and set it up as shown in Figure 15-6. This is essentially the same combination of controls used in the example in the previous section.

1. Add a `Frame` control and name it `FrameProgress`.
2. Add a `Label` control inside the `Frame`, name it `LabelProgress`, remove the label's caption, and make its background color red.
3. Add another label to describe what's going on (optional).
4. Next, activate the `MultiPage` control itself (not a page on the control) and set its `Style` property to 2 - `fmTabStyleNone`.

(This will hide the tabs.) You'll probably need to adjust the size of the `MultiPage` control to account for the fact that the tabs aren't displayed.



Tip

The easiest way to select the `MultiPage` control when the tabs are hidden is to use the drop-down list in the Properties window. To select a particular page, specify a `Value` for the `MultiPage` control: 0 for `Page1`, 1 for `Page2`, and so on.

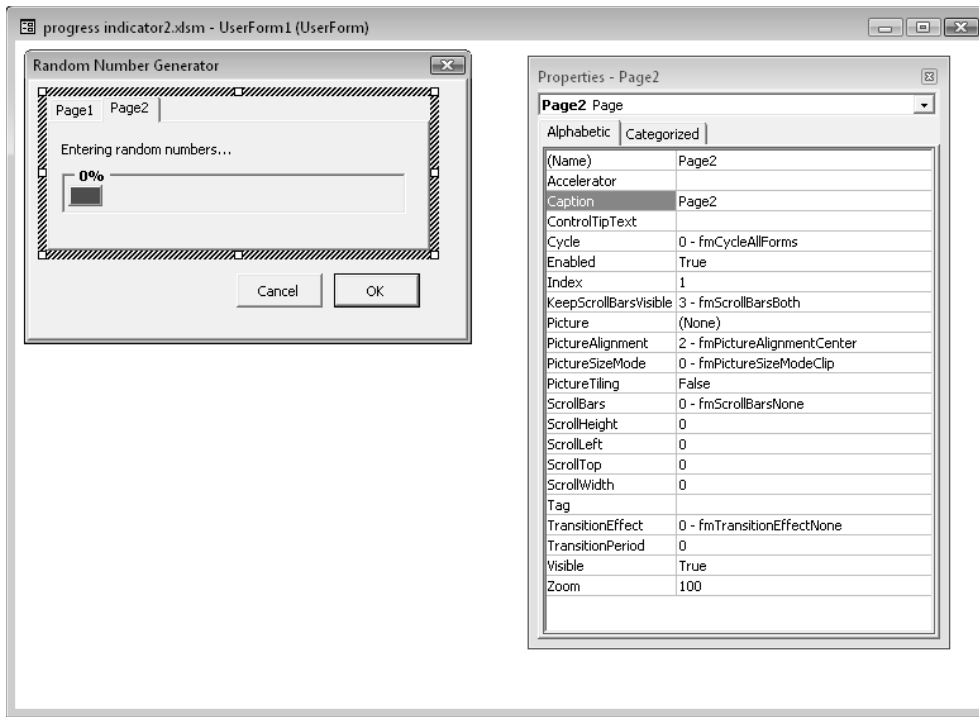


Figure 15-6: Page2 of the `MultiPage` control will display the progress indicator.

Inserting the `UpdateProgress` procedure for a progress indicator with a `MultiPage` control

Insert the following procedure in the code module for the UserForm:

```
Sub UpdateProgress(Pct)
    With UserForm1
        .FrameProgress.Caption = Format(Pct, "0%")
        .LabelProgress.Width = Pct * (.FrameProgress.Width - 10)
        .Repaint
    End With
End Sub
```

The `UpdateProgress` procedure is called from the macro that's executed when the user clicks the OK button, and it performs the updating of the progress indicator.

Modifying your procedure for a progress indicator with a MultiPage control

You need to modify the procedure that is executed when the user clicks the OK button — the `Click` event-handler procedure for the button named `OKButton_Click`. First, insert the following statement at the top of your procedure:

```
MultiPage1.Value = 1
```

This statement activates `Page2` of the `MultiPage` control (the page that displays the progress indicator).

In the next step, you're pretty much on your own. You need to write code to calculate the percent completed and assign this value to a variable named `PctDone`. Most likely, this calculation will be performed inside of a loop. Then insert the following statement, which will update the progress indicator:

```
Call UpdateProgress(PctDone)
```

How a progress indicator with a Multipage control works

This technique is very straightforward and, as you've seen, it involves only one UserForm. The code switches pages of the `MultiPage` control and converts your normal dialog box into a progress indicator. Because the `MultiPage` tabs are hidden, it doesn't even resemble a `MultiPage` control.

Showing a progress indicator without using a MultiPage control

The example in this section is similar to the example in the preceding section. However, this technique is simpler because it doesn't use a `MultiPage` control. Rather, the progress indicator is stored at the bottom of the UserForm — but the UserForm's height is reduced so that the progress indicator controls aren't visible. When it's time to display the progress indicator, the UserForm's height is increased, which makes the progress indicator visible.



On the CD

The companion CD-ROM contains an example that demonstrates this technique. The file is named `progress indicator3.xlsm`.

Figure 15-7 shows the UserForm in the VBE. The `Height` property of the UserForm is 172. However, before the UserForm is displayed, VBA code changes the `Height` to 124 (which means the progress indicator controls aren't visible to the user). When the user clicks OK, VBA code changes the `Height` property to 172 with the following statement:

```
Me.Height = 172
```

Figure 15-8 shows the UserForm with the progress indicator section unhidden.

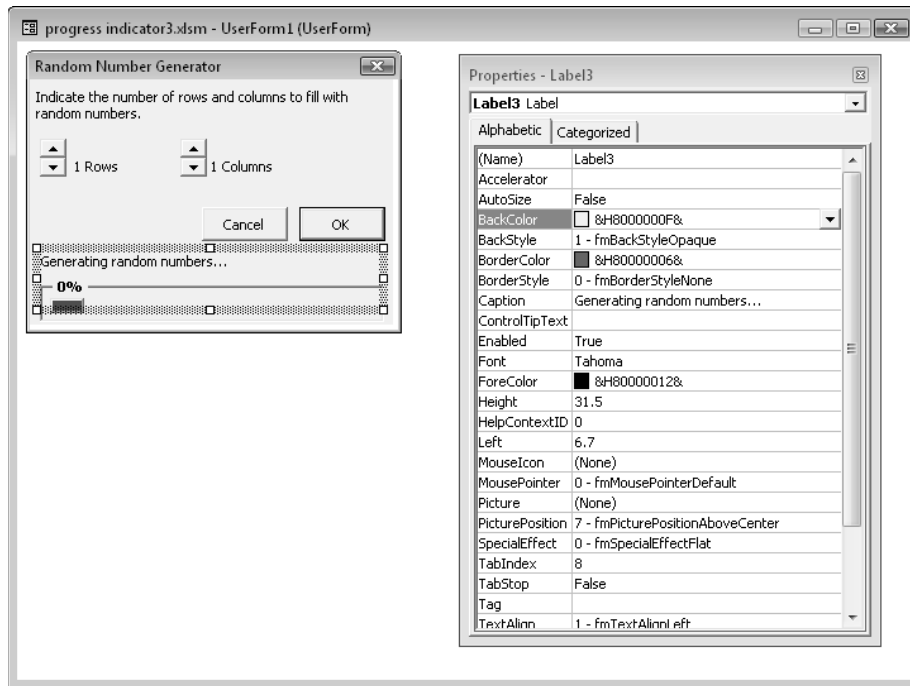


Figure 15-7: The progress indicator will be hidden by reducing the height of the UserForm.

	A	B	C	D	E	F	G	H	I	J
1	705	533	579	289	301	774	14	760	814	709
2	364	488	455	434	363	633	542	156	938	654
3	495	41					814	540	427	509
4	784	5					972	804	674	905
5	195	32					205	692	504	183
6	793	85					451	698	499	406
7	824	71					355	204	578	629
8	43	45					468	868	828	410
9	291	36					702	268	575	576
10	324	97					31	792	719	244
11	894	86					446	779	308	78
12	70	62					160	906	369	814
13	824	15					56	835	984	19
14	853	172	664	276	870	733	394	97	617	107
15	661	984	773	568	383	277	764	238	698	609
16	885	486	984	29	972	849	286	205	443	685
17	876	445	566	161	189	601	68	991	938	889
18	523	3	649	888	331	456	905	523	464	188

Figure 15-8: The progress indicator in action.

Creating Wizards

Many applications incorporate wizards to guide users through an operation. Excel's Text Import Wizard is a good example. A *wizard* is essentially a series of dialog boxes that solicit information from the user. Usually, the user's choices in earlier dialog boxes influence the contents of later dialog boxes. In most wizards, the user is free to go forward or backward through the dialog box sequence or to click the Finish button to accept all defaults.

You can create wizards by using VBA and a series of UserForms. However, I've found that the most efficient way to create a wizard is to use a single UserForm and a `MultiPage` control with the tabs hidden.

Figure 15-9 shows an example of a simple four-step wizard, which consists of a single UserForm that contains a `MultiPage` control. Each step of the wizard displays a different page in the `MultiPage` control.

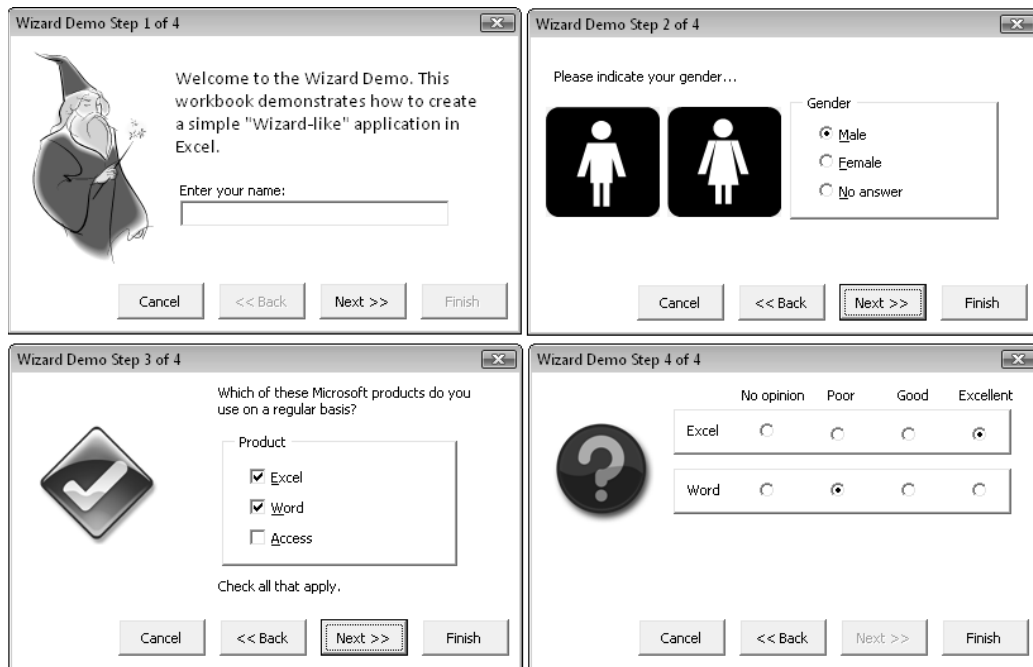


Figure 15-9: This four-step wizard uses a `MultiPage` control.



On the CD

The wizard example in this section is available on the companion CD-ROM. The file is named `wizard demo.xlsm`.

The sections that follow describe how I created the sample wizard.

Setting up the MultiPage control for the wizard

Start with a new UserForm and add a `MultiPage` control. By default, this control contains two pages. Right-click the `MultiPage` tab and insert enough new pages to handle your wizard (one page for each wizard step). The example on the CD-ROM is a four-step wizard, so the `MultiPage` control has four pages. The captions of the `MultiPage` tabs are irrelevant because they won't be seen. The `MultiPage` control's `Style` property will eventually be set to `2 - fmTabStyleNone`.



Tip

While working on the UserForm, you'll want to keep the `MultiPage` tabs visible to make it easier to access various pages.

Next, add the desired controls to each page of the `MultiPage` control. These controls will, of course, vary depending on your application. You may need to resize the `MultiPage` control while you work in order to have room for the controls.

Adding the buttons to the wizard's UserForm

Now add the buttons that control the progress of the wizard. These buttons are placed outside the `MultiPage` control because they're used while any of the pages are displayed. Most wizards have four buttons:

- **Cancel:** Cancels the wizard and performs no action.
- **Back:** Returns to the previous step. During Step 1 of the wizard, this button should be disabled.
- **Next:** Advances to the next step. During the last wizard step, this button should be disabled.
- **Finish:** Finishes the wizard.



Note

In some cases, the user is allowed to click the Finish button at any time and accept the defaults for items that were skipped over. In other cases, the wizard requires a user response for some items. If this is the case, the Finish button is disabled until all required input is made. The example on the CD-ROM requires an entry in the TextBox in Step 1.

In the example, these `CommandButtons` are named `CancelButton`, `BackButton`, `NextButton`, and `FinishButton`.

Programming the wizard's buttons

Each of the four wizard buttons requires a procedure to handle its `Click` event. The event handler for the `CancelButton` control follows. This procedure uses a `MsgBox` function (see Figure

15-10) to verify that the user really wants to exit. If the user clicks the Yes button, the UserForm is unloaded with no action taken. This type of verification, of course, is optional.

```
Private Sub CancelButton_Click()
    Dim Msg As String
    Dim Ans As Integer
    Msg = "Cancel the wizard?"
    Ans = MsgBox(Msg, vbQuestion + vbYesNo, APPNAME)
    If Ans = vbYes Then Unload Me
End Sub
```

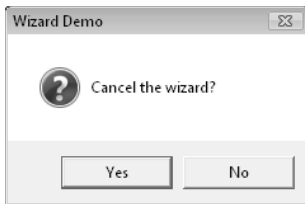


Figure 15-10: Clicking the Cancel button displays a confirmation message box.

The event-handler procedures for the Back and Next buttons follow:

```
Private Sub BackButton_Click()
    MultiPage1.Value = MultiPage1.Value - 1
    UpdateControls
End Sub
Private Sub NextButton_Click()
    MultiPage1.Value = MultiPage1.Value + 1
    UpdateControls
End Sub
```

These two procedures are very simple. They change the Value property of the MultiPage control and then call another procedure named UpdateControls (which follows).

The UpdateControls procedure is responsible for enabling and disabling the BackButton and NextButton controls.

```
Sub UpdateControls()
    Select Case MultiPage1.Value
        Case 0
            BackButton.Enabled = False
            NextButton.Enabled = True
        Case MultiPage1.Pages.Count - 1
            BackButton.Enabled = True
            NextButton.Enabled = False
    End Select
End Sub
```

```

        Case Else
            BackButton.Enabled = True
            NextButton.Enabled = True
        End Select

' Update the caption
Me.Caption = APPNAME & " Step " _
    & MultiPage1.Value + 1 & " of " _
    & MultiPage1.Pages.Count
' The Name field is required
If tbName.Text = "" Then
    FinishButton.Enabled = False
Else
    FinishButton.Enabled = True
End If
End Sub

```

The procedure changes the UserForm's caption to display the current step and the total number of steps. `APPNAME` is a public constant, defined in `Module1`. The procedure then examines the name field on the first page (a `TextBox` named `tbName`). This field is required, so the user can't click the `Finish` button if it's empty. If the `TextBox` is empty, the `FinishButton` is disabled; otherwise, it's enabled.

Programming dependencies in a wizard

In most wizards, a user's response on a particular step can affect what's displayed in a subsequent step. In this example, the user indicates which products he uses in Step 3 and then rates those products in Step 4. The `OptionButtons` for a product's rating are visible only if the user has indicated a particular product.

Programmatically, you accomplish this task by monitoring the `MultiPage`'s `Change` event. Whenever the value of the `MultiPage` is changed (by clicking the `Back` or `Next` button), the `MultiPage1_Change` procedure is executed. If the `MultiPage` control is on the last tab (Step 4), the procedure examines the values of the `CheckBox` controls in Step 3 and makes the appropriate adjustments in Step 4.

In this example, the code uses two arrays of controls — one for the product `CheckBox` controls (Step 3) and one for the `Frame` controls (Step 4). The code uses a `For-Next` loop to hide the `Frames` for the products that aren't used and then adjusts their vertical positioning. If none of the check boxes in Step 3 is checked, everything in Step 4 is hidden except a `TextBox` that displays `Click Finish to exit` (if a name is entered in Step 1) or `A name is required in Step 1` (if a name isn't entered in Step 1). The `MultiPage1_Change` procedure follows:

```

Private Sub MultiPage1_Change()
    Dim TopPos As Long
    Dim FSpace As Long
    Dim AtLeastOne As Boolean

```

```

Dim i As Long
' Set up the Ratings page?
If MultiPage1.Value = 3 Then
'   Create an array of CheckBox controls
   Dim ProdCB(1 To 3) As MSForms.CheckBox
   Set ProdCB(1) = cbExcel
   Set ProdCB(2) = cbWord
   Set ProdCB(3) = cbAccess

'   Create an array of Frame controls
   Dim ProdFrame(1 To 3) As MSForms.Frame
   Set ProdFrame(1) = FrameExcel
   Set ProdFrame(2) = FrameWord
   Set ProdFrame(3) = FrameAccess

   TopPos = 22
   FSpace = 8
   AtLeastOne = False
'   Loop through all products
   For i = 1 To 3
       If ProdCB(i) Then
           ProdFrame(i).Visible = True
           ProdFrame(i).Top = TopPos
           TopPos = TopPos + ProdFrame(i).Height + FSpace
           AtLeastOne = True
       Else
           ProdFrame(i).Visible = False
       End If
   Next i

'   Uses no products?
   If AtLeastOne Then
       lblHeadings.Visible = True
       Image4.Visible = True
       lblFinishMsg.Visible = False
   Else
       lblHeadings.Visible = False
       Image4.Visible = False
       lblFinishMsg.Visible = True
       If tbName = "" Then
           lblFinishMsg.Caption = _
               "A name is required in Step 1."
       Else
           lblFinishMsg.Caption = _
               "Click Finish to exit."
       End If
   End If
End If
End Sub

```

Performing the task with the wizard

When the user clicks the Finish button, the wizard performs its task: transferring the information from the UserForm to the next empty row in the worksheet. This procedure, named `FinishButton_Click`, is very straightforward. It starts by determining the next empty worksheet row and assigns this value to a variable (`r`). The remainder of the procedure simply translates the values of the controls and enters data into the worksheet.

```
Private Sub FinishButton_Click()
    Dim r As Long
    r = Application.WorksheetFunction. _
        CountA(Range("A:A")) + 1
    ' Insert the name
    Cells(r, 1) = tbName.Text

    ' Insert the gender
    Select Case True
        Case obMale: Cells(r, 2) = "Male"
        Case obFemale: Cells(r, 2) = "Female"
        Case obNoAnswer: Cells(r, 2) = "Unknown"
    End Select

    ' Insert usage
    Cells(r, 3) = cbExcel
    Cells(r, 4) = cbWord
    Cells(r, 5) = cbAccess

    ' Insert ratings
    If obExcel1 Then Cells(r, 6) = ""
    If obExcel2 Then Cells(r, 6) = 0
    If obExcel3 Then Cells(r, 6) = 1
    If obExcel4 Then Cells(r, 6) = 2
    If obWord1 Then Cells(r, 7) = ""
    If obWord2 Then Cells(r, 7) = 0
    If obWord3 Then Cells(r, 7) = 1
    If obWord4 Then Cells(r, 7) = 2
    If obAccess1 Then Cells(r, 8) = ""
    If obAccess2 Then Cells(r, 8) = 0
    If obAccess3 Then Cells(r, 8) = 1
    If obAccess4 Then Cells(r, 8) = 2

    ' Unload the form
    Unload Me
End Sub
```

After you test your wizard, and everything is working properly, you can set the `MultiPage` control's `Style` property to 2 - `fmTabStyleNone` to hide the tabs.

Emulating the MsgBox Function

VBA's `MsgBox` function (discussed in Chapter 12) is a bit unusual because, unlike most functions, it displays a dialog box. But, similar to other functions, it also returns a value: an integer that represents which button the user clicked.

This section describes a custom function that I created that emulates VBA's `MsgBox` function. On first thought, creating such a function might seem rather easy. Think again! The `MsgBox` function is extraordinarily versatile because of the arguments that it accepts. Consequently, creating a function to emulate `MsgBox` is no small feat.



Note

The point of this exercise is not to create an alternative messaging function. Rather, it's to demonstrate how to develop a relatively complex function that also incorporates a UserForm. However, some people might like the idea of being able to customize their messages. If so, you'll find that this function is very easy to customize. For example, you can change the font, colors, button text, and so on.

I named my pseudo-`MsgBox` function `MyMsgBox`. The emulation is close, but not perfect. The `MyMsgBox` function has the following limitations:

- It does not support the `Helpfile` argument (which adds a Help button that, when clicked, opens a Help file).
- It does not support the `Context` argument (which specifies the context ID for the Help file).
- It does not support the *system modal* option, which puts everything in Windows on hold until you respond to the dialog box.
- It does not play a sound when it is called.

The syntax for `MyMsgBox` is

```
MyMsgBox(prompt[, buttons] [, title])
```

This syntax is exactly the same as the `MsgBox` syntax except that it doesn't use the last two optional arguments (`Helpfile` and `Context`). `MyMsgBox` also uses the same predefined constants as `MsgBox`: `vbOKOnly`, `vbQuestion`, `vbDefaultButton1`, and so on.



Note

If you're not familiar with the VBA `MsgBox` function, consult the Help system to become familiar with its arguments.

MsgBox emulation: MyMsgBox code

The MyMsgBox function uses a UserForm named MyMsgBoxForm. The function itself, which follows, is very short. The bulk of the work is done in the UserForm_Initialize procedure.



On the CD

The complete code for the MyMsgBox function is too lengthy to list here, but it's available in a workbook named `msgbox emulation.xlsm`, available on the companion CD-ROM. The workbook is set up so that you can easily try various options.

```
Public Prompt1 As String
Public Buttons1 As Integer
Public Title1 As String
Public UserClick As Integer
Function MyMsgBox(ByVal Prompt As String, _
    Optional ByVal Buttons As Integer, _
    Optional ByVal Title As String) As Integer
    Prompt1 = Prompt
    Buttons1 = Buttons
    Title1 = Title
    MyMsgBoxForm.Show
    MyMsgBox = UserClick
End Function
```

Figure 15-11 shows MyMsgBox in use. It looks very similar to the VBA message box, but I used a different font for the message text (Calibri 12-point bold) and also used some different icons.



Figure 15-11: The result of the MsgBox emulation function.

If you use a multiple monitor system, the position of the displayed UserForm may not be centered in Excel's window. To solve that problem, use the following code to display the MyMsgBoxForm:

```
With MyMsgBoxForm
    .StartUpPosition = 0
    .Left = Application.Left + (0.5 * Application.Width) - (0.5 * .Width)
    .Top = Application.Top + (0.5 * Application.Height) - (0.5 * .Height)
    .Show
End With
```


Here's the code that I used to execute the function:

```
Prompt = "You have chosen to save this workbook" & vbCrLf
Prompt = Prompt & "on a drive that is not available to" & vbCrLf
Prompt = Prompt & "all employees." & vbCrLf & vbCrLf
Prompt = Prompt & "OK to continue?"
Buttons = vbQuestion + vbYesNo
Title = "We have a problem"
Ans = MsgBox(Prompt, Buttons, Title)
```



This example, of course, doesn't really wipe out your entire hard drive.

How the MsgBox function works

Notice the use of four `Public` variables. The first three (`Prompt1`, `Buttons1`, and `Title1`) represent the arguments that are passed to the function. The other variable (`UserClick`) represents the values returned by the function. The `UserForm_Initialize` procedure needs a way to get this information and send it back to the function, and using `Public` variables is the only way to accomplish that.

The UserForm (shown in Figure 15-12) contains four `Label` controls. Each of these `Label` controls has an image, which I pasted into the `Picture` property. The UserForm also has three `CommandButton` controls and a `TextBox` control.



I originally used `Image` controls to hold the four icons, but the images displayed with a faint outline. I switched to `Label` controls because the image is not displayed with an outline.

The code in the `UserForm_Initialize` procedure examines the arguments and does the following:

- Determines which, if any, image to display (and hides the others)
- Determines which button(s) to display (and hides the others)
- Determines which button is the default button
- Centers the buttons in the dialog box
- Determines the captions for the `CommandButtons`
- Determines the position of the text within the dialog box
- Determines how wide to make the dialog box (by using an API function call to get the video resolution)

- Determines how tall to make the dialog box
- Displays the UserForm

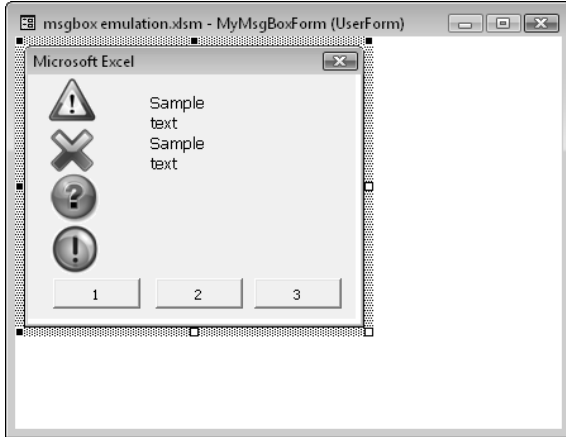


Figure 15-12: The UserForm for the `MyMsgBox` function.

Three additional event-handler procedures are included (one for each `CommandButton`). These routines determine which button was clicked and return a value for the function by setting a value for the `UserClick` variable.

Interpreting the second argument (`buttons`) is a bit challenging. This argument can consist of a number of constants added together. For example, the second argument can be something like this:

```
VbYesNoCancel + VbQuestion + VbDefaultButton3
```

This argument creates a three-button `MsgBox` (with Yes, No, and Cancel buttons), displays the question mark icon, and makes the third button the default button. The actual argument is 547 ($3 + 32 + 512$).

The challenge was pulling three pieces of information from a single number. The solution involves converting the argument to a binary number and then examining specific bits. For example, 547 in binary is 1000100011. Binary digits 4 through 6 determine the image displayed; digits 8 through 10 determine which buttons to display; and digits 1 and 2 determine which button is the default button.

Using the `MyMsgBox` function

To use this function in your own project, export the `MyMsgBoxMod` module and the `MyMsgBoxForm` UserForm. Then import these two files into your project. You can then use the `MyMsgBox` function in your code just as you'd use the `MsgBox` function.

A UserForm with Movable Controls

I'm not sure of the practical significance of this technique, but the example in this section will help you understand mouse-related events. The UserForm shown in Figure 15-13 contains three Image controls. The user can use the mouse to drag these images around in the dialog box.



Figure 15-13: You can drag and rearrange the three Image controls by using the mouse.



On the CD

This example is available on the companion CD-ROM. The file is named `move controls.xlsm`.

Each of the Image controls has two associated event procedures: `MouseDown` and `MouseMove`. The event procedures for the `Image1` control are shown here. (The others are identical except for the control names.)

```
Private Sub Image1_MouseDown(ByVal Button As Integer, _
    ByVal Shift As Integer, ByVal X As Single, ByVal Y As Single)
    ' Starting position when button is pressed
    OldX = X
    OldY = Y
    Image1.ZOrder 0
End Sub

Private Sub Image1_MouseMove(ByVal Button As Integer, _
    ByVal Shift As Integer, ByVal X As Single, ByVal Y As Single)
    ' Move the image
    If Button = 1 Then
        Image1.Left = Image1.Left + (X - OldX)
        Image1.Top = Image1.Top + (Y - OldY)
    End If
End Sub
```

When the mouse button is pressed, the `MouseDown` event occurs, and the X and Y positions of the mouse pointer are stored. Two public variables are used to keep track of the original position of the controls: `OldX` and `OldY`. This procedure also changes the `ZOrder` property, which puts the image “on top” of the others.

When the mouse is being moved, the `MouseMove` event occurs repeatedly. The event procedure checks the mouse button. If the `Button` argument is 1, it means that the left mouse button is depressed. If so, then the `Image` control is shifted relative to its old position.

Also, notice that the mouse pointer changes when it’s over an image. That’s because the `MousePointer` property is set to `15 - fmMousePointerSizeAll`. This mouse pointer style is commonly used to indicate that something can be moved.

A UserForm with No Title Bar

Excel provides no direct way to display a UserForm without its title bar. But this feat is possible with the help of a few API functions. Figure 15-14 shows a UserForm with no title bar.

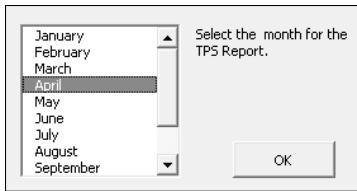


Figure 15-14: This UserForm lacks a title bar.

Another example of a UserForm without a title bar is in Figure 15-15. This dialog box contains an `Image` control and a `CommandButton` control.



On the CD

Both of these examples are in a workbook named `no title bar.xlsm`, which is available on the companion CD-ROM. The CD also contains another version of the splash screen example presented in Chapter 14. This version, named `splash screen2.xlsm`, displays the UserForm without a title bar.

Displaying a UserForm without a title bar requires four windows API functions: `GetWindowLong`, `SetWindowLong`, `DrawMenuBar`, and `FindWindowA` (see the example file on the CD for the function declaration). The `UserForm_Initialize` procedure calls these functions:

```
Private Sub UserForm_Initialize()
    Dim lngWindow As Long, lFrmHdl As Long
    lFrmHdl = FindWindowA(vbNullString, Me.Caption)
    lngWindow = GetWindowLong(lFrmHdl, GWL_STYLE)
    lngWindow = lngWindow And (Not WS_CAPTION)
    Call SetWindowLong(lFrmHdl, GWL_STYLE, lngWindow)
    Call DrawMenuBar(lFrmHdl)
End Sub
```



Figure 15-15: Another UserForm without a title bar.

One problem is that, without a title bar, the user has no way to reposition the dialog box. The solution is to use the `MouseDown` and `MouseMove` events, as described in the preceding section.



Note

Because the `FindWindowA` function uses the UserForm's caption, this technique won't work if the `Caption` property is set to an empty string.

Simulating a Toolbar with a UserForm

Creating a custom toolbar in versions prior to Excel 2007 was relatively easy. Beginning with Excel 2007, you can no longer create a custom toolbar. More accurately, you can still create a custom toolbar with VBA, but Excel ignores many of your VBA instructions. Beginning with Excel 2007, all custom toolbars are displayed in the Add-Ins→Custom Toolbars Ribbon group. You can't move, float, resize, or dock these toolbars.

This section describes how to create a toolbar alternative: a modeless UserForm that simulates a floating toolbar. Figure 15-16 shows a UserForm that may substitute for a toolbar.



On the CD

This example, named `simulated_toolbar.xlm`, is available on the companion CD-ROM.

The UserForm contains eight `Image` controls, and each executes a macro. Figure 15-17 shows the UserForm in the VBE. Notice that

- The controls aren't aligned.
- The UserForm isn't the final size.
- The title bar is the standard size.

	A	B	C	D	E	F	G	H
7	4,795	4,909	3,532	4,599	4,243	3,538	2,311	3,005
8	3,226	2,664	4,883	4,588	2,971	3,886	1,885	3,511
9	1,979	2,154	4,248	2,606	1,622	3,080	4,763	1,364
10	2,252	3,812	2,726	3,797	4,982	1,132	2,836	4,424
11	4,402	1,828	1,031	1,283	4,712	1,081	1,283	2,425
12	1,572	1,949	3,144	1,393				
13	3,203	4,784	3,172	2,556				
14	2,845	2,308	1,266	2,968				
15	4,385	1,546	2,452	3,578	3,482	1,741	1,953	4,254
16	1,489	2,192	1,946	3,799	3,018	1,176	1,428	3,000
17	1,775	3,564	2,409	4,064	3,535	3,368	4,440	3,124
18	2,549	3,051	4,225	2,124	2,543	1,930	1,808	2,854
19	2,266	3,239	1,401	3,878	3,733	1,042	4,886	3,644

Figure 15-16: A UserForm set up to function as a toolbar.

The VBA code takes care of the cosmetic details. It aligns the controls and adjusts the size of the UserForm to eliminate wasted space. In addition, the code uses Windows API functions to make the UserForm's title bar smaller — just like a real toolbar. To make the UserForm look even more like a toolbar, I also set the `ControlTipText` property of each `Image` control — which displays a very toolbar-like tooltip when the mouse is hovered over the control.

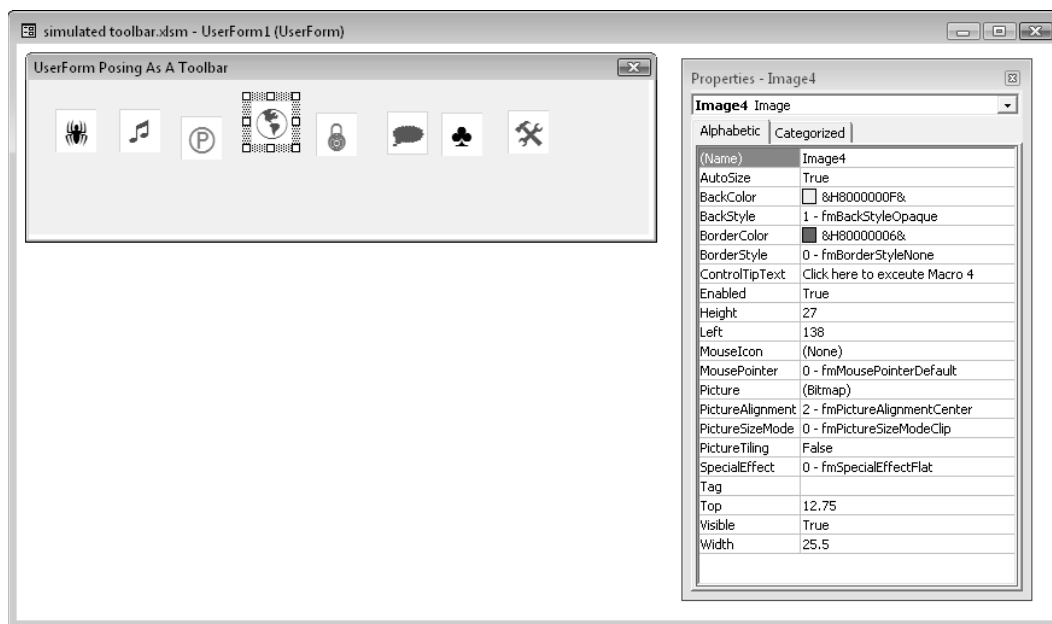


Figure 15-17: The UserForm that simulates a toolbar.

If you open the file on the CD-ROM, you'll also notice that the images change slightly when the mouse is hovered over them. That's because each `Image` control has an associated `MouseMove` event handler that changes the `SpecialEffect` property. Here's the `MouseMove` event handler procedure for `Image1` (the others are identical):

```
Private Sub Image1_MouseMove(ByVal Button As Integer, _  
    ByVal Shift As Integer, ByVal X As Single, ByVal Y As Single)  
    Call NoRaise  
    Image1.SpecialEffect = fmSpecialEffectRaised  
End Sub
```

This procedure calls the `NoRaise` procedure, which turns off the *raised* special effect for each control.

```
Private Sub NoRaise()  
    ' Remove the raised effect from all controls  
    Dim ctl As Control  
    For Each ctl In Controls  
        ctl.SpecialEffect = fmSpecialEffectFlat  
    Next ctl  
End Sub
```

The net effect is that the user gets some visual feedback when the mouse moves over a control — just like a real toolbar. The toolbar simulation only goes so far, however. You can't resize the UserForm (for example, make the images display vertically rather than horizontally). And, of course, you can't dock the pseudo-toolbar to one of the Excel window borders.



Tip

The images displayed on the controls are characters from the Wingding font. I used Excel's **Insert→Text→Symbol** command to enter the character into a cell. Then I copied it to the Clipboard and pasted it into the `Picture` property in the Properties box. This is a quick and easy way to add images to UserForm controls.

A Resizable UserForm

Excel uses several resizable dialog boxes. For example, you can resize the Name Manager dialog box by clicking and dragging the bottom-right corner.

If you'd like to create a resizable UserForm, you'll quickly discover that there's no direct way to do it. One solution is to resort to Windows API calls. That method works, but it's complicated to set up. In addition, that method doesn't generate any events, so your code can't respond when the UserForm is resized. In this section, I present a much simpler technique for creating a user-resizable UserForm.



Note

Credit for this technique goes to Andy Pope, an Excel expert and Microsoft MVP who lives in the UK. Andy is one of the most creative Excel developers I've ever met. For a real treat (and interesting downloads), visit his Web site at <http://andypope.info>.

Figure 15-18 shows the UserForm that's described in this section. It contains a `ListBox` control that displays data from a worksheet. Notice the scrollbars on the `ListBox`. That means the `ListBox` contains information that doesn't fit. Also, notice the bottom-right corner of the dialog box. It displays a (perhaps) familiar sizing control.

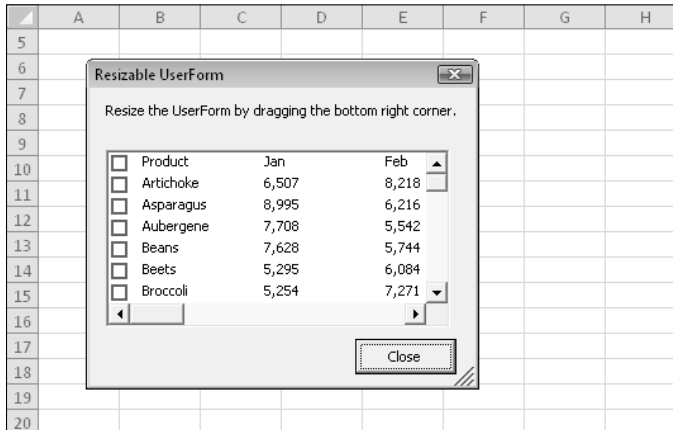


Figure 15-18: This is a resizable UserForm.

Figure 15-19 shows the same UserForm after the user resized it. Notice that the size of the `ListBox` is also increased, and the `Close` button remains in the same relative position. You can stretch this UserForm to the limits of your monitor.



On the CD

This example is available on the companion CD-ROM. The filename is `resizable userform.xlsm`.

The trick here involves a `Label` control, which is added to the UserForm at runtime. The sizing control at the bottom-right corner is actually a `Label` control that displays a single character: The letter `o` (character 111) from the Marlett font, character set 2. This control (named `objResizer`) is added to the UserForm in the `UserForm_Initialize` procedure:

```
Private Sub UserForm_Initialize()
'   Add a resizing control to bottom right corner of UserForm
Set objResizer = Me.Controls.Add("Forms.label.1", MResizer, True)
With objResizer
    .Caption = Chr(111)
    .Font.Name = "Marlett"
    .Font.Charset = 2
    .Font.Size = 14
    .BackStyle = fmBackStyleTransparent
    .AutoSize = True
    .ForeColor = RGB(100, 100, 100)
    .MousePointer = fmMousePointerSizeNWSE
    .ZOrder
End With
End Sub
```



```

.Top = Me.InsideHeight - .Height
.Left = Me.InsideWidth - .Width
End With
End Sub

```

Product	Jan	Feb	Mar	Apr	May	Jun	Jul
Artichoke	6,507	8,218	6,584	5,942	8,763	7,085	7,149
Asparagus	8,995	6,216	5,829	6,268	7,422	5,830	5,678
Aubergene	7,708	5,542	9,407	5,369	9,578	8,903	8,976
Beans	7,628	5,744	7,261	8,673	7,294	9,585	9,121
Beets	5,295	6,084	5,817	8,853	5,735	6,060	8,652
Broccoli	5,254	7,271	5,852	6,469	6,721	9,120	8,543
Brussel sprouts	8,634	9,301	8,106	5,105	7,357	9,452	9,669
Cabbage	5,483	8,870	9,898	5,373	7,133	9,407	7,943
Carrot	5,773	7,729	8,764	7,720	5,461	6,608	5,484
Cauliflower	9,989	5,609	8,701	9,338	7,390	7,323	8,678
Celeriac	5,022	5,086	5,586	8,434	8,657	7,892	7,284
Celery	6,775	9,352	9,243	6,467	7,143	5,487	7,035
Chard	9,642	9,654	5,530	8,669	7,849	8,981	9,516
Chicory	7,818	6,437	6,372	9,133	8,779	5,092	9,843
Collards	7,325	6,469	9,372	9,757	9,300	5,584	5,478
Corn	6,180	6,494	9,307	6,365	5,354	6,070	6,182
Cress	9,902	8,386	8,034	6,426	8,643	6,244	8,646
Cucumbers	8,968	7,810	8,783	6,777	5,284	8,683	9,153
Gourds	7,713	9,390	8,441	5,264	8,083	7,339	8,766
Kales	7,216	7,748	9,265	5,261	7,251	6,122	6,718
Kohlrabi	7,119	6,741	6,533	5,892	9,069	9,637	5,784
Leek	9,933	8,688	7,890	5,098	5,143	5,780	7,609

Figure 15-19: The UserForm after being increased in size.



Note

Although the `Label` control is added at runtime, the event-handler code for the object is contained in the module. Including code for an object that doesn't exist does not present a problem.

This technique relies on these facts:

- The user can move a control on a UserForm (see “A UserForm with Movable Controls,” earlier in this chapter).
- Events exist that can identify mouse movements and pointer coordinates. Specifically, these events are `MouseDown` and `MouseMove`.
- VBA code can change the size of a UserForm at runtime, but a user cannot.

Do a bit of creative thinking about these facts, and you see that it's possible to translate the user's movement of a `Label` control into information that you can use to resize a `UserForm`.

When the user clicks the `objResizer` `Label` object, the `objResizer_MouseDown` event-handler procedure is executed:

```
Private Sub objResizer_MouseDown(ByVal Button As Integer, _  
    ByVal Shift As Integer, ByVal X As Single, ByVal Y As Single)  
    If Button = 1 Then  
        LeftResizePos = X  
        TopResizePos = Y  
    End If  
End Sub
```

This procedure executes only if the left mouse button is pressed (that is, the `Button` argument is 1) and the cursor is on the `objResizer` label. The `X` and `Y` mouse coordinates at the time of the button click are stored in module-level variables: `LeftResizePos` and `TopResizePos`.

Subsequent mouse movements fire the `MouseMove` event, and the `objResizer_MouseMove` event handler kicks into action. Here's an initial take on this procedure:

```
Private Sub objResizer_MouseMove(ByVal Button As Integer, _  
    ByVal Shift As Integer, ByVal X As Single, ByVal Y As Single)  
    If Button = 1 Then  
        With objResizer  
            .Move .Left + X - LeftResizePos, .Top + Y - TopResizePos  
            Me.Width = Me.Width + X - LeftResizePos  
            Me.Height = Me.Height + Y - TopResizePos  
            .Left = Me.InsideWidth - .Width  
            .Top = Me.InsideHeight - .Height  
        End With  
    End If  
End Sub
```

If you study the code, you'll see that the `UserForm`'s `Width` and `Height` properties are adjusted, based on the movement of the `objResizer` `Label` control. Figure 15-20 shows how the `UserForm` looks after the user moves the `Label` control down and to the right.

The problem, of course, is that the other controls in the `UserForm` don't respond to the `UserForm`'s new size. The `ListBox` should be expanded, and the `CommandButton` should be relocated so that it remains in the lower-left corner.

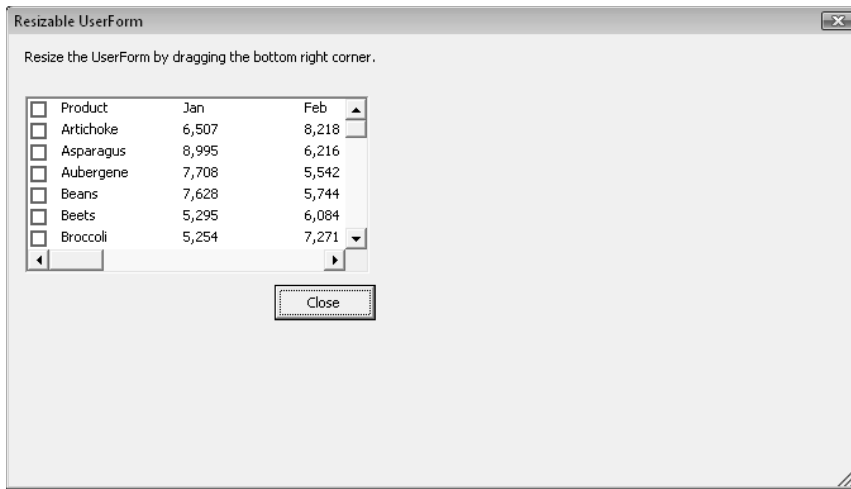


Figure 15-20: VBA code converts `Label` control movements into new `Width` and `Height` properties for the UserForm.

More VBA code is needed to adjust the controls in the UserForm when the UserForm size is changed. The location for this new code is in the `objResizer_MouseMove` event-handler procedure. The statements that follow do the job:

```
' Adjust the ListBox
On Error Resume Next
With ListBox1
    .Width = Me.Width - 22
    .Height = Me.Height - 100
End With
On Error GoTo 0
' Adjust the Close Button
With CloseButton
    .Left = Me.Width - 70
    .Top = Me.Height - 54
End With
```

These two controls are adjusted relative to the UserForm's size (that is, `Me`). After adding this new code, the dialog box works like a charm. The user can make it as large as needed, and the controls adjust.

It should be clear that the most challenging part of creating a resizable dialog box is figuring out how to adjust the controls. When you have more than two or three controls, things can get very complicated.

Handling Multiple UserForm Controls with One Event Handler

Every `CommandButton` on a `UserForm` must have its own procedure to handle its events. For example, if you have two `CommandButtons`, you'll need two event-handler procedures for the controls' click events:

```
Private Sub CommandButton1_Click()  
    ' Code goes here  
End Sub  
  
Private Sub CommandButton2_Click()  
    ' Code goes here  
End Sub
```

In other words, you can't assign a macro to execute when *any* `CommandButton` is clicked. Each `Click` event handler is hard-wired to its `CommandButton`. You can, however, have each event handler call another all-inclusive macro in the event-handler procedures, but you'll need to pass an argument to indicate which button was clicked. In the following examples, clicking either `CommandButton1` or `CommandButton2` executes the `ButtonClick` procedure, and the single argument tells the `ButtonClick` procedure which button was clicked:

```
Private Sub CommandButton1_Click()  
    Call ButtonClick(1)  
End Sub  
  
Private Sub CommandButton2_Click()  
    Call ButtonClick(2)  
End Sub
```

If your `UserForm` has many `CommandButtons`, setting up all these event handlers can get tedious. You might prefer to have a single procedure that can determine which button was clicked and take the appropriate action.

This section describes a way around this limitation by using a class module to define a new class.



On the CD

This example, named `multiple buttons.xlsm`, is available on the companion CD-ROM.

The following steps describe how to re-create the example `UserForm` shown in Figure 15-21:

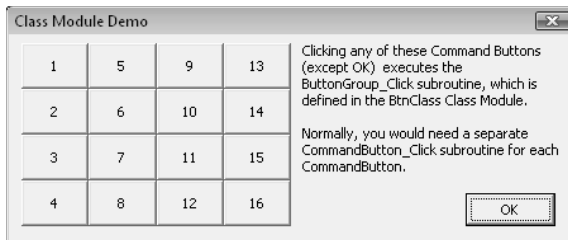


Figure 15-21: Many CommandButtons with a single event-handler procedure.

1. Create your UserForm as usual and add several CommandButtons.
(The example on the CD contains 16 CommandButton controls.) This example assumes that the form is named UserForm1.
2. Insert a class module into your project (choose Insert→Class Module), give it the name BtnClass, and enter the following code.

You will need to customize the ButtonGroup_Click procedure.

```
Public WithEvents ButtonGroup As MsForms.CommandButton

Private Sub ButtonGroup_Click()
    Dim Msg As String
    Msg = "You clicked " & ButtonGroup.Name & vbCrLf & vbCrLf
    Msg = Msg & "Caption: " & ButtonGroup.Caption & vbCrLf
    Msg = Msg & "Left Position: " & ButtonGroup.Left & vbCrLf
    Msg = Msg & "Top Position: " & ButtonGroup.Top
    MsgBox Msg, vbInformation, ButtonGroup.Name
End Sub
```



Tip

You can adapt this technique to work with other types of controls. You need to change the type name in the Public WithEvents declaration. For example, if you have OptionButtons instead of CommandButtons, use a declaration statement like this:

```
Public WithEvents ButtonGroup As MsForms.OptionButton
```

3. Insert a normal VBA module and enter the following code.
This routine simply displays the UserForm.

```
Sub ShowDialog()
    UserForm1.Show
End Sub
```

4. In the code module for the UserForm, enter the UserForm_Initialize code that follows.

This procedure is kicked off by the UserForm's `Initialize` event. Notice that the code excludes a button named `OKButton` from the button group. Therefore, clicking the OK button doesn't execute the `ButtonGroup_Click` procedure.

```
Dim Buttons() As New BtnClass

Private Sub UserForm_Initialize()
    Dim ButtonCount As Integer
    Dim ctl As Control
    ' Create the Button objects
    ButtonCount = 0
    For Each ctl In UserForm1.Controls
        If TypeName(ctl) = "CommandButton" Then
            'Skip the OKButton
            If ctl.Name <> "OKButton" Then
                ButtonCount = ButtonCount + 1
                ReDim Preserve Buttons(1 To ButtonCount)
                Set Buttons(ButtonCount).ButtonGroup = ctl
            End If
        End If
    Next ctl
End Sub
```

After performing these steps, you can execute the `ShowDialog` procedure to display the UserForm. Clicking any of the CommandButtons (except the OK button) executes the `ButtonGroup_Click` procedure. Figure 15-22 shows an example of the message displayed when a button is clicked.

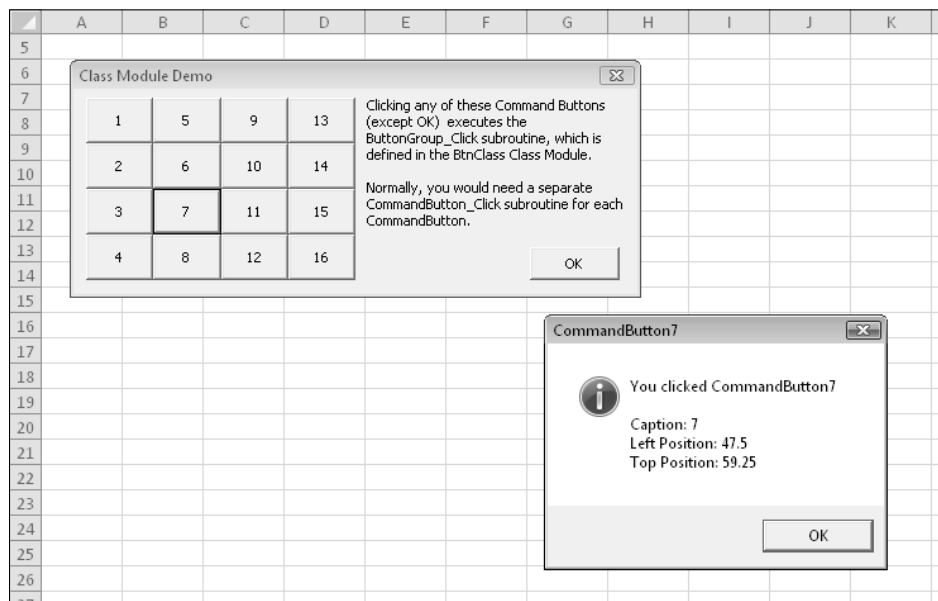


Figure 15-22: The `ButtonGroup_Click` procedure describes the button that was clicked.

Selecting a Color in a UserForm

The example in this section is a function that displays a dialog box (similar in concept to the `MyMsgBox` function, presented earlier). The function, named `GetAColor`, returns a color value:

```
Public ColorValue As Variant

Function GetAColor() As Variant
    UserForm1.Show
    GetAColor = ColorValue
End Function
```

You can use the `GetAColor` function with a statement like the following:

```
UserColor = GetAColor()
```

Executing this statement displays the UserForm. The user selects a color and clicks OK. The function then assigns the user's selected color value to the `UserColor` variable.

The UserForm, shown in Figure 15-23, contains three `ScrollBar` controls — one for each of the color components (red, green, and blue). The value range for each `ScrollBar` is from 0 to 255. The module contains procedures for the `ScrollBar` `Change` events. For example, here's the procedure that's executed when the first `ScrollBar` is changed:

```
Private Sub ScrollBarRed_Change()
    LabelRed.BackColor = RGB(ScrollBarRed.Value, 0, 0)
    Call UpdateColor
End Sub
```

The `UpdateColor` procedure adjusts the color sample displayed, and also updates the RGB values.

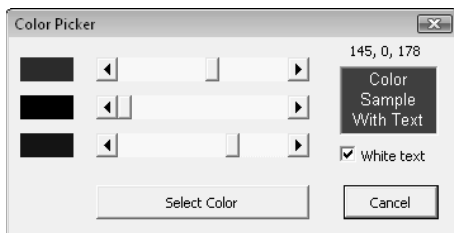


Figure 15-23: This dialog box lets the user select a color by specifying the red, green, and blue components.



On the CD

This example, named `getacolor function.xlsm`, is available on the companion CD-ROM.

The `GetAColor` UserForm has another twist: It remembers the last color that was selected. When the function ends, the three `ScrollBar` values are stored in the Windows Registry, using this code (`APPNAME` is a string defined in `Module1`):

```
SaveSetting APPNAME, "Colors", "RedValue", ScrollBarRed.Value
SaveSetting APPNAME, "Colors", "BlueValue", ScrollBarBlue.Value
SaveSetting APPNAME, "Colors", "GreenValue", ScrollBarGreen.Value
```

The `UserForm_Initialize` procedure retrieves these values and assigns them to the scrollbars:

```
ScrollBarRed.Value = GetSetting(APPNAME, "Colors", "RedValue", 128)
ScrollBarGreen.Value = GetSetting(APPNAME, "Colors", "GreenValue", 128)
ScrollBarBlue.Value = GetSetting(APPNAME, "Colors", "BlueValue", 128)
```

The last argument for the `GetSetting` function is the default value, which is used if the Registry key is not found. In this case, each color defaults to 128, which produces middle gray.

The `SaveSetting` and `GetSetting` functions always use this Registry key:

```
HKEY_CURRENT_USER\Software\VB and VBA Program Settings\
```

Figure 15-24 shows the Registry data, displayed with the Windows `Regedit.exe` program.



Cross-Ref

To learn more about how Excel uses colors, refer to Chapter 30.

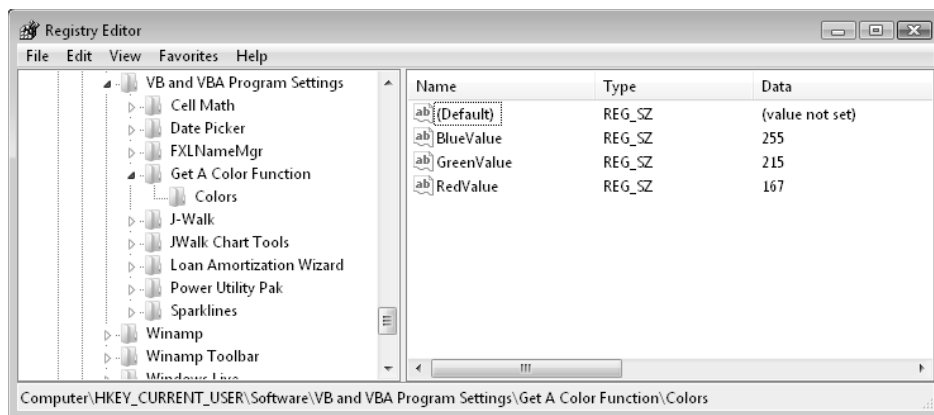


Figure 15-24: The user's `ScrollBar` values are stored in the Windows Registry and retrieved the next time the `GetAColor` function is used.

Displaying a Chart in a UserForm

Oddly, Excel provides no direct way to display a chart in a UserForm. You can, of course, copy the chart and paste it to the `Picture` property of an `Image` control, but this creates a static image of the chart, so it won't display any changes that are made to the chart.

This section describes a technique to display a chart in a UserForm. Figure 15-25 shows a UserForm with a chart displayed in an `Image` object. The chart actually resides on a worksheet, and the UserForm always displays the current chart. This technique works by copying the chart to a temporary graphics file and then using the `LoadPicture` function to specify that file for the `Image` control's `Picture` property.



On the CD

This workbook is available on the companion CD-ROM. The filename is `chart` in `userform.xlsm`.

To display a chart in a UserForm, follow these general steps:

1. Create your chart or charts as usual.
2. Insert a UserForm and then add an `Image` control.
3. Write VBA code to save the chart as a GIF file and then set the `Image` control's `Picture` property to the GIF file.

You need to use VBA's `LoadPicture` function to do this.

4. Add other bells and whistles as desired.

For example, the UserForm in the demo file contains controls that let you change the chart type. Alternatively, you could write code to display multiple charts.

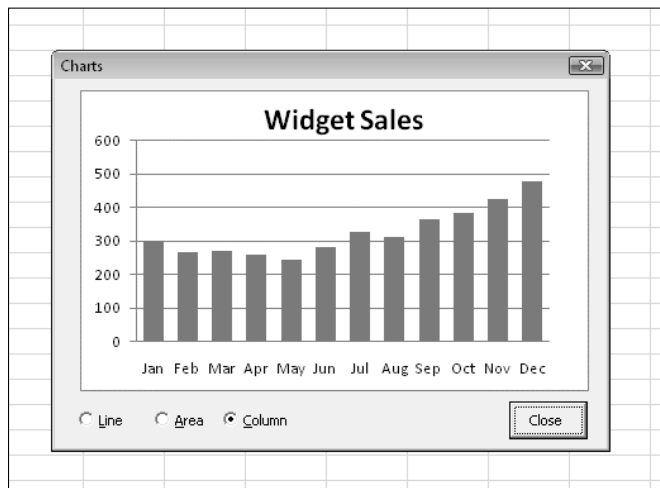


Figure 15-25: With a bit of trickery, a UserForm can display “live” charts.

Saving a chart as a GIF file

The following code demonstrates how to create a GIF file (named `temp.gif`) from a chart (in this case, the first chart object on the sheet named `Data`):

```
Set CurrentChart = Sheets("Data").ChartObjects(1).Chart
Fname = ThisWorkbook.Path & "\temp.gif"
CurrentChart.Export FileName:=Fname, FilterName:="GIF"
```

Changing the Image control Picture property

If the Image control on the UserForm is named `Image1`, the following statement loads the image (represented by the `Fname` variable) into the Image control:

```
Image1.Picture = LoadPicture(Fname)
```



Note

This technique works fine, but you may notice a slight delay when the chart is saved and then retrieved. On a fast system, however, this delay is not noticeable.

Making a UserForm Semitransparent

Normally, a UserForm is opaque — it completely hides whatever is underneath it. However, you can make a UserForm semitransparent, such that the user can see the worksheet under the UserForm.

Creating a semitransparent UserForm requires a number of Windows API functions. You can set the transparency level using values that range from 0 (UserForm is invisible) to 255 (UserForm is completely opaque, as usual). Values in between 0 and 255 specify a level of semitransparency.

Figure 15-26 shows an example of a UserForm with a transparency level of 128.



On the CD

This workbook is available on the companion CD-ROM. The filename is `semi-transparent userform.xlsm`.

What good is a semitransparent UserForm? After giving this question some thought, I came up with a potential use for this technique: creating a *light-box effect*. You've probably seen Web sites that use the light-box effect. The Web page is dimmed (as if the lights are lowered), and an image or pop-up is displayed. This effect serves to focus the user's attention to a specific item on the screen.

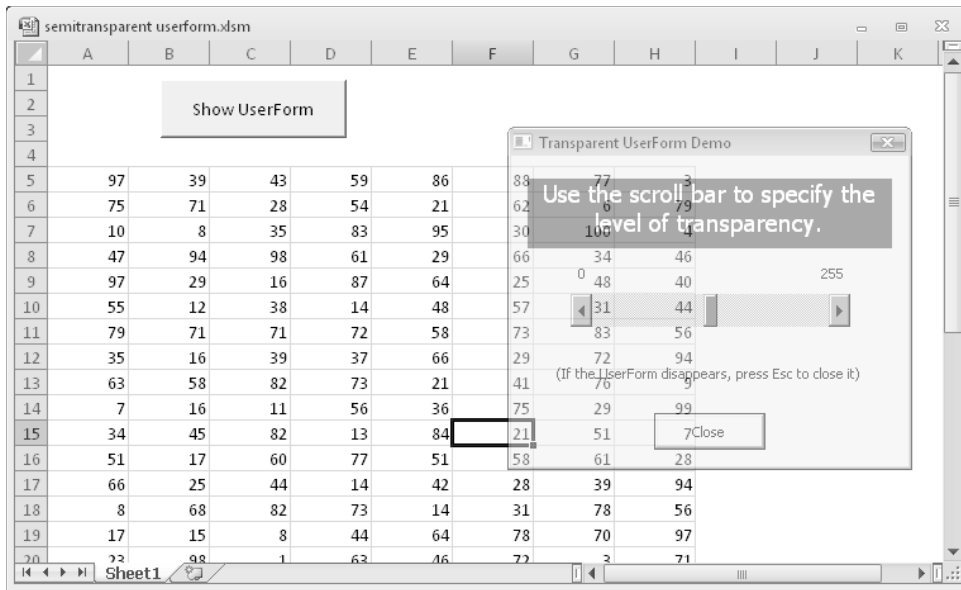


Figure 15-26: A semitransparent UserForm.

Figure 15-27 shows an Excel workbook that uses the light-box effect. Excel's window is dimmed, but the message box displays normally. How does it work? I created a UserForm with a black background. Then I wrote code to resize and position the UserForm so that it completely covers Excel's window. Here's the code to accomplish the coverup:

```
With Me
    .Height = Application.Height
    .Width = Application.Width
    .Left = Application.Left
    .Top = Application.Top
End With
```

Then, the UserForm was made semitransparent, which gives Excel's window a dimmed appearance. The message box (or another UserForm) is displayed on top of the semitransparent UserForm.



On the CD

This workbook is available on the companion CD-ROM. The filename is `excel light-box.xlsm`.

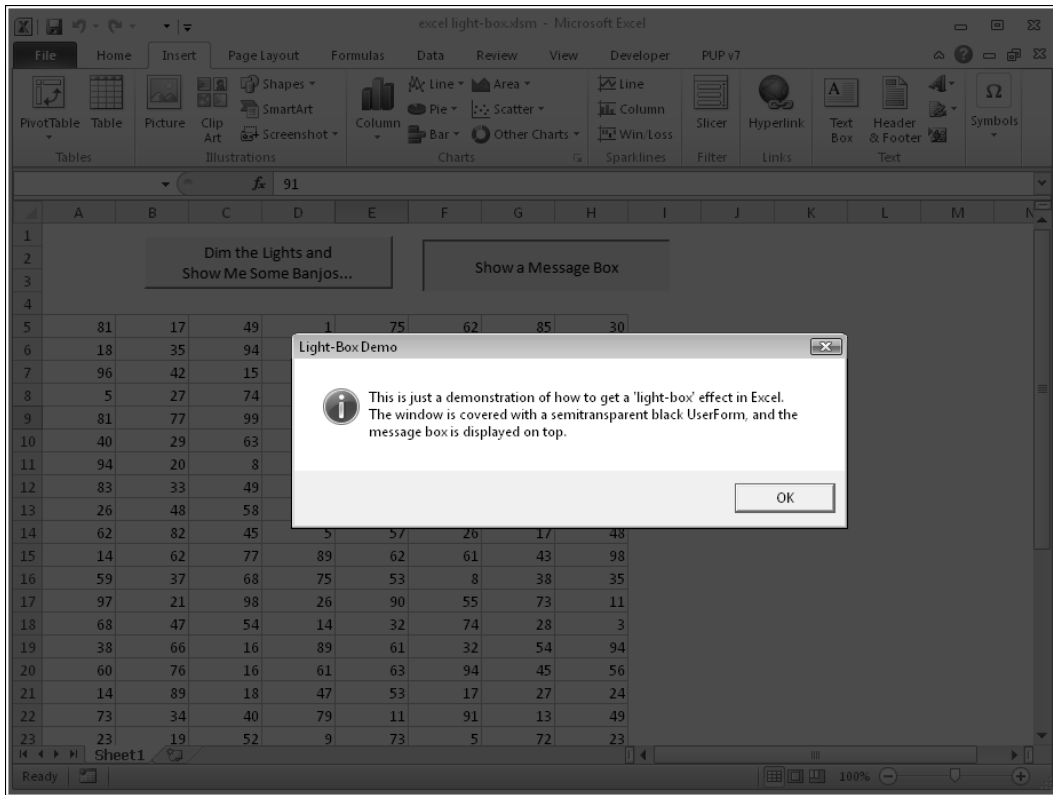


Figure 15-27: Creating a light-box effect in Excel.

An Enhanced Data Form

The example in this section is probably one of the more complex UserForms that you'll encounter. I designed it as a replacement for Excel's built-in Data Form, which is shown in Figure 15-28.



Note

Displaying Excel's Data Form is not easy in Excel 2010. This command isn't part of Excel's user interface, so you need to add the command to the Ribbon or to the Quick Access toolbar. To add it to the Quick Access toolbar, right-click the Quick Access toolbar and choose **Customize Quick Access Toolbar**. Then, in the Excel Options dialog box, add the **Form** command from the **Commands Not in the Ribbon** group. Then, the **Form** command will appear on your Quick Access toolbar.

Like Excel's Data Form, my Enhanced Data Form works with a list in a worksheet. But as you can see in Figure 15-29, it has a dramatically different appearance and offers several advantages.

	A	B	C	D	E	F	G	H	I	J	K
1	Agent	Date Listed	Area	List Price	Bedrooms	Baths	SqFt	Type	Pool	Sold	SqFt Price
2	Adams	10/8/2009	Central	\$199,000	3	2.5	1,510	Condo	FALSE	FALSE	\$132
3	Adams	5/23/2009	N. County	\$349,000	4	2.5	2,730	Condo	TRUE	TRUE	\$128
4	Adams	8/7/2009	N. County	\$379,000	3	3	2,354	Condo	FALSE	TRUE	\$161
5	Adams	6/5/2009	N. County	\$379,900	3	2.5	2,468	Condo	FALSE	FALSE	\$154
6	Barnes	9/26/2009			3	2,041	Condo	FALSE	FALSE	\$118	
7	Barnes	3/13/2009			3	2,495	Condo	FALSE	FALSE	\$106	
8	Barnes	3/6/2009			2	2,050	Condo	FALSE	FALSE	\$146	
9	Barnes	8/9/2009			3	2,388	Condo	TRUE	TRUE	\$144	
10	Barnes	3/21/2009			2.5	1,991	Condo	FALSE	TRUE	\$176	
11	Barnes	6/25/2009			2.5	2,647	Condo	TRUE	FALSE	\$134	
12	Bennet	5/26/2009			3	2,041	Condo	FALSE	FALSE	\$113	
13	Bennet	4/20/2009			3	2,266	Condo	FALSE	FALSE	\$101	
14	Chung	8/2/2009			2.5	2,284	Condo	FALSE	FALSE	\$100	
15	Chung	9/29/2009			3	2,723	Condo	FALSE	FALSE	\$87	
16	Chung	10/17/2009			2.5	2,488	Condo	FALSE	FALSE	\$106	
17	Daily	10/2/2009			2.5	2,517	Condo	FALSE	FALSE	\$135	
18	Jenkins	4/10/2009			2	1,690	Condo	TRUE	FALSE	\$189	
19	Jenkins	4/21/2009			2.5	1,590	Condo	FALSE	TRUE	\$150	
20	Jenkins	5/25/2009			2.5	1,730	Condo	FALSE	TRUE	\$144	
21	Kelly	9/11/2009			1	1,101	Condo	FALSE	FALSE	\$227	
22	Lang	2/25/2009	Central	\$259,900	2	2	1,248	Condo	FALSE	FALSE	\$192
23	Lang	8/22/2009	N. County	\$264,900	3	2.5	2,062	Condo	FALSE	FALSE	\$128
24	Lang	5/2/2009	N. County	\$369,900	3	2.5	2,030	Condo	TRUE	FALSE	\$182
25	Lang	4/18/2009	S. County	\$325,000	4	3	2,800	Condo	TRUE	TRUE	\$116
26	Peterson	6/17/2009	N. County	\$235,990	4	2	1,656	Condo	TRUE	FALSE	\$143
27	Peterson	4/14/2009	N. County	\$259,900	4	3	1,734	Condo	FALSE	TRUE	\$150
28	Peterson	4/6/2009	N. County	\$309,900	5	3	2,447	Condo	TRUE	FALSE	\$127
29	Peterson	4/20/2009	S. County	\$227,500	4	3	1,905	Condo	FALSE	TRUE	\$119
30	Peterson	4/24/2009	S. County	\$240,000	3	2.5	1,595	Condo	FALSE	TRUE	\$150

Figure 15-28: Excel's Data Form.

	A	B	C	D	E	F	G	H	I	J	K
1	Agent	Date Listed	Area	List Price	Bedrooms	Baths	SqFt	Type	Pool	Sold	SqFt Price
2	Adams	10/8/2009	Central	\$199,000	3	2.5	1,510	Condo	FALSE	FALSE	\$132
3	Adams	5/23/2009	N. County	\$349,000	4	2.5	2,730	Condo	TRUE	TRUE	\$128
4	Adams	8/7/2009						Condo	FALSE	TRUE	\$161
5	Adams	6/5/2009						Condo	FALSE	FALSE	\$154
6	Barnes	9/26/2009						Condo	FALSE	FALSE	\$118
7	Barnes	3/13/2009						Condo	FALSE	FALSE	\$106
8	Barnes	3/6/2009						Condo	FALSE	FALSE	\$146
9	Barnes	8/9/2009						Condo	TRUE	TRUE	\$144
10	Barnes	3/21/2009						Condo	FALSE	TRUE	\$176
11	Barnes	6/25/2009						Condo	TRUE	FALSE	\$134
12	Bennet	5/26/2009						Condo	FALSE	FALSE	\$113
13	Bennet	4/20/2009						Condo	FALSE	FALSE	\$101
14	Chung	8/2/2009						Condo	FALSE	FALSE	\$100
15	Chung	9/29/2009						Condo	FALSE	FALSE	\$87
16	Chung	10/17/2009						Condo	FALSE	FALSE	\$106
17	Daily	10/2/2009						Condo	FALSE	FALSE	\$135
18	Jenkins	4/10/2009						Condo	TRUE	FALSE	\$189
19	Jenkins	4/21/2009						Condo	FALSE	TRUE	\$150
20	Jenkins	5/25/2009						Condo	FALSE	TRUE	\$144
21	Kelly	9/11/2009						Condo	FALSE	FALSE	\$227
22	Lang	2/25/2009	Central	\$259,900	2	2	1,248	Condo	FALSE	FALSE	\$192
23	Lang	8/22/2009	N. County	\$264,900	3	2.5	2,062	Condo	FALSE	FALSE	\$128
24	Lang	5/2/2009	N. County	\$369,900	3	2.5	2,030	Condo	TRUE	FALSE	\$182
25	Lang	4/18/2009	S. County	\$325,000	4	3	2,800	Condo	TRUE	TRUE	\$116
26	Peterson	6/17/2009	N. County	\$235,990	4	2	1,656	Condo	TRUE	FALSE	\$143
27	Peterson	4/14/2009	N. County	\$259,900	4	3	1,734	Condo	FALSE	TRUE	\$150
28	Peterson	4/6/2009	N. County	\$309,900	5	3	2,447	Condo	TRUE	FALSE	\$127
29	Peterson	4/20/2009	S. County	\$227,500	4	3	1,905	Condo	FALSE	TRUE	\$119
30	Peterson	4/24/2009	S. County	\$240,000	3	2.5	1,595	Condo	FALSE	TRUE	\$150

Figure 15-29: My Enhanced Data Form.

About the Enhanced Data Form

The Enhanced Data Form features the enhancements listed in Table 15-1.

Table 15-1: Comparing the Enhanced Data Form with the Excel Data Form

Enhanced Data Form	Excel Data Form
Handles any number of records and fields.	Limited to 32 fields.
Dialog box can be displayed in any size that you like, and can be resized by the user.	Dialog box adjusts its size based on the number of fields. In fact, it can take up the entire screen!
Fields can consist of either InputBox or ComboBox controls.	Uses only InputBoxes.
Can modify the width of the descriptive column headers.	Can't change column header fields.
Can easily change the language used in the dialog box (VBA password required).	Can't change language.
Record displayed in the dialog box is always visible on-screen and is highlighted so that you know exactly where you are.	Doesn't scroll the screen for you and doesn't highlight the current record.
At start-up, the dialog box always displays the record at the active cell.	Always starts with the first record in the database.
When you close the dialog box, the current record is selected for you.	Doesn't change your selection when you exit.
Lets you insert a new record at any position in the database.	Adds new records only at the end of the database.
Includes an Undo button for Data Entry, Insert Record, Delete Record, and New Record.	Includes only a Restore button.
Search criteria are stored in a separate panel, so you always know exactly what you're searching for.	The search criteria aren't always apparent.
Supports approximate matches while searching (*, ?, and #).	Excel's Data Form doesn't support wildcard characters.
The complete VBA source code is available, so you can customize it to your needs.	Data Form isn't written in VBA and can't be customized.



On the CD

The Enhanced Data Form is a commercial product (sort of). Versions for Excel 97 and later are available on the companion CD-ROM. These files may be distributed freely.

If you'd like to customize the code or UserForm, access to the complete VBA source is available for a modest fee. You can find out the details at <http://spreadsheetpage.com>.

com.

Installing the Enhanced Data Form add-in

To try out the Enhanced Data Form, install the add-in:

1. Copy the `dataform3.xlam` file from the CD-ROM to a directory on your hard drive.
2. In Excel, press Alt+TI to display the Add-Ins dialog box.
3. In the Add-Ins dialog box, click Browse and locate the `dataform3.xlam` file in the directory from Step 1.

After performing these steps, you can access the Enhanced Data Form by using Data→DataForm→J-Walk Enhanced DataForm. You can use the Enhanced Data Form to work with any worksheet list or table.

A Puzzle on a UserForm

The example in this section is a familiar sliding puzzle, displayed on a UserForm (see Figure 15-30). This puzzle was invented by Noyes Chapman in the late 1800s. In addition to providing a few minutes of amusement, you may find the coding instructive.

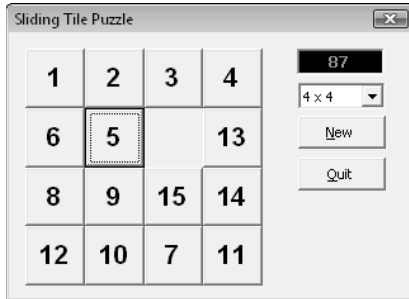


Figure 15-30: A sliding tile puzzle in a UserForm.

The goal is to arrange the shuffled tiles (CommandButton controls) in numerical order. Click a button next to the empty space, and the button moves to the empty space. The ComboBox control lets the user choose from three configurations: 3 x 3, 4 x 4, and 5 x 5. The New button shuffles the tiles, and a Label control keeps track of the number of moves.

This application uses a class module to handle all the button events (see “Handling Multiple UserForm Controls with One Event Handler,” earlier in this chapter).

The VBA code is rather lengthy, so it's not listed here. Here are a few points to keep in mind when examining the code:

- The `CommandButton` controls are added to the UserForm via code. The number and size of the buttons are determined by the `ComboBox` value.
- The tiles are shuffled by simulating a few thousand random clicks on the buttons. Another option is to simply assign random numbers, but that could result in some unsolvable games.
- The blank space is actually a `CommandButton` with its `Visible` property set to `False`.
- The class module contains one event procedure (`MouseDown`), which is executed whenever the user clicks a tile.
- When the user clicks a `CommandButton` tile, its `Caption` is swapped with the hidden button. The code doesn't actually move any buttons.



On the CD

This workbook, named `sliding tile puzzle.xlsm`, is available on the companion CD-ROM.

Video Poker on a UserForm

And finally, proof that Excel doesn't have to be boring. Figure 15-31 shows a UserForm set up as a casino-style video poker game. The game features

- A choice between two games: Joker's Wild and Jacks Or Better
- A chart that shows your winning (or losing) history
- The ability to change the payoffs
- Help (displayed on a worksheet)
- An emergency button that quickly hides the UserForm

All that's missing is the casino noise.



On the CD

This workbook, named `video poker.xlsm`, is available on the companion CD-ROM.



Figure 15-31: A feature-packed video poker game.

As you might expect, the code is much too lengthy to list here, but if you examine the workbook, you'll find lots of useful UserForm tips — including a class module example.

PART

V

Advanced Programming Techniques

CHAPTER 16

Developing Excel Utilities with VBA

CHAPTER 17

Working with Pivot Tables

CHAPTER 18

Working with Charts

CHAPTER 19

Understanding Excel's Events

CHAPTER 20

Interacting with Other Applications

CHAPTER 21

Creating and Using Add-Ins

Developing Excel Utilities with VBA

In This Chapter

- Exploring Excel utilities and utilities in general
- Developing utilities with VBA
- Creating good utilities
- Manipulating text in cells
- Finding additional Excel utilities

About Excel Utilities

A *utility*, in general, is something that enhances software, adding useful features or making existing features more accessible. A utility isn't an end product, such as a quarterly report. Rather, it's a tool that helps you produce an end product. An Excel utility is (almost always) an add-in that enhances Excel with new features or capabilities.

Excel is a great product, but many users soon develop a wish list of features that they'd like to see added to the software. For example, users who work with dates may want a pop-up calendar feature to facilitate entering dates into cells. And some users desire an easier way to export a range of data to a separate file or to save a chart as a graphics file. These are all examples of features that aren't currently available in Excel. You can, however, add these features by creating a utility.

Utilities don't need to be complicated. Some of the most useful ones are actually very simple. For example, have you noticed that Excel 2010 doesn't have a Ribbon command to toggle the page break display in a worksheet? If you don't like to see those dotted lines in your worksheet, it requires a trip to the Excel Options dialog box to turn them off. Even worse, you can't add that command to the Ribbon or Quick Access toolbar.

Here's an extremely simple VBA macro that toggles the page break display:

```
Sub TogglePageBreaks()  
    With ActiveSheet  
        .DisplayPageBreaks = Not .DisplayPageBreaks  
    End With  
End Sub
```

You can store this macro in your Personal Macro Workbook so that it's always available. Or you may prefer to package your favorite utilities in an add-in. For quicker access, you can assign your utility macros to a shortcut key or a right-click shortcut menu or modify your Quick Access toolbar or the Ribbon.

As you'll see, creating utilities for Excel is an excellent way to make a great product even better.

Using VBA to Develop Utilities

Excel 5, released in 1992, was the first version of Excel to include VBA. When I received the beta version of Excel 5, I was very impressed by VBA's potential. VBA was light-years ahead of Excel's powerful (but cryptic) XLM macro language, and I decided that I wanted to explore this new language and see what it was capable of.

In an effort to learn VBA, I wrote a collection of Excel utilities by using only VBA. I figured that I would learn the language more quickly if I gave myself a tangible goal. The result was a product that I call the *Power Utility Pak for Excel*, which is available to you at a discounted price as a benefit of buying this book. (Use the coupon in the back of the book to order your copy.)

I learned several things from my initial efforts on this project:

- VBA can be difficult to grasp at first, but it becomes much easier with practice.
- Experimentation is the key to mastering VBA. Every project that I undertake usually involves dozens of small coding experiments that eventually lead to a finished product.
- VBA enables you to extend Excel in a way that is consistent with Excel's look and feel, including custom worksheet functions and dialog boxes. And, if you're willing to step outside of VBA, you can write XML code to customize the Ribbon automatically when your application is opened.
- Excel can do almost anything. When you reach a dead end, chances are that another path leads to a solution. It helps if you're creative and know where to look for help.

Few other software packages include such an extensive set of tools that enable the end user to extend the software.

What Makes a Good Utility?

An Excel utility, of course, should ultimately make your job easier or more efficient. But if you're developing utilities for other users, what makes an Excel utility valuable? I've put together a list of elements that are common to good utilities:

- **It adds something to Excel.** This addition could be a new feature, a way to combine existing features, or just a way to make an existing feature easier to use.
- **It's general in nature.** Ideally, a utility should be useful under a wide variety of conditions. Of course, writing a general-purpose utility is more difficult than it is to write one that works in a highly defined environment.
- **It's flexible.** The best utilities provide many options to handle various situations.
- **It looks, works, and feels like an Excel command.** Although adding your own special touch to utilities is tempting, other users will find them easier to use if they look and act like familiar Excel commands and dialog boxes.
- **It provides help for the user when needed.** In other words, the utility requires documentation that's thorough and accessible.
- **It traps errors.** An end user should never see a VBA error message. Any error messages that appear should be ones that you write.
- **Users can undo its effects.** Users who don't like the result caused by your utility should be able to reverse their path.

Text Tools: The Anatomy of a Utility

In this section, I describe an Excel utility that I developed and use very frequently. It's also part of my Power Utility Pak add-in. The Text Tools utility enables the user to manipulate text in a selected range of cells. Specifically, this utility enables the user to do the following:

- Change the case of the text (uppercase, lowercase, proper case, sentence case, or toggle case).
- Add characters to the text (at the beginning, at the end, or at a specific character position).
- Remove characters from the text (from the beginning, from the end, or from a specific position within the string).
- Remove spaces from the text (either all spaces or excess spaces).
- Delete characters from the text (nonprinting characters, alphabetic characters, non-numeric characters, non-alphabetic characters, or numeric characters).

Figure 16-1 shows the Text Tools Utility dialog box.

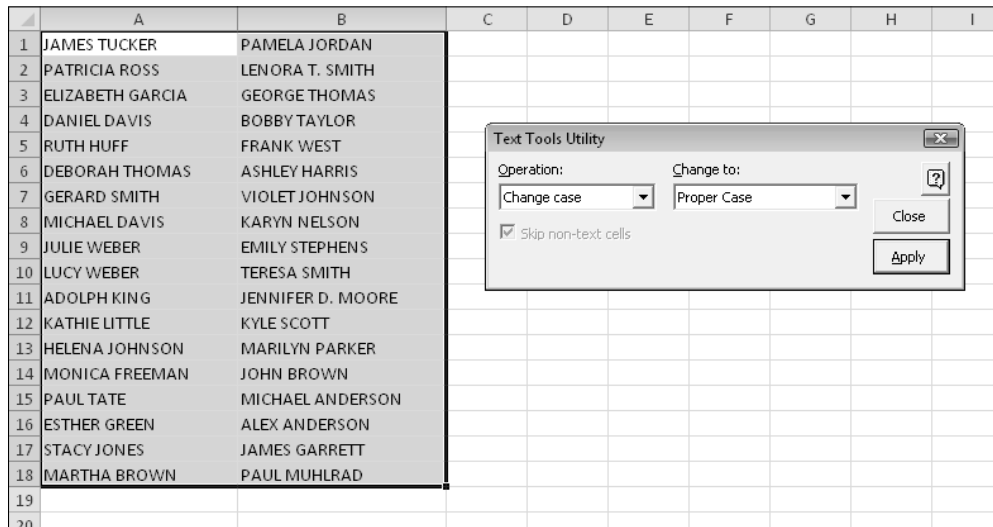


Figure 16-1: Use the Text Tools utility to change the case of selected text.



On the CD

The Text Tools utility is available on the CD-ROM that accompanies this book. It's a stand-alone version of the tool that's included with the Power Utility Pak. The file, named `text tools.xlam`, is a standard Excel add-in. When installed, it adds a new command to the Ribbon: **Home**→**Utilities**→**Text Tools**. The VBA project isn't protected with a password, so you can examine the code to see how it works, or make changes to better suit your needs.

Background for Text Tools

Excel has many worksheet functions that can manipulate text strings in useful ways. For example, you can make the text in a cell uppercase (UPPER), add characters to text (CONCATENATE), remove spaces (TRIM), and so on. But to perform any of these operations, you need to write formulas, copy them, convert the formulas to values, and then paste the values over the original text. In other words, Excel doesn't make modifying text particularly easy. Wouldn't it be nice if Excel had some text manipulation tools that didn't require formulas?

By the way, many good utility ideas come from statements that begin, "Wouldn't it be nice if . . .?"

Project goals for Text Tools

The first step in designing a utility is to envision exactly how you want the utility to work. Here's my original plan, stated in the form of a dozen goals:

- Its main features will be those listed at the beginning of this section.
- It will enable the user to specify that the preceding types of changes work with nontext cells as well as with text cells.
- It will have the same look and feel of other Excel commands. In other words, it will have a dialog box that looks like Excel's dialog boxes.
- It will be in the form of an add-in and will also be accessible from the Ribbon.
- It will operate with the current selection of cells (including multiple selections), and it will enable the user to modify the range selection while the dialog box is displayed.
- It will remember the last operation used and display those settings the next time the dialog box is invoked.
- It will have no effect on cells that contain formulas.
- It will be fast and efficient. For example, if the user selects an entire column, the utility should ignore the empty cells in the column.
- It will use a nonmodal dialog box, so the user can keep the dialog box on-screen and ready to use.
- It will be compact in size so that it doesn't hide too much of the worksheet.
- It will enable the user to undo the changes.
- Comprehensive help will be available.

The Text Tools workbook

The Text Tools utility is an XLAM add-in file. During development, I worked with the file as a macro-enabled XLSM workbook. When I was satisfied that all was working properly, I saved the workbook as an add-in.

The Text Tools workbook consists of the following components:

- **One worksheet:** Every workbook (including add-ins) must have at least one worksheet. I take advantage of this fact and use this worksheet to store information used in the Undo procedure (see "Implementing Undo," later in this chapter).
- **One VBA module:** This module contains public variable and constant declarations, the code to display the UserForm, and the code to handle the undo procedure.
- **One UserForm:** This contains the dialog box. The code that does the actual text manipulation work is stored in the code module for the UserForm.



Installing an add-in

To install an add-in, including the `text tools.xlam` add-in, follow these steps:

1. Choose File→Options.
2. In the Excel Options dialog box, click the Add-Ins tab.
3. In the drop-down list labeled Manage, select Excel Add-Ins and then click Go to display the Add-Ins dialog box.
4. If the add-in that you want to install is listed in the Add-Ins Available list, place a check mark next to the item.

If the add-in isn't listed, click Browse to locate the XLAM or XLA add-in file.

5. Click OK, and the add-in will be installed.

It will remain installed until you deselect it from the list.

In the preceding instructions, you can skip Steps 1 through 3 and press Alt+TI, which is the pre-Excel 2007 keyboard sequence to display the Add-Ins dialog box.



Note

The file also contains some manual modifications that I made in order to get the command to display on the Ribbon. See “Adding the RibbonX code,” later in this chapter. Unfortunately, you can't modify Excel's Ribbon using only VBA.

How the Text Tools utility works

The Text Tools add-in contains some RibbonX code that creates a new item in the Ribbon: Home→Utilities→Text Tools. Selecting this item executes the `StartTextTools` procedure, which calls the `ShowTextToolsDialog` procedure.



Cross-Ref

To find out why this utility requests both the `StartTextTools` procedure and the `ShowTextToolsDialog` procedure, see “Adding the RibbonX code,” later in this chapter.

The user can specify various text modifications and click the Apply button to perform them. The changes are visible in the worksheet, and the dialog box remains displayed. Each operation can be undone, or the user can perform additional text modifications. Clicking the Help button displays a Help window, and clicking the Close button dismisses the dialog box. Note that this is a *modeless* dialog box. In other words, you can keep working in Excel while the dialog box is displayed. In that sense, a modeless dialog box is similar to a toolbar.

The UserForm for the Text Tools utility

When I create a utility, I usually begin by designing the user interface. In this case, it's the dialog box that's displayed to the user. Creating the dialog box forces me to think through the project one more time.

Figure 16-2 shows the UserForm for the Text Tools utility.

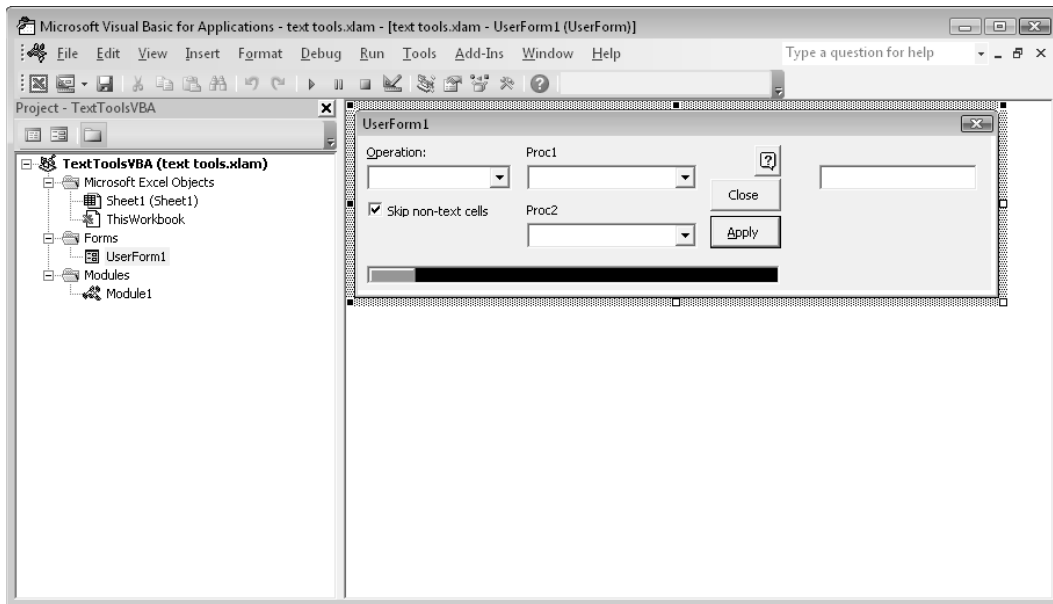


Figure 16-2: The UserForm for the Text Tools utility.

Notice that the controls on this UserForm are laid out differently from how they actually appear to the user. That's because some options use different controls, and the positioning of the controls is handled dynamically in the code. The controls are listed and described next.

- **The Operation ComboBox:** This always appears on the left, and you use it to select the operation to be performed.
- **Proc1 ComboBox:** Most of the text manipulation options use this ComboBox to further specify the operation.
- **Proc2 ComboBox:** Two of the text manipulation options use this ComboBox to specify the operation even further. Specifically, this additional ComboBox is used by Add Text and Remove by Position.
- **Check box:** The Skip Non-Text Cells check box is an option relevant to some of the operations.
- **Help button:** Clicking this CommandButton displays help.
- **Close button:** Clicking this CommandButton unloads the UserForm.
- **Apply button:** Clicking this CommandButton applies the selected text manipulation option.
- **Progress bar:** This consists of a `Label` control inside a `Frame` control.
- **Text box:** This text box is used for the Add Text option.

Figure 16-3 shows how the UserForm looks for each of the five operations. Notice that the configuration of the controls varies, depending on which option is selected.

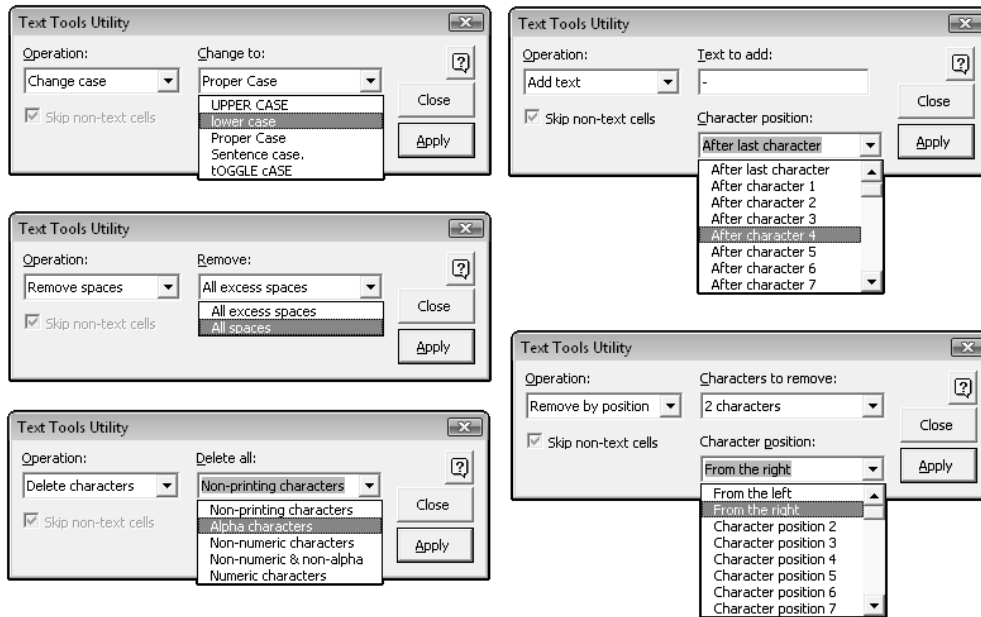


Figure 16-3: The UserForm layout changes for each operation.

The Module1 VBA module

The `Module1` VBA module contains the declarations, a simple procedure that starts the utility, and a procedure that handles the undo operation.

Declarations in the Module1 VBA module

Following are the declarations at the top of the `Module1` module:

```
Public Const APPNAME As String = "Text Tools Utility"
Public Const PROGRESSTHRESHOLD = 2000
Public UserChoices(1 To 8) As Variant 'stores user's last choices
Public UndoRange As Range ' For undoing
Public UserSelection As Range 'For undoing
```

I declare a `Public` constant containing a string that stores the name of the application. This string is used in the UserForm caption and in various message boxes.

The `PROGRESSTHRESHOLD` constant specifies the number of cells that will display the progress indicator. When this constant is 2,000, the progress indicator will be shown only if the utility is working on 2,000 or more cells.

The `UserChoices` array holds the value of each control. This information is stored in the Windows Registry when the user closes the dialog box and is retrieved when the utility is executed again. I added this convenience feature because I found that many users tend to perform the same operation every time they use the utility.

Two other `Range` object variables are used to store information used for undoing.

The ShowTextToolsDialog procedure in the Module1 VBA module

The `ShowTextToolsDialog` procedure follows:

```
Sub ShowTextToolsDialog()  
    Dim InvalidContext As Boolean  
    If Val(Application.Version) < 12 Then  
        MsgBox "This utility requires Excel 2007 or later.", vbCritical  
        Exit Sub  
    End If  
    If ActiveSheet Is Nothing Then InvalidContext = True  
    If TypeName(ActiveSheet) <> "Worksheet" Then InvalidContext = True  
    If InvalidContext Then  
        MsgBox "Select some cells in a range.", vbCritical, APPNAME  
    Else  
        UserForm1.Show vbModeless  
    End If  
End Sub
```

The procedure starts by checking the version of Excel. If the version is prior to Excel 2007, the user is informed that the utility requires Excel 2007 or later.



Note

You can certainly design this utility so that it also works with previous versions. For simplicity, I made this utility an application for Excel 2007 or later.

If the user is running the appropriate version, the `ShowTextToolsDialog` procedure checks to make sure that a sheet is active, and then it makes sure that the sheet is a worksheet. If either one isn't true, the `InvalidContext` variable is set to `True`. The `If-Then-Else` construct checks this variable and displays either a message (see Figure 16-4) or the `UserForm`. Notice that the `Show` method uses the `vbModeless` argument, which makes it a *modeless* `UserForm` (that is, the user can keep working in Excel while it's displayed).

Notice that the code doesn't ensure that a range is selected. This additional error handling is included in the code that's executed when the `Apply` button is clicked.

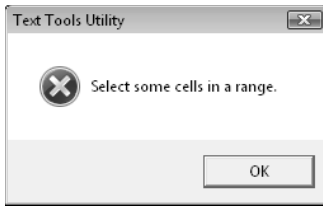


Figure 16-4: This message is displayed if no workbook is active or if the active sheet isn't a worksheet.



Tip

While I was developing this utility, I assigned a keyboard shortcut (Ctrl+Shift+T) to the `ShowTextToolsDialog` procedure for testing purposes. That's because I saved the Ribbon modification task for last, and I needed a way to test the utility. After I added the Ribbon button, I removed the keyboard shortcut.

To assign a keyboard shortcut to a macro, press Alt+F8 to display the Macro dialog box. Type `ShowTextToolsDialog` in the Macro Name box and then click Options. Use the Macro Options dialog box to assign (or unassign) the shortcut key combination.

The `UndoTextTools` procedure in the `Module1` VBA module

The `UndoTextTools` procedure is executed when the user clicks the Undo button (or presses Ctrl+Z). This technique is explained later in this chapter (see “Implementing Undo”).

The `UserForm1` code module

All the real work is done by VBA code contained in the code module for `UserForm1`. Here, I briefly describe each of the procedures in this module. The code is too lengthy to list here, but you can view it by opening the `text tools.xlam` file on the companion CD-ROM.

The `UserForm_Initialize` procedure in the `UserForm1` code module

This procedure is executed before the UserForm is displayed. It sizes the UserForm and retrieves (from the Windows Registry) the previously selected values for the controls. It also adds the list items to the ComboBox (named `ComboBoxOperation`) that determines which operation will be performed. These items are

- Change case
- Add text
- Remove by position
- Remove spaces
- Delete characters

The `ComboBoxOperation_Change` procedure in the `UserForm1` code module

This procedure is executed whenever the user selects an item in the `ComboBoxOperation`. It does the work of displaying or hiding the other controls. For example, if the user selects the Change Case option, the code unhides the second `ComboBox` control (named `ComboProc1`) and fills it with the following choices:

- UPPER CASE
- lower case
- Proper Case
- Sentence case
- tOGGLE cASE

The `ApplyButton_Click` procedure in the `UserForm1` code module

This procedure is executed when the Apply button is clicked. It does some error checking to ensure that a range is selected and then calls the `CreateWorkRange` function to make sure that empty cells aren't included in the cells to be processed. See the upcoming section, "Making the Text Tools utility efficient."

The `ApplyButton_Click` procedure also calls the `SaveForUndo` procedure, which saves the current data in case the user needs to undo the operation. See "Implementing Undo," later in this chapter.

The procedure then uses a `Select Case` construct to call the appropriate procedure to perform the operation. It calls one of the following `Sub` procedures:

- `ChangeCase`
- `AddText`
- `RemoveText`
- `RemoveSpaces`
- `RemoveCharacters`

Some of these procedures make calls to function procedures. For example, the `ChangeCase` procedure might call the `ToggleCase` or `SentenceCase` procedure.

The `CloseButton_Click` procedure in the `UserForm1` code module

This procedure is executed when the Close button is clicked. It saves the current control settings to the Windows Registry and then unloads the `UserForm`.

The HelpButton_Click procedure in the UserForm1 code module

This procedure is executed when the Help button is clicked. It simply displays the Help file (which is a standard compiled HTML help file).

Making the Text Tools utility efficient

The procedures in the Text Tools utility work by looping through a range of cells. It makes no sense to loop through cells that will not be changed — for example, empty cells and cells that contain a formula. Therefore, I added code to improve the efficiency of the cell processing.

The ApplyButton_Click procedure calls a Function procedure named CreateWorkRange. This function creates and returns a Range object that consists of all non-empty and nonformula cells in the user's selected range. For example, assume that column A contains text in the range A1:A12. If the user selects the entire column, the CreateWorkRange function would convert that complete column range into a subset that consists of only the non-empty cells (that is, the range A:A would be converted to A1:A12). This conversion makes the code much more efficient because empty cells and formulas need not be included in the loop.

The CreateWorkRange function accepts two arguments:

- Rng: A Range object that represents the range selected by the user.
- TextOnly: A Boolean value. If True, the function returns only text cells. Otherwise, it returns all non-empty cells.

```
Private Function CreateWorkRange(Rng, TextOnly)
'   Creates and returns a Range object
Set CreateWorkRange = Nothing
'   Single cell, has a formula
If Rng.Count = 1 And Rng.HasFormula Then
    Set CreateWorkRange = Nothing
    Exit Function
End If
'   Single cell, or single merged cell
If Rng.Count = 1 Or Rng.MergeCells = True Then
    If TextOnly Then
        If Not IsNumeric(Rng(1).Value) Then
            Set CreateWorkRange = Rng
            Exit Function
        Else
            Set CreateWorkRange = Nothing
            Exit Function
        End If
    Else
        If Not IsEmpty(Rng(1)) Then
            Set CreateWorkRange = Rng
            Exit Function
        End If
    End If
End If
End Function
```



```

        End If
    End If
End If
On Error Resume Next
Set Rng = Intersect(Rng, Rng.Parent.UsedRange)
If TextOnly = True Then
    Set CreateWorkRange = Rng.SpecialCells(xlConstants, xlTextValues)
    If Err <> 0 Then
        Set CreateWorkRange = Nothing
        On Error GoTo 0
        Exit Function
    End If
Else
    Set CreateWorkRange = Rng.SpecialCells _
        (xlConstants, xlTextValues + xlNumbers)
    If Err <> 0 Then
        Set CreateWorkRange = Nothing
        On Error GoTo 0
        Exit Function
    End If
End If
End Function

```



Note

The `CreateWorkRange` function makes heavy use of the `SpecialCells` property. To learn more about the `SpecialCells` property, try recording a macro while making various selections in Excel's Go To Special dialog box. You can display this dialog box by pressing F5 and then clicking the Special button in the Go To dialog box.

It's important to understand how the Go To Special dialog box works. Normally, it operates on the current range selection. For example, if an entire column is selected, the result is a subset of that column. But if a single cell is selected, it operates on the entire worksheet. Because of this, the `CreateWorkRange` function checks the number of cells in the range passed to it.

Saving the Text Tools utility settings

The Text Tools utility has a very useful feature: It remembers the last settings that you used. This feature is handy because many people tend to use the same option each time they invoke it.

The most recently used settings are stored in the Windows Registry. When the user clicks the Close button, the code uses VBA's `SaveSetting` function to save the value of each control. When the Text Tools utility is started, it uses the `GetSetting` function to retrieve those values and set the controls accordingly.

In the Windows Registry, the settings are stored at the following location:

```

HKEY_CURRENT_USER\Software\VB and VBA Program Settings\
Text Tools Utility\Settings

```

Figure 16-5 shows these settings in the Windows Registry Editor program (`regedit.exe`).

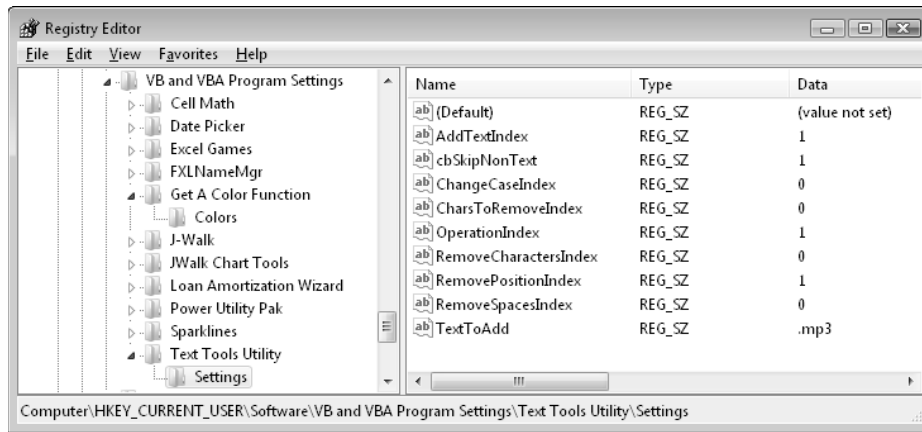


Figure 16-5: Use the Windows Registry Editor program to view the settings stored in the Registry.

If you examine the code for the Text Tools utility, you'll find that I used an eight-element array (named `UserChoices`) to store the settings. I could have used separate variables for each setting, but using an array made the coding a bit easier.

The following VBA code reads the settings from the Registry and stores them in the `UserChoices` array:

```
' Get previous settings
UserChoices(1) = GetSetting(APPNAME, "Settings", "OperationIndex", 0)
UserChoices(2) = GetSetting(APPNAME, "Settings", "ChangeCaseIndex", 0)
UserChoices(3) = GetSetting(APPNAME, "Settings", "TextToAdd", "")
UserChoices(4) = GetSetting(APPNAME, "Settings", "AddTextIndex", 0)
UserChoices(5) = GetSetting(APPNAME, "Settings", "CharsToRemoveIndex", 0)
UserChoices(6) = GetSetting(APPNAME, "Settings", "RemovePositionIndex", 0)
UserChoices(7) = GetSetting(APPNAME, "Settings", "RemoveSpacesIndex", 0)
UserChoices(8) = GetSetting(APPNAME, "Settings", "RemoveCharactersIndex", 0)
cbSkipNonText.Value = GetSetting(APPNAME, "cbSkipNonText", 0)
```

The code that follows is executed when the dialog box is closed. These statements retrieve the values from the `UserChoices` array and write them to the Registry.

```
' Store settings
SaveSetting APPNAME, "Settings", "OperationIndex", UserChoices(1)
SaveSetting APPNAME, "Settings", "ChangeCaseIndex", UserChoices(2)
SaveSetting APPNAME, "Settings", "TextToAdd", UserChoices(3)
SaveSetting APPNAME, "Settings", "AddTextIndex", UserChoices(4)
SaveSetting APPNAME, "Settings", "CharsToRemoveIndex", UserChoices(5)
SaveSetting APPNAME, "Settings", "RemovePositionIndex", UserChoices(6)
```

```
SaveSetting APPNAME, "Settings", "RemoveSpacesIndex", UserChoices(7)
SaveSetting APPNAME, "Settings", "RemoveCharactersIndex", UserChoices(8)
SaveSetting APPNAME, "Settings", "cbSkipNonText", cbSkipNonText.Value * -1
```

Implementing Undo

Unfortunately, Excel doesn't provide a direct way to undo an operation performed using VBA. Undoing a VBA macro is possible, but it takes quite a bit of work. And, unlike Excel's Undo feature, the undo technique used in the Text Tools utility is a single level. In other words, the user can undo only the most recent operation. Refer to the sidebar, "Undoing a VBA procedure," for additional information about using Undo with your applications.

The Text Tools utility implements Undo by saving the original data in a worksheet. If the user undoes the operation, that data is then copied back to the user's workbook.

In the Text Tools utility, recall that the `Module1` VBA module declared two public variables for handling undo:

```
Public UndoRange As Range
Public UserSelection As Range
```

Before modifying any data, the `ApplyButton_Click` procedure calls the `SaveForUndo` procedure. The procedure starts with three statements:

```
Set UserSelection = Selection
Set UndoRange = WorkRange
ThisWorkbook.Sheets(1).UsedRange.Clear
```

The `UserSelection` object variable saves the user's current selection so that you can reselect it after the undo operation. `WorkRange` is a `Range` object that's returned by the `CreateWorkRange` function. The range consists of the non-empty and nonformula cells in the user's selection. The preceding third statement erases any existing saved data from the worksheet.

Next, the following loop is executed:

```
For Each RngArea In WorkRange.Areas
    ThisWorkbook.Sheets(1).Range _
        (RngArea.Address).Formula = RngArea.Formula
Next RngArea
```

This code loops through each area of the `WorkRange` and stores the data in the worksheet. (If the `WorkRange` consists of a contiguous range of cells, it will contain only one area.)

After the specified operation is performed, the code then uses the `OnUndo` method to specify the procedure to execute if the user chooses Undo. For example, after performing a case change operation, this statement is executed:

```
Application.OnUndo "Undo Change Case", "UndoTextTools"
```

Excel's Undo drop-down list will then contain a menu item: Undo Change Case (see Figure 16-6). If the user selects the command, the `UndoTextTools` procedure, shown next, will be executed.

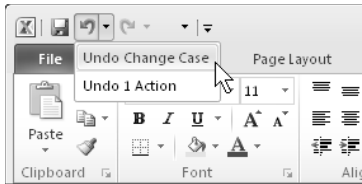


Figure 16-6: The Text Tools utility includes a single level of undo.

```
Private Sub UndoTextTools()
'   Undoes the last operation
Dim a As Range
On Error GoTo ErrHandler
Application.ScreenUpdating = False
With UserSelection
    .Parent.Parent.Activate
    .Parent.Activate
    .Select
End With
For Each a In UndoRange.Areas
    a.Formula = ThisWorkbook.Sheets(1).Range(a.Address).Formula
Next a
Application.ScreenUpdating = True
On Error GoTo 0
Exit Sub
ErrHandler:
Application.ScreenUpdating = True
MsgBox "Can't undo", vbInformation, APPNAME
On Error GoTo 0
End Sub
```

The `UndoTextTools` procedure first ensures that the correct workbook and worksheet are activated and then selects the original range selected by the user. Then it loops through each area of the stored data (which is available because of the `UndoRange` public variable) and puts the data back to its original location (overwriting the changes, of course).



Undoing a VBA procedure

Computer users have become accustomed to being able to undo an operation. You can undo almost every operation that you perform in Excel. Even better, beginning with Excel 2007, Microsoft increased the number of undo levels from 16 to 100.

If you program in VBA, you may have wondered whether you can undo the effects of a procedure. Although the answer is yes, the qualified answer is *it's not always easy*.

Making the effects of your VBA procedures undoable isn't automatic. Your procedure needs to store the previous state so that it can be restored if the user chooses the Undo command (which is located in the Quick Access toolbar). How you store the previous state can vary depending on what the procedure does. You can save the old information in a worksheet or in an array. In extreme cases, you may need to save an entire worksheet. If your procedure modifies a range, for example, you need to save only the contents of that range.

Also, keep in mind that executing a VBA Sub procedure wipes out Excel's undo stack. In other words, after you run a macro, it's impossible to undo any previous operations.

The `Application` object contains an `OnUndo` method, which lets the programmer specify text to appear on the Undo drop-down list and a procedure to execute if the user chooses the Undo command. For example, the following statement causes the Undo drop-down list to display Undo my cool macro. If the user chooses Undo→Undo My Cool Macro, the `UndoMyMacro` procedure is executed:

```
Application.OnUndo "Undo my cool macro", "UndoMyMacro"
```



On the CD

The companion CD-ROM contains a simpler example that demonstrates how to enable the Undo command after a VBA procedure is executed. This example, named `simple undo demo.xlsm`, stores the data in an array rather than a worksheet. The array is made up of a custom data type that includes the value and address of each cell.

Displaying the Help file

I created a simple compiled HTML Help file named `texttools.chm` for this utility. Clicking the `HelpButton` on the UserForm executes this procedure:

```
Private Sub HelpButton_Click()  
    Application.Help (ThisWorkbook.Path & "\" & "texttools.chm", 0)  
End Sub
```

Figure 16-7 shows one of the Help screens.

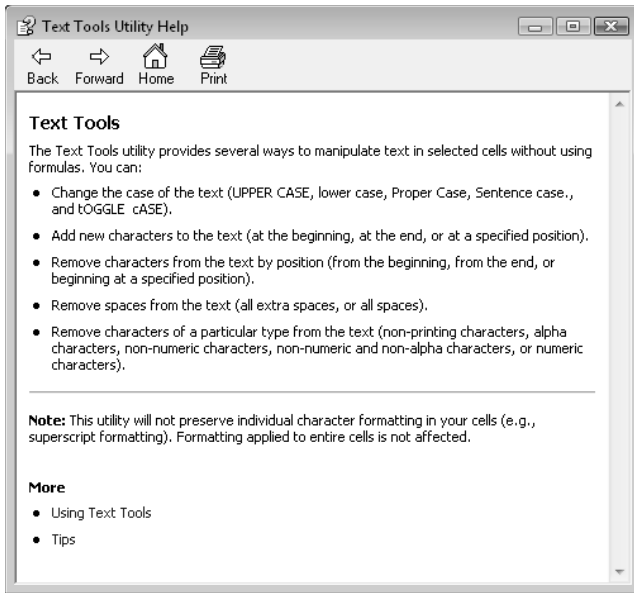


Figure 16-7: A Help screen for the Text Tools utility.



The companion CD-ROM includes all of the source files that were used to create the Help file. These files are in a directory named `\helpsource`. If you're not familiar with HTML Help files, refer to Chapter 24 for additional information.

Adding the RibbonX code

The final task in creating this utility is to provide a way to execute it. Before Excel 2007, inserting a new menu command or toolbar button was relatively easy. But, with the new Ribbon user interface, this once-simple job is significantly more challenging.

I used the Custom UI Editor for Microsoft Office to add the RibbonX code that generates a new Ribbon group and command. The Custom UI Editor isn't included with Microsoft Office, but you can locate and download the program on the Internet.



Chapter 22 contains additional information about working with the Ribbon and the Custom UI Editor.

Figure 16-8 shows a portion of the Ribbon with a new group (called Utilities) added to the end of the Home tab. This group contains a single control that, when clicked, executes this procedure:

```
Sub StartTextTools(control As IRibbonControl)
    Call ShowTextToolsDialog
End Sub
```

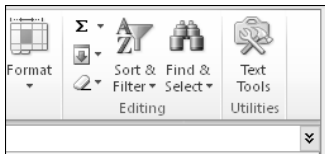


Figure 16-8: The Ribbon contains a new group in the Home tab.

Figure 16-9 shows the RibbonX code in the Custom UI Editor.

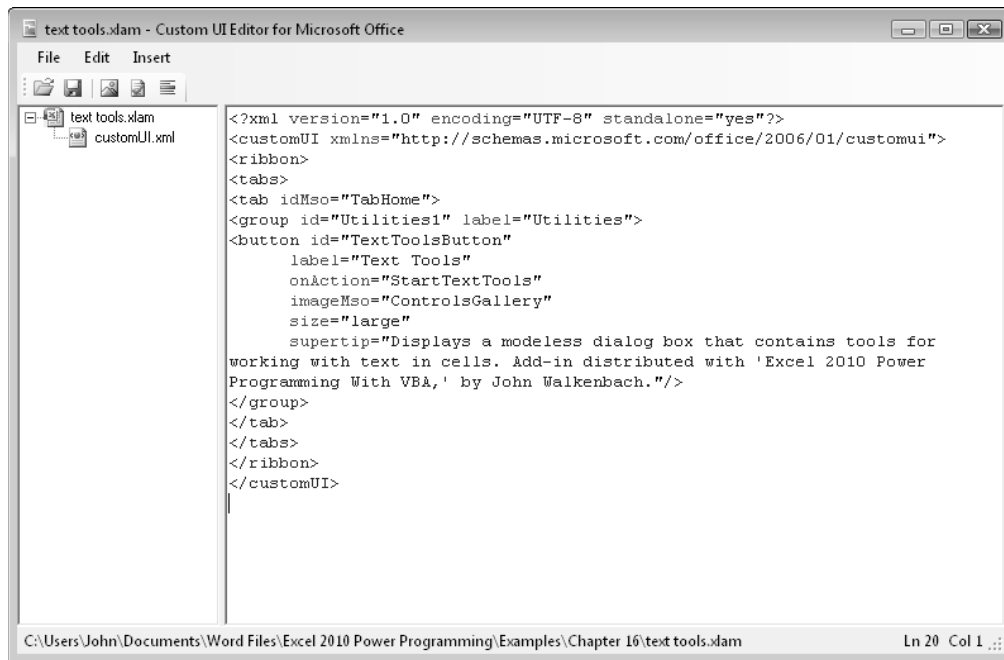


Figure 16-9: Using the Custom UI Editor to provide a way to execute the utility from the Ribbon.



Note

When a workbook has a customized Ribbon, the Ribbon customizations appear only when that workbook is active. But, fortunately, there is an exception to this rule. When the Ribbon customization is contained in an XLAM add-in file (as in this example), the Ribbon modifications appear as long as the add-in file is opened, regardless of which workbook is active.

Post-mortem of the project

The previous sections describe each component of the Text Tools utility. At this point, it's useful to revisit the original project goals to see whether they were met. The original goals, along with my comments, are as follows:

- **Its main features will be those listed at the beginning of this section.** Accomplished.
- **It will enable the user to request the preceding types of changes on nontext cells as well as text cells.** Accomplished.
- **It will have the same look and feel of other Excel commands. In other words, it will have a dialog box that looks like Excel's dialog boxes.** The Text Tools utility deviates from Excel's normal look and feel by using an Apply button rather than an OK button. And, unlike most of Excel's dialog boxes, Text Tools uses a modeless, stay-on-top dialog box. In light of the enhanced usability, I think these deviations are quite reasonable.
- **It will be in the form of an add-in and will be accessible from the Ribbon.** Accomplished.
- **It will operate with the current selection of cells (including multiple selections), and it will enable the user to modify the range selection while the dialog box is displayed.** Accomplished. And because the dialog box need not be dismissed, it didn't require the use of a `RefEdit` control.
- **It will remember the last operation used and display those settings the next time the dialog box is invoked.** Accomplished (thanks to the Windows Registry).
- **It will have no effect on cells that contain formulas.** Accomplished.
- **It will be fast and efficient. For example, if the user selects an entire range, the utility should ignore empty cells.** Accomplished.
- **It will use a nonmodal dialog box so that the user can keep the dialog box on-screen and ready to use.** Accomplished.
- **It will be compact in size so that it doesn't hide too much of the worksheet.** Accomplished.
- **It will enable the user to undo the changes.** Accomplished.
- **Comprehensive help will be available.** Accomplished.

Understand the Text Tools utility

If you don't fully understand how this utility works, I urge you to load the add-in and use the Debugger to step through the code. Try it out with different types of selections, including an entire worksheet. You'll see that regardless of the size of the original selection, only the appropriate cells are processed, and empty cells are completely ignored. If a worksheet has only one cell with text in it, the utility operates just as quickly whether you select that cell or the entire worksheet.

If you convert the add-in to a standard workbook, you'll be able to see how the original data is stored in the worksheet for undo. To convert the add-in to a workbook, double-click the `ThisWorkbook` code module in the Properties window. Press F4 to display the Properties box and then change the `IsAddin` property to `False`.

More about Excel Utilities

If you are interested in creating Excel utilities, I urge you to download a trial copy of Power Utility Pak. This product includes about 60 useful utilities (plus many custom worksheet functions). If you find it helpful, you can use the coupon in the back of this book to order a copy at a discounted price. The complete VBA source code also is available for a small fee.

In addition to the Power Utility Pak, many other utilities are available, and you can download most of them from the Internet.

Working with Pivot Tables

In This Chapter

- Creating pivot tables with VBA
- Looking at examples of VBA procedures that create pivot tables
- Using VBA to create a worksheet table from a summary table

An Introductory Pivot Table Example

Excel's pivot table feature is, arguably, its most innovative and powerful feature. Pivot tables first appeared in Excel 5, and the feature has been improved in every subsequent version. This chapter is not an introduction to pivot tables. I assume that you're familiar with this feature and its terminology and that you know how to create and modify pivot tables manually.

As you probably know, creating a pivot table from a database or list enables you to summarize data in ways that otherwise would not be possible — and it's amazingly fast and requires no formulas. You also can write VBA code to generate and modify pivot tables.

This section gets the ball rolling with a simple example of using VBA to create a pivot table.

Figure 17-1 shows a very simple worksheet range. It contains four fields: SalesRep, Region, Month, and Sales. Each record describes the sales for a particular sales representative in a particular month.



On the CD

This workbook, named `simple pivot table.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E
1	SalesRep	Region	Month	Sales	
2	Amy	North	Jan	33,488	
3	Amy	North	Feb	47,008	
4	Amy	North	Mar	32,128	
5	Bob	North	Jan	34,736	
6	Bob	North	Feb	92,872	
7	Bob	North	Mar	76,128	
8	Chuck	South	Jan	41,536	
9	Chuck	South	Feb	23,192	
10	Chuck	South	Mar	21,736	
11	Doug	South	Jan	44,834	
12	Doug	South	Feb	32,002	
13	Doug	South	Mar	23,932	
14					
15					
16					

Figure 17-1: This table is a good candidate for a pivot table.

Creating a pivot table

Figure 17-2 shows a pivot table created from the data, along with the PivotTable Field List task bar. This pivot table summarizes the sales performance by sales representative and month. This pivot table is set up with the following fields:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Region	(All)										
2												
3	Sum of Sales											
4		Jan	Feb	Mar	Grand Total							
5	Amy	33488	47008	32128	112624							
6	Bob	34736	92872	76128	203736							
7	Chuck	41536	23192	21736	86464							
8	Doug	44834	32002	23932	100768							
9	Grand Total	154594	195074	153924	503592							
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

PivotTable Field List

Choose fields to add to report:

- ☒ SalesRep
- ☒ Region
- ☒ Month
- ☒ Sales

Drag fields between areas below:

☒ Report Filter: Region

☐ Column Labels: Month

☐ Row Labels: SalesRep

☐ Values: Sum of Sales

☐ Defer Layout Update

Update

Figure 17-2: A pivot table created from the data in Figure 17-1.

- **Region:** A report filter field in the pivot table.
- **SalesRep:** A row field in the pivot table.

- **Month:** A column field in the pivot table.
- **Sales:** A values field in the pivot table that uses the Sum function.

I turned on the macro recorder before I created this pivot table and specified a new worksheet for the pivot table location. The code that was generated follows:

```
Sub RecordedMacro()
    Range("A1").Select
    Sheets.Add
    ActiveWorkbook.PivotCaches.Create _
        (SourceType:=xlDatabase, _
        SourceData:="Sheet1!R1C1:R13C4", _
        Version:=xlPivotTableVersion14).CreatePivotTable _
        TableDestination:="Sheet2!R3C1", _
        TableName:="PivotTable1", _
        DefaultVersion:=xlPivotTableVersion14)
    Sheets("Sheet2").Select
    Cells(3, 1).Select
    With ActiveSheet.PivotTables("PivotTable1") _
        .PivotFields("SalesRep")
        .Orientation = xlRowField
        .Position = 1
    End With
    With ActiveSheet.PivotTables("PivotTable1") _
        .PivotFields("Month")
        .Orientation = xlColumnField
        .Position = 1
    End With
    ActiveSheet.PivotTables("PivotTable1") _
        .AddDataField ActiveSheet.PivotTables("PivotTable1") _
        .PivotFields("Sales"), "Sum of Sales", xlSum
    With ActiveSheet.PivotTables("PivotTable1"). _
        PivotFields("Region")
        .Orientation = xlPageField
        .Position = 1
    End With
End Sub
```

If you execute this macro, it will almost certainly produce an error. Examine the code, and you'll see that the macro recorder hard-coded the worksheet name (`Sheet2`) for the pivot table. If that sheet already exists (or if the new sheet that's added has a different name), the macro ends with an error. It also hard-coded the pivot table name. The name won't be `PivotTable1` if the workbook has other pivot tables.

But even though the recorded macro doesn't work, it's not completely useless. The code provides lots of insight for writing code to generate pivot tables.



Data appropriate for a pivot table

A pivot table requires that your data is in the form of a rectangular database. You can store the database in either a worksheet range (which can be a table or just a normal range) or an external database file. Although Excel can generate a pivot table from any database, not all databases benefit.

Generally speaking, fields in a database table consist of two types:

- **Data:** Contains a value or data to be summarized. For the bank account example, the Amount field is a data field.
- **Category:** Describes the data. For the bank account data, the Date, AcctType, OpenedBy, Branch, and Customer fields are category fields because they describe the data in the Amount field.

A database table that's appropriate for a pivot table is said to be *normalized*. In other words, each record (or row) contains information that describes the data.

A single database table can have any number of data fields and category fields. When you create a pivot table, you usually want to summarize one or more of the data fields. Conversely, the values in the category fields appear in the pivot table as rows, columns, or filters.

If you're not clear on the concept, the companion CD-ROM contains a workbook named `normalized data.xlsx`. This workbook contains an example of a range of data before and after being normalized so it's suitable for a pivot table.

Examining the recorded code for the pivot table

VBA code that works with pivot tables can be confusing. To make any sense of the recorded macro, you need to know about a few relevant objects, all of which are explained in the Help system.

- **PivotCaches:** A collection of `PivotCache` objects in a `Workbook` object (the data used by a pivot table is stored in a pivot cache).
- **PivotTables:** A collection of `PivotTable` objects in a `Worksheet` object.
- **PivotFields:** A collection of fields in a `PivotTable` object.
- **PivotItems:** A collection of individual data items within a field category.
- **CreatePivotTable:** A method that creates a pivot table by using the data in a pivot cache.

Cleaning up the recorded pivot table code

As with most recorded macros, the preceding example isn't as efficient as it could be. And, as I noted, it's very likely to generate an error. You can simplify the code to make it more understandable

and also to prevent the error. The hand-crafted code that follows generates the same pivot table as the procedure previously listed:

```
Sub CreatePivotTable()
    Dim PTCache As PivotCache
    Dim PT As PivotTable

    ' Create the cache
    Set PTCache = ActiveWorkbook.PivotCaches.Create( _
        SourceType:=xlDatabase, _
        SourceData:=Range("A1").CurrentRegion)

    ' Add a new sheet for the pivot table
    Worksheets.Add

    ' Create the pivot table
    Set PT = ActiveSheet.PivotTables.Add( _
        PivotCache:=PTCache, _
        TableDestination:=Range("A3"))

    ' Specify the fields
    With PT
        .PivotFields("Region").Orientation = xlPageField
        .PivotFields("Month").Orientation = xlColumnField
        .PivotFields("SalesRep").Orientation = xlRowField
        .PivotFields("Sales").Orientation = xlDataField
        'no field captions
        .DisplayFieldCaptions = False
    End With
End Sub
```

The `CreatePivotTable` procedure is simplified (and might be easier to understand) because it declares two object variables: `PTCache` and `PT`. A new `PivotCache` object is created by using the `Create` method. A worksheet is added, and it becomes the active sheet (the destination for the pivot table). Then a new `PivotTable` object is created by using the `Add` method of the `PivotTables` collection. The last section of the code adds the four fields to the pivot table and specifies their location within it by assigning a value to the `Orientation` property.

The original macro hard-coded both the data range used to create the `PivotCache` object (`'Sheet1!R1C1:R13C4'`) and the pivot table location (`Sheet2`). In the `CreatePivotTable` procedure, the pivot table is based on the current region surrounding cell `A1`. This ensures that the macro will continue to work properly if more data is added.

Adding the worksheet before the pivot table is created eliminates the need to hard-code the sheet reference. Yet another difference is that the hand-written macro doesn't specify a pivot table name. Because the `PT` object variable is created, your code doesn't ever have to refer to the pivot table by name.



Pivot table compatibility

If you plan to share a workbook that contains a pivot table with users of previous versions of Excel, you need to pay careful attention to compatibility. If you look at the recorded macro in the “Creating a pivot table” section, you see the following statement:

```
DefaultVersion:=xlPivotTableVersion14
```

If your workbook is in compatibility mode, the recorded statement is:

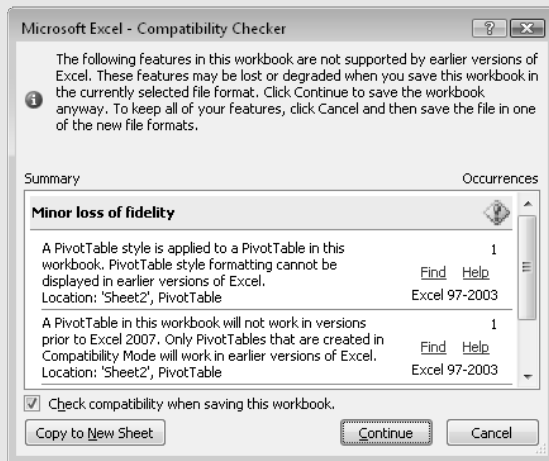
```
DefaultVersion:=xlPivotTableVersion10
```

You’ll also find that the recorded code is completely different because Microsoft has made significant changes in pivot tables beginning with Excel 2007.

Assume that you create a pivot table in Excel 2010 and give the workbook to a coworker who has Excel 2003. The coworker will see the pivot table, but it will not be refreshable. In other words, it’s just a dead table of numbers.

To create a backward compatible pivot table in Excel 2010, you must save your file in XLS format and then re-open it. After doing so, pivot tables that you create will work with versions prior to Excel 2007. But, of course, you won’t be able to take advantage of all the new pivot table features introduced in Excel 2007 and Excel 2010.

Fortunately, Excel’s Compatibility Checker will alert you regarding this type of compatibility issue (see the accompanying figure). However, it won’t check your pivot table-related macros for compatibility.



The macros in this chapter do *not* generate backward compatible pivot tables.



Note

The code also could be more general through the use of indices rather than literal strings for the `PivotFields` collections. This way, if the user changes the column headings, the code will still work. For example, more general code would use `PivotFields(1)` rather than `PivotFields('Region')`.

As always, the best way to master this topic is to record your actions within a macro to find out its relevant objects, methods, and properties. Then study the Help topics to understand how everything fits together. In almost every case, you'll need to modify the recorded macros. Or, after you understand how to work with pivot tables, you can write code from scratch and avoid the macro recorder.

Creating a More Complex Pivot Table

In this section, I present VBA code to create a relatively complex pivot table.

Figure 17-3 shows part of a large worksheet table. This table has 15,840 rows and consists of hierarchical budget data for a corporation. The corporation has five divisions, and each division contains 11 departments. Each department has four budget categories, and each budget category contains several budget items. Budgeted and actual amounts are included for each of the 12 months. The goal is to summarize this information with a pivot table.

	A	B	C	D	E	F	G
1	Division	Department	Category	Item	Month	Budget	Actual
2	N. America	Data Processing	Compensation	Salaries	Jan	2583	3165
3	N. America	Data Processing	Compensation	Benefits	Jan	4496	2980
4	N. America	Data Processing	Compensation	Bonuses	Jan	3768	3029
5	N. America	Data Processing	Compensation	Commissions	Jan	3133	2815
6	N. America	Data Processing	Compensation	Payroll Taxes	Jan	3559	3770
7	N. America	Data Processing	Compensation	Training	Jan	3099	3559
8	N. America	Data Processing	Compensation	Conferences	Jan	2931	3199
9	N. America	Data Processing	Compensation	Entertainment	Jan	2632	2633
10	N. America	Data Processing	Facility	Rent	Jan	2833	2508
11	N. America	Data Processing	Facility	Lease	Jan	3450	2631
12	N. America	Data Processing	Facility	Utilities	Jan	4111	3098
13	N. America	Data Processing	Facility	Maintenance	Jan	3070	2870
14	N. America	Data Processing	Facility	Telephone	Jan	3827	4329
15	N. America	Data Processing	Facility	Other	Jan	3843	3322
16	N. America	Data Processing	Supplies & Services	General Office	Jan	2642	3218
17	N. America	Data Processing	Supplies & Services	Computer Supplies	Jan	3052	4098
18	N. America	Data Processing	Supplies & Services	Books & Subs	Jan	4346	3361
19	N. America	Data Processing	Supplies & Services	Outside Services	Jan	2869	3717
20	N. America	Data Processing	Supplies & Services	Other	Jan	3328	3116
21	N. America	Data Processing	Equipment	Computer Hardware	Jan	3088	2728
22	N. America	Data Processing	Equipment	Software	Jan	4226	2675
23	N. America	Data Processing	Equipment	Photocopiers	Jan	3780	3514
24	N. America	Data Processing	Equipment	Telecommunication	Jan	3893	3664
25	N. America	Data Processing	Equipment	Other	Jan	2851	4380
26	N. America	Human Resources	Compensation	Salaries	Jan	3604	3501
27	N. America	Human Resources	Compensation	Benefits	Jan	2859	4493
28	N. America	Human Resources	Compensation	Bonuses	Jan	3020	2676

Figure 17-3: The data in this workbook will be summarized in a pivot table.



On the CD

This workbook is available on the companion CD-ROM. The file is named `budget pivot table.xlsm`.

Figure 17-4 shows a pivot table created from the data. Notice that the pivot table contains a calculated field named `Variance`. This field is the difference between the Budget amount and the Actual amount.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Division	(All)												
2	Category	(All)												
3														
4		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
5	Accounting													
6	Budget	422,455	433,317	420,522	417,964	411,820	414,012	427,431	418,530	412,134	421,678	426,602	418,445	5,044,910
7	Actual	422,662	413,163	416,522	420,672	431,303	429,993	425,879	415,253	417,401	417,806	425,271	420,026	5,055,951
8	Variance	-0,207	20,154	4,000	-2,708	-19,483	-15,981	1,552	3,277	-5,267	3,872	1,331	-1,581	-11,041
9	Advertising													
10	Budget	424,590	419,331	417,949	420,324	427,150	424,169	421,183	420,245	429,454	412,078	411,896	423,101	5,051,470
11	Actual	416,008	420,828	425,437	417,310	419,996	428,330	428,958	420,856	416,067	419,232	411,739	424,492	5,049,253
12	Variance	8,582	-1,497	-7,488	3,014	7,154	-4,161	-7,775	-0,611	13,387	-7,154	0,157	-1,391	2,217
13	Data Processing													
14	Budget	422,197	422,057	419,659	417,260	422,848	421,038	421,676	418,093	419,999	418,752	421,106	428,679	5,053,364
15	Actual	414,743	438,990	430,545	424,214	411,775	421,909	420,210	414,966	419,913	430,262	417,478	408,644	5,053,649
16	Variance	7,454	-16,933	-10,886	-6,954	11,073	-0,871	1,466	3,127	0,086	-11,510	3,628	20,035	-0,285
17	Human Resources													
18	Budget	422,053	425,313	418,634	423,038	423,514	419,602	415,197	419,701	422,762	413,741	410,972	422,746	5,037,273
19	Actual	424,934	429,275	407,053	429,187	410,258	421,870	428,551	422,469	422,252	421,838	415,125	417,222	5,050,034
20	Variance	-2,881	-3,962	11,581	-6,149	13,256	-2,268	-13,354	-2,768	0,510	-8,097	-4,153	5,524	-12,761
21	Operations													
22	Budget	413,530	427,975	419,527	422,299	415,298	414,805	413,149	425,287	412,284	414,242	427,521	420,190	5,026,107
23	Actual	415,819	406,592	426,827	418,223	431,307	413,201	416,350	411,339	422,584	416,132	424,041	426,461	5,028,876
24	Variance	-2,289	21,383	-7,300	4,076	-16,009	1,604	-3,201	13,948	-10,300	-1,890	3,480	-6,271	-2,769
25	Public Relations													
26	Budget	424,896	414,507	415,179	417,100	426,223	408,425	422,138	416,146	429,216	410,282	414,608	421,044	5,019,764
27	Actual	413,526	414,084	415,476	414,040	396,652	416,201	423,826	427,949	423,197	408,537	425,103	412,853	4,991,444
28	Variance	11,370	0,423	-0,297	3,060	29,571	-7,776	-1,688	-11,803	6,019	1,745	-10,495	8,191	28,320
29	R&D													
30	Budget	417,771	429,880	424,066	421,539	417,440	421,174	417,151	413,086	417,919	417,782	419,949	419,881	5,037,638
31	Actual	432,019	426,644	419,595	427,567	412,038	425,932	426,686	424,366	411,557	421,449	423,256	428,113	5,079,222
32	Variance	-14,248	3,236	4,471	-6,028	5,402	-4,758	-9,535	-11,280	6,362	-3,667	-3,307	-8,232	-41,584
33	Sales													
34	Budget	420,659	421,962	417,814	420,302	422,409	426,802	428,460	420,879	422,334	426,271	408,725	411,322	5,047,939
35	Actual	431,565	421,251	408,661	408,912	425,620	428,596	424,737	416,638	408,030	417,463	415,480	413,360	5,020,313
36	Variance	-10,906	0,711	9,153	11,390	-3,211	-1,794	3,723	4,241	14,304	8,808	-6,755	-2,038	27,626
37	Security													
38	Budget	419,195	419,294	413,258	421,700	421,875	421,231	417,392	410,715	417,112	430,013	412,302	419,939	5,024,026
39	Actual	409,486	418,697	427,401	419,221	421,266	420,388	423,828	424,682	418,400	415,569	410,717	423,031	5,032,686
40	Variance	9,709	0,597	-14,143	2,479	0,609	0,843	-6,436	-13,967	-1,288	14,444	1,585	-3,092	-8,660
41	Shipping													
42	Budget	429,595	429,917	423,975	419,617	433,168	421,732	413,330	429,881	428,164	428,851	412,565	423,607	5,094,402
43	Actual	413,835	413,777	414,932	411,949	410,561	422,913	411,481	421,191	420,974	419,458	428,434	416,709	5,006,214
44	Variance	15,760	16,140	9,043	7,668	22,607	-1,181	1,849	8,690	7,190	9,393	-15,869	6,898	88,188
45	Training													
46	Budget	415,605	422,608	413,129	409,728	417,812	428,315	416,646	427,315	428,783	412,503	418,569	415,366	5,026,379
47	Actual	423,292	419,292	426,844	420,360	433,136	421,086	415,139	420,813	422,749	418,739	431,727	422,936	5,076,113
48	Variance	-7,687	3,316	-13,715	-10,632	-15,324	7,229	1,507	6,502	6,034	-6,236	-13,158	-7,570	-49,734
49	Total Budget	4,632,546	4,666,161	4,603,712	4,610,871	4,639,557	4,621,305	4,613,753	4,619,878	4,640,161	4,606,193	4,584,815	4,624,320	55,463,272
50	Total Actual	4,617,889	4,622,593	4,619,293	4,611,655	4,603,912	4,650,419	4,645,645	4,620,522	4,603,124	4,606,485	4,628,371	4,613,847	55,443,755
51	Total Variance	14,657	43,568	-15,581	-0,784	35,645	-29,114	-31,892	-0,644	37,037	-0,292	-43,556	10,473	19,517

Figure 17-4: A pivot table created from the budget data.



Another option is to insert a new column in the table and create a formula to calculate the difference between the budget and actual amounts. If the data is from an external source (rather than in a worksheet), that option may not be possible.

The code that created the pivot table

Here's the VBA code that created the pivot table:

```
Sub CreatePivotTable()
    Dim PTcache As PivotCache
    Dim PT As PivotTable

    Application.ScreenUpdating = False
    ' Delete PivotSheet if it exists
    On Error Resume Next
    Application.DisplayAlerts = False
    Sheets("PivotSheet").Delete
    On Error GoTo 0

    ' Create a Pivot Cache
    Set PTcache = ActiveWorkbook.PivotCaches.Create( _
        SourceType:=xlDatabase, _
        SourceData:=Range("A1").CurrentRegion.Address)
    ' Add new worksheet
    Worksheets.Add
    ActiveSheet.Name = "PivotSheet"
    ActiveWindow.DisplayGridlines = False
    ' Create the Pivot Table from the Cache
    Set PT = ActiveSheet.PivotTables.Add( _
        PivotCache:=PTcache, _
        TableDestination:=Range("A1"), _
        TableName:="BudgetPivot")

    With PT
        ' Add fields
        .PivotFields("Category").Orientation = xlPageField
        .PivotFields("Division").Orientation = xlPageField
        .PivotFields("Department").Orientation = xlRowField
        .PivotFields("Month").Orientation = xlColumnField
        .PivotFields("Budget").Orientation = xlDataField
        .PivotFields("Actual").Orientation = xlDataField
        .DataPivotField.Orientation = xlRowField

        ' Add a calculated field to compute variance
        .CalculatedFields.Add "Variance", "=Budget-Actual"
        .PivotFields("Variance").Orientation = xlDataField

        ' Specify a number format
```

```
.DataBodyRange.NumberFormat = "0,000"

'    Apply a style
    .TableStyle2 = "PivotStyleMedium2"

'    Hide Field Headers
    .DisplayFieldCaptions = False

'    Change the captions
    .PivotFields("Sum of Budget").Caption = " Budget"
    .PivotFields("Sum of Actual").Caption = " Actual"
    .PivotFields("Sum of Variance").Caption = " Variance"
End With
End Sub
```

How the more complex pivot table works

The `CreatePivotTable` procedure starts by deleting the `PivotSheet` worksheet if it already exists. It then creates a `PivotCache` object, inserts a new worksheet named `PivotSheet`, and creates the pivot table from the `PivotCache`. The code then adds the following fields to the pivot table:

- **Category:** A report filter (page) field
- **Division:** A report filter (page) field
- **Department:** A row field
- **Month:** A column field
- **Budget:** A data field
- **Actual:** A data field

Notice that the `Orientation` property of the `DataPivotField` is set to `xlRowField` in the following statement:

```
.DataPivotField.Orientation = xlRowField
```

This statement determines the overall orientation of the pivot table, and it represents the `Sum Value` field in the Pivot Table Field list (see Figure 17-5). Try moving that field to the `Column Labels` section to see how it affects the pivot table layout.

Next, the procedure uses the `Add` method of the `CalculatedFields` collection to create the calculated field `Variance`, which subtracts the `Actual` amount from the `Budget` amount. This calculated field is assigned as a data field.

**Note**

To add a calculated field to a pivot table manually, use the **PivotTable→Options→Calculations→Fields, Items, & Sets→Calculated Field** command, which displays the **Insert Calculated Field** dialog box.

Finally, the code makes a few cosmetic adjustments:

- Applies a number format to the `DataBodyRange` (which represents the entire pivot table data).
- Applies a style.
- Hides the captions (equivalent to the **PivotTable Tools→Options→Show→Field Headers** control).

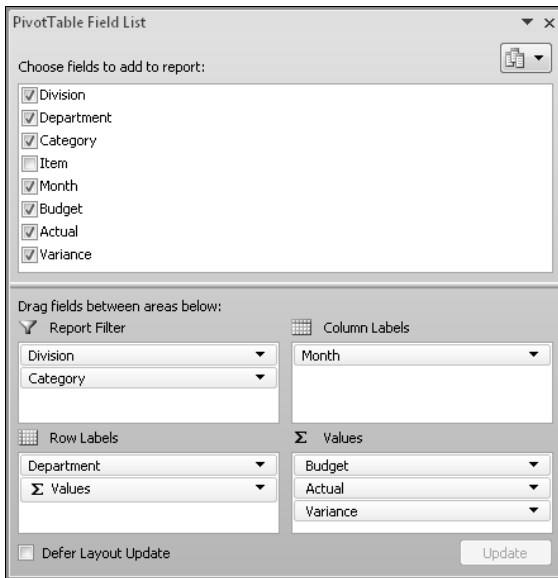


Figure 17-5: The Pivot Table Field List.

- Changes the captions displayed in the pivot table. For example, `Sum of Budget` is replaced by `Budget`. Note that the string `Budget` is preceded by a space. Excel doesn't allow you to change a caption that corresponds to a field name, so adding a space gets around this restriction.

**Note**

While creating this procedure, I used the macro recorder extensively to learn about the various properties. That, combined with the information in the Help system (and a fair amount of trial and error), provided all the information I needed.

Creating Multiple Pivot Tables

The final example creates a series of pivot tables that summarize data collected in a customer survey. That data is stored in a worksheet database (see Figure 17-6) and consists of 150 rows. Each row contains the respondent's sex plus a numerical rating using a 1–5 scale for each of the 14 survey items.



On the CD

This workbook, named `survey data pivot tables.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Name	Sex	Store locations are convenient	Store hours are convenient	Stores are well-maintained	You are easy to reach by phone	I like your web site	Employees are friendly	Employees are helpful	Employee are knowledgeable	Pricing is competitive	You have a good selection of products	I like your TV ads	You sell quality products	Overall, I am satisfied	I would recommend your company
2	Subject1	Male	1	4	4	4	1	1	2	1	1	2	5	2	2	1
3	Subject2	Female	2	5	1	1	4	2	4	3	3	2	2	5	2	3
4	Subject3	Male	1	1	4	2	3	3	2	1	2	3	2	4	3	2
5	Subject4	Male	2	1	3	5	1	2	3	4	2	1	3	4	1	2
6	Subject5	Female	2	2	5	5	4	2	1	5	5	2	3	4	2	5
7	Subject6	Female	2	4	3	3	1	1	4	4	4	2	2	2	2	4
8	Subject7	Female	2	4	5	4	5	3	2	5	4	4	1	5	4	4
9	Subject8	Male	3	2	1	2	3	4	3	1	2	4	3	4	4	2
10	Subject9	Female	3	4	4	4	5	1	4	1	4	1	2	1	1	4
11	Subject10	Male	2	1	5	5	5	1	4	1	2	2	5	2	2	2
12	Subject11	Male	4	3	3	2	1	2	4	2	1	4	2	2	4	1
13	Subject12	Female	2	1	4	5	5	5	3	1	4	1	2	3	4	4
14	Subject13	Female	4	3	4	3	2	5	3	3	2	2	5	2	4	2
15	Subject14	Female	2	3	4	2	1	1	4	2	1	3	3	1	3	1
16	Subject15	Female	1	3	5	1	2	2	4	1	3	4	2	5	4	3
17	Subject16	Male	1	4	1	3	4	3	4	4	5	3	4	1	3	3
18	Subject17	Female	3	4	3	5	5	4	4	3	2	4	2	2	4	2
19	Subject18	Male	1	5	5	3	5	3	4	2	3	2	3	3	2	3
20	Subject19	Female	1	3	5	4	5	5	5	1	1	5	3	2	5	1
21	Subject20	Male	2	2	5	2	2	5	5	3	1	5	2	4	5	1
22	Subject21	Male	3	4	1	4	5	1	3	1	4	1	2	1	1	4
23	Subject22	Male	2	1	5	5	5	1	2	1	2	2	5	2	2	2
24	Subject23	Male	4	3	4	2	1	2	1	2	1	4	4	1	4	2
25	Subject24	Female	1	1	2	5	5	5	3	1	4	1	2	3	1	2
26	Subject25	Female	2	3	4	3	2	5	3	3	2	2	5	2	1	2
27	Subject26	Male	1	3	4	2	1	1	3	2	1	3	2	1	1	1
28	Subject27	Male	1	3	4	1	2	2	2	1	3	4	5	2	4	3

Figure 17-6: Creating a series of pivot tables will summarize this survey data.

Figure 17-7 shows a few of the 28 pivot tables produced by the macro. Each survey item is summarized in two pivot tables (one showing percentages, and one showing the actual frequencies).

The VBA code that created the pivot tables follows:

```
Sub MakePivotTables()
' This procedure creates 28 pivot tables
Dim PTCache As PivotCache
Dim PT As PivotTable
Dim SummarySheet As Worksheet
Dim ItemName As String
```

```

Dim Row As Long, Col As Long, i As Long

Application.ScreenUpdating = False

' Delete Summary sheet if it exists
On Error Resume Next
Application.DisplayAlerts = False
Sheets("Summary").Delete
On Error GoTo 0

' Add Summary sheet
Set SummarySheet = Worksheets.Add
ActiveSheet.Name = "Summary"

' Create Pivot Cache
Set PTCache = ActiveWorkbook.PivotCaches.Create( _
    SourceType:=xlDatabase, _
    SourceData:=Sheets("SurveyData").Range("A1"). _

```

	A	B	C	D	E	F	G	H	I
1	Store locations are convenient					Store locations are convenient			
2	Frequency					Percent			
3		Female	Male	Grand Total			Female	Male	Grand Total
4	Strongly Disagree	28	40	68		Strongly Disagree	39.4%	50.6%	45.3%
5	Disagree	20	16	36		Disagree	28.2%	20.3%	24.0%
6	Undecided	15	9	24		Undecided	21.1%	11.4%	16.0%
7	Agree	6	14	20		Agree	8.5%	17.7%	13.3%
8	Strongly Agree	2		2		Strongly Agree	2.8%	0.0%	1.3%
9	Grand Total	71	79	150					
10									
11	Store hours are convenient					Store hours are convenient			
12	Frequency					Percent			
13		Female	Male	Grand Total			Female	Male	Grand Total
14	Strongly Disagree	11	13	24		Strongly Disagree	15.5%	16.5%	16.0%
15	Disagree	7	11	18		Disagree	9.9%	13.9%	12.0%
16	Undecided	30	26	56		Undecided	42.3%	32.9%	37.3%
17	Agree	20	22	42		Agree	28.2%	27.8%	28.0%
18	Strongly Agree	3	7	10		Strongly Agree	4.2%	8.9%	6.7%
19	Grand Total	71	79	150					
20									
21	Stores are well-maintained					Stores are well-maintained			
22	Frequency					Percent			
23		Female	Male	Grand Total			Female	Male	Grand Total
24	Strongly Disagree	7	14	21		Strongly Disagree	9.9%	17.7%	14.0%
25	Disagree	7	4	11		Disagree	9.9%	5.1%	7.3%
26	Undecided	16	14	30		Undecided	22.5%	17.7%	20.0%
27	Agree	29	29	58		Agree	40.8%	36.7%	38.7%
28	Strongly Agree	12	18	30		Strongly Agree	16.9%	22.8%	20.0%
29	Grand Total	71	79	150					
30									

Figure 17-7: Six of the 28 pivot tables created by a VBA procedure.

```

        CurrentRegion)

Row = 1
For i = 1 To 14
    For Col = 1 To 6 Step 5 '2 columns
        ItemName = Sheets("SurveyData").Cells(1, i + 2)
        With Cells(Row, Col)
            .Value = ItemName
            .Font.Size = 16
        End With
        ' Create pivot table
        Set PT = ActiveSheet.PivotTables.Add( _
            PivotCache:=PTCache, _
            TableDestination:=SummarySheet.Cells(Row + 1, Col))

        ' Add the fields
        If Col = 1 Then 'Frequency tables
            With PT.PivotFields(ItemName)
                .Orientation = xlDataField
                .Name = "Frequency"
                .Function = xlCount
            End With
        Else ' Percent tables
            With PT.PivotFields(ItemName)
                .Orientation = xlDataField
                .Name = "Percent"
                .Function = xlCount
                .Calculation = xlPercentOfColumn
                .NumberFormat = "0.0%"
            End With
        End If

        PT.PivotFields(ItemName).Orientation = xlRowField
        PT.PivotFields("Sex").Orientation = xlColumnField
        PT.TableStyle2 = "PivotStyleMedium2"
        PT.DisplayFieldCaptions = False
        If Col = 6 Then
            ' add data bars to the last column
            PT.ColumnGrand = False
            PT.DataBodyRange.Columns(3).FormatConditions. _
                AddDatabar
            With pt.DataBodyRange.Columns(3).FormatConditions(1)
                .BarFillType = xlDataBarFillSolid
                .MinPoint.Modify newtype:=xlConditionValueNumber, newvalue:=0
                .MaxPoint.Modify newtype:=xlConditionValueNumber, newvalue:=1
            End With
        End If
    Next Col
    Row = Row + 10

```



```
Next i

'   Replace numbers with descriptive text
With Range("A:A,F:F")
    .Replace "1", "Strongly Disagree"
    .Replace "2", "Disagree"
    .Replace "3", "Undecided"
    .Replace "4", "Agree"
    .Replace "5", "Strongly Agree"
End With
End Sub
```

Notice that all these pivot tables were created from a single `PivotCache` object.

The pivot tables are created within a nested loop. The `Col` loop counter goes from 1 to 6 by using the `Step` parameter. The instructions vary a bit for the second column of pivot tables. Specifically, the pivot tables in the second column do the following:

- Display the count as a percent of the column.
- Do not show grand totals for the rows.
- Are assigned a number format.
- Display format conditioning data bars.

The `Row` variable keeps track of the starting row of each pivot table. The final step is to replace the numeric categories in columns A and F with text. For example, 1 is replaced with *Strongly Agree*.

Creating a Reverse Pivot Table

A pivot table is a summary of data in a table. But what if you have a summary table, and you'd like to create a table from it? Figure 17-8 shows an example. Range B2:F14 contains a summary table — similar to a very simple pivot table. Columns I:K contain a 48-row table created from the summary table. In the table, each row contains one data point, and the first two columns describe that data point. In other words, the transformed data is normalized. (See the sidebar, “Data appropriate for a pivot table,” earlier in this chapter.)

Excel doesn't provide a way to transform a summary table into a normalized table, so it's a good job for a VBA macro. After I created this macro, I spent a bit more time and added a UserForm, shown in Figure 17-9. The UserForm gets the input and output ranges and also has an option to convert the output range to a table.



This workbook, named `reverse pivot table.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E	F	G	H	I	J	K
1									Column1	Column2	Column3
2		Month	Amy	Bob	Chuck	Doug			Jan	Amy	47,955
3		Jan	47,955	34,240	55,560	56,380			Jan	Bob	34,240
4		Feb	44,715	35,435	61,810	63,325			Jan	Chuck	55,560
5		Mar	41,635	34,005	58,655	60,055			Jan	Doug	56,380
6		Apr	48,515	32,065	63,530	57,700			Feb	Amy	44,715
7		May	53,945	39,225	67,860	57,900			Feb	Bob	35,435
8		Jun	50,990	38,305	64,370	61,760			Feb	Chuck	61,810
9		Jul	49,235	38,675	66,020	65,220			Feb	Doug	63,325
10		Aug	55,725	34,300	70,160	63,140			Mar	Amy	41,635
11		Sep	57,710	26,615	68,985	65,740			Mar	Bob	34,005
12		Oct	54,020	24,220	70,035	63,300			Mar	Chuck	58,655
13		Nov	52,055	19,365	65,240	62,905			Mar	Doug	60,055
14		Dec	48,690	20,440	64,165	54,915			Apr	Amy	48,515
15									Apr	Bob	32,065
16									Apr	Chuck	63,530
17									Apr	Doug	57,700
18									May	Amy	53,945
19									May	Bob	39,225
20									May	Chuck	67,860
21									May	Doug	57,900
22									Jun	Amy	50,990
23									Jun	Bob	38,305
24									Jun	Chuck	64,370
25									Jun	Doug	61,760
26									Jul	Amy	49,235

Figure 17-8: The summary table on the left will be converted to the table on the right.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Month	Amy	Bob	Chuck	Doug							
3		Jan	47,955	34,240	55,560	56,380							
4		Feb	44,715	35,435	61,810	63,325							
5		Mar	41,635	34,005	58,655	60,055							
6		Apr	48,515	32,065	63,530	57,700							
7		May	53,945	39,225	67,860	57,900							
8		Jun	50,990	38,305	64,370	61,760							
9		Jul	49,235	38,675	66,020	65,220							
10		Aug	55,725	34,300	70,160	63,140							
11		Sep	57,710	26,615	68,985	65,740							
12		Oct	54,020	24,220	70,035	63,300							
13		Nov	52,055	19,365	65,240	62,905							
14		Dec	48,690	20,440	64,165	54,915							
15													
16													
17													
18													
19													
20													
21													
22													
23													

Reverse Pivot

This utility creates a 3-column table from a two-way summary

Month	Amy	Bob	Chuck
Jan	47,955	34,240	55,560
Feb	44,715	35,435	61,810
Mar	41,635	34,005	58,655
Apr	48,515	32,065	63,530
May	53,945	39,225	67,860
Jun	50,990	38,305	64,370
Jul	49,235	38,675	66,020
Aug	55,725	34,300	70,160
Sep	57,710	26,615	68,985
Oct	54,020	24,220	70,035
Nov	52,055	19,365	65,240
Dec	48,690	20,440	64,165

Month	Name	Value
Jan	Amy	47,955
Jan	Bob	34,240
Jan	Chuck	55,560
Feb	Amy	44,715
Feb	Bob	35,435
Feb	Chuck	61,810
Mar	Amy	41,635
Mar	Bob	34,005
Mar	Chuck	58,655
Apr	Amy	48,515
Apr	Bob	32,065
Apr	Chuck	63,530
May	Amy	53,945
May	Bob	39,225
May	Chuck	67,860
Jun	Amy	50,990
Jun	Bob	38,305
Jun	Chuck	64,370
Jul	Amy	49,235
Jul	Bob	38,675
Jul	Chuck	66,020
Aug	Amy	55,725
Aug	Bob	34,300
Aug	Chuck	70,160
Sep	Amy	57,710
Sep	Bob	26,615
Sep	Chuck	68,985
Oct	Amy	54,020
Oct	Bob	24,220
Oct	Chuck	70,035
Nov	Amy	52,055
Nov	Bob	19,365
Nov	Chuck	65,240
Dec	Amy	48,690
Dec	Bob	20,440
Dec	Chuck	64,165

Summary table range:

Data!\$B\$2:\$F\$14

Output range (one cell):

Data!\$J\$1

☒ Create a formatted table

Cancel OK

Figure 17-9: This dialog box asks the user for the ranges.

When the user clicks the OK button in the UserForm, VBA code validates the ranges and then calls the `ReversePivot` procedure with this statement:

```
Call ReversePivot(SummaryTable, OutputRange, cbCreateTable)
```

It passes three arguments:

- `SummaryTable`: A `Range` object that represents the summary table.
- `OutputRange`: A `Range` object that represents the upper-left cell of the output range.
- `cbCreateTable`: The `Checkbox` object on the UserForm.

This procedure will work for any size summary table. The number of data rows in the output table will be equal to $(r-1) * (c-1)$, where r and c represent the number of rows and columns in the `SummaryTable`.

The code for the `ReversePivot` procedure follows:

```
Sub ReversePivot(SummaryTable As Range, _
    OutputRange As Range, CreateTable As Boolean)
    Dim r As Long, c As Long
    Dim OutRow As Long, OutCol As Long
    ' Convert the range
    OutRow = 2
    Application.ScreenUpdating = False
    OutputRange.Range("A1:C3") = Array("Column1", "Column2", "Column3")
    For r = 2 To SummaryTable.Rows.Count
        For c = 2 To SummaryTable.Columns.Count
            OutputRange.Cells(OutRow, 1) = SummaryTable.Cells(r, 1)
            OutputRange.Cells(OutRow, 2) = SummaryTable.Cells(1, c)
            OutputRange.Cells(OutRow, 3) = SummaryTable.Cells(r, c)
            OutRow = OutRow + 1
        Next c
    Next r
    ' Make it a table?
    If CreateTable Then _
        ActiveSheet.ListObjects.Add xlSrcRange, _
            OutputRange.CurrentRegion, , xlYes
End Sub
```

The procedure is fairly simple. The code loops through the rows and columns in the input range and then writes the data to the output range. The output range will always have three columns. The `OutRow` variable keeps track of the current row in the output range. Finally, if the user checked the check box, the output range is converted to a table by using the `Add` method of the `ListObjects` collection.

Working with Charts

In This Chapter

- Discovering essential background information on Excel charts
- Knowing the difference between embedded charts and chart sheets
- Understanding the `Chart` object model
- Using methods other than the macro recorder to help you learn about `Chart` objects
- Exploring examples of common charting tasks that use VBA
- Navigating more complex charting macros
- Finding out some interesting (and useful) chart-making tricks
- Working with Sparkline charts

Getting the Inside Scoop on Charts

Excel's charting feature lets you create a wide variety of charts using data that's stored in a worksheet. You have a great deal of control over nearly every aspect of each chart.

An Excel chart is simply packed with objects, each of which has its own properties and methods. Because of this, manipulating charts with Visual Basic for Applications (VBA) can be a bit of a challenge. In this chapter, I discuss the key concepts that you need to understand in order to write VBA code that generates or manipulates charts. The secret, as you'll see, is a good understanding of the object hierarchy for charts.



New Feature

Excel 2010 includes a new feature called **Sparklines**. A **Sparkline** is a small chart contained in a cell. The **Sparklines** feature uses an entirely separate object model than charts. I cover this feature in this chapter.

Chart locations

In Excel, a chart can be located in either of two places within a workbook:

- **As an embedded object on a worksheet:** A worksheet can contain any number of embedded charts.
- **In a separate chart sheet:** A chart sheet normally holds a single chart.

Most users create charts manually by using the commands in the Insert→Charts group. But you can also create charts by using VBA. And, of course, you can use VBA to modify existing charts.



Tip

The fastest way to create a chart manually is to select your data and then press Alt+F1. Excel creates an embedded chart and uses the default chart type. To create a new default chart on a chart sheet, select the data and press F11.

A key concept when working with charts is the *active chart* — that is, the chart that's currently selected. When the user clicks an embedded chart or activates a chart sheet, a `Chart` object is activated. In VBA, the `ActiveChart` property returns the activated `Chart` object (if any). You can write code to work with this `Chart` object, much like you can write code to work with the `Workbook` object returned by the `ActiveWorkbook` property.

Here's an example: If a chart is activated, the following statement will display the `Name` property for the `Chart` object:

```
MsgBox ActiveChart.Name
```

If a chart isn't activated, the preceding statement generates an error.



Note

As you see later in this chapter, you don't need to activate a chart in order to manipulate it with VBA.

The macro recorder and charts

If you've read other chapters in the book, you know that I often recommend using the macro recorder to learn about objects, properties, and methods. In the Excel 2007 edition of this book, I was forced to mention a serious problem with the macro recorder and charts: The macro recorder simply didn't record all your actions. Fortunately, this problem has been corrected in Excel 2010. Recording chart macros works fairly well in Excel 2010. The generated code isn't perfect, but it's much better than it was in Excel 2007.

As always, recorded macros are best viewed as a learning tool. The recorded code will almost always steer you to the relevant objects, properties, and methods.



Compatibility note

The VBA code in this chapter uses many new chart-related properties and methods that were introduced in Excel 2007. As a result, most of the code presented here won't work with versions prior to Excel 2007.

The Chart object model

When you first start exploring the object model for a `Chart` object, you'll probably be very confused — which isn't surprising; the object model *is* very confusing. It's also very deep.

For example, assume that you want to change the title displayed in an embedded chart. The top-level object, of course, is the `Application` object (Excel). The `Application` object contains a `Workbook` object, and the `Workbook` object contains a `Worksheet` object. The `Worksheet` object contains a `ChartObject` object, which contains a `Chart` object. The `Chart` object has a `ChartTitle` object, and the `ChartTitle` object has a `Text` property that stores the text that's displayed as the chart's title.

Here's another way to look at this hierarchy for an embedded chart:

```
Application
  Workbook
    Worksheet
      ChartObject
        Chart
          ChartTitle
```

Your VBA code must, of course, follow this object model precisely. For example, to set a chart's title to `YTD Sales`, you can write a VBA instruction like this:

```
Worksheets("Sheet1").ChartObjects(1).Chart.ChartTitle. _
    Text = "YTD Sales"
```

This statement assumes the active workbook is the `Workbook` object. The statement works with the first item in the `ChartObjects` collection on the worksheet named `Sheet1`. The `Chart` property returns the actual `Chart` object, and the `ChartTitle` property returns the `ChartTitle` object. Finally, you get to the `Text` property.

Note that the preceding statement will fail if the chart doesn't have a title. To add a default title to the chart (which displays the text `Chart Title`), use this statement:

```
Worksheets("Sheet1").ChartObjects(1).Chart.HasTitle = True
```

For a chart sheet, the object hierarchy is a bit different because it doesn't involve the `Worksheet` object or the `ChartObject` object. For example, here's the hierarchy for the `ChartTitle` object for a chart in a chart sheet:

```
Application
  Workbook
    Chart
      ChartTitle
```

In terms of VBA, you could use this statement to set the chart title in a chart sheet to `YTD Sales`:

```
Sheets("Chart1").ChartTitle.Text = "YTD Sales"
```

A chart sheet is essentially a `Chart` object, and it has no containing `ChartObject` object. Put another way, the parent object for an embedded chart is a `ChartObject` object, and the parent object for a chart on a separate chart sheet is a `Worksheet` object.

Both of the following statements will display a message box with the word `Chart` in it:

```
MsgBox TypeName(Sheets("Sheet1").ChartObjects(1).Chart)
Msgbox TypeName(Sheets("Chart1"))
```



Note

When you create a new embedded chart, you're adding to the `ChartObjects` collection and the `Shapes` collection contained in a particular worksheet. (There is no `Charts` collection for a worksheet.) When you create a new chart sheet, you're adding to the `Charts` collection and the `Sheets` collection for a particular workbook.

Creating an Embedded Chart

A `ChartObject` is a special type of `Shape` object. Therefore, it's a member of the `Shapes` collection. To create a new chart, use the `AddChart` method of the `Shapes` collection. The following statement creates an empty embedded chart:

```
ActiveSheet.Shapes.AddChart
```

The `AddChart` method can use five arguments (all are optional):

- **Type:** The type of chart. If omitted, the default chart type is used. Constants for all the chart types are provided (for example, `xlArea`, `xlColumnClustered`, and so on).
- **Left:** The left position of the chart, in points. If omitted, Excel centers the chart horizontally.

- **Top:** The top position of the chart, in points. If omitted, Excel centers the chart vertically.
- **Width:** The width of the chart, in points. If omitted, Excel uses 354.
- **Height:** The height of the chart, in points. If omitted, Excel uses 210.

In many cases, you may find it efficient to create an object variable when the chart is created. The following procedure creates a line chart that you can reference in code by using the `MyChart` object variable:

```
Sub CreateChart()
    Dim MyChart As Chart
    Set MyChart = ActiveSheet.Shapes.AddChart(xlLineMarkers).Chart
End Sub
```

A chart without data isn't very useful, so you'll want to use the `SetSourceData` method to add data to a newly created chart. The procedure that follows demonstrates the `SetSourceData` method. This procedure creates the chart shown in Figure 18-1.

```
Sub CreateChart()
    Dim MyChart As Chart
    Dim DataRange As Range
    Set DataRange = ActiveSheet.Range("A1:C7")
    Set MyChart = ActiveSheet.Shapes.AddChart.Chart
    MyChart.SetSourceData Source:=DataRange
End Sub
```

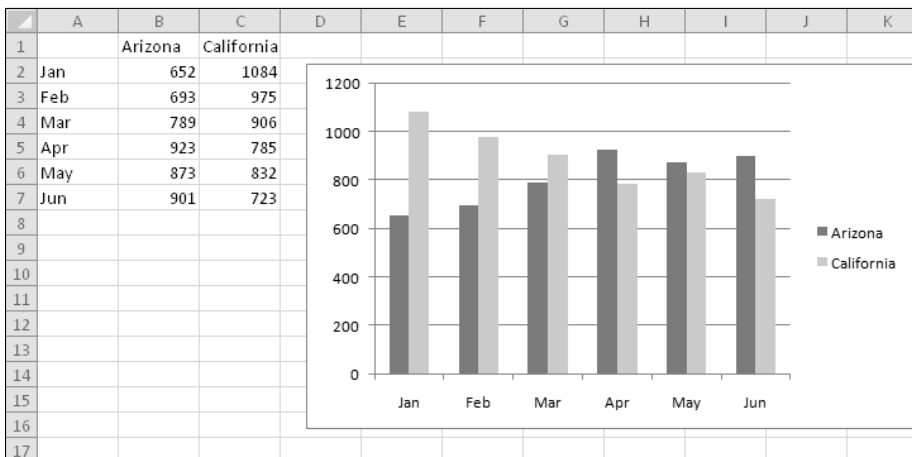


Figure 18-1: A few lines of VBA code created this chart.



Creating a chart the old way

Using the `AddChart` method of the `Shapes` collection (as described in “Creating an Embedded Chart”) is the “new” way of creating charts, introduced in Excel 2007. For compatibility purposes, you can still use the `Add` method of the `ChartObjects` collection. This method, unlike the `AddChart` method of the `Shapes` objects, doesn't allow you to specify the chart type as an argument, so you need to use the `ChartType` property if you want to use anything except the default chart type. In addition, the `Left`, `Top`, `Width`, and `Height` arguments are required.

The procedure that follows uses the `Add` method of the `ChartObjects` collection to create an embedded chart.

```
Sub CreateChart2()  
    Dim MyChart As Chart  
    Dim DataRange As Range  
    Set DataRange = ActiveSheet.Range("A1:C7")  
    Set MyChart = ActiveSheet.ChartObjects.Add(10, 10, 354, 210).Chart  
    MyChart.SetSourceData Source:=DataRange  
    MyChart.ChartType = xlColumnClustered  
End Sub
```

Creating a Chart on a Chart Sheet

The preceding section describes the basic procedures for creating an embedded chart. To create a chart on a chart sheet, use the `Add` method of the `Charts` collection. The `Add` method of the `Charts` collection uses several optional arguments, but these arguments specify the position of the chart sheet — not chart-related information.

The example that follows creates a chart on a chart sheet and specifies the data range and chart type:

```
Sub CreateChartSheet()  
    Dim MyChart As Chart  
    Dim DataRange As Range  
    Set DataRange = ActiveSheet.Range("A1:C7")  
    Set MyChart = Charts.Add  
    MyChart.SetSourceData Source:=DataRange  
    ActiveChart.ChartType = xlColumnClustered  
End Sub
```

Figure 18-2 shows the result.

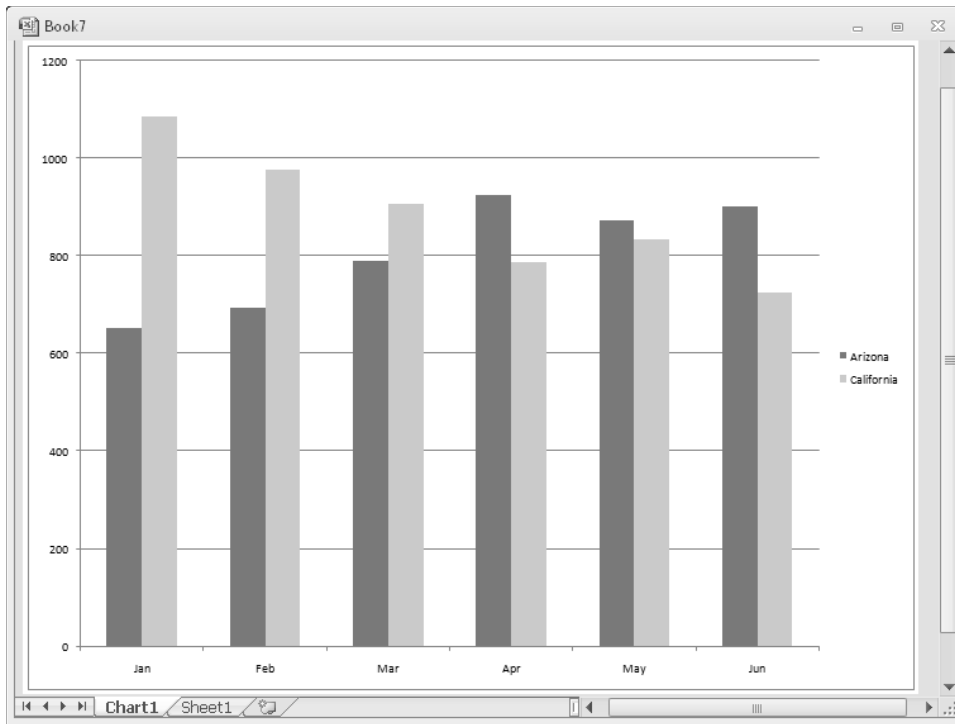


Figure 18-2: Creating a chart on a chart sheet.

Using VBA to Activate a Chart

When a user clicks any area of an embedded chart, the chart is activated. Your VBA code can activate an embedded chart with the `Activate` method. Here's a VBA statement that's the equivalent of Ctrl+clicking an embedded chart:

```
ActiveSheet.ChartObjects("Chart 1").Activate
```

If the chart is on a chart sheet, use a statement like this:

```
Sheets("Chart1").Activate
```

Alternatively, you can activate a chart by selecting its containing Shape:

```
ActiveSheet.Shapes("Chart 1").Select
```

When a chart is activated, you can refer to it in your code by using the `ActiveChart` property (which returns a `Chart` object). For example, the following instruction displays the name of the active chart. If there is no active chart, the statement generates an error:

```
MsgBox ActiveChart.Name
```

To modify a chart with VBA, it's not necessary to activate it. The two procedures that follow have exactly the same effect. That is, they change the embedded chart named `Chart 1` to an area chart. The first procedure activates the chart before performing the manipulations; the second one doesn't:

```
Sub ModifyChart1()  
    ActiveSheet.ChartObjects("Chart 1").Activate  
    ActiveChart.ChartType = xlArea  
End Sub  
  
Sub ModifyChart2()  
    ActiveSheet.ChartObjects("Chart 1").Chart.ChartType = xlArea  
End Sub
```

Moving a Chart

A chart embedded on a worksheet can be converted to a chart sheet. To do so manually, just activate the embedded chart and choose **Chart Tools**→**Design**→**Location**→**Move Chart**. In the **Move Chart** dialog box, select the **New Sheet** option and specify a name.

You can also convert an embedded chart to a chart sheet by using VBA. Here's an example that converts the first `ChartObject` on a worksheet named `Sheet1` to a chart sheet named `MyChart`:

```
Sub MoveChart1()  
    Sheets("Sheet1").ChartObjects(1).Chart. _  
        Location xlLocationAsNewSheet, "MyChart"  
End Sub
```

The following example does just the opposite of the preceding procedure: It converts the chart on a chart sheet named `MyChart` to an embedded chart on the worksheet named `Sheet1`.

```
Sub MoveChart2()  
    Charts("MyChart"). _  
        .Location xlLocationAsObject, "Sheet1"  
End Sub
```



What's your name?

Every `ChartObject` object has a name, and every `Chart` contained in a `ChartObject` has a name. That certainly seems straightforward enough, but chart names can be confusing. Create a new chart on `Sheet1` and activate it. Then activate the VBA Immediate window and type a few commands:

```
? ActiveSheet.Shapes(1).Name
Chart 1
? ActiveSheet.ChartObjects(1).Name
Chart 1
? ActiveChart.Name
Sheet1 Chart 1
? ActiveSheet.ChartObjects(1).Chart.Name
Sheet1 Chart 1
```

If you change the name of the worksheet, the name of the `Chart` also changes. However, you can't change the name of a `Chart` that's contained in a `ChartObject`. This statement generates an inexplicable "out of memory" error:

```
ActiveSheet.ChartObjects(1).Chart.Name = "New Name"
```

What about changing the name of a `ChartObject`? The logical place to do so is in the Name box (to the left of the formula bar). Although you can rename a shape by using the Name box, you can't rename a chart (even though a chart is actually a shape). To rename an embedded chart, use the Chart Name control in the Chart Tools→Layout→Properties group. This control displays the name of the active chart (which is actually the name of the `ChartObject`), and you can use this control to change the name of the `ChartObject`. Oddly, Excel allows you to use the name of an existing `ChartObject`. In other words, you could have a dozen embedded charts on a worksheet, and every one of them can be named `Chart 1`.

Bottom line? Be aware of this quirk. If you find that your VBA charting macro isn't working, make sure that you don't have two identically named charts.



Using the `Location` method also activates the relocated chart.

Using VBA to Deactivate a Chart

You can use the `Activate` method to activate a chart, but how do you deactivate (that is, unselect) a chart? According to the Help System, you can use the `Deselect` method to deactivate a chart:

```
ActiveChart.Deselect
```

However, this statement simply doesn't work.

As far as I can tell, the only way to deactivate a chart by using VBA is to select something other than the chart. For an embedded chart, you can use the `RangeSelection` property of the `ActiveWindow` object to deactivate the chart and select the range that was selected before the chart was activated:

```
ActiveWindow.RangeSelection.Select
```

To deactivate a chart on a chart sheet, just write code that selects a different sheet.

Determining Whether a Chart Is Activated

A common type of macro performs some manipulations on the active chart (the chart selected by a user). For example, a macro might change the chart's type, apply a style, add data labels, or export the chart to a graphics file.

The question is, how can your VBA code determine whether the user has actually selected a chart? By selecting a chart, I mean either activating a chart sheet or activating an embedded chart by clicking it. Your first inclination might be to check the `TypeName` property of the `Selection`, as in this expression:

```
TypeName(Selection) = "Chart"
```

In fact, this expression never evaluates to `True`. When a chart is activated, the actual selection will be an object within the `Chart` object. For example, the selection might be a `Series` object, a `ChartTitle` object, a `Legend` object, a `PlotArea` object, and so on.

The solution is to determine whether `ActiveChart` is `Nothing`. If so, then a chart isn't active. The following code checks to ensure that a chart is active. If not, the user sees a message, and the procedure ends:

```
If ActiveChart Is Nothing Then
    MsgBox "Select a chart."
    Exit Sub
Else
    'other code goes here
End If
```

You may find it convenient to use a VBA function procedure to determine whether a chart is activated. The `ChartIsSelected` function, which follows, returns `True` if a chart sheet is active or if an embedded chart is activated, but returns `False` if a chart isn't activated:

```
Private Function ChartIsSelected() As Boolean
    ChartIsSelected = Not ActiveChart Is Nothing
End Function
```

Deleting from the ChartObjects or Charts Collection

To delete a chart on a worksheet, you must know the name or index of the `ChartObject` or the `Shape` object. This statement deletes the `ChartObject` named `Chart 1` on the active worksheet:

```
ActiveSheet.ChartObjects("Chart 1").Delete
```

To delete all `ChartObject` objects on a worksheet, use the `Delete` method of the `ChartObjects` collection:

```
ActiveSheet.ChartObjects.Delete
```

You can also delete embedded charts by accessing the `Shapes` collection. The following statement deletes the shape named `Chart 1` on the active worksheet:

```
ActiveSheet.Shapes("Chart 1").Delete
```

This code deletes all embedded charts (and all other shapes) on the active sheet:

```
Dim shp As Shape
For Each shp In ActiveSheet.Shapes
    shp.Delete
Next shp
```

To delete a single chart sheet, you must know the chart sheet's name or index. The following statement deletes the chart sheet named `Chart1`:

```
Charts("Chart1").Delete
```

To delete all chart sheets in the active workbook, use the following statement:

```
ActiveWorkbook.Charts.Delete
```

Deleting sheets causes Excel to display a warning like the one shown in Figure 18-3. The user must reply to this prompt in order for the macro to continue. If you're deleting a sheet with a macro, you probably won't want this warning prompt to appear. To eliminate the prompt, use the following series of statements:

```
Application.DisplayAlerts = False
ActiveWorkbook.Charts.Delete
Application.DisplayAlerts = True
```

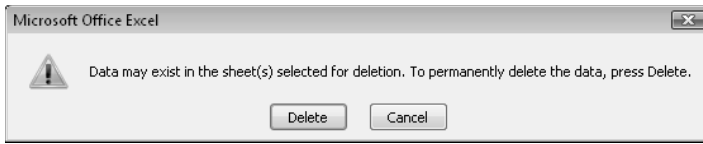


Figure 18-3: Attempting to delete one or more chart sheets results in this message.

Looping through All Charts

In some cases, you may need to perform an operation on all charts. The following example applies changes to every embedded chart on the active worksheet. The procedure uses a loop to cycle through each object in the `ChartObjects` collection and then accesses the `Chart` object in each and changes several properties.

```
Sub FormatAllCharts()  
    Dim ChtObj As ChartObject  
    For Each ChtObj In ActiveSheet.ChartObjects  
        With ChtObj.Chart  
            .ChartType = xlLineMarkers  
            .ApplyLayout 3  
            .ChartStyle = 12  
            .ClearToMatchStyle  
            .SetElement msoElementChartTitleAboveChart  
            .SetElement msoElementLegendNone  
            .SetElement msoElementPrimaryValueAxisTitleNone  
            .SetElement msoElementPrimaryCategoryAxisTitleNone  
            .Axes(xlValue).MinimumScale = 0  
            .Axes(xlValue).MaximumScale = 1000  
        End With  
    Next ChtObj  
End Sub
```



On the CD

This example is available on the companion CD-ROM. The filename is `format all charts.xlsm`.

Figure 18-4 shows four charts that use a variety of different formatting; Figure 18-5 shows the same charts after running the `FormatAllCharts` macro.

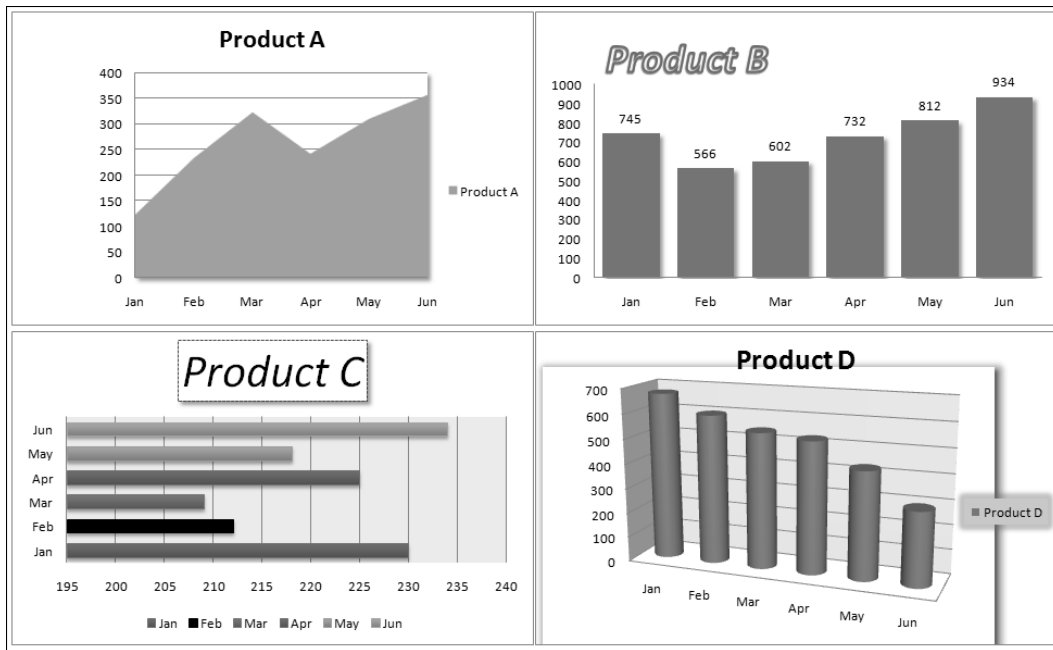


Figure 18-4: These charts use different formatting.

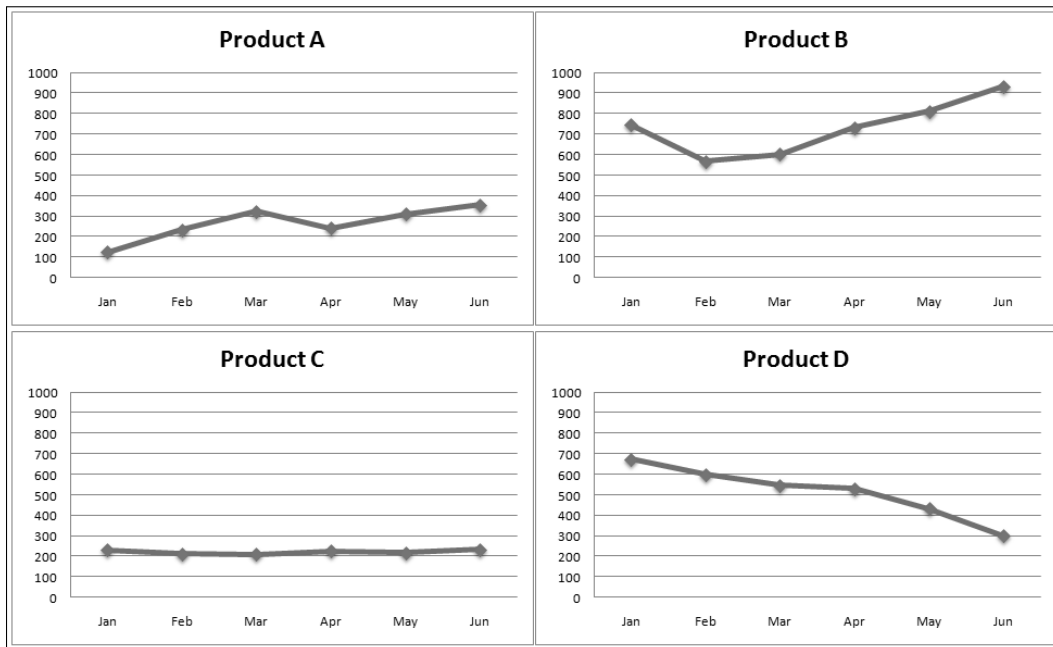


Figure 18-5: A simple macro applied consistent formatting to the four charts.

The following macro performs the same operation as the preceding `FormatAllCharts` procedure but works on all the chart sheets in the active workbook:

```
Sub FormatAllCharts2()
    Dim cht as Chart
    For Each cht In ActiveWorkbook.Charts
        With cht
            .ChartType = xlLineMarkers
            .ApplyLayout 3
            .ChartStyle = 12
            .ClearToMatchStyle
            .SetElement msoElementChartTitleAboveChart
            .SetElement msoElementLegendNone
            .SetElement msoElementPrimaryValueAxisTitleNone
            .SetElement msoElementPrimaryCategoryAxisTitleNone
            .Axes(xlValue).MinimumScale = 0
            .Axes(xlValue).MaximumScale = 1000
        End With
    Next cht
End Sub
```

Sizing and Aligning ChartObjects

A `ChartObject` object has standard positional (`Top` and `Left`) and sizing (`Width` and `Height`) properties that you can access with your VBA code. The Excel Ribbon has controls (in the Chart Tools→Format→Size group) to set the `Height` and `Width`, but not the `Top` and `Left`.

The following example resizes all `ChartObject` objects on a sheet so that they match the dimensions of the active chart. It also arranges the `ChartObject` objects into a user-specified number of columns.

```
Sub SizeAndAlignCharts()
    Dim W As Long, H As Long
    Dim TopPosition As Long, LeftPosition As Long
    Dim ChtObj As ChartObject
    Dim i As Long, NumCols As Long

    If ActiveChart Is Nothing Then
        MsgBox "Select a chart to be used as the base for the sizing"
```

```

        Exit Sub
    End If

    'Get columns
    On Error Resume Next
    NumCols = InputBox("How many columns of charts?")
    If Err.Number <> 0 Then Exit Sub
    If NumCols < 1 Then Exit Sub
    On Error GoTo 0

    'Get size of active chart
    W = ActiveChart.Parent.Width
    H = ActiveChart.Parent.Height

    'Change starting positions, if necessary
    TopPosition = 100
    LeftPosition = 20
    For i = 1 To ActiveSheet.ChartObjects.Count
        With ActiveSheet.ChartObjects(i)
            .Width = W
            .Height = H
            .Left = LeftPosition + ((i - 1) Mod NumCols) * W
            .Top = TopPosition + Int((i - 1) / NumCols) * H
        End With
    Next i
End Sub

```

If no chart is active, the user is prompted to activate a chart that will be used as the basis for sizing the other charts. I use an `InputBox` function to get the number of columns. The values for the `Left` and `Top` properties are calculated within the loop.

Figure 18-6 shows some charts, neatly sized and arranged.



On the CD

This workbook, named `size and align charts.xlsm`, is available on the companion CD-ROM.

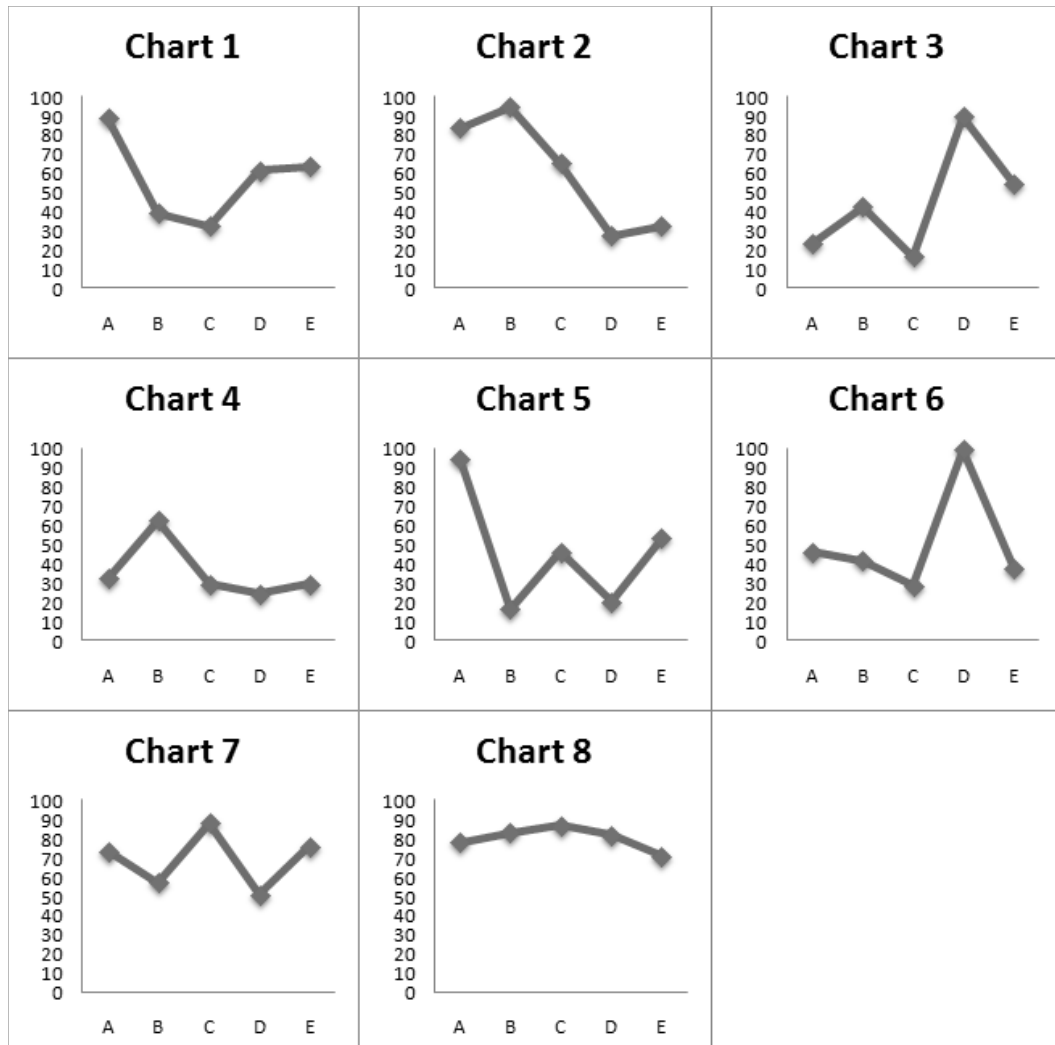


Figure 18-6: Using a VBA macro to size and align embedded charts.

Exporting a Chart

In some cases, you may need an Excel chart in the form of a graphics file. For example, you may want to post the chart on a Web site. One option is to use a screen-capture program and copy the pixels directly from the screen. Another choice is to write a simple VBA macro.

The procedure that follows uses the `Export` method of the `Chart` object to save the active chart as a GIF file:

```
Sub SaveChartAsGIF ()
    Dim FName as String
    If ActiveChart Is Nothing Then Exit Sub
    FName = ThisWorkbook.Path & "\" & ActiveChart.Name & ".gif"
    ActiveChart.Export FileName:=FName, FilterName:="GIF"
End Sub
```

Other choices for the `FilterName` argument are "JPEG" and "PNG". Usually, GIF and PNG files look better. The Help system lists a third argument for the `Export` method: `Interactive`. If this argument is `True`, you're supposed to see a dialog box in which you can specify export options. However, this argument has no effect.

Keep in mind that the `Export` method will fail if the user doesn't have the specified graphics export filter installed. These filters are installed in the Office (or Excel) setup program.

Exporting all graphics

One way to export all graphic images from a workbook is to save the file in HTML format. Doing so creates a directory that contains GIF and PNG images of the charts, shapes, clipart, and even copied range images (created with `Home`→`Clipboard`→`Paste`→`Picture (U)`).

Here's a VBA procedure that automates the process. It works with the active workbook:

```
Sub SaveAllGraphics()
    Dim FileName As String
    Dim TempName As String
    Dim DirName As String
    Dim gFile As String

    FileName = ActiveWorkbook.FullName
    TempName = ActiveWorkbook.Path & "\" & _
        ActiveWorkbook.Name & "graphics.htm"
    DirName = Left(TempName, Len(TempName) - 4) & "_files"

    ' Save active workbook as HTML, then reopen original
    ActiveWorkbook.Save
    ActiveWorkbook.SaveAs FileName:=TempName, FileFormat:=xlHtml
    Application.DisplayAlerts = False
    ActiveWorkbook.Close
    Workbooks.Open FileName

    ' Delete the HTML file
    Kill TempName

    ' Delete all but *.PNG files in the HTML folder
```

```

gFile = Dir(DirName & "\*.*)"
Do While gFile <> ""
    If Right(gFile, 3) <> "png" Then Kill DirName & "\" & gFile
    gFile = Dir
Loop
' Show the exported graphics
Shell "explorer.exe " & DirName, vbNormalFocus
End Sub

```

The procedure starts by saving the active workbook. Then it saves the workbook as an HTML file, closes the file, and re-opens the original workbook. Next, it deletes the HTML file because we're just interested in the folder that it creates (that's where the images are). The code then loops through the folder and deletes everything except the PNG files. Finally, it uses the `Shell` function to display the folder.



On the CD

This example is available on the companion CD-ROM. The filename is `export all graphics.xlsm`.

Changing the Data Used in a Chart

The examples so far in this chapter have used the `SourceData` property to specify the complete data range for a chart. In many cases, you'll want to adjust the data used by a particular chart series. To do so, access the `Values` property of the `Series` object. The `Series` object also has an `XValues` property that stores the category axis values.



Note

The `Values` property corresponds to the third argument of the `SERIES` formula, and the `XValues` property corresponds to the second argument of the `SERIES` formula. See the sidebar, "Understanding a chart's `SERIES` formula."



Understanding a chart's `SERIES` formula

The data used in each series in a chart is determined by its `SERIES` formula. When you select a data series in a chart, the `SERIES` formula appears in the formula bar. This is not a real formula: In other words, you can't use it in a cell, and you can't use worksheet functions within the `SERIES` formula. You can, however, edit the arguments in the `SERIES` formula.

A `SERIES` formula has the following syntax:

```
=SERIES(series_name, category_labels, values, order, sizes)
```

The arguments that you can use in the SERIES formula are

- **series_name:** (Optional) A reference to the cell that contains the series name used in the legend. If the chart has only one series, the name argument is used as the title. This argument can also consist of text in quotation marks. If omitted, Excel creates a default series name (for example, *Series 1*).
- **category_labels:** (Optional) A reference to the range that contains the labels for the category axis. If omitted, Excel uses consecutive integers beginning with 1. For XY charts, this argument specifies the X values. A noncontiguous range reference is also valid. The ranges' addresses are separated by a comma and enclosed in parentheses. The argument could also consist of an array of comma-separated values (or text in quotation marks) enclosed in curly brackets.
- **values:** (Required) A reference to the range that contains the values for the series. For XY charts, this argument specifies the Y values. A noncontiguous range reference is also valid. The ranges' addresses are separated by a comma and enclosed in parentheses. The argument could also consist of an array of comma-separated values enclosed in curly brackets.
- **order:** (Required) An integer that specifies the plotting order of the series. This argument is relevant only if the chart has more than one series. For example, in a stacked column chart, this parameter determines the stacking order. Using a reference to a cell is not allowed.
- **sizes:** (Only for bubble charts) A reference to the range that contains the values for the size of the bubbles in a bubble chart. A noncontiguous range reference is also valid. The ranges' addresses are separated by a comma and enclosed in parentheses. The argument could also consist of an array of values enclosed in curly brackets.

Range references in a SERIES formula are always absolute, and they always include the sheet name. For example:

```
=SERIES(Sheet1!$B$1, , Sheet1!$B$2:$B$7, 1)
```

A range reference can consist of a noncontiguous range. If so, each range is separated by a comma, and the argument is enclosed in parentheses. In the following SERIES formula, the `values` range consists of B2:B3 and B5:B7:

```
=SERIES(, , (Sheet1!$B$2:$B$3, Sheet1!$B$5:$B$7), 1)
```

You can substitute range names for the range references. If you do so (and the name is a workbook-level name), Excel changes the reference in the SERIES formula to include the workbook. For example:

```
=SERIES(Sheet1!$B$1, , budget.xlsx!CurrentData, 1)
```

Changing chart data based on the active cell

Figure 18-7 shows a chart that's based on the data in the row of the active cell. When the user moves the cell pointer, the chart is updated automatically.

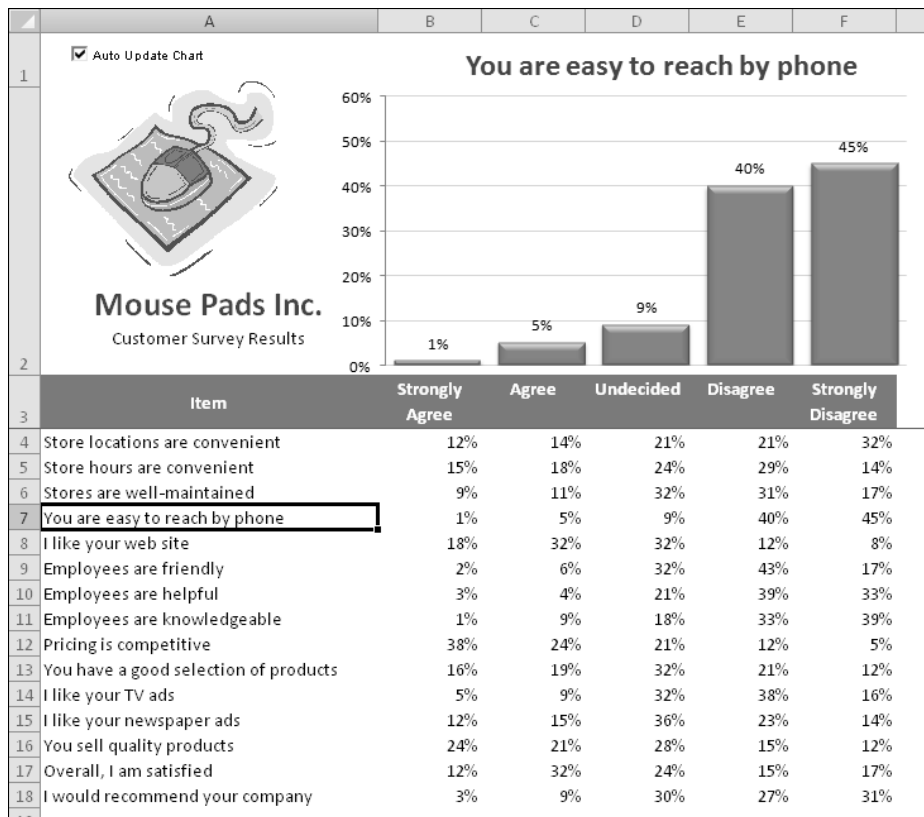


Figure 18-7: This chart always displays the data from the row of the active cell.

This example uses an event handler for the `Sheet1` object. The `SelectionChange` event occurs whenever the user changes the selection by moving the cell pointer. The event-handler procedure for this event (which is located in the code module for the `Sheet1` object) is as follows:

```
Private Sub Worksheet_SelectionChange(ByVal Target _
    As Excel.Range)
    If CheckBox1 Then Call UpdateChart
End Sub
```

In other words, every time the user moves the cell cursor, the `Worksheet_SelectionChange` procedure is executed. If the Auto Update Chart check box (an ActiveX control on the sheet) is checked, this procedure calls the `UpdateChart` procedure, which follows:

```
Sub UpdateChart()
    Dim ChtObj As ChartObject
    Dim UserRow As Long
```



```

Set ChtObj = ActiveSheet.ChartObjects(1)
UserRow = ActiveCell.Row
If UserRow < 4 Or IsEmpty(Cells(UserRow, 1)) Then
    ChtObj.Visible = False
Else
    ChtObj.Chart.SeriesCollection(1).Values = _
        Range(Cells(UserRow, 2), Cells(UserRow, 6))
    ChtObj.Chart.ChartTitle.Text = Cells(UserRow, 1).Text
    ChtObj.Visible = True
End If
End Sub

```

The `UserRow` variable contains the row number of the active cell. The `If` statement checks that the active cell is in a row that contains data. (The data starts in row 4.) If the cell cursor is in a row that doesn't have data, the `ChartObject` object is hidden, and the underlying text is visible ("Cannot display chart"). Otherwise, the code sets the `Values` property for the `Series` object to the range in columns 2–6 of the active row. It also sets the `ChartTitle` object to correspond to the text in column A.



On the CD

This example, named `chart active cell.xlsm`, is available on the companion CD-ROM.

Using VBA to determine the ranges used in a chart

The previous example demonstrated how to use the `Values` property of a `Series` object to specify the data used by a chart series. This section discusses using VBA macros to identify the ranges used by a series in a chart. For example, you might want to increase the size of each series by adding a new cell to the range.

Following is a description of three properties that are relevant to this task:

- **Formula** property: Returns or sets the `SERIES` formula for the `Series`. When you select a series in a chart, its `SERIES` formula is displayed in the formula bar. The `Formula` property returns this formula as a string.
- **Values** property: Returns or sets a collection of all the values in the series. This property can be specified as a range on a worksheet or as an array of constant values, but not a combination of both.
- **XValues** property: Returns or sets an array of X values for a chart series. The `XValues` property can be set to a range on a worksheet or to an array of values, but it can't be a combination of both. The `XValues` property can also be empty.

If you create a VBA macro that needs to determine the data range used by a particular chart series, you might think that the `Values` property of the `Series` object is just the ticket. Similarly, the `XValues` property seems to be the way to get the range that contains the X values (or category labels). In theory, that certainly *seems* correct. But, in practice, it doesn't work.

When you set the `Values` property for a `Series` object, you can specify a `Range` object or an array. But when you read this property, an array is always returned. Unfortunately, the object model provides no way to get a `Range` object used by a `Series` object.

One possible solution is to write code to parse the `SERIES` formula and extract the range addresses. This task sounds simple, but it's actually difficult because a `SERIES` formula can be very complex. Following are a few examples of valid `SERIES` formulas:

```
=SERIES(Sheet1!$B$1, Sheet1!$A$2:$A$4, Sheet1!$B$2:$B$4, 1)
=SERIES(, , Sheet1!$B$2:$B$4, 1)
=SERIES(, Sheet1!$A$2:$A$4, Sheet1!$B$2:$B$4, 1)
=SERIES("Sales Summary", , Sheet1!$B$2:$B$4, 1)
=SERIES(, {"Jan", "Feb", "Mar"}, Sheet1!$B$2:$B$4, 1)
=SERIES(, (Sheet1!$A$2, Sheet1!$A$4), (Sheet1!$B$2, Sheet1!$B$4), 1)
=SERIES(Sheet1!$B$1, Sheet1!$A$2:$A$4, Sheet1!$B$2:$B$4, 1, Sheet1!$C$2:$C$4)
```

As you can see, a `SERIES` formula can have missing arguments, use arrays, and even use noncontiguous range addresses. And, to confuse the issue even more, a bubble chart has an additional argument (for example, the last `SERIES` formula in the preceding list). Attempting to parse the arguments is certainly not a trivial programming task.

I spent a lot of time working on this problem, and I eventually arrived at a solution that involves evaluating the `SERIES` formula by using a dummy function. This function accepts the same arguments as a `SERIES` formula and returns a 2 x 5 element array that contains all the information in the `SERIES` formula.

I simplified the solution by creating four custom VBA functions, each of which accepts one argument (a reference to a `Series` object) and returns a two-element array. These functions are the following:

- `SERIESNAME_FROM_SERIES`: The first array element contains a string that describes the data type of the first `SERIES` argument (`Range`, `Empty`, or `String`). The second array element contains a range address, an empty string, or a string.
- `XVALUES_FROM_SERIES`: The first array element contains a string that describes the data type of the second `SERIES` argument (`Range`, `Array`, `Empty`, or `String`). The second array element contains a range address, an array, an empty string, or a string.
- `VALUES_FROM_SERIES`: The first array element contains a string that describes the data type of the third `SERIES` argument (`Range` or `Array`). The second array element contains a range address or an array.
- `BUBBLESIZE_FROM_SERIES`: The first array element contains a string that describes the data type of the fifth `SERIES` argument (`Range`, `Array`, or `Empty`). The second array element contains a range address, an array, or an empty string. This function is relevant only for bubble charts.

Note that I did not create a function to get the fourth SERIES argument (plot order). You can obtain this argument directly by using the `PlotOrder` property of the `Series` object.



On the CD

The VBA code for these functions is too lengthy to be listed here, but the code is available on the companion CD-ROM in a file named `get series ranges.xlsm`. These functions are documented in such a way that they can be easily adapted to other situations.

The following example demonstrates the `VALUES_FROM_SERIES` function. It displays the address of the values range for the first series in the active chart.

```
Sub ShowValueRange()
    Dim Ser As Series
    Dim x As Variant
    Set Ser = ActiveChart.SeriesCollection(1)
    x = VALUES_FROM_SERIES(Ser)
    If x(1) = "Range" Then
        MsgBox Range(x(2)).Address
    End If
End Sub
```

The variable `x` is defined as a variant and will hold the two-element array that's returned by the `VALUES_FROM_SERIES` function. The first element of the `x` array contains a string that describes the data type. If the string is `Range`, the message box displays the address of the range contained in the second element of the `x` array.

Figure 18-8 shows another example. The chart has three data series. Buttons on the sheet execute macros that expand and contract each of the data ranges.

The `ContractAllSeries` procedure follows. This procedure loops through the `Series Collection` collection and uses the `XVALUE_FROM_SERIES` and the `VALUES_FROM_SERIES` functions to retrieve the current ranges. It then uses the `Resize` method to decrease the size of the ranges.

```
Sub ContractAllSeries()
    Dim s As Series
    Dim Result As Variant
    Dim DRange As Range
    For Each s In ActiveSheet.ChartObjects(1).Chart.SeriesCollection
        Result = XVALUES_FROM_SERIES(s)
        If Result(1) = "Range" Then
            Set DRange = Range(Result(2))
            If DRange.Rows.Count > 1 Then
                Set DRange = DRange.Resize(DRange.Rows.Count - 1)
                s.XValues = DRange
            End If
        End If
    End For
End Sub
```

```

Result = VALUES_FROM_SERIES(s)
If Result(1) = "Range" Then
    Set DRange = Range(Result(2))
    If DRange.Rows.Count > 1 Then
        Set DRange = DRange.Resize(DRange.Rows.Count - 1)
        s.Values = DRange
    End If
End If
Next s
End Sub

```

The `ExpandAllSeries` procedure is very similar. When executed, it expands each range by one cell.

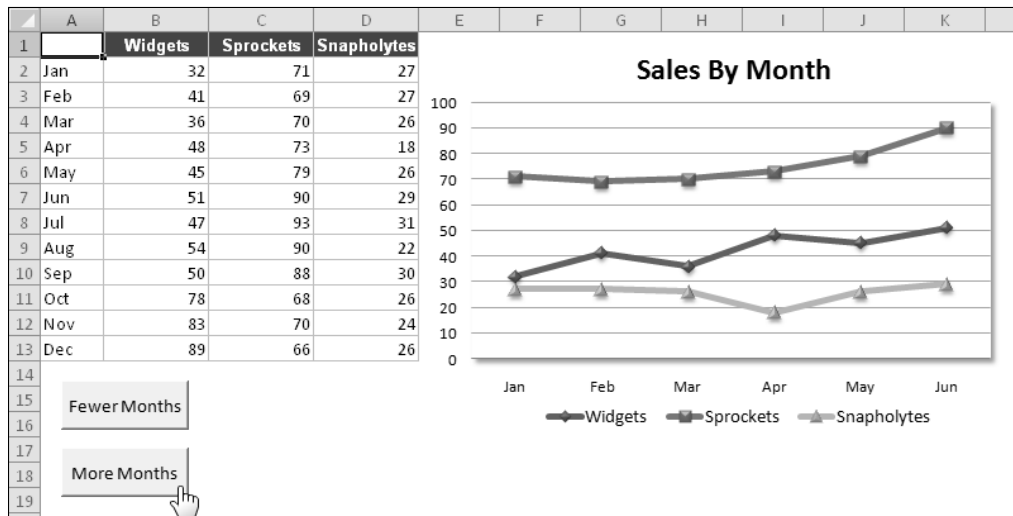


Figure 18-8: This workbook demonstrates how to expand and contract the chart series by using VBA macros.

Using VBA to Display Arbitrary Data Labels on a Chart

One of the most frequent complaints about Excel's charting is its inflexible data labeling feature. For example, consider the XY chart in Figure 18-9. It would be useful to display the associated name for each data point. However, you can search all day, and you'll never find the Excel command that lets you do this automatically. Such a command doesn't exist. Data labels are limited to the data values only — unless you want to edit each data label manually and replace it with text (or a formula) of your choice.

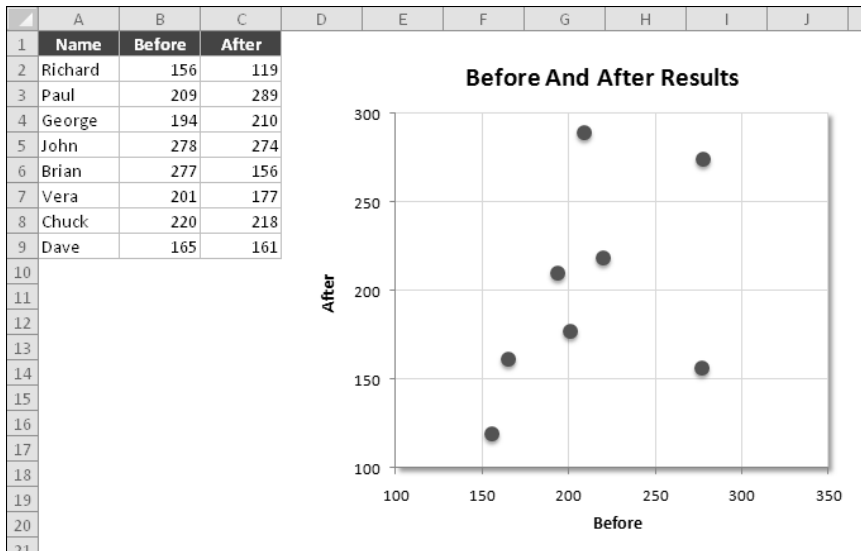


Figure 18-9: An XY chart with no data labels.

The `DataLabelsFromRange` procedure works with the first chart on the active sheet. It prompts the user for a range and then loops through the `Points` collection and changes the `Text` property to the values found in the range.

```
Sub DataLabelsFromRange()
    Dim DLRange As Range
    Dim Cht As Chart
    Dim i As Integer, Pts As Integer

    ' Specify chart
    Set Cht = ActiveSheet.ChartObjects(1).Chart

    ' Prompt for a range
    On Error Resume Next
    Set DLRange = Application.InputBox _
        (prompt:="Range for data labels?", Type:=8)
    If DLRange Is Nothing Then Exit Sub
    On Error GoTo 0

    ' Add data labels
    Cht.SeriesCollection(1).ApplyDataLabels _
        Type:=xlDataLabelsShowValue, _
        AutoText:=True, _
        LegendKey:=False

    ' Loop through the Points, and set the data labels
    Pts = Cht.SeriesCollection(1).Points.Count
    For i = 1 To Pts
```

```

Cht.SeriesCollection(1). _
    Points(i).DataLabel.Text = DLRRange(i)
Next i
End Sub

```



On the CD

This example, named `data labels.xlsm`, is available on the companion CD-ROM.

Figure 18-10 shows the chart after running the `DataLabelsFromRange` procedure and specifying A2:A9 as the data range.

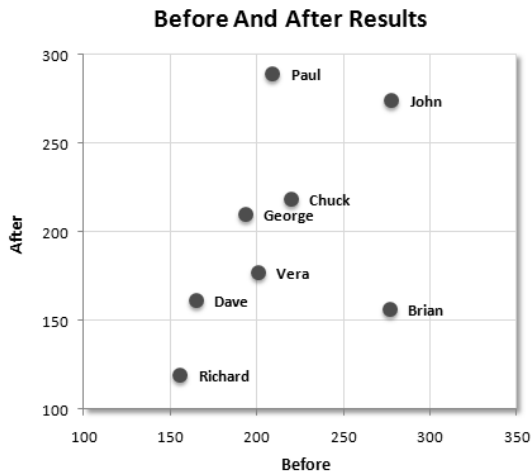


Figure 18-10: This XY chart has data labels, thanks to a VBA procedure.

A data label in a chart can also consist of a link to a cell. To modify the `DataLabelsFromRange` procedure so it creates cell links, just change the statement within the `For-Next` loop to:

```

Cht.SeriesCollection(1).Points(i).DataLabel.Text = _
    "=" & "'" & DLRRange.Parent.Name & "!" & _
    DLRRange(i).Address(ReferenceStyle:=xlR1C1)

```



Note

The preceding procedure is rather crude and does very little error checking. In addition, it only works with the first `Series` object. The Power Utility Pak add-in (which you can obtain by using the coupon in the back of the book) includes a much more sophisticated chart data-labeling utility.

Displaying a Chart in a UserForm

In Chapter 15, I describe a way to display a chart in a UserForm. The technique saves the chart as a GIF file and then loads the GIF file into an Image control on the UserForm.

The example in this section uses that same technique but adds a new twist: The chart is created on the fly and uses the data in the row of the active cell. Figure 18-11 shows an example.

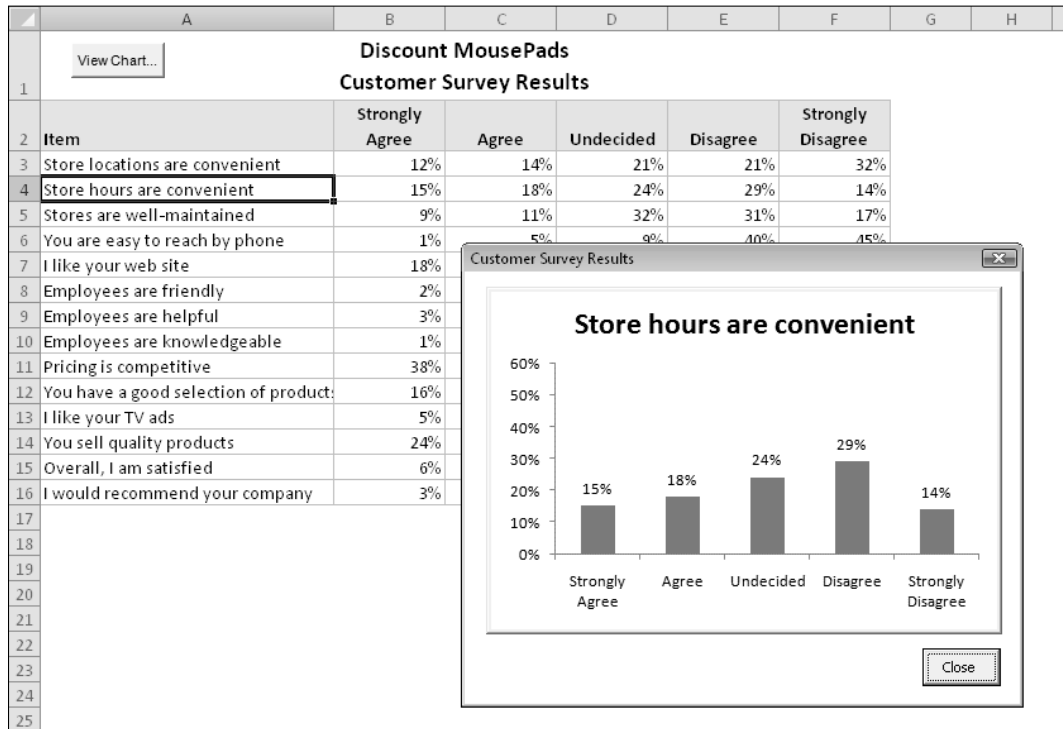


Figure 18-11: The chart in this UserForm is created on the fly from the data in the active row.

The UserForm for this example is very simple. It contains an Image control and a CommandButton (Close). The worksheet that contains the data has a button that executes the following procedure:

```
Sub ShowChart()
    Dim UserRow As Long
    UserRow = ActiveCell.Row
    If UserRow < 2 Or IsEmpty(Cells(UserRow, 1)) Then
        MsgBox "Move the cell pointer to a row that contains data."
        Exit Sub
    End If
    CreateChart (UserRow)
    UserForm1.Show
End Sub
```

Because the chart is based on the data in the row of the active cell, the procedure warns the user if the cell pointer is in an invalid row. If the active cell is appropriate, `ShowChart` calls the `CreateChart` procedure to create the chart and then displays the `UserForm`.

The `CreateChart` procedure accepts one argument, which represents the row of the active cell. This procedure originated from a macro recording that I cleaned up to make more general.

```
Sub CreateChart(r)
    Dim TempChart As Chart
    Dim CatTitles As Range
    Dim SrcRange As Range, SourceData As Range
    Dim FName As String

    Set CatTitles = ActiveSheet.Range("A2:F2")
    Set SrcRange = ActiveSheet.Range(Cells(r, 1), Cells(r, 6))
    Set SourceData = Union(CatTitles, SrcRange)

    ' Add a chart
    Application.ScreenUpdating = False
    Set TempChart = ActiveSheet.Shapes.AddChart.Chart
    TempChart.SetSourceData Source:=SourceData

    ' Fix it up
    With TempChart
        .ChartType = xlColumnClustered
        .SetSourceData Source:=SourceData, PlotBy:=xlRows
        .HasLegend = False
        .PlotArea.Interior.ColorIndex = xlNone
        .Axes(xlValue).MajorGridlines.Delete
        .ApplyDataLabels Type:=xlDataLabelsShowValue, LegendKey:=False
        .Axes(xlValue).MaximumScale = 0.6
        .ChartArea.Format.Line.Visible = False
    End With

    ' Adjust the ChartObject's size size
    With ActiveSheet.ChartObjects(1)
        .Width = 300
        .Height = 200
    End With

    ' Save chart as GIF
    FName = Application.DefaultFilePath & Application.PathSeparator & "temp.gif"
    TempChart.Export Filename:=FName, filterName:="GIF"
    ActiveSheet.ChartObjects(1).Delete
    Application.ScreenUpdating = True
End Sub
```

When the `CreateChart` procedure ends, the worksheet contains a `ChartObject` with a chart of the data in the row of the active cell. However, the `ChartObject` isn't visible because `ScreenUpdating` is turned off. The chart is exported and deleted, and `ScreenUpdating` is turned back on.

The final instruction of the `ShowChart` procedure loads the `UserForm`. Following is the `UserForm_Initialize` procedure. This procedure simply loads the GIF file into the `Image` control.

```
Private Sub UserForm_Initialize()  
    Dim FName As String  
    FName = Application.DefaultFilePath & _  
        Application.PathSeparator & "temp.gif"  
    UserForm1.Image1.Picture = LoadPicture(FName)  
End Sub
```



This workbook, named `chart in userform.xlsm`, is available on the companion CD-ROM.

Understanding Chart Events

Excel supports several events associated with charts. For example, when a chart is activated, it generates an `Activate` event. The `Calculate` event occurs after the chart receives new or changed data. You can, of course, write VBA code that gets executed when a particular event occurs.



Refer to Chapter 19 for additional information about events.

Table 18-1 lists all the chart events.

Table 18-1: Events Recognized by the Chart Object

Event	Action That Triggers the Event
Activate	A chart sheet or embedded chart is activated.
BeforeDoubleClick	An embedded chart is double-clicked. This event occurs before the default double-click action.
BeforeRightClick	An embedded chart is right-clicked. The event occurs before the default right-click action.
Calculate	New or changed data is plotted on a chart.
Deactivate	A chart is deactivated.
MouseDown	A mouse button is pressed while the pointer is over a chart.
MouseMove	The position of the mouse pointer changes over a chart.
MouseUp	A mouse button is released while the pointer is over a chart.
Resize	A chart is resized.
Select	A chart element is selected.
SeriesChange	The value of a chart data point is changed.

An example of using Chart events

To program an event handler for an event taking place on a chart sheet, your VBA code must reside in the code module for the `Chart` object. To activate this code module, double-click the `Chart` item in the Project window. Then, in the code module, select `Chart` from the Object drop-down list on the left and select the event from the Procedure drop-down list on the right (see Figure 18-12).

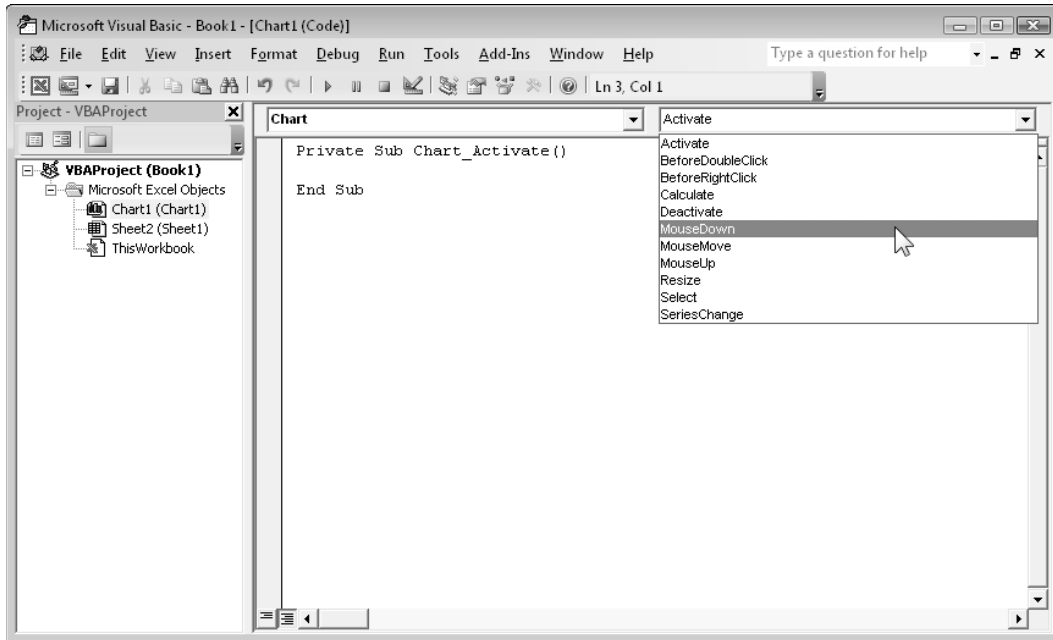


Figure 18-12: Selecting an event in the code module for a `Chart` object.



Note

Because an embedded chart doesn't have its own code module, the procedure that I describe in this section works only for chart sheets. You can also handle events for embedded charts, but you must do some initial setup work that involves creating a class module. This procedure is described later in "Enabling events for an embedded chart."

The example that follows simply displays a message when the user activates a chart sheet, deactivates a chart sheet, or selects any element on the chart. I created a workbook with a chart sheet; then I wrote three event handler procedures named as follows:

- `Chart_Activate`: Executed when the chart sheet is activated.
- `Chart_Deactivate`: Executed when the chart sheet is deactivated.
- `Chart_Select`: Executed when an element on the chart sheet is selected.



On the CD

This workbook, named `events - chart sheet.xlsm`, is available on the companion CD-ROM.

The `Chart_Activate` procedure follows:

```
Private Sub Chart_Activate()  
    Dim msg As String  
    msg = "Hello " & Application.UserName & vbCrLf & vbCrLf  
    msg = msg & "You are now viewing the six-month sales "  
    msg = msg & "summary for Products 1-3." & vbCrLf & vbCrLf  
    msg = msg & _  
        "Click an item in the chart to find out what it is."  
    MsgBox msg, vbInformation, ActiveWorkbook.Name  
End Sub
```

This procedure displays a message whenever the chart is activated. See Figure 18-13.

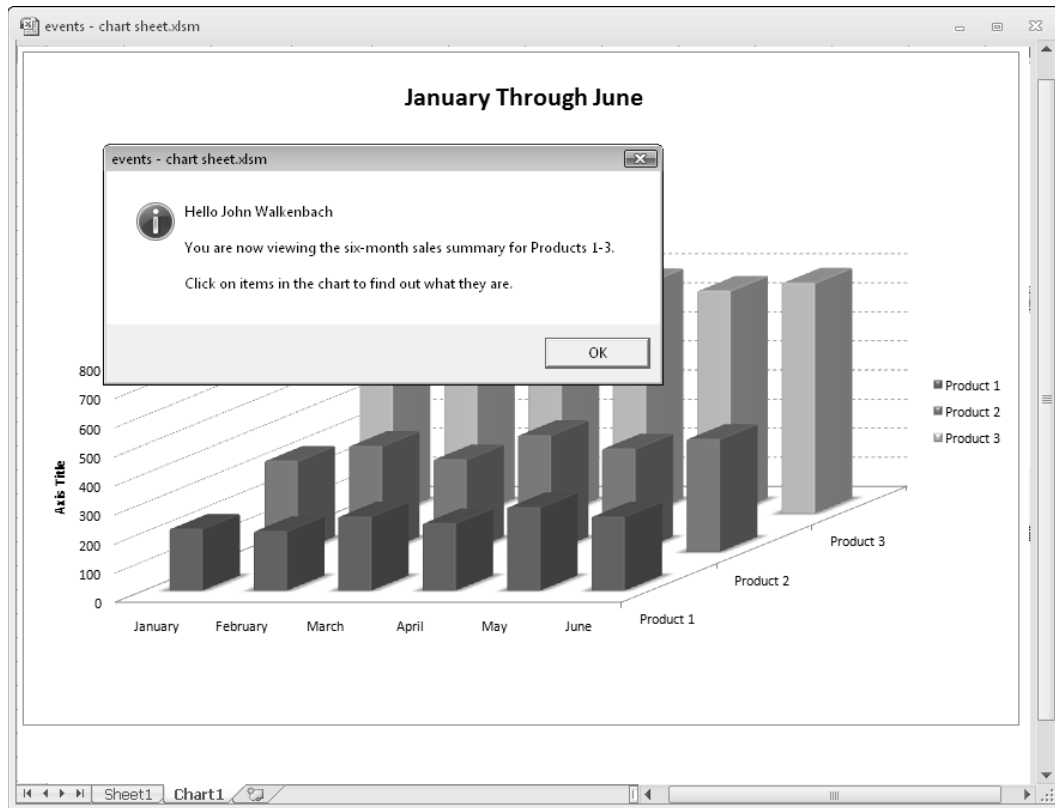


Figure 18-13: Activating the chart causes `Chart_Activate` to display this message.

The `Chart_Deactivate` procedure that follows also displays a message, but only when the chart sheet is deactivated:

```
Private Sub Chart_Deactivate()
    Dim msg As String
    msg = "Thanks for viewing the chart."
    MsgBox msg, , ActiveWorkbook.Name
End Sub
```

The `Chart_Select` procedure that follows is executed whenever an item on the chart is selected:

```
Private Sub Chart_Select(ByVal ElementID As Long, _
    ByVal Arg1 As Long, ByVal Arg2 As Long)
    Dim Id As String
    Select Case ElementID
        Case xlAxis: Id = "Axis"
        Case xlAxisTitle: Id = "AxisTitle"
        Case xlChartArea: Id = "ChartArea"
        Case xlChartTitle: Id = "ChartTitle"
        Case xlCorners: Id = "Corners"
        Case xlDataLabel: Id = "DataLabel"
        Case xlDataTable: Id = "DataTable"
        Case xlDownBars: Id = "DownBars"
        Case xlDropLines: Id = "DropLines"
        Case xlErrorBars: Id = "ErrorBars"
        Case xlFloor: Id = "Floor"
        Case xlHiLoLines: Id = "HiLoLines"
        Case xlLegend: Id = "Legend"
        Case xlLegendEntry: Id = "LegendEntry"
        Case xlLegendKey: Id = "LegendKey"
        Case xlMajorGridlines: Id = "MajorGridlines"
        Case xlMinorGridlines: Id = "MinorGridlines"
        Case xlNothing: Id = "Nothing"
        Case xlPlotArea: Id = "PlotArea"
        Case xlRadarAxisLabels: Id = "RadarAxisLabels"
        Case xlSeries: Id = "Series"
        Case xlSeriesLines: Id = "SeriesLines"
        Case xlShape: Id = "Shape"
        Case xlTrendline: Id = "Trendline"
        Case xlUpBars: Id = "UpBars"
        Case xlWalls: Id = "Walls"
        Case xlXErrorBars: Id = "XErrorBars"
        Case xlYErrorBars: Id = "YErrorBars"
        Case Else: Id = "Some unknown thing"
    End Select

    MsgBox "Selection type:" & Id & vbCrLf & Arg1 & vbCrLf & Arg2
End Sub
```

This procedure displays a message box that contains a description of the selected item, plus the values for `Art1` and `Arg2`. When the `Select` event occurs, the `ElementID` argument contains an integer that corresponds to what was selected. The `Arg1` and `Arg2` arguments provide additional information about the selected item (see the Help system for details). The `Select Case` structure converts the built-in constants to descriptive strings.



This isn't a comprehensive listing of all items that could appear in a `Chart` object. That's why I include the `Case Else` statement.

Enabling events for an embedded chart

As I note in the preceding section, `Chart` events are automatically enabled for chart sheets but not for charts embedded in a worksheet. To use events with an embedded chart, you need to perform the following steps.

Create a class module

In the Visual Basic Editor (VBE) window, select your project in the Project window and choose **Insert→Class Module**. This will add a new (empty) class module to your project. Then use the Properties window to give the class module a more descriptive name (such as `clsChart`). Renaming the class module isn't necessary, but it's a good practice.

Declare a public `Chart` object

The next step is to declare a `Public` variable that will represent the chart. The variable should be of type `Chart`, and it must be declared in the class module by using the `WithEvents` keyword. If you omit the `WithEvents` keyword, the object will not respond to events. Following is an example of such a declaration:

```
Public WithEvents clsChart As Chart
```

Connect the declared object with your chart

Before your event handler procedures will run, you must connect the declared object in the class module with your embedded chart. You do this by declaring an object of type `clsChart` (or whatever your class module is named). This should be a module-level object variable, declared in a regular VBA module (not in the class module). Here's an example:

```
Dim MyChart As New clsChart
```

Then you must write code to associate the `clsChart` object with a particular chart. The statement below accomplishes this:

```
Set MyChart.clsChart = ActiveSheet.ChartObjects(1).Chart
```

After the preceding statement is executed, the `clsChart` object in the class module points to the first embedded chart on the active sheet. Consequently, the event-handler procedures in the class module will execute when the events occur.

Write event handler procedures for the chart class

In this section, I describe how to write event-handler procedures in the class module. Recall that the class module must contain a declaration such as the following:

```
Public WithEvents clsChart As Chart
```

After this new object has been declared with the `WithEvents` keyword, it appears in the Object drop-down list box in the class module. When you select the new object in the Object box, the valid events for that object are listed in the Procedure drop-down box on the right.

The following example is a simple event-handler procedure that is executed when the embedded chart is activated. This procedure simply pops up a message box that displays the name of the `Chart` object's parent (which is a `ChartObject` object).

```
Private Sub clsChart_Activate()  
    MsgBox clsChart.Parent.Name & " was activated!"  
End Sub
```



On the CD

The companion CD-ROM contains a workbook that demonstrates the concepts that I describe in this section. The file is `events - embedded chart.xlsm`.

Example: Using Chart events with an embedded chart

The example in this section provides a practical demonstration of the information presented in the previous section. The example shown in Figure 18-14 consists of an embedded chart that functions as a clickable image map. When chart events are enabled, clicking one of the chart columns activates a worksheet that shows detailed data for the region.

The workbook is set up with four worksheets. The sheet named `Main` contains the embedded chart. The other sheets are named `North`, `South`, and `West`. Formulas in `B1:B4` sum the data in the respective sheets, and this summary data is plotted in the chart. Clicking a column in the chart triggers an event, and the event-handler procedure activates the appropriate sheet so that the user can view the details for the desired region.

The workbook contains both a class module named `EmbChartClass` and a normal VBA module named `Module1`. For demonstration purposes, the `Main` worksheet also contains a check box control (from the Forms group). Clicking the check box executes the `CheckBox1_Click` procedure, which turns event monitoring on and off:

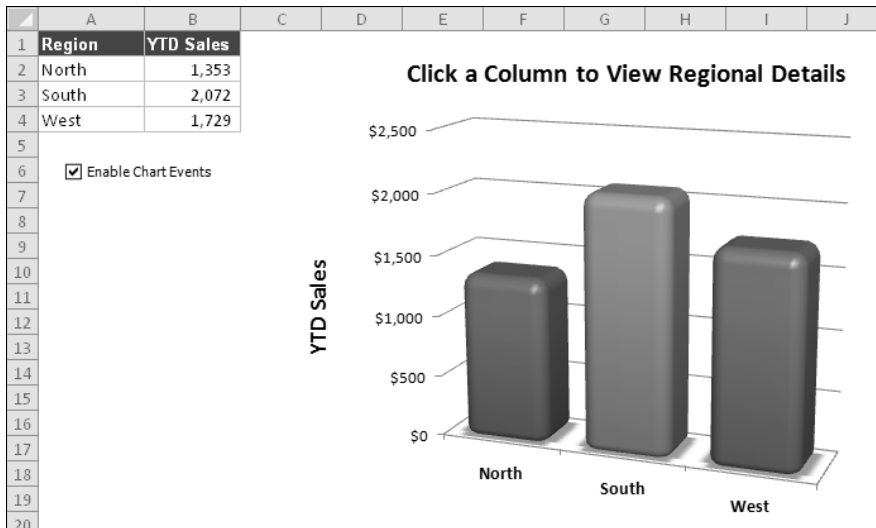


Figure 18-14: This chart serves as a clickable image map.

In addition, each of the other worksheets contains a button that executes the `ReturnToMain` macro that reactivates the Main sheet.

The complete listing of `Module1` follows:

```
Dim SummaryChart As New EmbChartClass
Sub CheckBox1_Click()
    If Worksheets("Main").CheckBoxes("Check Box 1") = xlOn Then
        'Enable chart events
        Range("A1").Select
        Set SummaryChart.myChartClass = _
            Worksheets(1).ChartObjects(1).Chart
    Else
        'Disable chart events
        Set SummaryChart.myChartClass = Nothing
        Range("A1").Select
    End If
End Sub
Sub ReturnToMain()
    ' Called by worksheet button
    Sheets("Main").Activate
End Sub
```

The first instruction declares a new object variable `SummaryChart` to be of type `EmbChart Class` — which, as you recall, is the name of the class module. When the user clicks the `Enable Chart Events` button, the embedded chart is assigned to the `SummaryChart` object, which, in effect, enables the events for the chart. The contents of the class module for `EmbChartClass` follow:

```

Public WithEvents myChartClass As Chart
Private Sub myChartClass_MouseDown(ByVal Button As Long, _
    ByVal Shift As Long, ByVal X As Long, ByVal Y As Long)

    Dim IDnum As Long
    Dim a As Long, b As Long

    ' The next statement returns values for
    ' IDnum, a, and b
    myChartClass.GetChartElement X, Y, IDnum, a, b
    ' Was a series clicked?
    If IDnum = xlSeries Then
        Select Case b
            Case 1
                Sheets("North").Activate
            Case 2
                Sheets("South").Activate
            Case 3
                Sheets("West").Activate
        End Select
    End If
    Range("A1").Select
End Sub

```

Clicking the chart generates a `MouseDown` event, which executes the `myChartClass_MouseDown` procedure. This procedure uses the `GetChartElement` method to determine what element of the chart was clicked. The `GetChartElement` method returns information about the chart element at specified X and Y coordinates (information that is available via the arguments for the `myChartClass_MouseDown` procedure).



On the CD

This workbook, named `chart image map.xlsm`, is available on the companion CD-ROM.

Discovering VBA Charting Tricks

This section contains a few charting tricks that I've discovered over the years. Some of these techniques might be useful in your applications, and others are simply for fun. At the very least, studying them could give you some new insights into the object model for charts.

Printing embedded charts on a full page

When an embedded chart is selected, you can print the chart by choosing File→Print. The embedded chart will be printed on a full page by itself (just as if it were on a chart sheet), yet it will remain an embedded chart.

The following macro prints all embedded charts on the active sheet, and each chart is printed on a full page:

```
Sub PrintEmbeddedCharts()  
    Dim ChtObj As ChartObject  
    For Each ChtObj In ActiveSheet.ChartObjects  
        ChtObj.Chart.PrintOut  
    Next ChtObj  
End Sub
```

Hiding series by hiding columns

By default, Excel charts don't display data contained in hidden rows or columns. The workbook shown in Figure 18-15 demonstrates an easy way to allow the user to hide and unhide particular chart series. The chart has seven data series, and it's a confusing mess. A few simple macros allow the user to use the ActiveX CheckBox to indicate which series they'd like to view. Figure 18-16 shows the chart with only three series displayed.

Each series is in a named range: Product_A, Product_B, and so on. Each check box has its own Click event procedure. For example, the procedure that's executed when the user clicks the Product A check box is

```
Private Sub CheckBox1_Click()  
    ActiveSheet.Range("Product_A").EntireColumn.Hidden = _  
        Not ActiveSheet.OLEObjects(1).Object.Value  
End Sub
```



On the CD

This workbook, named `hide and unhide series.xlsm`, is available on the companion CD-ROM.

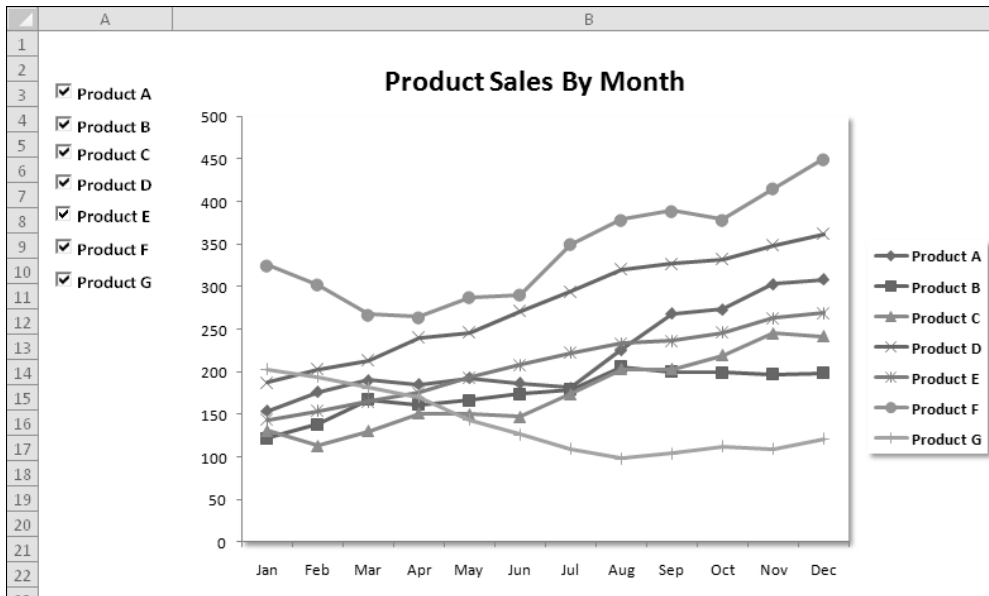


Figure 18-15: Using CheckBox controls to specify which data series to display.

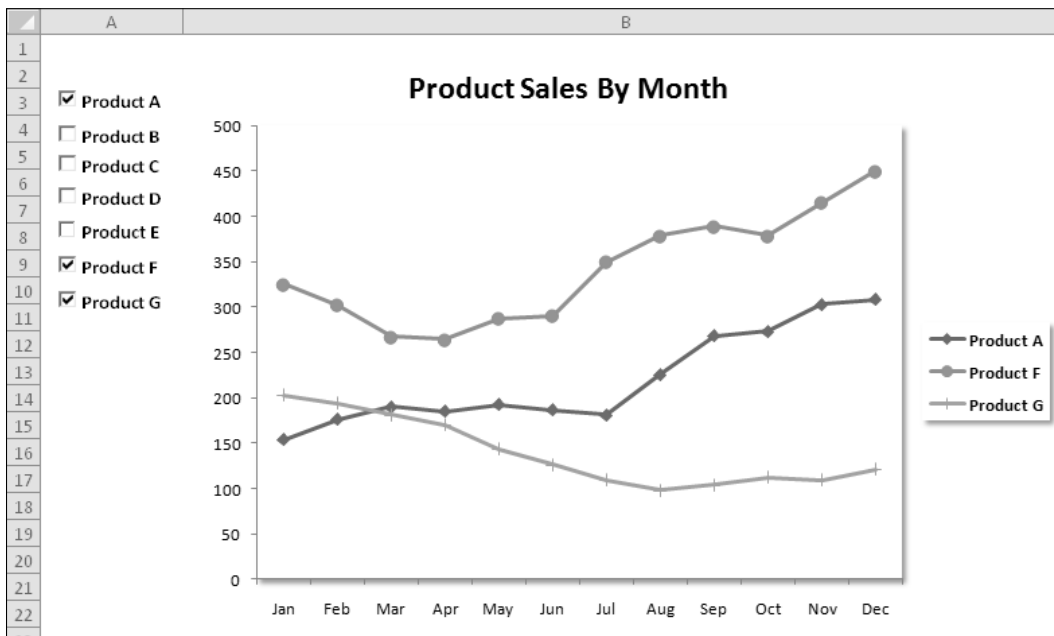


Figure 18-16: A confusing line chart is less confusing when some of the data columns are hidden.

Creating unlinked charts

Normally, an Excel chart uses data stored in a range. Change the data in the range, and the chart is updated automatically. In some cases, you might want to unlink the chart from its data ranges and produce a *dead chart* (a chart that never changes). For example, if you plot data generated by various what-if scenarios, you might want to save a chart that represents some baseline so that you can compare it with other scenarios.

The three ways to create such a chart are

- **Copy the chart as a picture.** Activate the chart and choose Home→Clipboard→Copy→Copy As Picture (accept the defaults in the Copy Picture dialog box). Then click a cell and choose Home→Clipboard→Paste. The result will be a picture of the copied chart.
- **Convert the range references to arrays.** Click a chart series and then click the formula bar. Press F9 to convert the ranges to an array, and press Enter. Repeat this for each series in the chart.
- **Use VBA to assign an array rather than a range to the `XValues` or `Values` properties of the `Series` object.** This technique is described next.

The following procedure creates a chart (see Figure 18-17) by using arrays. The data isn't stored in the worksheet. As you can see, the `SERIES` formula contains arrays and not range references.

```
Sub CreateUnlinkedChart()  
    Dim MyChart As Chart  
    Set MyChart = ActiveSheet.Shapes.AddChart.Chart  
    With MyChart  
        .SeriesCollection.NewSeries  
        .SeriesCollection(1).Name = "Sales"  
        .SeriesCollection(1).XValues = Array("Jan", "Feb", "Mar")  
        .SeriesCollection(1).Values = Array(125, 165, 189)  
        .ChartType = xlColumnClustered  
        .SetElement msoElementLegendNone  
    End With  
End Sub
```

Because Excel imposes a limit to the length of a chart's `SERIES` formula, this technique works only for relatively small data sets.

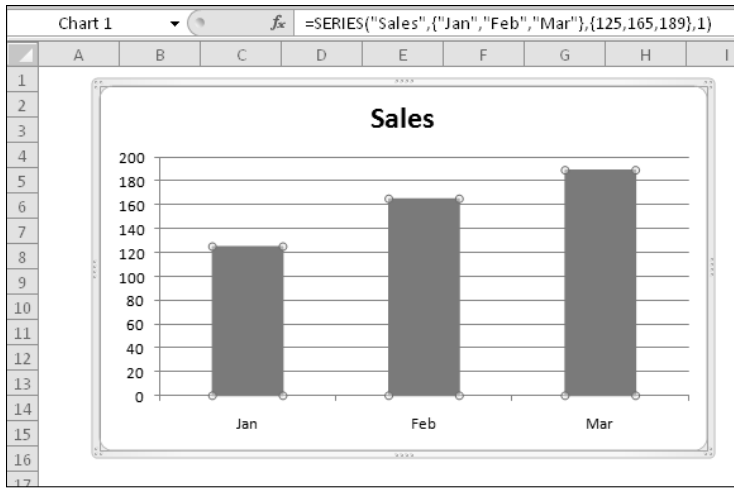


Figure 18-17: This chart uses data from arrays (not stored in a worksheet).

The following procedure creates a picture of the active chart. (The original chart isn't deleted.) It works only with embedded charts.

```
Sub ConvertChartToPicture()
    Dim Cht As Chart
    If ActiveChart Is Nothing Then Exit Sub
    If TypeName(ActiveSheet) = "Chart" Then Exit Sub
    Set Cht = ActiveChart
    Cht.CopyPicture Appearance:=xlPrinter, _
        Size:=xlScreen, Format:=xlPicture
    ActiveWindow.RangeSelection.Select
    ActiveSheet.Paste
End Sub
```

When a chart is converted to a picture, you can create some interesting displays by using the Picture Tools→Format→Picture Styles commands (see Figure 18-18 for an example).



On the CD

The two examples in this section are available on the companion CD-ROM. The filename is `unlinked charts.xlsm`.

Displaying text with the MouseOver event

A common charting question deals with modifying chart tips. A *chart tip* is the small message that appears next to the mouse pointer when you move the mouse over an activated chart. The chart tip displays the chart element name and (for series) the value of the data point. The `Chart` object model does not expose these chart tips, so there is no way to modify them.

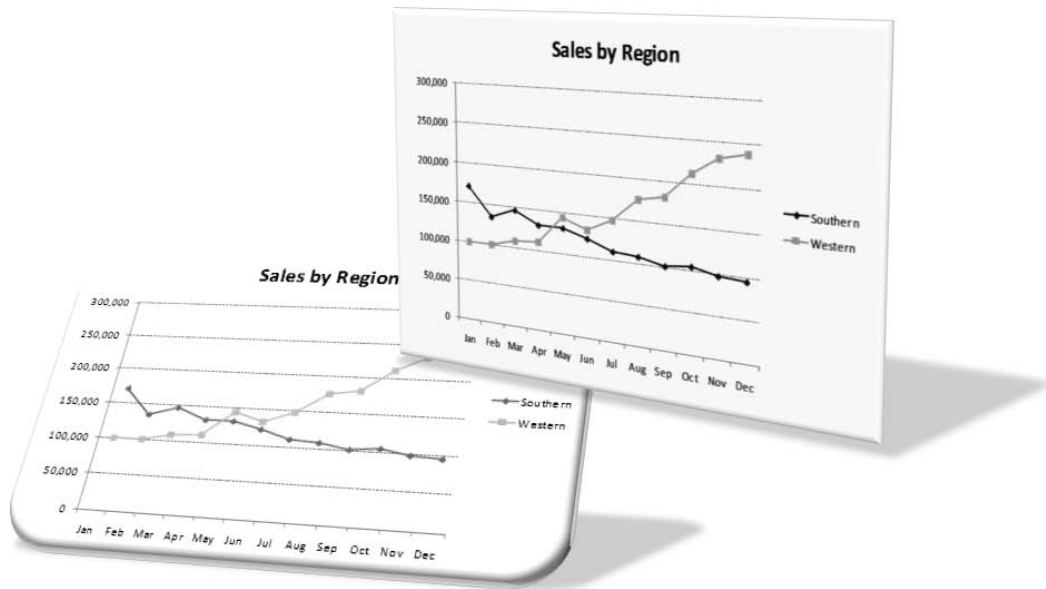


Figure 18-18: After converting a chart to a picture, you can manipulate it by using a variety of commands.



Tip

To turn chart tips on or off, choose **File→Options** to display the Excel Options dialog box. Click the **Advanced** tab and locate the **Display** section. The options are labeled **Show Chart Element Names on Hover** and **Show Data Point Values on Hover**.

This section describes an alternative to chart tips. Figure 18-19 shows a column chart that uses the `MouseOver` event. When the mouse pointer is positioned over a column, the text box (a Shape object) in the upper-left displays information about the data point. The information is stored in a range and can consist of anything you like.

The event procedure that follows is located in the code module for the Chart sheet that contains the chart.

```
Private Sub Chart_MouseMove(ByVal Button As Long, ByVal Shift As Long, _
    ByVal X As Long, ByVal Y As Long)
    Dim ElementId As Long
    Dim arg1 As Long, arg2 As Long
    On Error Resume Next
    ActiveChart.GetChartElement X, Y, ElementId, arg1, arg2
    If ElementId = xlSeries Then
        ActiveChart.Shapes(1).Visible = msoCTrue
        ActiveChart.Shapes(1).TextFrame.Characters.Text = _
            Sheets("Sheet1").Range("Comments").Offset(arg2, arg1)
    Else
        ActiveChart.Shapes(1).Visible = msoFalse
    End If
End Sub
```

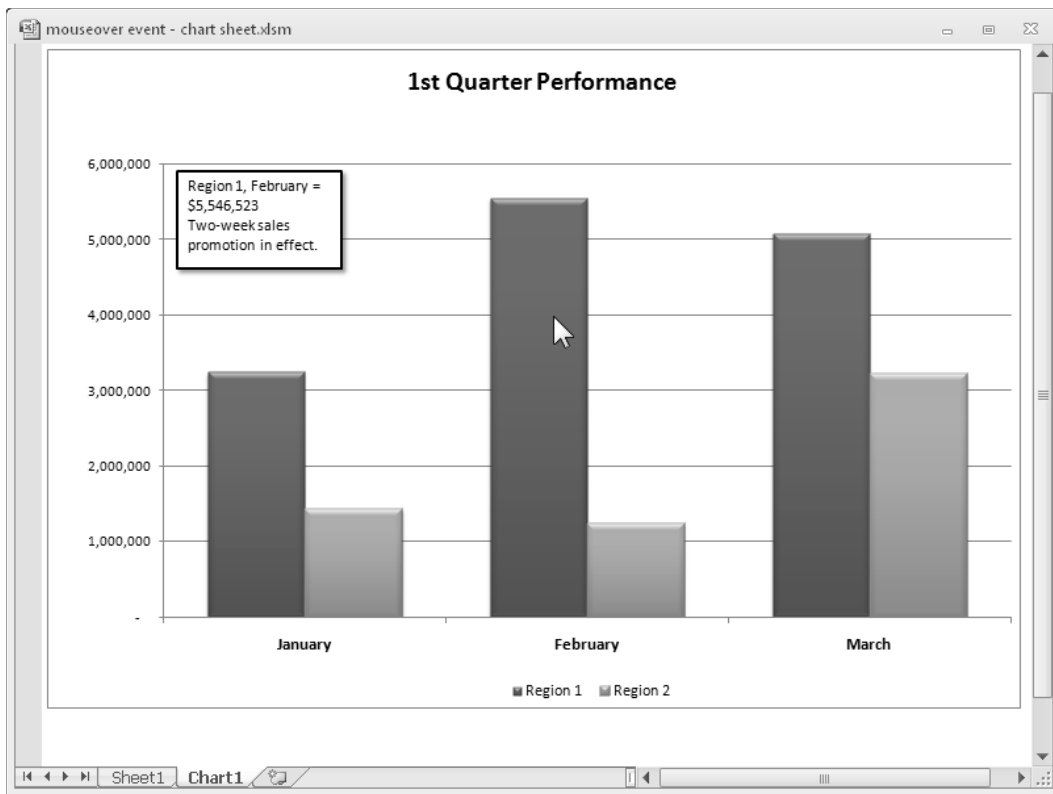


Figure 18-19: A text box displays information about the data point under the mouse pointer.

This procedure monitors all mouse movements on the Chart sheet. The mouse coordinates are contained in the `x` and `y` variables, which are passed to the procedure. The `Button` and `Shift` arguments aren't used in this procedure.

As in the previous example, the key component in this procedure is the `GetChartElement` method. If `ElementId` is `xlSeries`, the mouse pointer is over a series. The `TextBox` is made visible and displays the text in a particular cell. This text contains descriptive information about the data point (see Figure 18-20). If the mouse pointer isn't over a series, the text box is hidden.

The example workbook also contains a `Chart_Activate` event procedure that turns off the normal `ChartTip` display, and a `Chart_Deactivate` procedure that turns the settings back on. The `Chart_Activate` procedure is:

```
Private Sub Chart_Activate()
    Application.ShowChartTipNames = False
    Application.ShowChartTipValues = False
End Sub
```

	A	B	C
1	Month	Region 1	Region 2
2	January	3,245,151	1,434,343
3	February	5,546,523	1,238,709
4	March	5,083,204	3,224,855
5			
6	Comments		
7		Region 1, January = \$3,245,151	Region 2, January = \$1,434,343
8		Region 1, February = \$5,546,523 Two-week sales promotion in effect.	Region 2, February = \$1,238,709
9		Region 1, March = \$5,083,204	Region 2, March = \$3,224,855 L.A. merger took place in week three.
10			

Figure 18-20: Range B7:C9 contains data point information that's displayed in the text box on the chart.



On the CD

The companion CD-ROM contains this example set up for an embedded chart

(mouseover event - embedded.xlsm) and for a chart sheet (mouseover event - chart sheet.xlsm).

Animating Charts

Most people don't realize it, but Excel is capable of performing simple animations. For example, you can animate shapes and charts. Consider the XY chart shown in Figure 18-21.

The X values (column A) depend on the value in cell A1. The value in each row is the previous row's value plus the value in A1. Column B contains formulas that calculate the SIN of the corresponding value in column A. The following simple procedure produces an interesting animation. It uses a loop to continually change the value in cell A1, which causes the values in the X and Y ranges to change. The effect is an animated chart.

```
Sub SimpleAnimation()
    Dim i As Long
    Range("A1") = 0
    For i = 1 To 150
        DoEvents
        Range("A1") = Range("A1") + 0.035
        DoEvents
    Next i
    Range("A1") = 0
End Sub
```

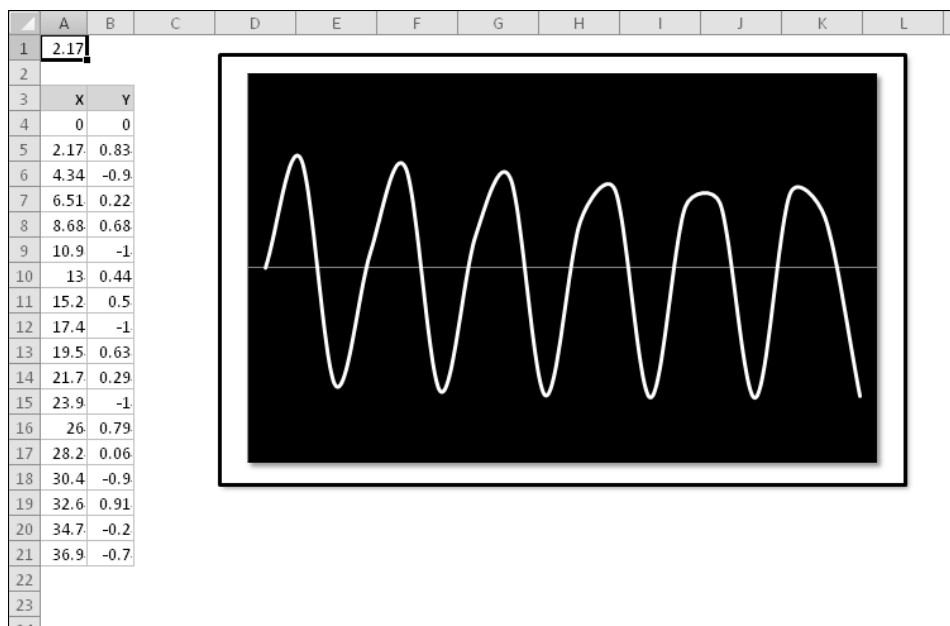


Figure 18-21: A simple VBA procedure will turn this graph into an interesting animation.

The key to chart animation is to use one or more `DoEvents` statements. This statement passes control to the operating system, which (apparently) causes the chart to be updated when control is passed back to Excel. Without the `DoEvents` statements, the chart's changes would not be displayed inside of the loop.



On the CD

The companion CD-ROM contains a workbook that includes this animated chart, plus several other animation examples. The filename is `animated charts.xlsm`.

Scrolling a chart

Figure 18-22 shows a chart with 5,218 data points in each series. The workbook contains six names:

- `StartDay`: A name for cell F1.
- `NumDays`: A name for cell F2.
- `Increment`: A name for cell F3 (used for automatic scrolling).
- `Date`: A named formula:

```
=OFFSET(Sheet1!$A$1,StartDay,0,NumDays,1)
```

- `ProdA`: A named formula:

```
=OFFSET(Sheet1!$B$1,StartDay,0,NumDays,1)
```


► ProdB: A named formula:

```
=OFFSET(Sheet1!$C$1, StartDay, 0, NumDays, 1)
```

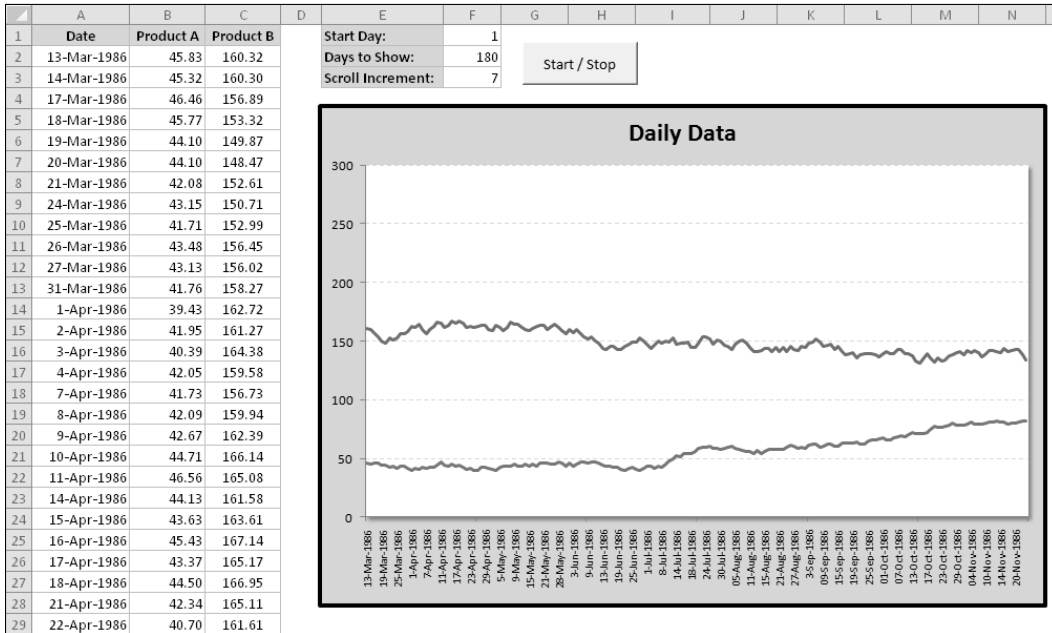


Figure 18-22: The values in column F determine which data to display in the chart.

Each of the SERIES formulas in the chart uses names for the category values and the data. The SERIES formula for the Product A series is as follows (I deleted the sheet name and workbook name for clarity):

```
=SERIES($B$1, Date, ProdA, 1)
```

The SERIES formula for the Product B series is:

```
=SERIES($C$1, Date, ProdB, 2)
```

Using these names enables the user to specify a value for StartDay and NumDays, and the chart will display a subset of the data.



The companion CD-ROM contains a workbook that includes this animated chart, plus several other animation examples. The filename is `scrolling chart.xlsm`.

A relatively simple macro makes the chart scroll. The button in the worksheet executes the following macro that scrolls (or stops scrolling) the chart:

```
Public AnimationInProgress As Boolean

Sub AnimateChart()
    Dim StartVal As Long, r As Long
    If AnimationInProgress Then
        AnimationInProgress = False
    End If
    End If
    AnimationInProgress = True
    StartVal = Range("StartDay")
    For r = StartVal To 5219 - Range("NumDays") _
        Step Range("Increment")
        Range("StartDay") = r
        DoEvents
    Next r
    AnimationInProgress = False
End Sub
```

The `AnimateChart` procedure uses a public variable (`AnimationInProgress`) to keep track of the animation status. The animation results from a loop that changes the value in the `StartDay` cell. Because the two chart series use this value, the chart is continually updated with a new starting value. The `Scroll Increment` setting determines how quickly the chart scrolls.

To stop the animation, I use an `End` statement rather than an `Exit Sub` statement. For some reason, `Exit Sub` doesn't work reliably and may even crash Excel.

Creating a hypocycloid chart

Even if you hated your high school trigonometry class, you'll probably like the example in this section — which relies heavily on trigonometric functions. The workbook shown in Figure 18-23 contains an XY chart that displays a nearly infinite number of dazzling hypocycloid curves. A *hypocycloid* curve is the path formed by a point on a circle that rolls inside of another circle. This, as you may recall from your childhood, is the same technique used in Hasbro's popular Spirograph toy.



On the CD

This workbook is available on the companion CD-ROM. The filename is `hypocycloid - animate.xlsm`.

The chart is an XY chart, with everything hidden except the data series. The X and Y data are generated by using formulas stored in columns A and B. The scroll bar controls at the top let you adjust the three parameters that determine the look of the chart. In addition, clicking the `Random` button generates random values for the three parameters.

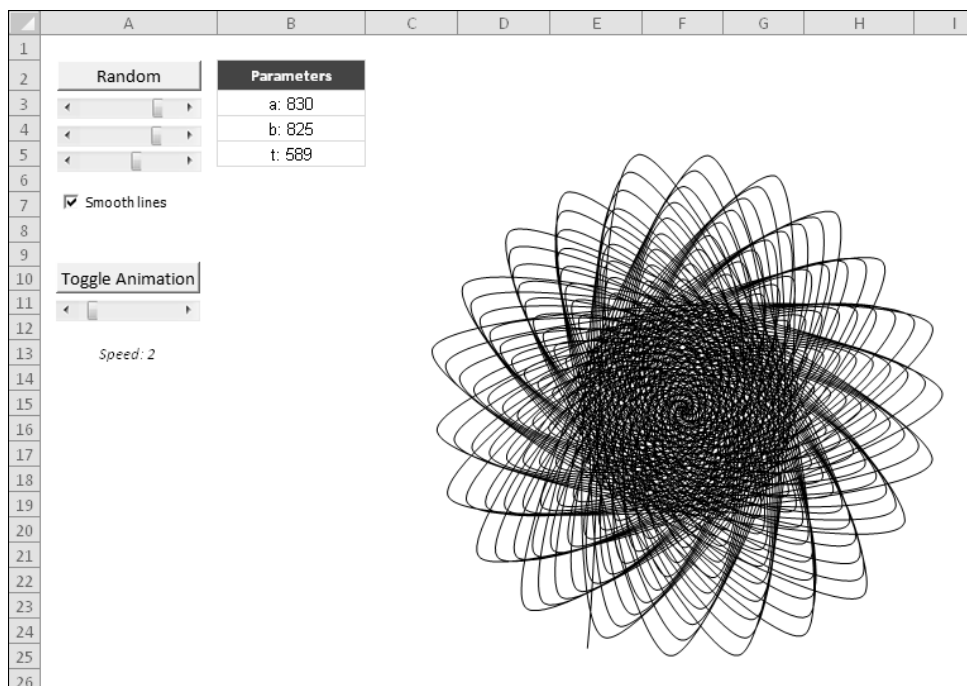


Figure 18-23: This workbook generates hypocycloid curves.

The chart itself is interesting enough, but it gets *really* interesting when it's animated. The animation occurs by changing the starting value for the series within a loop.

Creating a “clock” chart

Figure 18-24 shows an XY chart formatted to look like a clock. It not only looks like a clock, but it also functions as a clock. I can't think of a single reason why anyone would need to display a clock like this on a worksheet, but creating the workbook was challenging, and you might find it instructive.



On the CD

This workbook, named `vba clock chart.xlsm`, is available on the companion CD-ROM.

Besides the clock chart, the workbook contains a text box that displays the time as a normal string, as shown in Figure 18-25. Normally the text box is hidden, but you can display it by deselecting the Analog Clock check box.

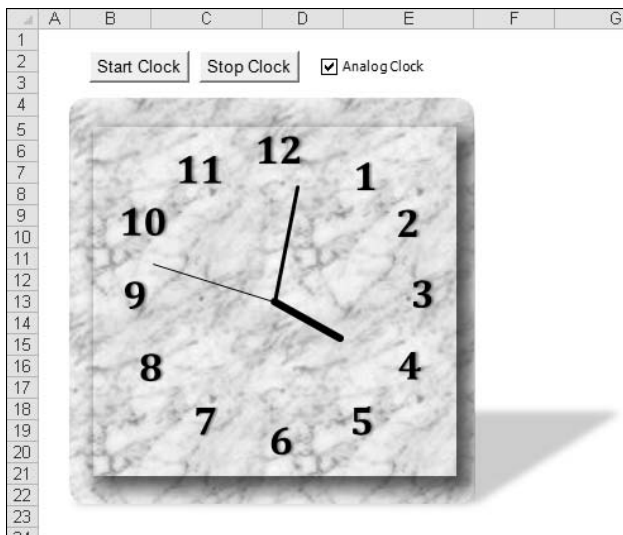


Figure 18-24: This clock is fully functional and is actually an XY chart in disguise.

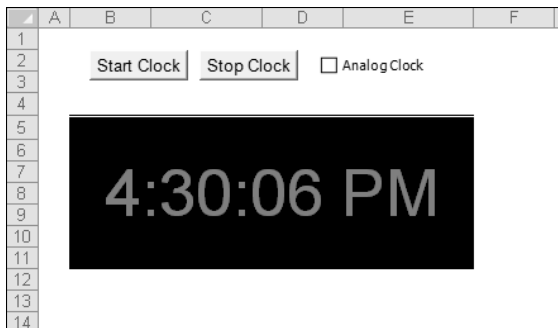


Figure 18-25: Displaying a digital clock in a worksheet is much easier but not as much fun to create.

As you explore this workbook from the CD-ROM, here are a few things to keep in mind:

- The `ChartObject` is named `ClockChart`, and it covers up a range named `DigitalClock`, which is used to display the time digitally.
- The two buttons on the worksheet are from the Forms toolbar, and each has a macro assigned (`StartClock` and `StopClock`).
- The `CheckBox` control (named `cbClockType`) on the worksheet is from the Forms toolbar — not from the Control Toolbox toolbar. Clicking the object executes a procedure named `cbClockType_Click`, which simply toggles the `Visible` property of the `ChartObject`. When it's invisible, the digital clock is revealed.
- The chart is an XY chart with four `Series` objects. These series represent the hour hand, the minute hand, the second hand, and the 12 numbers.

- The `UpdateClock` procedure is executed when the Start Clock button is clicked. It also uses the `OnTime` method of the `Application` object to set up a new `OnTime` event that will occur in one second. In other words, the `UpdateClock` procedure is called every second.
- Unlike most charts, this one doesn't use any worksheet ranges for its data. Rather, the values are calculated in VBA and transferred directly to the `Values` and `xValues` properties of the chart's `Series` object.



Caution

Although this clock is an interesting demo, it isn't feasible to display a continually updating clock in a worksheet. The VBA macro must be running at all times in the background, which may interfere with other macros and reduce the overall performance.

Creating an Interactive Chart without VBA

The example shown in Figure 18-26 is a useful application that allows the user to choose two U.S. cities (from a list of 284 cities) and view a chart that compares the cities by month in any of the following categories: average precipitation, average temperature, percent sunshine, and average wind speed.

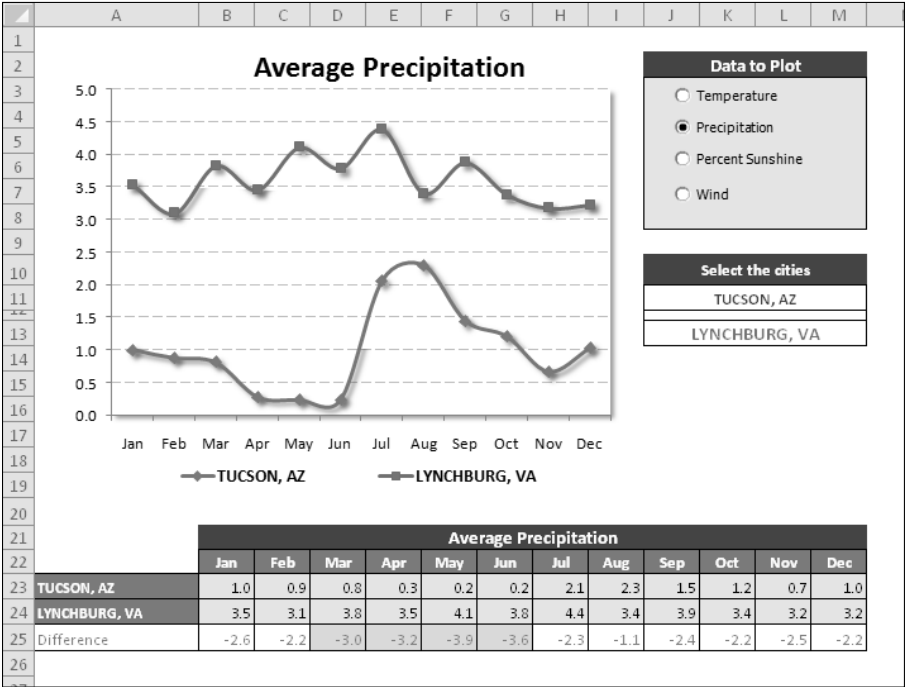


Figure 18-26: This application uses a variety of techniques to plot monthly climate data for two selected U.S. cities.

The most interesting aspect of this application is that it uses no VBA macros. The interactivity is a result of using Excel's built-in features. The cities are chosen from a drop-down list, using Excel's Data Validation feature, and the data option is selected using four Option Button controls, which are linked to a cell. The pieces are all connected using a few formulas.

This example demonstrates that it is indeed possible to create a user-friendly, interactive application without the assistance of macros.



On the CD

This workbook, named `climate data.xlsx`, is available on the companion CD-ROM.

The following sections describe the steps I took to set up this application.

Getting the data to create an interactive chart

I did a Web search and spent about five minutes locating the data I needed at the National Climatic Data Center. I copied the data from my browser window, pasted it to an Excel worksheet, and did a bit of clean-up work. The result was four 13-column tables of data, which I named `PrecipitationData`, `TemperatureData`, `SunshineData`, and `WindData`. To keep the interface as clean as possible, I put the data on a separate sheet (named `Data`).

Creating the Option Button controls for an interactive chart

I needed a way to allow the user to select the data to plot and decided to use `OptionButton` controls from the Forms toolbar. Because option buttons work as a group, the four `OptionButton` controls are all linked to the same cell: cell O3. Cell O3, therefore, contains a value from 1 to 4, depending on which option button is selected.

I needed a way to obtain the name of the data table based on the numeric value in cell O3. The solution was to write a formula (in cell O4) that uses Excel's `CHOOSE` function:

```
=CHOOSE(O3, "TemperatureData", "PrecipitationData", "SunshineData", "WindData")
```

Therefore, cell O4 displays the name of one of the four named data tables. I then did some cell formatting behind the `OptionButton` controls to make them more visible.

Creating the city lists for the interactive chart

The next step is setting up the application: creating drop-down lists to enable the user to choose the cities to be compared in the chart. Excel's Data Validation feature makes creating a drop-down list in a cell very easy. First, I did some cell merging to create a wider field. I merged cells J11:M11 for the first city list and gave them the name `City1`. I merged cells J13:M13 for the second city list and gave them the name `City2`.

To make working with the list of cities easier, I created a named range, `CityList`, which refers to the first column in the `PrecipitationData` table.

Following are the steps that I used to create the drop-down lists:

1. Select J11:M11.
(Remember, these are merged cells.)
2. Choose Data→Data Validation to display Excel's Data Validation dialog box.
3. Select the Settings tab in the Data Validation dialog box.
4. In the Allow field, choose List.
5. In the Source field, enter `=CityList`.
6. Click OK.
7. Copy J11:M11 to J13:M13.

This duplicates the Data Validation settings for the second city.

Figure 18-27 shows the result.

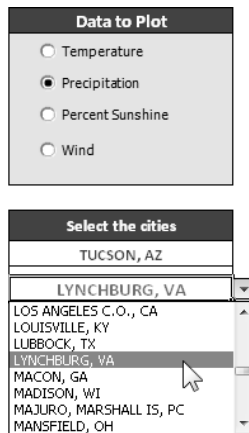


Figure 18-27: Use the Data Validation drop-down list to select a city.

Creating the interactive chart data range

The key to this application is that the chart uses data in a specific range. The data in this range is retrieved from the appropriate data table by using formulas that utilize the `VLOOKUP` function (see Figure 18-28).

	A	B	C	D	E	F	G	H	I	J	K	L	M
20													
21													
22		Average Precipitation											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23	TUCSON, AZ	1.0	0.9	0.8	0.3	0.2	0.2	2.1	2.3	1.5	1.2	0.7	1.0
24	LYNCHBURG, VA	3.5	3.1	3.8	3.5	4.1	3.8	4.4	3.4	3.9	3.4	3.2	3.2
25	Difference	-2.6	-2.2	-3.0	-3.2	-3.9	-3.6	-2.3	-1.1	-2.4	-2.2	-2.5	-2.2
26													
27													

Figure 18-28: The chart uses the data retrieved by formulas in A23:M24.

The formula in cell A23, which looks up data based on the contents of `City1`, is

```
=VLOOKUP(City1, INDIRECT(DataTable), COLUMN(), FALSE)
```

The formula in cell A24 is the same except that it looks up data based on the contents of `City2`:

```
=VLOOKUP(City2, INDIRECT(DataTable), COLUMN(), FALSE)
```

After entering these formulas, I simply copied them across to the next 12 columns.



Note

You may be wondering about the use of the `COLUMN` function for the third argument of the `VLOOKUP` function. This function returns the column number of the cell that contains the formula. This is a convenient way to avoid hard-coding the column to be retrieved and allows the same formula to be used in each column.

Row 25 contains formulas that calculate the difference between the two cities for each month. I used conditional formatting to apply a different color background for the largest difference and the smallest difference.

The label above the month names is generated by a formula that refers to the `DataTable` cell and constructs a descriptive title: The formula is:

```
= "Average " & LEFT(DataTable, LEN(DataTable)-4)
```

Creating the interactive chart

After completing the previous tasks, the final step — creating the actual chart — is a breeze. The line chart has two data series and uses the data in A22:M24. The chart title is linked to cell A21. The data in A22:M24 changes, of course, whenever an `OptionButton` control is selected or a new city is selected from either of the Data Validation lists.

Working with Sparkline Charts

I conclude this chapter with a brief discussion of Sparkline charts, a new feature in Excel 2010. A *Sparkline* is a small chart that's displayed in a cell. A Sparkline lets the viewer quickly spot time-based trends or variations in data. Because they're so compact, Sparklines are often used in a group.

Figure 18-29 shows examples of the three types of Sparklines supported by Excel.

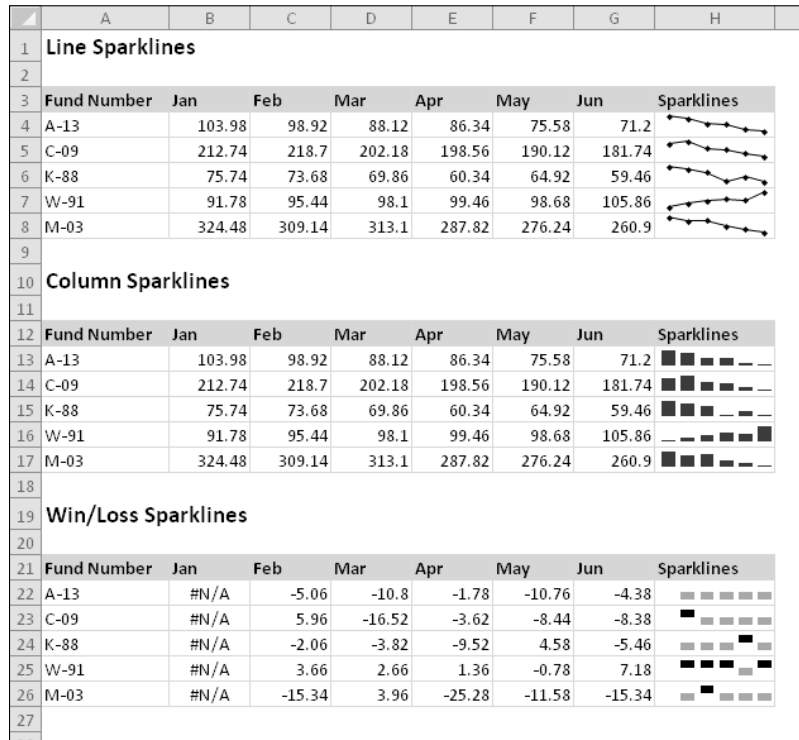


Figure 18-29: Sparkline examples.

I was pleased to see that Microsoft added this feature to Excel's object model, which means that you can work with Sparklines using VBA. At the top of the object hierarchy is the *Sparkline Groups* collection, which is a collection of all *SparklineGroup* objects. A *SparklineGroup* object contains *Sparkline* objects. Contrary to what you might expect, the parent of the *SparklineGroups* collection is a *Range* object, not a *Worksheet* object. Therefore, the following statement generates an error:

```
MsgBox ActiveSheet.SparklineGroups.Count
```

Rather, you need to use the `Cells` property (which returns a range object):

```
MsgBox Cells.SparklineGroups.Count
```

The following example lists the address of each Sparkline group on the active worksheet:

```
Sub ListSparklineGroups()
    Dim sg As SparklineGroup
    Dim i As Long
    For i = 1 To Cells.SparklineGroups.Count
        Set sg = Cells.SparklineGroups(i)
        MsgBox sg.Location.Address
    Next i
End Sub
```

For some reason, you can't use the `For Each` construct to loop through the objects in the `SparklineGroups` collection. You need to refer to the objects by their index number.

Following is another example of working with Sparklines in VBA. The `SparklineReport` procedure lists information about each Sparkline on the active sheet.

```
Sub SparklineReport()
    Dim sg As SparklineGroup
    Dim sl As Sparkline
    Dim SGType As String
    Dim SLSheet As Worksheet
    Dim i As Long, j As Long, r As Long

    If Cells.SparklineGroups.Count = 0 Then
        MsgBox "No sparklines were found on the active sheet."
        Exit Sub
    End If

    Set SLSheet = ActiveSheet
    ' Insert new worksheet for the report
    Worksheets.Add

    ' Headings
    With Range("A1")
        .Value = "Sparkline Report: " & SLSheet.Name & " in " & _
            & SLSheet.Parent.Name
```

```

        .Font.Bold = True
        .Font.Size = 16
    End With
    With Range("A3:F3")
        .Value = Array("Group #", "Sparkline Grp Range", _
            "# in Group", "Type", "Sparkline #", "Source Range")
        .Font.Bold = True
    End With
    r = 4

    'Loop through each sparkline group
    For i = 1 To SLSheet.Cells.SparklineGroups.Count
        Set sg = SLSheet.Cells.SparklineGroups(i)
        Select Case sg.Type
            Case 1: SGType = "Line"
            Case 2: SGType = "Column"
            Case 3: SGType = "Win/Loss"
        End Select
        ' Loop through each sparkline in the group
        For j = 1 To sg.Count
            Set sl = sg.Item(j)
            Cells(r, 1) = i 'Group #
            Cells(r, 2) = sg.Location.Address
            Cells(r, 3) = sg.Count
            Cells(r, 4) = SGType
            Cells(r, 5) = j 'Sparkline # within Group
            Cells(r, 6) = sl.SourceData
            r = r + 1
        Next j
        r = r + 1
    Next i
End Sub

```

Figure 18-30 shows the report generated for the worksheet in Figure 18-29.



On the CD

This workbook, named `sparkline report.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E	F	G
1	Sparkline Report: Sheet1 in sparkline examples.xlsx						
2							
3	Group #	Sparkline Grp Range	# in Group	Type	Sparkline #	Source Range	
4	1	\$H\$4:\$H\$8	5	Line	1	Sheet1!B4:G4	
5	1	\$H\$4:\$H\$8	5	Line	2	Sheet1!B5:G5	
6	1	\$H\$4:\$H\$8	5	Line	3	Sheet1!B6:G6	
7	1	\$H\$4:\$H\$8	5	Line	4	Sheet1!B7:G7	
8	1	\$H\$4:\$H\$8	5	Line	5	Sheet1!B8:G8	
9							
10	2	\$H\$13:\$H\$17	5	Column	1	Sheet1!B13:G13	
11	2	\$H\$13:\$H\$17	5	Column	2	Sheet1!B14:G14	
12	2	\$H\$13:\$H\$17	5	Column	3	Sheet1!B15:G15	
13	2	\$H\$13:\$H\$17	5	Column	4	Sheet1!B16:G16	
14	2	\$H\$13:\$H\$17	5	Column	5	Sheet1!B17:G17	
15							
16	3	\$H\$22:\$H\$26	5	Win/Loss	1	Sheet1!B22:G22	
17	3	\$H\$22:\$H\$26	5	Win/Loss	2	Sheet1!B23:G23	
18	3	\$H\$22:\$H\$26	5	Win/Loss	3	Sheet1!B24:G24	
19	3	\$H\$22:\$H\$26	5	Win/Loss	4	Sheet1!B25:G25	
20	3	\$H\$22:\$H\$26	5	Win/Loss	5	Sheet1!B26:G26	
21							
22							

Figure 18-30: The SparklineReport procedure.

Understanding Excel's Events

In This Chapter

- Recognizing the types of events that Excel can monitor
- Figuring out what you need to know to work with events
- Exploring examples of `Workbook` events, `Worksheet` events, `Chart` events, and `UserForm` events
- Using `Application` events to monitor all open workbooks
- Seeing examples of processing time-based events and keystroke events

What You Should Know about Events

In several earlier chapters in this book, I present examples of VBA *event-handler procedures*, which are specially named procedures that are executed when a specific event occurs. An example is the `CommandButton1_Click` procedure that is executed when the user clicks an object named `CommandButton1` stored on a `UserForm` or on a worksheet. Clicking the button is an event that triggers the execution of the event-handler VBA code.

Excel is programmed to monitor many different events that occur. These events can be classified as the following:

- **Workbook events:** Events that occur for a particular workbook. Examples of such events include `Open` (the workbook is opened or created), `BeforeSave` (the workbook is about to be saved), and `NewSheet` (a new sheet is added).
- **Worksheet events:** Events that occur for a particular worksheet. Examples include `Change` (a cell on the sheet is changed), `SelectionChange` (the user moves the cell indicator), and `Calculate` (the worksheet is recalculated).

- **Chart events:** Events that occur for a particular chart. These events include `Select` (an object in the chart is selected) and `SeriesChange` (a value of a data point in a series is changed). To monitor events for an embedded chart, you use a class module, as I demonstrate in Chapter 18.
- **Application events:** Events that occur for the application (Excel). Examples include `NewWorkbook` (a new workbook is created), `WorkbookBeforeClose` (any workbook is about to be closed), and `SheetChange` (a cell in any open workbook is altered). To monitor `Application`-level events, you need to use a class module.
- **UserForm events:** Events that occur for a particular UserForm or an object contained on the UserForm. For example, a UserForm has an `Initialize` event (occurs before the UserForm is displayed), and a `CommandButton` on a UserForm has a `Click` event (occurs when the button is clicked).
- **Events not associated with objects:** The final category consists of two useful `Application`-level events that I call *On events*: `OnTime` and `OnKey`. These work in a different manner than other events.

This chapter is organized according to the preceding list. Within each section, I provide examples to demonstrate some of the events.

Understanding event sequences

Some actions trigger multiple events. For example, when you insert a new worksheet into a workbook, this action triggers three `Application`-level events:

- `WorkbookNewSheet`: Occurs when a new worksheet is added.
- `SheetDeactivate`: Occurs when the active worksheet is deactivated
- `SheetActivate`: Occurs when the newly added worksheet is activated.



Note

Event sequencing is a bit more complicated than you might think. The preceding events are `Application`-level events. When adding a new worksheet, additional events occur at the `Workbook` level and at the `Worksheet` level.

At this point, just keep in mind that events fire in a particular sequence, and knowing what the sequence is can sometimes be critical when writing event-handler procedures. Later in this chapter, I describe how to determine the order of the events that occur for a particular action (see “Monitoring `Application`-level events”).

Where to put event-handler procedures

VBA newcomers often wonder why their event-handler procedures aren’t being executed when the corresponding event occurs. The answer is almost always because these procedures are located in the wrong place.

In the Visual Basic Editor (VBE) window, each project is listed in the Projects window. The project components are arranged in a collapsible list, as shown in Figure 19-1.

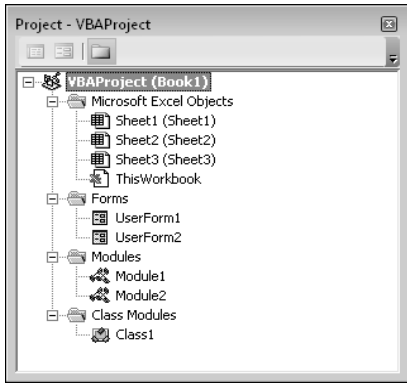


Figure 19-1: The components for each VBA project are listed in the Project window.

Each of the following components has its own code module:

- **Sheet** objects (for example, Sheet1, Sheet2, and so on): Use this module for event-handler code related to the particular worksheet.
- **Chart** objects (that is, chart sheets): Use this module for event-handler code related to the chart.
- **ThisWorkbook** object: Use this module for event-handler code related to the workbook.
- **General VBA modules:** You never put event-handler procedures in a general (that is, non-object) module.
- **UserForm** objects: Use this module for event-handler code related to the UserForm or controls on the UserForm.
- **Class modules:** Use class modules for special-purpose event handlers, including application-level events and events for embedded charts.

Even though the event-handler procedure must be located in the correct module, the procedure can call other standard procedures stored in other modules. For example, the following event-handler procedure, located in the module for the `ThisWorkbook` object, calls a procedure named `WorkbookSetup`, which you can store in a regular VBA module:

```
Private Sub Workbook_Open()  
    Call WorkbookSetup  
End Sub
```



Events in older versions of Excel

Versions of Excel prior to Office 97 also supported events, but the programming techniques required to take advantage of those were quite different from what I describe in this chapter.

For example, if you had a procedure named `Auto_Open` stored in a regular VBA module, this procedure would be executed when the workbook was opened. Beginning with Excel 97, the `Auto_Open` procedure was supplemented by the `Workbook_Open` event-handler procedure, which was stored in the code module for the `ThisWorkbook` object and was executed prior to `Auto_Open`.

Before Excel 97, you often needed to explicitly set up events. For example, if you needed to execute a procedure whenever data was entered into a cell, you would need to execute a statement such as the following:

```
Sheets("Sheet1").OnEntry = "ValidateEntry"
```

This statement instructs Excel to execute the procedure named `ValidateEntry` whenever data is entered into a cell. With Excel 97 and later, you simply create a procedure named `Worksheet_Change` and store it in the code module for the `Sheet1` object.

For compatibility reasons, Excel 97 and later versions still support the older event mechanism (although they are no longer documented in the Help system). I mention old events just in case you ever encounter an old workbook that seems to have some odd statements.

Disabling events

By default, all events are enabled. To disable all events, execute the following VBA instruction:

```
Application.EnableEvents = False
```

To enable events, use this one:

```
Application.EnableEvents = True
```



Note

Disabling events does *not* apply to events triggered by UserForm controls — for example, the `Click` event generated by clicking a `CommandButton` control on a UserForm.

Why would you need to disable events? One common reason is to prevent an infinite loop of cascading events.

For example, suppose that cell A1 of your worksheet must always contain a value less than or equal to 12. You can write some code that is executed whenever data is entered into a cell to validate the cell's contents. In this case, you're monitoring the `Change` event for a `Worksheet` with

a procedure named `Worksheet_Change`. Your procedure checks the user's entry, and, if the entry isn't less than or equal to 12, it displays a message and then clears that entry. The problem is that clearing the entry with your VBA code generates a new `Change` event, so your event-handler procedure is executed again. This is not what you want to happen, so you need to disable events before you clear the cell, and then enable events again so that you can monitor the user's next entry.

Another way to prevent an infinite loop of cascading events is to declare a `Static Boolean` variable at the beginning of your event-handler procedure, such as this:

```
Static AbortProc As Boolean
```

Whenever the procedure needs to make its own changes, set the `AbortProc` variable to `True` (otherwise, make sure that it's set to `False`). Insert the following code at the top of the procedure:

```
If AbortProc Then  
    AbortProc = False  
    Exit Sub  
End if
```

The event procedure is re-entered, but the `True` state of `AbortProc` causes the procedure to end. In addition, `AbortProc` is reset to `False`.



Cross-Ref

For a practical example of validating data, see “Monitoring a range to validate data entry,” later in this chapter.



Caution

Disabling events in Excel applies to all workbooks. For example, if you disable events in your procedure and then open another workbook that has, say, a `Workbook_Open` procedure, that procedure will not execute.

Entering event-handler code

Every event-handler procedure has a predetermined name, and you can't change those names. Following are some examples of event-handler procedure names:

- `Worksheet_SelectionChange`
- `Workbook_Open`
- `Chart_Activate`
- `Class_Initialize`

You can declare the procedure by typing it manually, but a much better approach is to let the VBE do it for you.

Figure 19-2 shows the code module for the `ThisWorkbook` object. To insert a procedure declaration, select `Workbook` from the objects list on the left. Then select the event from the procedures list on the right. When you do so, you get a procedure “shell” that contains the procedure declaration line and an `End Sub` statement.

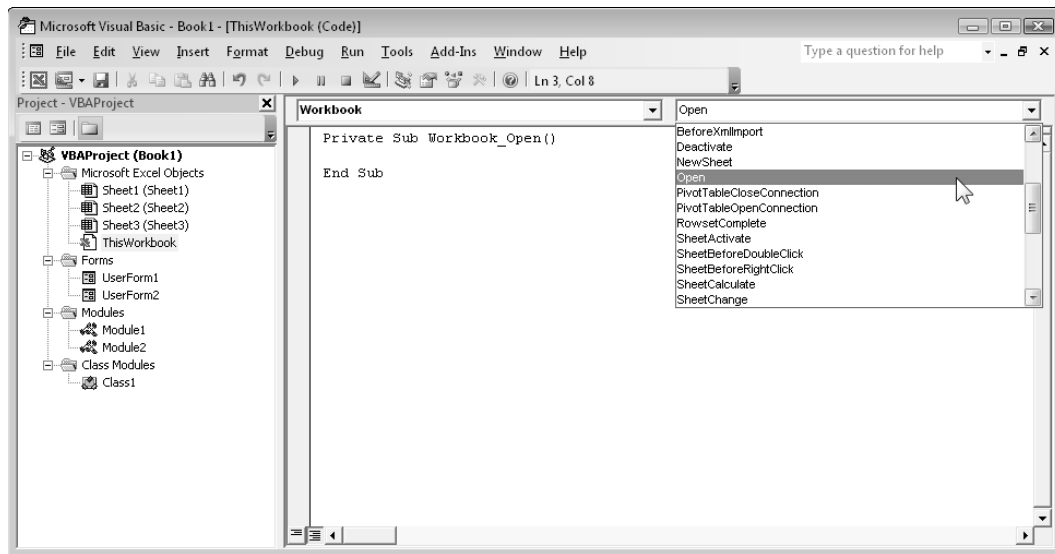


Figure 19-2: The best way to create an event procedure is to let the VBE do it for you.

For example, if you select `Workbook` from the objects list and `Open` from the procedures list, the VBE inserts the following (empty) procedure:

```
Private Sub Workbook_Open()

End Sub
```

Your VBA code, of course, goes between these two statements.

Event-handler procedures that use arguments

Some event-handler procedures use an argument list. For example, you may need to create an event-handler procedure to monitor the `SheetActivate` event for a workbook. If you use the technique described in the previous section, the VBE creates the following procedure:

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)

End Sub
```

This procedure uses one argument (*Sh*), which represents the sheet that was activated. In this case, *Sh* is declared as an *Object* data type rather than a *Worksheet* data type because the activated sheet can also be a chart sheet.

Your code can use the data passed as an argument. The following procedure is executed whenever a sheet is activated. It displays the type and name of the activated sheet by using VBA's *TypeName* function and accessing the *Name* property of the object passed in the argument:

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    MsgBox TypeName(Sh) & vbCrLf & Sh.Name
End Sub
```

Figure 19-3 shows the message that appears when *Sheet1* is activated.

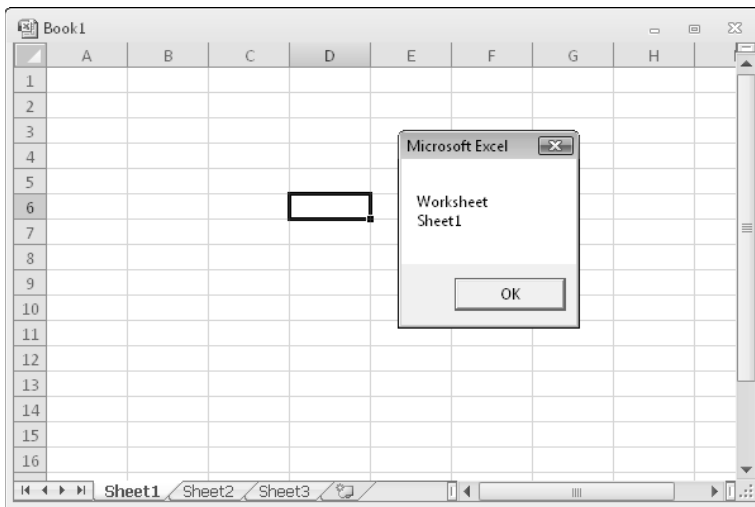


Figure 19-3: This message box was triggered by a *SheetActivate* event.

Several event-handler procedures use a Boolean argument named *Cancel*. For example, the declaration for a workbook's *BeforePrint* event is as follows:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
```

The value of *Cancel* passed to the procedure is *False*. However, your code can set *Cancel* to *True*, which will cancel the printing. The following example demonstrates this:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    Dim Msg As String
    Dim Ans As Integer
    Msg = "Have you loaded the 5164 label stock?"
```

```

Ans = MsgBox(Msg, vbYesNo, "About to print...")
If Ans = vbNo Then Cancel = True
End Sub

```

The `Workbook_BeforePrint` procedure is executed before the workbook is printed. This routine displays the message box shown in Figure 19-4. If the user clicks the No button, `Cancel` is set to `True`, and nothing is printed.

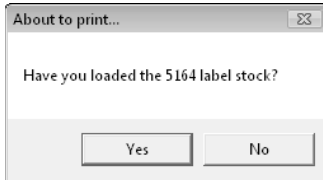


Figure 19-4: You can cancel the print operation by changing the `Cancel` argument.



Tip

The `BeforePrint` event also occurs when the user previews a worksheet.

Unfortunately, Excel doesn't provide a sheet-level `BeforePrint` event. Therefore, your code can't determine which sheet is about to be printed. Often, you can assume that the `ActiveSheet` is the sheet that will be printed. However, there is no way to detect if the user requests that the entire workbook be printed.

Getting Acquainted with Workbook-Level Events

Workbook-level events occur within a particular workbook. Table 19-1 lists the commonly used workbook events, along with a brief description of each. Consult the Help system for a complete list of Workbook-level events. Workbook event-handler procedures are stored in the code module for the `ThisWorkbook` object.

Table 19-1: Commonly Used Workbook Events

Event	Action That Triggers the Event
Activate	A workbook is activated.
AddinInstall	A workbook is installed as an add-in.
AddinUninstall	A workbook is uninstalled as an add-in.
After Save	A workbook has been saved.
BeforeClose	A workbook is about to be closed.
BeforePrint	A workbook (or anything in it) is about to be printed or previewed.
BeforeSave	A workbook is about to be saved.

Event	Action That Triggers the Event
Deactivate	A workbook is deactivated.
NewChart	A chart has been created.
NewSheet	A new sheet is created in a workbook.
Open	A workbook is opened.
SheetActivate	Any sheet is activated.
SheetBeforeDoubleClick	Any worksheet is double-clicked. This event occurs before the default double-click action.
SheetBeforeRightClick	Any worksheet is right-clicked. This event occurs before the default right-click action.
SheetCalculate	Any worksheet is calculated (or recalculated).
SheetChange	Any worksheet is changed by the user or by an external link.
SheetDeactivate	Any sheet is deactivated.
SheetFollowHyperlink	A hyperlink on a sheet is clicked.
SheetPivotTableUpdate	A pivot table is changed or refreshed.
SheetSelectionChange	The selection on any worksheet is changed.
WindowActivate	Any workbook window is activated.
WindowDeactivate	Any workbook window is deactivated.
WindowResize	Any workbook window is resized.



Cross-Ref

If you need to monitor events for *any* workbook, you need to work with Application-level events (see “Monitoring with Application Events,” later in this chapter). The remainder of this section presents examples of using Workbook-level events. All the example procedures that follow must be located in the code module for the `ThisWorkbook` object. If you put them into any other type of code module, they won't work.

The Open event

One of the most common events that is monitored is the `Open` event for a workbook. This event is triggered when the workbook (or add-in) is opened and executes the procedure named `Workbook_Open`. A `Workbook_Open` procedure is often used for tasks such as these:

- Displaying welcome messages.
- Opening other workbooks.
- Setting up shortcut menus.
- Activating a particular sheet or cell.
- Ensuring that certain conditions are met. For example, a workbook may require that a particular add-in is installed.

- Setting up certain automatic features. For example, you can define key combinations (see “The OnKey event” section, later in this chapter).
- Setting a worksheet’s `ScrollArea` property (which isn’t stored with the workbook).
- Setting `UserInterfaceOnly` protection for worksheets so that your code can operate on protected sheets. This setting is an argument for the `Protect` method and isn’t stored with the workbook.

**Note**

Creating event-handler procedures doesn’t guarantee that they will be executed. If the user holds down the Shift key when opening a workbook, the workbook’s `Workbook_Open` procedure won’t execute. And, of course, the procedure won’t execute if the workbook is opened with macros disabled.

Following is an example of a `Workbook_Open` procedure. It uses VBA’s `Weekday` function to determine the day of the week. If it’s Friday, a message box appears, reminding the user to perform a weekly file backup. If it’s not Friday, nothing happens.

```
Private Sub Workbook_Open()  
    If Weekday(Now) = vbFriday Then  
        Msg = "Today is Friday. Make sure that you "  
        Msg = Msg & "do your weekly backup!"  
        MsgBox Msg, vbInformation  
    End If  
End Sub
```

The Activate event

The following procedure is executed whenever the workbook is activated. This procedure simply maximizes the active window. If the workbook window is already maximized, the procedure has no effect.

```
Private Sub Workbook_Activate()  
    ActiveWindow.WindowState = xlMaximized  
End Sub
```

The SheetActivate event

The following procedure is executed whenever the user activates any sheet in the workbook. If the sheet is a worksheet, the code selects cell A1. If the sheet isn’t a worksheet, nothing happens. This procedure uses VBA’s `TypeName` function to ensure that the activated sheet is a worksheet (as opposed to a chart sheet).

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    If TypeName(Sh) = "Worksheet" Then _
        Range("A1").Select
End Sub
```

The following procedure demonstrates an alternative method that doesn't require checking the sheet type. In this procedure, the error is just ignored.

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    On Error Resume Next
    Range("A1").Select
End Sub
```

The NewSheet event

The following procedure is executed whenever a new sheet is added to the workbook. The sheet is passed to the procedure as an argument. Because a new sheet can be a worksheet or a chart sheet, this procedure determines the sheet type. If it's a worksheet, the code adjusts the width of all columns and inserts a date and time stamp in cell A1 on the new sheet.

```
Private Sub Workbook_NewSheet(ByVal Sh As Object)
    If TypeName(Sh) = "Worksheet" Then
        Sh.Cells.ColumnWidth = 35
        Sh.Range("A1") = "Sheet added " & Now()
    End If
End Sub
```

The BeforeSave event

The `BeforeSave` event occurs before the workbook is actually saved. As you know, choosing the **File→Save** command sometimes brings up the **Save As** dialog box. This dialog box appears if the workbook has never been saved or if it was opened in read-only mode.

When the `Workbook_BeforeSave` procedure is executed, it receives an argument (`SaveAsUI`) that indicates whether the **Save As** dialog box will be displayed. The following example demonstrates this:

```
Private Sub Workbook_BeforeSave _
    (ByVal SaveAsUI As Boolean, Cancel As Boolean)
    If SaveAsUI Then
        MsgBox "Make sure you save this file on drive J."
    End If
End Sub
```

When the user attempts to save the workbook, the `Workbook_BeforeSave` procedure is executed. If the save operation will bring up Excel's Save As dialog box, the `SaveAsUI` variable is `True`. The `Workbook_BeforeSave` procedure checks this variable and displays a message only if the Save As dialog box will be displayed. If the procedure sets the `Cancel` argument to `True`, the file won't be saved (or the Save As dialog box won't be shown).

The Deactivate event

The following example demonstrates the `Deactivate` event. This procedure is executed whenever the workbook is deactivated, and essentially never lets the user deactivate the workbook. One way to trigger the `Deactivate` event is to activate a different workbook window. When the `Deactivate` event occurs, the code reactivates the workbook and displays a message.

```
Private Sub Workbook_Deactivate()  
    Me.Activate  
    MsgBox "Sorry, you may not leave this workbook"  
End Sub
```



Note

I don't recommend using procedures, such as this one, that attempt to "take over" Excel. It can be very frustrating and confusing for the user. Rather, I would recommend training the user how to use your application correctly.

This example also illustrates the importance of understanding event sequences. If you try out this procedure, you'll see that it works well if the user attempts to activate another workbook. However, it's important to understand that the workbook `Deactivate` event is also triggered by the following actions:

- Closing the workbook
- Opening a new workbook
- Minimizing the workbook

In other words, this procedure may not perform as it was originally intended. When programming event procedures, you need to make sure that you understand all the actions that can trigger the events.

The BeforePrint event

The `BeforePrint` event occurs when the user requests a print or a print preview but before the printing or previewing actually occurs. The event uses a `Cancel` argument, so your code can cancel the printing or previewing by setting the `Cancel` variable to `True`. Unfortunately, you can't determine whether the `BeforePrint` event was triggered by a print request or by a preview request.

Updating a header or footer

Excel's page header and footer options are very flexible, but these options don't include a common request: the ability to print the contents of a specific cell in the header or footer. The `Workbook_BeforePrint` event provides a way to display the current contents of a cell in the header or footer when the workbook is printed. The following code updates each sheet's left footer whenever the workbook is printed or previewed. Specifically, it inserts the contents of cell A1 on Sheet1:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    Dim sht As Object
    For Each sht In ThisWorkbook.Sheets
        sht.PageSetup.LeftFooter = _
            Worksheets("Sheet1").Range("A1")
    Next sht
End Sub
```

This procedure loops through each sheet in the workbook and sets the `LeftFooter` property of the `PageSetup` object to the value in cell A1 on Sheet1.

Hiding columns before printing

The example that follows uses a `Workbook_BeforePrint` procedure to hide columns B:D in Sheet1 before printing or previewing.

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    'Hide columns B:D on Sheet1 before printing
    Worksheets("Sheet1").Range("B:D").EntireColumn.Hidden = True
End Sub
```

Ideally, you would want to unhide the columns after printing has occurred. It would be nice if Excel provided an `AfterPrint` event, but that event doesn't exist. However, there is a way to unhide the columns automatically. The modified procedure that follows schedules an `OnTime` event, which calls a procedure named `UnhideColumns` five seconds after printing or previewing.

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    'Hide columns B:D on Sheet1 before printing
    Worksheets("Sheet1").Range("B:D").EntireColumn.Hidden = True
    Application.OnTime Now() + TimeValue("0:00:05"), "UnhideColumns"
End Sub
```

The `UnhideColumns` procedure goes in a standard VBA module.

```
Sub UnhideColumns()
    Worksheets("Sheet1").Range("B:D").EntireColumn.Hidden = False
End Sub
```



On the CD

This example, named `hide columns before printing.xlsm`, is available on the companion CD-ROM.



Cross-Ref

For more information about `OnTime` events, see “The `OnTime` event,” later in this chapter.

The BeforeClose event

The `BeforeClose` event occurs before a workbook is closed. This event is often used in conjunction with a `Workbook_Open` event handler. For example, you might use the `Workbook_Open` procedure to add shortcut menu items for your workbook and then use the `Workbook_BeforeClose` procedure to delete the shortcut menu items when the workbook is closed. That way, the custom menu is available only when the workbook is open.

Unfortunately, the `Workbook_BeforeClose` event isn't implemented very well. For example, if you attempt to close a workbook that hasn't been saved, Excel displays a prompt asking whether you want to save the workbook before closing, as shown in Figure 19-5. The problem is, the `Workbook_BeforeClose` event has already occurred by the time the user sees this message. If the user cancels, your event-handler procedure has already executed.

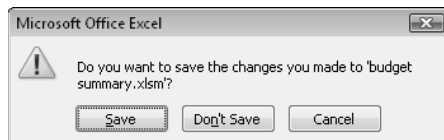


Figure 19-5: When this message appears, `Workbook_BeforeClose` has already done its thing.

Consider this scenario: You need to display custom shortcut menus when a particular workbook is open. Therefore, your workbook uses a `Workbook_Open` procedure to create the menu items when the workbook is opened, and it uses a `Workbook_BeforeClose` procedure to remove the menu items when the workbook is closed. These two event-handler procedures follow. Both of these call other procedures, which aren't shown here.

```
Private Sub Workbook_Open()  
    Call CreateShortcutMenuItems  
End Sub  
  
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call DeleteShortcutMenuItems  
End Sub
```

As I note earlier, Excel's Do you want to save . . . prompt displays *after* the `Workbook_BeforeClose` event handler runs. So, if the user clicks `Cancel`, the workbook remains open, but the custom menu items have already been deleted.

One solution to this problem is to bypass Excel's prompt and write your own code in the `Workbook_BeforeClose` procedure to ask the user to save the workbook. The following code demonstrates:

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Dim Msg As String
    If Me.Saved = False Then
        Msg = "Do you want to save the changes you made to "
        Msg = Msg & Me.Name & "?"
        Ans = MsgBox(Msg, vbQuestion + vbYesNoCancel)
        Select Case Ans
            Case vbYes
                Me.Save
            Case vbCancel
                Cancel = True
                Exit Sub
        End Select
    End If
    Call DeleteShortcutMenuItems
    Me.Saved = True
End Sub
```

This procedure checks the `Saved` property of the `Workbook` object to determine whether the workbook has been saved. If so, no problem — the `DeleteShortcutMenuItems` procedure is executed, and the workbook is closed. But, if the workbook hasn't been saved, the procedure displays a message box that duplicates the one that Excel would normally show. The effect of clicking each of the three buttons is

- **Yes:** The workbook is saved, the shortcut menu items are deleted, and the workbook is closed.
- **No:** The code sets the `Saved` property of the `Workbook` object to `True` (but doesn't actually save the file), deletes the menu items, and closes the file.
- **Cancel:** The `BeforeClose` event is canceled, and the procedure ends without deleting the shortcut menu items.



On the CD

A workbook with this example is available on the companion CD-ROM. The file is named `workbook_beforeclose_workaround.xlsm`.

Examining Worksheet Events

The events for a `Worksheet` object are some of the most useful, because most of what happens in Excel occurs on a worksheet. Monitoring these events can make your applications perform feats that would otherwise be impossible.

Table 19-2 lists the most commonly used worksheet events, with a brief description of each.

Table 19-2: Commonly Used Worksheet Events

Event	Action That Triggers the Event
Activate	The worksheet is activated.
BeforeDoubleClick	The worksheet is double-clicked.
BeforeRightClick	The worksheet is right-clicked.
Calculate	The worksheet is calculated (or recalculated).
Change	Cells on the worksheet are changed by the user or by an external link.
Deactivate	The worksheet is deactivated.
FollowHyperlink	A hyperlink on the sheet is clicked.
PivotTableUpdate	A pivot table on the sheet is updated.
SelectionChange	The selection on the worksheet is changed or refreshed.

Remember that the code for a worksheet event must be stored in the code module for the specific worksheet.



Tip

To quickly activate the code module for a worksheet, right-click the sheet tab and then choose **View Code**.

The Change event

The `Change` event is triggered when any cell in a worksheet is changed by the user or by a VBA procedure. The `Change` event is not triggered when a calculation generates a different value for a formula or when an object is added to the sheet.

When the `Worksheet_Change` procedure is executed, it receives a `Range` object as its `Target` argument. This `Range` object represents the changed cell or range that triggered the event. The following procedure is executed whenever the worksheet is changed. It displays a message box that shows the address of the `Target` range:

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    MsgBox "Range " & Target.Address & " was changed."
End Sub
```

To get a better feel for the types of actions that generate a `Change` event for a worksheet, enter the preceding procedure in the code module for a `Worksheet` object. After entering this procedure, activate Excel and make some changes to the worksheet by using various techniques. Every time the `Change` event occurs, you'll see a message box that displays the address of the range that was changed.

When I ran this procedure, I discovered some interesting quirks. Some actions that should trigger the event don't, and other actions that shouldn't trigger the event do!

- Changing the formatting of a cell doesn't trigger the `Change` event (as expected). But copying and pasting formatting *does* trigger the `Change` event. Choosing the `Home`→`Editing`→`Clear`→`Clear Formats` command also triggers the event.
- Merging cells doesn't trigger the `Change` event, even if the contents of some of the merged cells are deleted in the process.
- Adding, editing, or deleting a cell comment doesn't trigger the `Change` event.
- Pressing `Delete` generates an event even if the cell is empty to start with.
- Cells that are changed by using Excel commands may or may not trigger the `Change` event. For example, sorting a range doesn't trigger the event. But using the spell checker does.
- If your VBA procedure changes a cell, it *does* trigger the `Change` event.

As you can see from the preceding list, it's not a good idea to rely on the `Change` event to detect cell changes for critical applications.

Monitoring a specific range for changes

The `Change` event occurs when any cell on the worksheet is changed. But, in most cases, all you care about are changes made to a specific cell or range. When the `Worksheet_Change` event handler procedure is called, it receives a `Range` object as its argument. This `Range` object represents the cell or cells that were changed.

Assume that your worksheet has a range named `InputRange`, and you'd like to monitor changes made only within this range. There is no `Change` event for a `Range` object, but you can perform a quick check within the `Worksheet_Change` procedure:

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    Dim MRange As Range
    Set MRange = Range("InputRange")
    If Not Intersect(Target, MRange) Is Nothing Then _
        MsgBox "A changed cell is in the input range."
End Sub
```

This example uses a `Range` object variable named `MRange`, which represents the worksheet range that you're interested in monitoring for changes. The procedure uses VBA's `Intersect` function to determine whether the `Target` range (passed to the procedure in its argument) intersects with `MRange`. The `Intersect` function returns an object that consists of all the cells that are contained in both of its arguments. If the `Intersect` function returns `Nothing`, the ranges have no cells in common. The `Not` operator is used so the expression returns `True` if the ranges *do* have at least one cell in common. Therefore, if the changed range has any cells in common with the range named `InputRange`, a message box is displayed. Otherwise, the procedure ends, and nothing happens.

Monitoring a range to make formulas bold

The following example monitors a worksheet and also makes formula entries bold and nonformula entries not bold.

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    Dim cell As Range
    For Each cell In Target
        cell.Font.Bold = cell.HasFormula
    Next cell
End Sub
```

Because the object passed to the `Worksheet_Change` procedure can consist of a multicell range, the procedure loops through each cell in the `Target` range. If the cell has a formula, the cell is made bold. Otherwise, the `Bold` property is set to `False`.

The procedure works, but it has a problem. What if the user deletes a row or column? In such a case, the `Target` range consists of a huge number of cells. The `For Each` loop would take a very long time to examine them all — and it wouldn't find any formulas.

The modified procedure listed next solves this problem by changing the `Target` range to be the intersection of the `Target` range and the worksheet's used range. The check to ensure that `Target` is `Not Nothing` handles the case in which an empty row or column outside of the used range is deleted.

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    Dim cell As Range
    Set Target = Intersect(Target, Target.Parent.UsedRange)
    If Not Target Is Nothing Then
        For Each cell In Target
            cell.Font.Bold = cell.HasFormula
        Next cell
    End If
End Sub
```



On the CD

This example, named `make formulas bold.xlsm`, is available on the companion CD-ROM.



Caution

A potentially serious side-effect of using a `Worksheet_Change` procedure is that doing so may effectively turn off Excel's Undo feature. Excel's Undo stack is destroyed whenever an event procedure makes a change to the worksheet.

Monitoring a range to validate data entry

Excel's data validation feature is a useful tool, but it suffers from a potentially serious problem. When you paste data to a cell that uses data validation, the pasted value not only fails to get validated, but it also deletes the validation rules associated with the cell! This fact makes the data validation feature practically worthless for critical applications. In this section, I demonstrate how you can use the `Change` event for a worksheet to create your own data validation procedure.



On the CD

The companion CD-ROM contains two versions of this example. One (named `validate entry1.xlsm`) uses the `EnableEvents` property to prevent cascading `Change` events; the other (named `validate entry2.xlsm`) uses a `Static` variable. See "Disabling events," earlier in this chapter.

The `Worksheet_Change` procedure that follows is executed when a user changes a cell. The validation is restricted to the range named `InputRange`. Values entered into this range must be integers between 1 and 12.

```
Private Sub Worksheet_Change(ByVal Target As Range)
    Dim VRange As Range, cell As Range
    Dim Msg As String
    Dim ValidateCode As Variant
    Set VRange = Range("InputRange")
    If Intersect(VRange, Target) Is Nothing Then Exit Sub
    For Each cell In Intersect(VRange, Target)
        ValidateCode = EntryIsValid(cell)
        If TypeName(ValidateCode) = "String" Then
            Msg = "Cell " & cell.Address(False, False) & ":"
            Msg = Msg & vbCrLf & vbCrLf & ValidateCode
            MsgBox Msg, vbCritical, "Invalid Entry"
            Application.EnableEvents = False
            cell.ClearContents
            cell.Activate
            Application.EnableEvents = True
        End If
    Next cell
End Sub
```

The `Worksheet_Change` procedure creates a `Range` object (named `VRange`) that represents the worksheet range that is validated. Then it loops through each cell in the `Target` argument, which represents the cell or cells that were changed. The code determines whether each cell is contained in the range to be validated. If so, it passes the cell as an argument to a custom function (`EntryIsValid`), which returns `True` if the cell is a valid entry.

If the entry isn't valid, the `EntryIsValid` function returns a string that describes the problem, and the user is informed via a message box (see Figure 19-6). When the message box is dismissed, the invalid entry is cleared from the cell, and the cell is activated. Notice that events are disabled before the cell is cleared. If events weren't disabled, clearing the cell would produce a `Change` event that causes an endless loop.

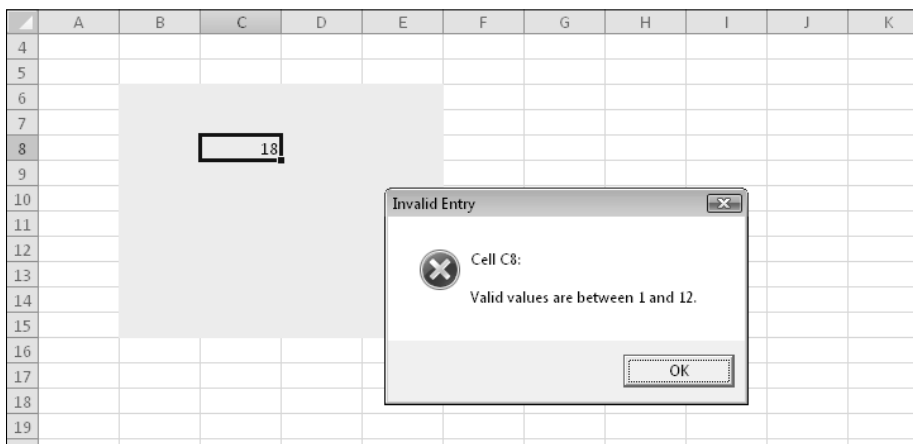


Figure 19-6: This message box describes the problem when the user makes an invalid entry.

The `EntryIsValid` function procedure is shown here:

```
Private Function EntryIsValid(cell) As Variant
' Returns True if cell is an integer between 1 and 12
' Otherwise it returns a string that describes the problem
' Numeric?
If Not WorksheetFunction.IsNumber (cell) Then
    EntryIsValid = "Non-numeric entry."
    Exit Function
End If
' Integer?
If CInt(cell) <> cell Then
    EntryIsValid = "Integer required."
    Exit Function
End If
' Between 1 and 12?
If cell < 1 Or cell > 12 Then
    EntryIsValid = "Valid values are between 1 and 12."
    Exit Function
End If
End Function
```



```
End If
' It passed all the tests
EntryIsValid = True
End Function
```

The preceding technique works, but it can be rather tedious to set up. Wouldn't it be nice if you could take advantage of Excel's data validation feature, yet ensure that the data validation rules don't get deleted if the user pastes data into the validation range? The next example solves the problem.

```
Private Sub Worksheet_Change(ByVal Target As Range)
    Dim VT As Long
    'Do all cells in the validation range
    'still have validation?
    On Error Resume Next
    VT = Range("InputRange").Validation.Type
    If Err.Number <> 0 Then
        Application.Undo
        MsgBox "Your last operation was canceled." & _
            "It would have deleted data validation rules.", vbCritical
    End If
End Sub
```

This event procedure checks the validation type of the range (named `InputRange`) that is *supposed* to contain the data validation rules. If the `VT` variable contains an error, that means that one or more cells in the `InputRange` no longer contain data validation. In other words, the worksheet change probably resulted from data being copied into the range that contains data validation. If that's the case, the code executes the `Undo` method of the `Application` object and reverses the user's action. Then it displays the message box shown in Figure 19-7.



Note

A nice side-benefit to using this procedure is that the Undo stack isn't destroyed.



On the CD

This example, named `validate entry3.xlsm`, is available on the companion CD-ROM.

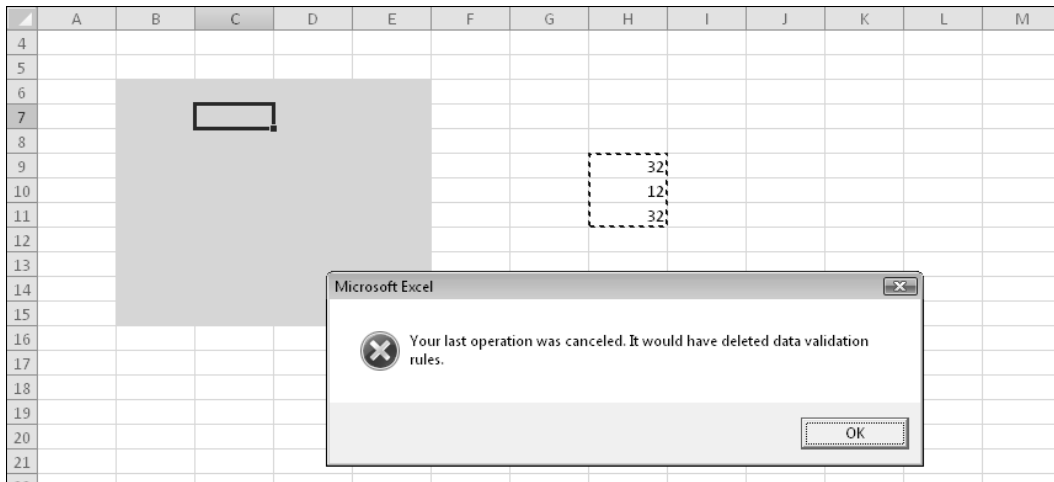


Figure 19-7: The `Worksheet_Change` procedure ensures that data validation doesn't get deleted.

The SelectionChange event

The following procedure demonstrates the `SelectionChange` event. It's executed whenever the user makes a new selection on the worksheet.

```
Private Sub Worksheet_SelectionChange(ByVal Target _
As Excel.Range)
    Cells.Interior.ColorIndex = xlNone
    With ActiveCell
        .EntireRow.Interior.Color = RGB(219, 229, 241)
        .EntireColumn.Interior.Color = RGB(219, 229, 241)
    End With
End Sub
```

This procedure shades the row and column of the active cell, which makes identifying the active cell very easy. The first statement removes the background color for all cells in the worksheet. Next, the entire row and column of the active cell is shaded light blue. Figure 19-8 shows the shading in effect.

You won't want to use the procedure if your worksheet contains any background shading because the shading will be wiped out. The exceptions are tables with a style applied and background colors resulting from conditional formatting. In both of these instances, the background color *is* maintained. Keep in mind, however, that executing the `Worksheet_SelectionChange` macro destroys the Undo stack, so using this technique essentially disables Excel's Undo feature.



This example, named `shade active row and column.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E	F	G	H	I	J	K
1		Project-1	Project-2	Project-3	Project-4	Project-5	Project-6	Project-7	Project-8	Project-9	Project-10
2	Jan-2008	2158	1527	3870	4863	3927	3993	2175	2143	3965	
3	Feb-2008	4254	28	4345	2108	412	2857	3098	87	2181	
4	Mar-2008	3631	1240	4208	452	3443	2965	91	2935	170	
5	Apr-2008	724	4939	1619	1721	3631	3487	3581	3082	3729	
6	May-2008	3060	1034	1646	345	978	526	4422	1390	3566	
7	Jun-2008	394	1241	2965	1411	3545	4499	2477	735	2533	
8	Jul-2008	2080	3978	3304	1460	4533	3335	2675	1687	2475	
9	Aug-2008	411	753	732	1207	1902	4009	1793	2262	916	
10	Sep-2008	2711	95	2267	2634	1944	3920	2020	402	3183	
11	Oct-2008	2996	4934	3932	2938	4730	1139	3776	3366	2239	
12	Nov-2008	2837	1116	3879	1740	1466	3628	212	780	4518	
13	Dec-2008	300	2917	321	1219	841	3554	1924	1786	3967	
14	Jan-2009	1604	768	2617	3414	4732	863	2993	4184	3432	
15	Feb-2009	1662	1380	4590	531	4143	1758	2990	2938	4400	
16	Mar-2009	1001	3454	4611	4852	456	46	4475	1340	859	
17	Apr-2009	4407	46	4185	4868	2313	2750	4948	4525	3896	
18	May-2009	3948	1292	1462	1977	2418	1816	4810	2803	4973	
19	Jun-2009	160	2908	3834	2396	4120	2231	3689	486	4751	
20	Jul-2009	1131	118	3193	40	1965	424	4802	3379	3645	
21	Aug-2009	2480	2564	373	3893	4932	4362	4472	3707	2411	
22	Sep-2009	4949	2649	2335	9	2309	3454	657	3519	658	
23	Oct-2009	3268	2652	2164	1898	1598	1237	1524	4752	1237	

Figure 19-8: Moving the cell cursor causes the active cell's row and column to be shaded.

The BeforeDoubleClick event

You can set up a VBA procedure to be executed when the user double-clicks a cell. In the following example (which is stored in the Code window for a `Sheet` object), double-clicking a cell toggles the cell's style. If the cell style is "Normal", it applies the "Good" style. If the style is "Good", it applies the "Normal" style.

```
Private Sub Worksheet_BeforeDoubleClick _
    (ByVal Target As Excel.Range, Cancel As Boolean)
    If Target.Style = "Good" Then
        Target.Style = "Normal"
    Else
        Target.Style = "Good"
    End If
    Cancel = True
End Sub
```

If `Cancel` is set to `True`, the default double-click action doesn't occur. In other words, double-clicking the cell won't put Excel into cell edit mode.

The BeforeRightClick event

When the user right-clicks in a worksheet, Excel displays a shortcut menu. If, for some reason, you'd like to prevent the shortcut menu from appearing in a particular sheet, you can trap the `RightClick` event. The following procedure sets the `Cancel` argument to `True`, which cancels the `RightClick` event and thereby cancels the shortcut menu. Instead, a message box is displayed.

```
Private Sub Worksheet_BeforeRightClick _  
    (ByVal Target As Excel.Range, Cancel As Boolean)  
    Cancel = True  
    MsgBox "The shortcut menu is not available."  
End Sub
```

Keep in mind that the user can still access the shortcut menu by using `Shift+F10`. However, only a tiny percentage of Excel users are aware of that keystroke combination.



Cross-Ref

To find out how to intercept the `Shift+F10` key combination, see “The `OnKey` event,” later in this chapter. Chapter 23 describes other methods for disabling shortcut menus.

Following is another example that uses the `BeforeRightClick` event. This procedure checks to see whether the cell that was right-clicked contains a numeric value. If so, the code displays the `Number` tab of the `Format Cells` dialog box and sets the `Cancel` argument to `True` (avoiding the normal shortcut menu display). If the cell doesn't contain a numeric value, nothing special happens — the shortcut menu is displayed as usual.

```
Private Sub Worksheet_BeforeRightClick _  
    (ByVal Target As Excel.Range, Cancel As Boolean)  
    If IsNumeric(Target) And Not IsEmpty(Target) Then  
        Application.CommandBars.ExecuteMso ("NumberFormatsDialog")  
        Cancel = True  
    End If  
End Sub
```

Notice that the code makes an additional check to determine if the cell is not empty. This check is because VBA considers empty cells to be numeric.

Checking Out Chart Events

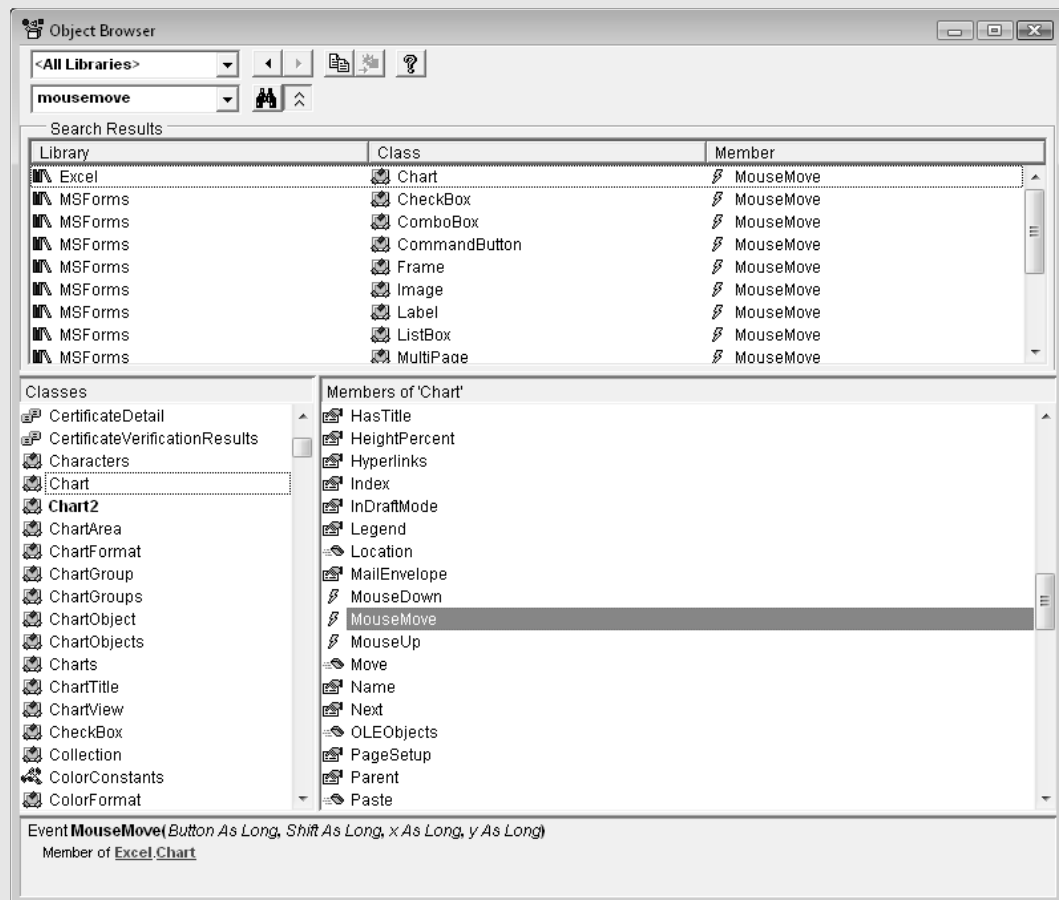
This section describes some of the events associated with charts. By default, events are enabled only for charts that reside on a chart sheet. To work with events for an embedded chart, you need to create a class module.



Using the Object Browser to locate events

The Object Browser is a useful tool that can help you learn about objects and their properties and methods. It can also help you find out which objects support a particular event. For example, say you'd like to find out which objects support the `MouseMove` event. Activate the VBE and press F2 to display the Object Browser window. Make sure that `<All Libraries>` is selected; then type **MouseMove** and click the binoculars icon (see the accompanying figure).

The Object Browser displays a list of matching items. Events are indicated with a small yellow lightning bolt. From this list, you can see which objects support the `MouseMove` event. Most of the objects located are controls in the `MSForms` library, home of the UserForm control. But you can also see that Excel's `Chart` object supports the `MouseMove` event.



continued

continued

Notice how the list is divided into three columns: Library, Class, and Member. The match for the item that you're searching for might appear in any of these columns. This brings up a crucial point: The name of an event or term belonging to one library or class could be the same as that for another belonging to a different library or class — although they probably don't share the same functionality. So be sure to click each item in the Object Browser list and check the status bar at the bottom of the list for the syntax. You may find, for example, that one class or library treats an event differently.



Cross-Ref

Refer to Chapter 18 for examples that deal with `Chart` events. Chapter 18 also describes how to create a class module to enable events for embedded charts.

Table 19-3 contains a list of the chart events as well as a brief description of each.

Table 19-3: Events Recognized by a Chart Sheet

Event	Action That Triggers the Event
Activate	The chart sheet or embedded chart is activated.
BeforeDoubleClick	The chart sheet or an embedded chart is double-clicked. This event occurs before the default double-click action.
BeforeRightClick	The chart sheet or an embedded chart is right-clicked. The event occurs before the default right-click action.
Calculate	New or changed data is plotted on a chart.
Deactivate	The chart is deactivated.
MouseDown	A mouse button is pressed while the pointer is over a chart.
MouseMove	The position of the mouse pointer changes over a chart.
MouseUp	A mouse button is released while the pointer is over a chart.
Resize	The chart is resized.
Select	A chart element is selected.
SeriesChange	The value of a chart data point is changed.

Monitoring with Application Events

In earlier sections, I discuss `Workbook` events and `Worksheet` events. Those events are monitored for a particular workbook. If you want to monitor events for all open workbooks or all worksheets, you use `Application`-level events.



Note

Creating event-handler procedures to handle `Application` events always requires a class module and some setup work.

Table 19-4 lists the commonly used `Application` events with a brief description of each. Excel 2010 added a few new events that deal with protected view windows and pivot tables. Consult the Help system for details.

Table 19-4: Commonly Used Events Recognized by the Application Object

Event	Action That Triggers the Event
<code>AfterCalculate</code>	A calculation has been completed and no outstanding queries exist.
<code>NewWorkbook</code>	A new workbook is created.
<code>SheetActivate</code>	Any sheet is activated.
<code>SheetBeforeDoubleClick</code>	Any worksheet is double-clicked. This event occurs before the default double-click action.
<code>SheetBeforeRightClick</code>	Any worksheet is right-clicked. This event occurs before the default right-click action.
<code>SheetCalculate</code>	Any worksheet is calculated (or recalculated).
<code>SheetChange</code>	Cells in any worksheet are changed by the user or by an external link.
<code>SheetDeactivate</code>	Any sheet is deactivated.
<code>SheetFollowHyperlink</code>	A hyperlink is clicked.
<code>SheetPivotTableUpdate</code>	Any pivot table is updated.
<code>SheetSelectionChange</code>	The selection changes on any worksheet except a chart sheet.
<code>WindowActivate</code>	Any workbook window is activated.
<code>WindowDeactivate</code>	Any workbook window is deactivated.
<code>WindowResize</code>	Any workbook window is resized.
<code>WorkbookActivate</code>	Any workbook is activated.
<code>WorkbookAddinInstall</code>	A workbook is installed as an add-in.
<code>WorkbookAddinUninstall</code>	Any add-in workbook is uninstalled.
<code>WorkbookBeforeClose</code>	Any open workbook is closed.
<code>WorkbookBeforePrint</code>	Any open workbook is printed.
<code>WorkbookBeforeSave</code>	Any open workbook is saved.
<code>WorkbookDeactivate</code>	Any open workbook is deactivated.
<code>WorkbookNewSheet</code>	A new sheet is created in any open workbook.
<code>WorkbookOpen</code>	A workbook is opened.

Enabling Application-level events

To use Application-level events, you need to do the following:

1. Create a new class module.
2. Set a name for this class module in the Properties window under *Name*.
By default, VBA gives each new class module a default name like `Class1`, `Class2`, and so on. You may want to give your class module a more meaningful name, such as `clsApp`.
3. In the class module, declare a public `Application` object by using the `WithEvents` keyword.

For example:

```
Public WithEvents XL As Application
```

4. Create a variable that you'll use to refer to the declared `Application` object in the class module.
It should be a module-level object variable declared in a regular VBA module (not in the class module). For example:

```
Dim X As New clsApp
```

5. Connect the declared object with the `Application` object.
This step is often done in a `Workbook_Open` procedure. For example:

```
Set X.XL = Application
```

6. Write event-handler procedures for the `XL` object in the class module.



Cross-Ref

This procedure is virtually identical to that required to use events with an embedded chart. See Chapter 18.

Determining when a workbook is opened

The example in this section keeps track of every workbook that is opened by storing information in a comma-separated variable (CSV) text file. You can import this file into Excel.

I start by inserting a new class module and naming it `clsApp`. The code in the class module is

```
Public WithEvents AppEvents As Application

Private Sub AppEvents_WorkbookOpen (ByVal Wb As Excel.Workbook)
    Call UpdateLogFile(Wb)
End Sub
```


This code declares `AppEvents` as an `Application` object with events. The `AppEvents_WorkbookOpen` procedure will be called whenever a workbook is opened. This event-handler procedure calls `UpdateLogFile` and passes the `Wb` variable, which represents the workbook that was opened. I then added a VBA module and inserted the following code:

```
Dim AppObject As New clsApp

Sub Init()
    ' Called by Workbook_Open
    Set AppObject.AppEvents = Application
End Sub

Sub UpdateLogFile(Wb)
    Dim txt As String
    Dim FName As String
    txt = Wb.FullName
    txt = txt & "," & Date & "," & Time
    txt = txt & "," & Application.UserName
    FName = Application.DefaultFilePath & "\logfile.csv"
    Open FName For Append As #1
    Print #1, txt
    Close #1
    MsgBox txt
End Sub
```

Notice at the top that the `AppObject` variable is declared as type `clsApp` (the name of the class module). The call to `Init` is in the `Workbook_Open` procedure, which is in the code module for `ThisWorkbook`. This procedure is as follows:

```
Private Sub Workbook_Open()
    Call Init
End Sub
```

The `UpdateLogFile` procedure opens a text file — or creates it if it doesn't exist. It then writes key information about the workbook that was opened: the filename and full path, the date, the time, and the username.

The `Workbook_Open` procedure calls the `Init` procedure. Therefore, when the workbook opens, the `Init` procedure creates the object variable. The final statement uses a message box to display the information that was written to the CSV file. You can delete this statement if you prefer not to see that message.



On the CD

This example, named `log workbook open.xlsm`, is available on the companion CD-ROM.

Monitoring Application-level events

To get a feel for the event-generation process, you may find it helpful to see a list of events that get generated as you go about your work.

I created an application that displays (in a UserForm) a description of various Application-level events as they occur (see Figure 19-9). You might find this helpful in learning about the types and sequence of events that occur.



On the CD

This example is available on the companion CD-ROM. The file is named application event tracker.xlsm.

The workbook contains a class module with 21 procedures defined, one for each of the commonly used Application-level events. Here's an example of one of them:

```
Private Sub XL_NewWorkbook(ByVal Wb As Excel.Workbook)
    LogEvent "NewWorkbook: " & Wb.Name
End Sub
```

Each of these procedures calls the LogEvent procedure and passes an argument that consists of the event name and the object. The LogEvent procedure follows:

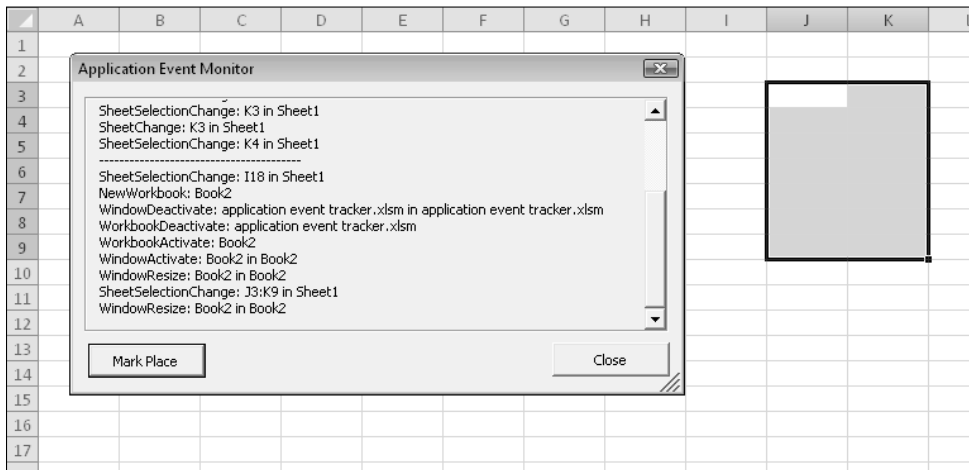


Figure 19-9: This workbook uses a class module to monitor all Application-level events.

```
Sub LogEvent(txt)
    EventNum = EventNum + 1
    With UserForm1
        With .lblEvents
            .AutoSize = False
            .Caption = .Caption & vbCrLf & txt
        End With
    End With
End Sub
```

```

        .Width = UserForm1.FrameEvents.Width - 20
        .AutoSize = True
    End With
    .FrameEvents.ScrollHeight = .lblEvents.Height + 20
    .FrameEvents.ScrollTop = EventNum * 20
End With
End Sub

```

The `LogEvent` procedure updates the UserForm by modifying the `Caption` property of the Label control named `lblEvents`. The procedure also adjusts the `ScrollHeight` and `ScrollTop` properties of the Frame named `FrameEvents`, which contains the Label. Adjusting these properties causes the most recently added text to be visible while older text scrolls out of view. You can also adjust the vertical size of this UserForm. It uses the technique described in Chapter 15.

Using UserForm Events

A UserForm supports quite a few events, and each control placed on a UserForm has its own set of events. Table 19-5 lists the UserForm events that you can use.

Table 19-5: Events Recognized by a UserForm

Event	Action That Triggers the Event
Activate	The UserForm is activated.
AddControl	A control is added at runtime.
BeforeDragOver	A drag-and-drop operation is in progress while the pointer is over the form.
BeforeDropOrPaste	The user is about to drop or paste data: that is, when the user has released the mouse button.
Click	A mouse is clicked while the pointer is over the form.
DblClick	A mouse is double-clicked while the pointer is over the form.
Deactivate	The UserForm is deactivated.
Error	A control detects an error and can't return the error information to a calling program.
Initialize	The UserForm is about to be shown.
KeyDown	A key is pressed.
KeyPress	The user presses any ANSI key.
KeyUp	A key is released.
Layout	A UserForm changes size.
MouseDown	A mouse button is pressed.

continued

Table 19-5: Events Recognized by a UserForm (*continued*)

Event	Action That Triggers the Event
MouseMove	The mouse is moved.
MouseUp	A mouse button is released.
QueryClose	Occurs before a UserForm closes.
RemoveControl	A control is removed from the UserForm at runtime.
Resize	The UserForm is resized.
Scroll	The UserForm is scrolled.
Terminate	The UserForm is terminated.
Zoom	The UserForm is zoomed.



Cross-Ref

Many of the examples in Chapters 13 through 15 demonstrate event handling for UserForms and UserForm controls.

Accessing Events Not Associated with an Object

The events that I discuss earlier in this chapter are all associated with an object (`Application`, `Workbook`, `Sheet`, and so on). In this section, I discuss two additional rogue events: `OnTime` and `OnKey`. These events aren't associated with an object. Rather, they're accessed by using methods of the `Application` object.



Note

Unlike the other events discussed in this chapter, you program these `On` events in a general VBA module.

The `OnTime` event

The `OnTime` event occurs at a specified time of day. The following example demonstrates how to program Excel so that it beeps and then displays a message at 3 p.m.:

```
Sub SetAlarm()
    Application.OnTime TimeValue("15:00:00"), "DisplayAlarm"
End Sub

Sub DisplayAlarm()
    Beep
    MsgBox "Wake up. It's time for your afternoon break!"
End Sub
```

In this example, the `SetAlarm` procedure uses the `OnTime` method of the `Application` object to set up the `OnTime` event. This method takes two arguments: the time (3 p.m., in the example) and the procedure to execute when the time occurs (`DisplayAlarm` in the example). After `SetAlarm` is executed, the `DisplayAlarm` procedure will be called at 3 p.m., bringing up the message in Figure 19-10.

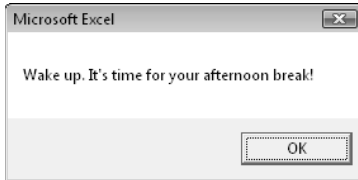


Figure 19-10: This message box was programmed to display at a particular time of day.

If you want to schedule an event relative to the current time — for example, 20 minutes from now — you can write an instruction like this:

```
Application.OnTime Now + TimeValue("00:20:00"), "DisplayAlarm"
```

You can also use the `OnTime` method to schedule a procedure on a particular day. The following statement runs the `DisplayAlarm` procedure at 12:01 a.m. on April 1, 2010:

```
Application.OnTime DateSerial(2010, 4, 1) + _  
    TimeValue("00:00:01"), "DisplayAlarm"
```



Note

The `OnTime` method has two additional arguments. If you plan to use this method, you should refer to the online help for complete details.

The two procedures that follow demonstrate how to program a repeated event. In this case, cell A1 is updated with the current time every five seconds. Executing the `UpdateClock` procedures writes the time to cell A1 and also programs another event five seconds later. This event reruns the `UpdateClock` procedure. To stop the events, execute the `StopClock` procedure (which cancels the event). Note that `NextTick` is a module-level variable that stores the time for the next event.



On the CD

This example, named `ontime event demo.xlsm`, is available on the companion CD-ROM.

```
Dim NextTick As Date  
Sub UpdateClock()  
'    Updates cell A1 with the current time  
    ThisWorkbook.Sheets(1).Range("A1") = Time
```

```
' Set up the next event five seconds from now
NextTick = Now + TimeValue("00:00:05")
Application.OnTime NextTick, "UpdateClock"
End Sub

Sub StopClock()
' Cancels the OnTime event (stops the clock)
On Error Resume Next
Application.OnTime NextTick, "UpdateClock", , False
End Sub
```

**Caution**

The `OnTime` event persists even after the workbook is closed. In other words, if you close the workbook without running the `StopClock` procedure, the workbook will reopen itself in five seconds (assuming that Excel is still running). To prevent this, use a `Workbook_BeforeClose` event procedure that contains the following statement:

```
Call StopClock
```

**Cross-Ref**

To see an example of a repeating `OnTime` event, see the analog clock example in Chapter 18.

The OnKey event

While you're working, Excel constantly monitors what you type. Because of this monitoring, you can set up a keystroke or a key combination that, when pressed, executes a particular procedure. The only time these keystrokes won't be recognized is when you're entering a formula or working with a dialog box.

**Caution**

It's important to understand that creating a procedure to respond to an `OnKey` event isn't limited to a single workbook. The re-mapped keystroke is valid in all open workbooks, not just the one in which you created the event procedure.

Also, if you set up an `OnKey` event, make sure that you provide a way to cancel the event. A common way to do this is to use the `Workbook_BeforeClose` event procedure.

An OnKey event example

The following example uses the `OnKey` method to set up an `OnKey` event. This event reassigns the `PgDn` and `PgUp` keys. After the `Setup_OnKey` procedure is executed, pressing `PgDn` executes the `PgDn_Sub` procedure, and pressing `PgUp` executes the `PgUp_Sub` procedure. The net effect is that pressing `PgDn` moves the cursor down one row, and pressing `PgUp` moves the cursor up one row. Key combinations that use `PgUp` and `PgDn` aren't affected. So, for example, `Ctrl+PgDn` will continue to activate the next worksheet in a workbook.

```
Sub Setup_OnKey()  
    Application.OnKey "{PgDn}", "PgDn_Sub"  
    Application.OnKey "{PgUp}", "PgUp_Sub"  
End Sub  
  
Sub PgDn_Sub()  
    On Error Resume Next  
    ActiveCell.Offset(1, 0).Activate  
End Sub  
  
Sub PgUp_Sub()  
    On Error Resume Next  
    ActiveCell.Offset(-1, 0).Activate  
End Sub
```



On the CD

This example, named `onkey event demo.xlsm`, is available on the companion CD-ROM.

In the preceding examples, I use `On Error Resume Next` to ignore any errors that are generated. For example, if the active cell is in the first row, trying to move up one row causes an error. Also, if the active sheet is a chart sheet, an error will occur because there is no such thing as an active cell in a chart sheet.

By executing the following procedure, you cancel the `OnKey` events and return these keys to their normal functionality:

```
Sub Cancel_OnKey()  
    Application.OnKey "{PgDn}"  
    Application.OnKey "{PgUp}"  
End Sub
```

Contrary to what you might expect, using an empty string as the second argument for the `OnKey` method does *not* cancel the `OnKey` event. Rather, it causes Excel to simply ignore the keystroke and do nothing at all. For example, the following instruction tells Excel to ignore Alt+F4 (the percent sign represents the Alt key):

```
Application.OnKey "%{F4}", ""
```



Cross-Ref

Although you can use the `OnKey` method to assign a shortcut key for executing a macro, it's better to use the Macro Options dialog box for this task. For more details, see Chapter 9.

Key Codes

In the previous section, notice that the PgDn keystroke appears in braces. Table 19-6 shows the key codes that you can use in your `OnKey` procedures.

Table 19-6: Key Codes for the `OnKey` Event

Key	Code
Backspace	{BACKSPACE} or {BS}
Break	{BREAK}
Caps Lock	{CAPSLOCK}
Delete or Del	{DELETE} or {DEL}
Down Arrow	{DOWN}
End	{END}
Enter	~ (tilde)
Enter (on the numeric keypad)	{ENTER}
Escape	{ESCAPE} or {ESC}
Home	{HOME}
Ins	{INSERT}
Left Arrow	{LEFT}
NumLock	{NUMLOCK}
Page Down	{PGDN}
Page Up	{PGUP}
Right Arrow	{RIGHT}
Scroll Lock	{SCROLLLOCK}
Tab	{TAB}
Up Arrow	{UP}
F1 through F15	{F1} through {F15}

You can also specify keys combined with Shift, Ctrl, and Alt. To specify a key combined with another key or keys, use the following symbols:

- **Shift:** Plus sign (+)
- **Ctrl:** Caret (^)
- **Alt:** Percent sign (%)

For example, to assign a procedure to the Ctrl+Shift+A key, use this code:

```
Application.OnKey "^+A", "SubName"
```


To assign a procedure to Alt+F11 (which is normally used to switch to the VB Editor window), use this code:

```
Application.OnKey "^{F11}", "SubName"
```

Disabling shortcut menus

Earlier in this chapter, I discuss a `Worksheet_BeforeRightClick` procedure that disables the right-click shortcut menu. The following procedure is placed in the `ThisWorkbook` code module:

```
Private Sub Worksheet_BeforeRightClick _  
    (ByVal Target As Excel.Range, Cancel As Boolean)  
    Cancel = True  
    MsgBox "The shortcut menu is not available."  
End Sub
```

I also noted that the user could still display the shortcut menu by pressing Shift+F10. To intercept the Shift+F10 key combination, add these procedures to a standard VBA module:

```
Sub SetupNoShiftF10()  
    Application.OnKey "+{F10}", "NoShiftF10"  
End Sub  
  
Sub TurnOffNoShiftF10()  
    Application.OnKey "+{F10}"  
End Sub  
  
Sub NoShiftF10()  
    MsgBox "Nice try, but that doesn't work either."  
End Sub
```

After the `SetupNoShiftF10` procedure is executed, pressing Shift+F10 displays the message box shown in Figure 19-11. Remember that the `Worksheet_BeforeRightClick` procedure is valid only in its own workbook. The Shift+F10 key event, on the other hand, applies to all open workbooks.



Note

Some keyboards have a dedicated key that displays a shortcut menu. On my keyboard, that key is on the right side of the keyboard between the Windows key and the Ctrl key. I was surprised to discover that intercepting the Shift+F10 key combination also disables the dedicated shortcut menu key.

	B	C	D	E	F	G	H	I	J
10	405	204	184	288	433	203	452	206	
11	337	483	471	139	126	470	446	124	
12	132	123	493	182	242	231	205	291	
13	234	192	350	468	103	144	489	413	
14	188	100	447	480	469	175	170	489	
15	307	207	297	360	230	333	335	272	
16	318	126	398					399	
17	442	258	268					463	
18	298	484	320					227	
19	349	114	236					119	
20	196	176	215					298	
21	472	146	363					146	
22	206	323	434	400	200	223	100	255	
23	360	227	200	355	151	333	394	319	
24									
25									
26									

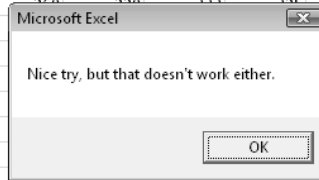


Figure 19-11: Pressing Shift+F10 displays this message.



On the CD

The companion CD-ROM contains a workbook that includes all these procedures. The file, named `no shortcut menus.xlsm`, includes workbook event-handler procedures:

`Workbook_Open` executes the `SetupNoShiftF10` procedure, and `Workbook_BeforeClose` calls the `TurnOffNoShiftF10` procedure.

Interacting with Other Applications

In This Chapter

- Starting or activating another application from Excel
- Displaying Windows Control Panel dialog boxes
- Using Automation to control another application
- Using `SendKeys` as a last resort

Starting an Application from Excel

Launching another application from Excel is often useful. For example, you might want to execute another Microsoft Office application or even a DOS batch file from Excel. Or, as an application developer, you may want to make it easy for a user to access the Windows Control Panel to adjust system settings.

Using the VBA Shell function

The VBA `Shell` function makes launching other programs relatively easy. Following is an example of VBA code that launches the Windows Calculator application.

```
Sub StartCalc()  
    Dim Program As String  
    Dim TaskID As Double  
    On Error Resume Next  
    Program = "calc.exe"  
    TaskID = Shell(Program, 1)
```

```

If Err <> 0 Then
    MsgBox "Cannot start " & Program, vbCritical, "Error"
End If
End Sub

```

You'll probably recognize the application that this procedure launches in Figure 20-1.

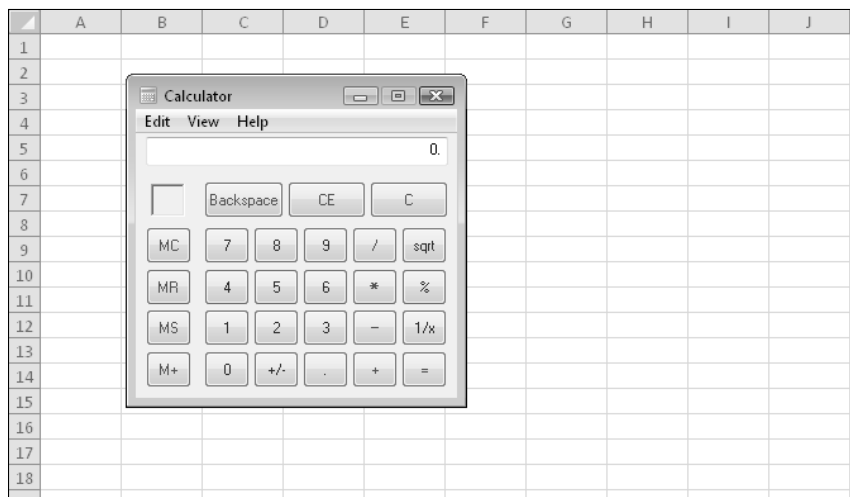


Figure 20-1: Running the Windows Calculator program from Excel.

The `Shell` function returns a task identification number for the application specified in the first argument. You can use this number later to activate the task. The second argument for the `Shell` function determines how the application is displayed. (1 is the code for a normal-size window, with the focus.) Refer to the Help system for other values for this argument.

If the `Shell` function isn't successful, it generates an error. Therefore, this procedure uses an `On Error` statement to display a message if the executable file can't be found or if some other error occurs.

It's important to understand that your VBA code doesn't pause while the application that was started with the `Shell` function is running. In other words, the `Shell` function runs the application *asynchronously*. If the procedure has more instructions after the `Shell` function is executed, these instructions are executed concurrently with the newly loaded program. If any instruction requires user intervention (for example, displaying a message box), Excel's title bar flashes while the other application is active.

In some cases, you may want to launch an application with the `Shell` function, but you need your VBA code to pause until the application is closed. For example, the launched application might generate a file that is used later in your code. Although you can't pause the execution of your code, you *can* create a loop that does nothing except monitor the application's status. The example that follows displays a message box when the application launched by the `Shell` function has ended:

```

Declare PtrSafe Function OpenProcess Lib "kernel32" _
    (ByVal dwDesiredAccess As Long, _
    ByVal bInheritHandle As Long, _
    ByVal dwProcessId As Long) As Long
Declare PtrSafe Function GetExitCodeProcess Lib "kernel32" _
    (ByVal hProcess As Long, _
    lpExitCode As Long) As Long
Sub StartCalc2()
    Dim TaskID As Long
    Dim hProc As Long
    Dim lExitCode As Long
    Dim ACCESS_TYPE As Integer, STILL_ACTIVE As Integer
    Dim Program As String
    ACCESS_TYPE = &H400
    STILL_ACTIVE = &H103
    Program = "Calc.exe"
    On Error Resume Next
    ' Shell the task
    TaskID = Shell(Program, 1)
    ' Get the process handle
    hProc = OpenProcess(ACCESS_TYPE, False, TaskID)

    If Err <> 0 Then
        MsgBox "Cannot start " & Program, vbCritical, "Error"
        Exit Sub
    End If

    Do 'Loop continuously
    ' Check on the process
        GetExitCodeProcess hProc, lExitCode
    ' Allow event processing
        DoEvents
    Loop While lExitCode = STILL_ACTIVE

    ' Task is finished, so show message
    MsgBox Program & " was closed"
End Sub

```

While the launched program is running, this procedure continually calls the `GetExitCodeProcess` function from within a Do-Loop structure, testing for its returned value (`lExitCode`). When the program is finished, `lExitCode` returns a different value, the loop ends, and the VBA code resumes executing.



On the CD

Both of the preceding examples are available on the companion CD-ROM. The filename is `start_calculator.xlsm`.



Displaying a folder window

The Shell function is also handy if you need to display a particular directory using Windows Explorer. For example, the statement that follows displays the folder of the active workbook (but only if the workbook has been saved):

```
If ActiveWorkbook.Path <> "" Then _
    Shell "explorer.exe " & ActiveWorkbook.Path, vbNormalFocus
```

Using the Windows ShellExecute API function

ShellExecute is a Windows Application Programming Interface (API) function that is useful for starting other applications. Importantly, this function can start an application only if an associated filename is known (assuming that the file type is registered with Windows). For example, you can use ShellExecute to display a Web document by starting the default Web browser. Or you can use an e-mail address to start the default e-mail client.

The API declaration follows (this code works only with Excel 2010):

```
Private Declare PtrSafe Function ShellExecute Lib "shell32.dll" _
    Alias "ShellExecuteA" (ByVal hWnd As Long, _
    ByVal lpOperation As String, ByVal lpFile As String, _
    ByVal lpParameters As String, ByVal lpDirectory As String, _
    ByVal nShowCmd As Long) As Long
```

The following procedure demonstrates how to call the ShellExecute function. In this example, it opens a graphics file by using the graphics program that's set up to handle JPG files. If the result returned by the function is less than 32, then an error occurred.

```
Sub ShowGraphic()
    Dim FileName As String
    Dim Result As Long
    FileName = ThisWorkbook.Path & "\flower.jpg"
    Result = ShellExecute(0&, vbNullString, FileName, _
        vbNullString, vbNullString, vbNormalFocus)
    If Result < 32 Then MsgBox "Error"
End Sub
```

The next procedure opens a text file, using the default text file program:

```
Sub OpenTextFile()
    Dim FileName As String
    Dim Result As Long
    FileName = ThisWorkbook.Path & "\textfile.txt"
```

```

Result = ShellExecute(0&, vbNullString, FileName, _
    vbNullString, vbNullString, vbNormalFocus)
If Result < 32 Then MsgBox "Error"
End Sub

```

The following example is similar, but it opens a Web URL by using the default browser:

```

Sub OpenURL()
    Dim URL As String
    Dim Result As Long
    URL = "http://spreadsheetpage.com"
    Result = ShellExecute(0&, vbNullString, URL, _
        vbNullString, vbNullString, vbNormalFocus)
    If Result < 32 Then MsgBox "Error"
End Sub

```

You can also use this technique with an e-mail address. The following example opens the default e-mail client (if one exists) and then addresses an e-mail to the recipient:

```

Sub StartEmail()
    Dim Addr As String
    Dim Result As Long
    Addr = "mailto:bgates@microsoft.com"
    Result = ShellExecute(0&, vbNullString, Addr, _
        vbNullString, vbNullString, vbNormalFocus)
    If Result < 32 Then MsgBox "Error"
End Sub

```



On the CD

These examples are available on the companion CD-ROM in a file named `shellexecute examples.xlsm`. This file uses API declarations that are compatible with all versions of Excel.

Activating an Application with Excel

In the previous section, I discuss various ways to start an application. You may find that if an application is already running, using the `Shell` function may start another instance of it. In most cases, however, you want to *activate* the instance that's running — not start another instance of it.

Using AppActivate

The following `StartCalculator` procedure uses the `AppActivate` statement to activate an application if it's already running (in this case, the Windows Calculator). The argument for

AppActivate is the caption of the application's title bar. If the AppActivate statement generates an error, it indicates that the Calculator is not running. Therefore, the routine starts the application.

```
Sub StartCalculator()
    Dim AppFile As String
    Dim CalcTaskID As Double

    AppFile = "Calc.exe"
    On Error Resume Next
    AppActivate "Calculator"
    If Err <> 0 Then
        Err = 0
        CalcTaskID = Shell(AppFile, 1)
        If Err <> 0 Then MsgBox "Can't start Calculator"
    End If
End Sub
```



On the CD

This example is available on the companion CD-ROM. The filename is `start calculator.xlsm`.

Activating a Microsoft Office application

If the application that you want to start is one of several Microsoft applications, you can use the `ActivateMicrosoftApp` method of the `Application` object. For example, the following procedure starts Word:

```
Sub StartWord()
    Application.ActivateMicrosoftApp xlMicrosoftWord
End Sub
```

If Word is already running when the preceding procedure is executed, it is activated. The other constants available for this method are:

- `xlMicrosoftPowerPoint`
- `xlMicrosoftMail` (activates Outlook)
- `xlMicrosoftAccess`
- `xlMicrosoftFoxPro`
- `xlMicrosoftProject`
- `xlMicrosoftSchedulePlus` (an obsolete Microsoft Office time-management program)

Running Control Panel Dialog Boxes

Windows provides quite a few system dialog boxes and wizards, most of which are accessible from the Windows Control Panel. You might need to display one or more of these from your Excel application. For example, you might want to display the Windows Date and Time dialog box, shown in Figure 20-2.

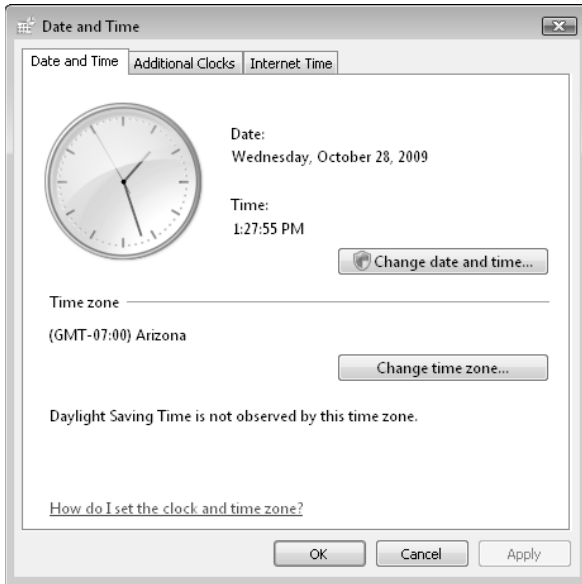


Figure 20-2: Use VBA to display a Control Panel dialog box.

The key to running other system dialog boxes is to execute the `rundll32.exe` application by using the VBA `Shell` function.

The following procedure displays the Date and Time dialog box:

```
Sub ShowDateTimeDlg()  
    Dim Arg As String  
    Dim TaskID As Double  
    Arg = "rundll32.exe shell32.dll,Control_RunDLL timedate.cpl"  
    On Error Resume Next  
    TaskID = Shell(Arg)  
    If Err <> 0 Then  
        MsgBox ("Cannot start the application.")  
    End If  
End Sub
```

Following is the general format for the `rundll32.exe` application:

```
rundll32.exe shell32.dll,Control_RunDLL filename.cpl, n,t
```

- `filename.cpl`: The name of one of the Control Panel *.CPL files.
- `n`: The zero-based number of the applet within the *.CPL file.
- `t`: The number of the tab (for multi-tabbed applets).



A workbook that displays 12 additional Control Panel applets, depicted in Figure 20-3, is available on the companion CD-ROM. The filename is `control panel dialogs.xlsm`.

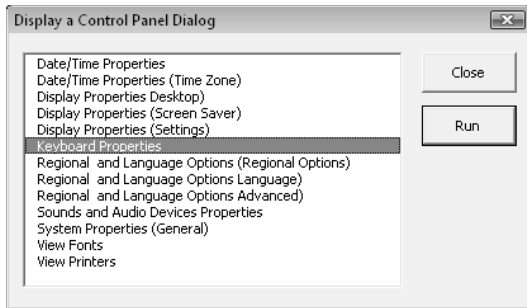


Figure 20-3: The workbook that displays this dialog box demonstrates how to run system dialog boxes from Excel.

Using Automation in Excel

You can write an Excel macro to control other applications, such as Microsoft Word. More accurately, the Excel macro will control Word's automation server. In such circumstances, Excel is the *client application*, and Word is the *server application*. Or you can write a VBA application in Word to control Excel. The process of one application's controlling another is sometimes known as *Object Linking and Embedding (OLE)*, or simply *automation*.

The concept behind automation is quite appealing. A developer who needs to generate a chart, for example, can just reach into another application's grab bag of objects, fetch a `Chart` object, and then manipulate its properties and use its methods. Automation, in a sense, blurs the boundaries between applications. An end user may be working with an Access object and not even realize it.



Some applications, such as Excel, can function as either a client application or a server application. Other applications can function only as client applications or only as server applications.

In this section, I demonstrate how to use VBA to access and manipulate the objects exposed by other applications. The examples use Microsoft Word, but the concepts apply to any application that exposes its objects for automation — which accounts for an increasing number of applications.

Working with foreign objects using automation

As you may know, you can use Excel's Insert→Text→Object command to embed an object, such as a Word document, in a worksheet. In addition, you can create an object and manipulate it with VBA. (This action is the heart of Automation.) When you do so, you usually have full access to the object. For developers, this technique is generally more beneficial than embedding the object in a worksheet. When an object is embedded, the user must know how to use the automation object's application. But when you use VBA to work with the object, you can program the object so that the user can manipulate it by an action as simple as a button click.

Early versus late binding

Before you can work with an external object, you must create an instance of the object. You can do so in either of two ways: early binding or late binding. *Binding* refers to matching the function calls written by the programmer to the actual code that implements the function.

Early binding

To use early binding, create a reference to the object library by choosing the Tools→References command in the Visual Basic Editor (VBE), which brings up the dialog box shown in Figure 20-4. Then put a check mark next to the object library you need to reference.

After the reference to the object library is established, you can use the Object Browser, shown in Figure 20-5, to view the object names, methods, and properties. To access the Object Browser, press F2 in the VBE.

When you use early binding, you must establish a reference to a version-specific object library. For example, you can specify Microsoft Word 10.0 Object Library (for Word 2002), Microsoft Word 11.0 Object Library (for Word 2003), Microsoft Word 12.0 Object Library (for Word 2007), or Microsoft Word 14.0 Object Library (for Word 2010). Then you use a statement like the following to create the object:

```
Dim WordApp As New Word.Application
```

Using early binding to create the object by setting a reference to the object library usually is more efficient and also often yields better performance. Early binding is an option, however, only if the object that you're controlling has a separate type library or object library file. You also need to ensure that the user of the application actually has a copy of the specific library installed.

Another advantage of early binding is that you can use constants that are defined in the object library. For example, Word (like Excel) contains many predefined constants that you can use in your VBA code. If you use early binding, you can use the constants in your code. If you use late binding, you'll need to use the actual value rather than the constant.

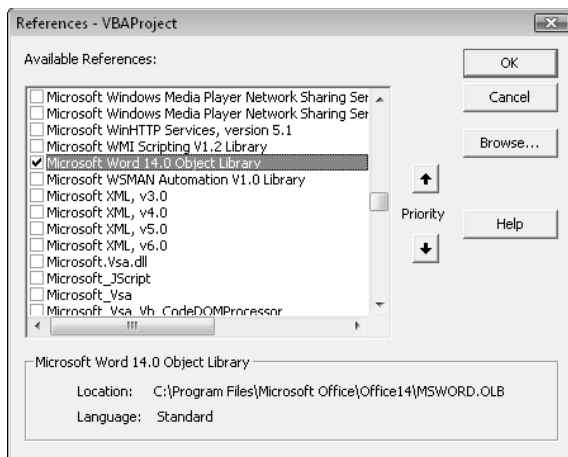


Figure 20-4: Adding a reference to an object library file.

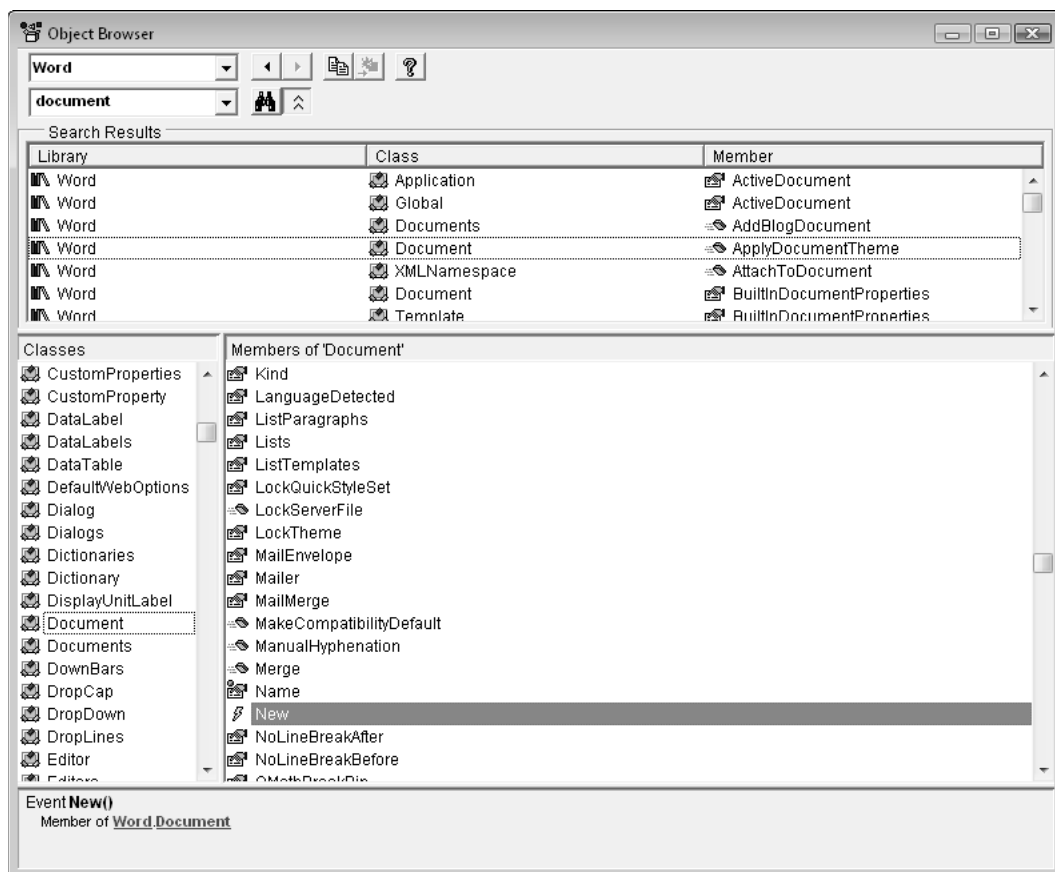


Figure 20-5: Use the Object Browser to learn about the objects in a referenced library.

Still another benefit of using early binding is that you can take advantage of the VBE Object Browser and Auto List Members option to make it easier to access properties and methods; this feature doesn't work when you use late binding because the type of the object is known only at runtime.

Late binding

At runtime, you use either the `CreateObject` function to create the object or the `GetObject` function to obtain a saved instance of the object. Such an object is declared as a generic `Object` type, and its object reference is resolved at runtime.

You can use late binding even when you don't know which version of the application is installed on the user's system. For example, the following code, which works with Word 97 and later, creates a `Word` object:

```
Dim WordApp As Object
Set WordApp = CreateObject("Word.Application")
```

If multiple versions of Word are installed, you can create an object for a specific version. The following statement, for example, uses Word 2003:

```
Set WordApp = CreateObject("Word.Application.11")
```

The Registry key for Word's Automation object and the reference to the `Application` object in VBA just happen to be the same: `Word.Application`. They do not, however, refer to the same thing. When you declare an object `As Word.Application` or `As New Word.Application`, the term refers to the `Application` object in the Word library. But when you invoke the function `CreateObject("Word.Application")`, the term refers to the moniker by which the latest version of Word is known in the Windows System Registry. This isn't the case for all automation objects, although it is true for the main Office 2010 components. If the user replaces Word 2003 with Word 2010, `CreateObject("Word.Application")` will continue to work properly, referring to the new application. If Word 2010 is removed, however, `CreateObject("Word.Application.14")`, which uses the alternate version-specific name for Word 2010, will fail to work.

The `CreateObject` function used on an automation object such as `Word.Application` or `Excel.Application` always creates a new *instance* of that automation object. That is, it starts up a new and separate copy of the automation part of the program. Even if an instance of the automation object is already running, a new instance is started, and then an object of the specified type is created.

To use the current instance or to start the application and have it load a file, use the `GetObject` function.



If you need to automate an Office application, it is recommended that you use early binding and reference the earliest version of the product that you expect could be installed on your client's system. For example, if you need to be able to automate Word 2003, Word 2007, and Word 2010, you should use the type library for Word 2003 to maintain compatibility with all three versions. This approach, of course, will mean that you can't use features found only in the later version of Word.

GetObject versus CreateObject

VBA's `GetObject` and `CreateObject` functions both return a reference to an object, but they work in different ways.

The `CreateObject` function creates an interface to a new instance of an application. Use this function when the application isn't running. If an instance of the application is already running, a new instance is started. For example, the following statement starts Excel, and the object returned in `XLApp` is a reference to the `Excel.Application` object that it created.

```
Set XLApp = CreateObject("Excel.Application")
```

The `GetObject` function is either used with an application that's already running or to start an application with a file already loaded. The following statement, for example, starts Excel with the file `Myfile.xls` already loaded. The object returned in `XLBook` is a reference to the `Workbook` object (the `Myfile.xlsx` file):

```
Set XLBook = GetObject("C:\Myfile.xlsx")
```

A simple example of late binding

The following example demonstrates how to create a `Word` object by using late binding. This procedure creates the object, displays the version number, closes the Word application, and then destroys the object (thus freeing the memory that it used):

```
Sub GetWordVersion()  
    Dim WordApp As Object  
    Set WordApp = CreateObject("Word.Application")  
    MsgBox WordApp.Version  
    WordApp.Quit  
    Set WordApp = Nothing  
End Sub
```



The `Word` object that's created in this procedure is invisible. If you'd like to see the object's window while it's being manipulated, set its `Visible` property to `True`, as follows:

```
WordApp.Visible = True
```

This example can also be programmed using early binding. Before doing so, choose Tools→References to set a reference to the Word object library. Then you can use the following code:

```
Sub GetWordVersion()  
    Dim WordApp As New Word.Application  
    MsgBox WordApp.Version  
    WordApp.Quit  
    Set WordApp = Nothing  
End Sub
```

Controlling Word from Excel

The example in this section demonstrates Automation by using Word. The `MakeMemos` procedure creates three customized memos in Word and then saves each document to a file. The information used to create the memos is stored in a worksheet, as shown in Figure 20-6.

	A	B	C	D	E
1	Northern	477	\$881,466		
2	Western	375	\$753,459		
3	Central	762	\$1,545,987		
4					
5					
6					
7					
8					
9					

Create Word Memos Using
Data on This Worksheet

Message:

The monthly sales data for your region is listed below. This information was obtained from the corporate sales database.

Please keep up the good work, and try to encourage your sales staff to sell more stuff.

Please call if you have any questions.

Figure 20-6: Word automatically generates three memos based on this Excel data.

The `MakeMemos` procedure starts by creating an object called `WordApp`. The routine cycles through the three rows of data in `Sheet1` and uses Word's properties and methods to create each memo and save it to disk. A range named `Message` (in cell E6) contains the text used in the memo. All the action occurs behind the scenes: That is, Word isn't visible.

```
Sub MakeMemos()  
    ' Creates memos in word using Automation  
    Dim WordApp As Object  
    Dim Data As Range, message As String  
    Dim Records As Integer, i As Integer  
    Dim Region As String, SalesAmt As String, SalesNum As String  
    Dim SaveAsName As String  
    ' Start Word and create an object (late binding)
```

```

Set WordApp = CreateObject("Word.Application")

' Information from worksheet
Set Data = Sheets("Sheet1").Range("A1")
Message = Sheets("Sheet1").Range("Message")

' Cycle through all records in Sheet1
Records = Application.CountA(Sheets("Sheet1").Range("A:A"))
For i = 1 To Records
'   Update status bar progress message
   Application.StatusBar = "Processing Record " & i
'   Assign current data to variables
   Region = Data.Cells(i, 1).Value
   SalesNum = Data.Cells(i, 2).Value
   SalesAmt = Format(Data.Cells(i, 3).Value, "#,000")

'   Determine the filename
   SaveAsName = Application.DefaultFilePath & _
       "\" & Region & ".docx"
'   Send commands to Word
   With WordApp
       .Documents.Add
       With .Selection
           .Font.Size = 14
           .Font.Bold = True
           .ParagraphFormat.Alignment = 1
           .TypeText Text:="M E M O R A N D U M"
           .TypeParagraph
           .TypeParagraph
           .Font.Size = 12
           .ParagraphFormat.Alignment = 0
           .Font.Bold = False
           .TypeText Text:="Date:" & vbTab & _
               Format(Date, "mmm d, yyyy")
           .TypeParagraph
           .TypeText Text:="To:" & vbTab & Region & _
               " Manager"
           .TypeParagraph
           .TypeText Text:="From:" & vbTab & _
               Application.UserName
           .TypeParagraph
           .TypeParagraph
           .TypeText Message
           .TypeParagraph
           .TypeParagraph
           .TypeText Text:="Units Sold:" & vbTab & _
               SalesNum
           .TypeParagraph
           .TypeText Text:="Amount:" & vbTab & _
               Format(SalesAmt, "$#,##0")
       End With
   End With
End For

```



```

        End With
        .ActiveDocument.SaveAs FileName:=SaveAsName
    End With
Next i
' Kill the object
WordApp.Quit
Set WordApp = Nothing
' Reset status bar
Application.StatusBar = ""
MsgBox Records & " memos were created and saved in " & _
    Application.DefaultFilePath
End Sub

```

Figure 20-7 shows one of the documents created by the `MakeMemos` procedure.



On the CD

This workbook, named `make memos.xlsm`, is available on the companion CD-ROM.

Creating this macro involved several steps. I started by recording a macro in Word. I recorded my actions while creating a new document, adding and formatting some text, and saving the file. That Word macro provided the information that I needed about the appropriate properties and methods. I then copied the macro to an Excel module. Notice that I used `With-End With`. I added a dot before each instruction between `With` and `End With`. For example, the original Word macro contained (among others) the following instruction:

```
Documents.Add
```

I modified the macro as follows:

```

With WordApp
    .Documents.Add
' more instructions here
End With

```

The macro that I recorded in Word used a few of Word's built-in constants. Because this example uses late binding, I had to substitute actual values for those constants. I was able to learn the values by using the Immediate window in Word's VBE.

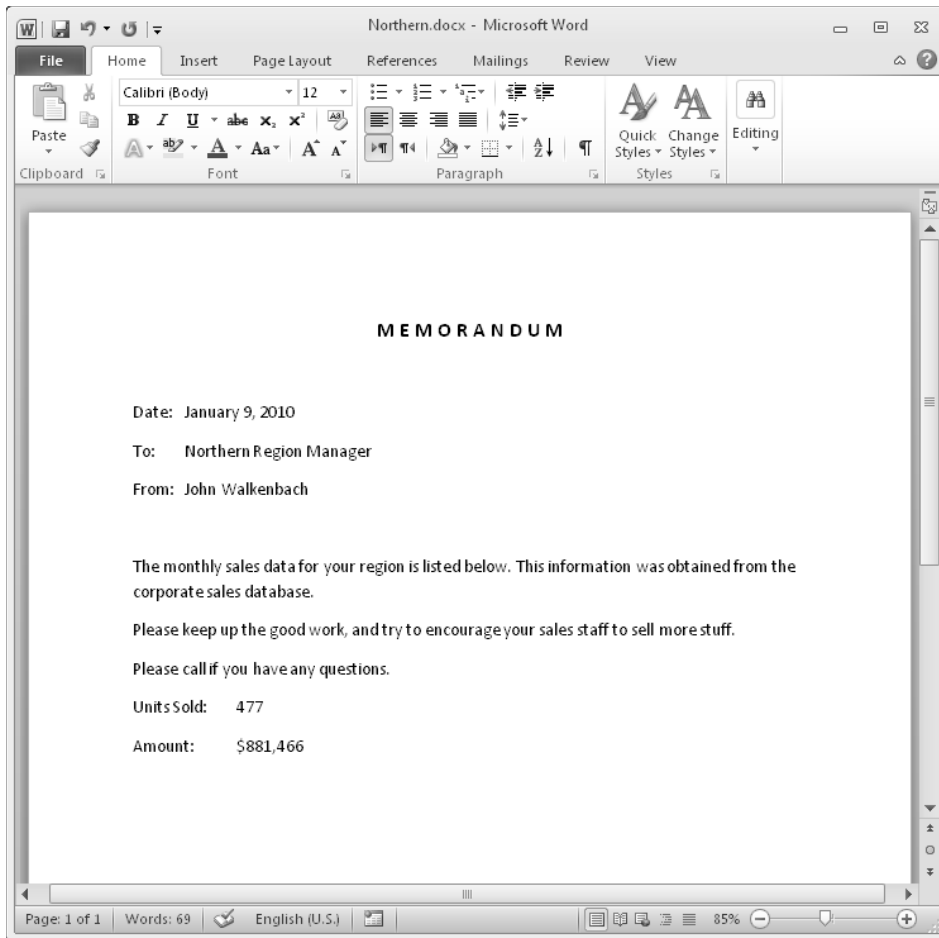


Figure 20-7: An Excel procedure created this Word document.

Controlling Excel from another application

You can, of course, also control Excel from another application (such as another programming language or a Word VBA procedure). For example, you may want to perform some calculations in Excel and return the result to a Word document.

You can create any of the following Excel objects with the adjacent functions:

- Application object: `CreateObject ("Excel.Application")`
- Workbook object: `CreateObject ("Excel.Sheet")`
- Chart object: `CreateObject ("Excel.Chart")`

The code that follows is a procedure that is located in a VBA module in a Word 2010 document. This procedure creates an Excel `Worksheet` object (whose moniker is `"Excel.Sheet"`) from an existing workbook and pastes it into the Word file.

```
Sub MakeLoanTable()  
    Dim XLSheet As Object  
    Dim LoanAmt  
    Dim Wbook As String  
    ' Prompt for values  
    LoanAmt = InputBox("Loan Amount?")  
    If LoanAmt = "" Then Exit Sub  
  
    ' Clear the document  
    ThisDocument.Content.Delete  
  
    ' Create Sheet object  
    Wbook = ThisDocument.Path & "\mortgagecalcs.xlsx"  
    Set XLSheet = GetObject(Wbook, "Excel.Sheet").ActiveSheet  
  
    ' Put values in sheet  
    XLSheet.Range("LoanAmount") = LoanAmt  
    XLSheet.Calculate  
    ' Insert page heading  
    Selection.Style = "Title"  
    Selection.TypeText "Loan Amount: " & _  
        Format(LoanAmt, "$#,##0")  
    Selection.TypeParagraph  
    Selection.TypeParagraph  
    ' Copy data from sheet & paste to document  
    XLSheet.Range("DataTable").Copy  
    Selection.Paste  
  
    Selection.TypeParagraph  
    Selection.TypeParagraph  
  
    ' Copy chart and paste to document  
    XLSheet.ChartObjects(1).Copy  
    Selection.PasteSpecial _  
        Link:=False, _  
        DataType:=wdPasteMetafilePicture, _  
        Placement:=wdInLine  
  
    ' Kill the object  
    Set XLSheet = Nothing  
End Sub
```



On the CD

This example is available on the companion CD-ROM. The Word document is named `automate excel.docm`, and the Excel workbook is named `mortgagecalcs.xlsx`. When you open the Word file, execute the `MakeLoanTable` macro by choosing **Insert→Mortgage→Get Mortgage Amount**.

The Excel worksheet used by this Word procedure is shown in Figure 20-8. The `MakeLoanTable` procedure prompts the user for a loan amount and inserts the value into cell C7 (named `LoanAmount`).

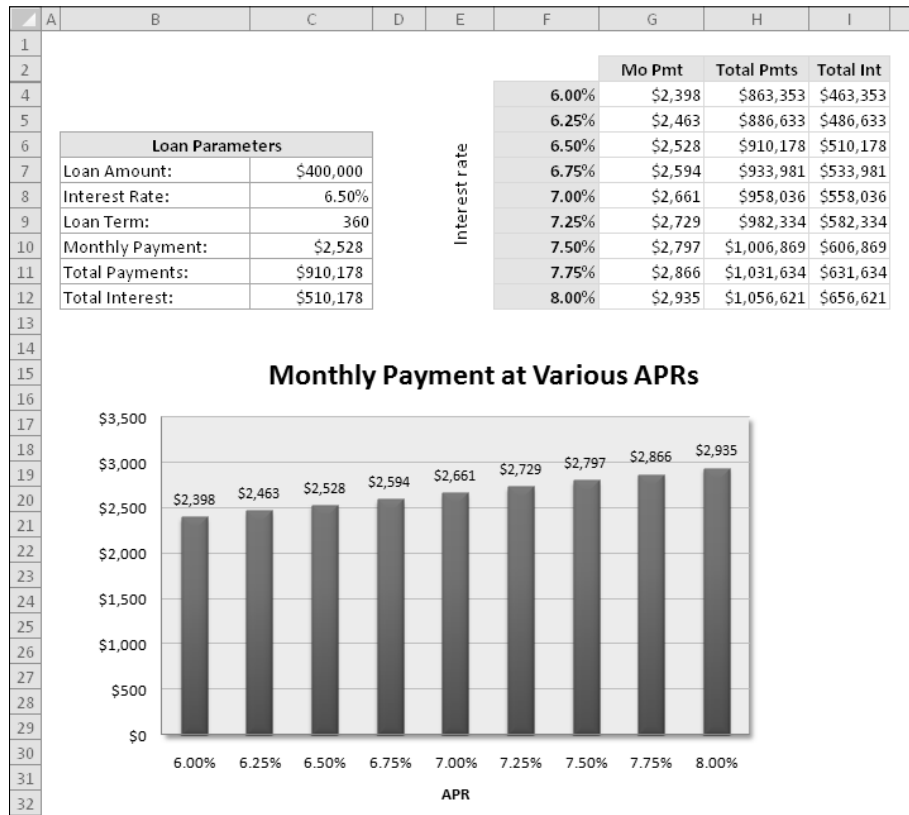


Figure 20-8: a VBA procedure in Word uses this worksheet.

Recalculating the worksheet updates a data table in range F2:I12 (named `DataTable`) and also updates the chart. The `DataTable` range and the chart are then copied from the Excel object and pasted into the Word document. The result is shown in Figure 20-9.

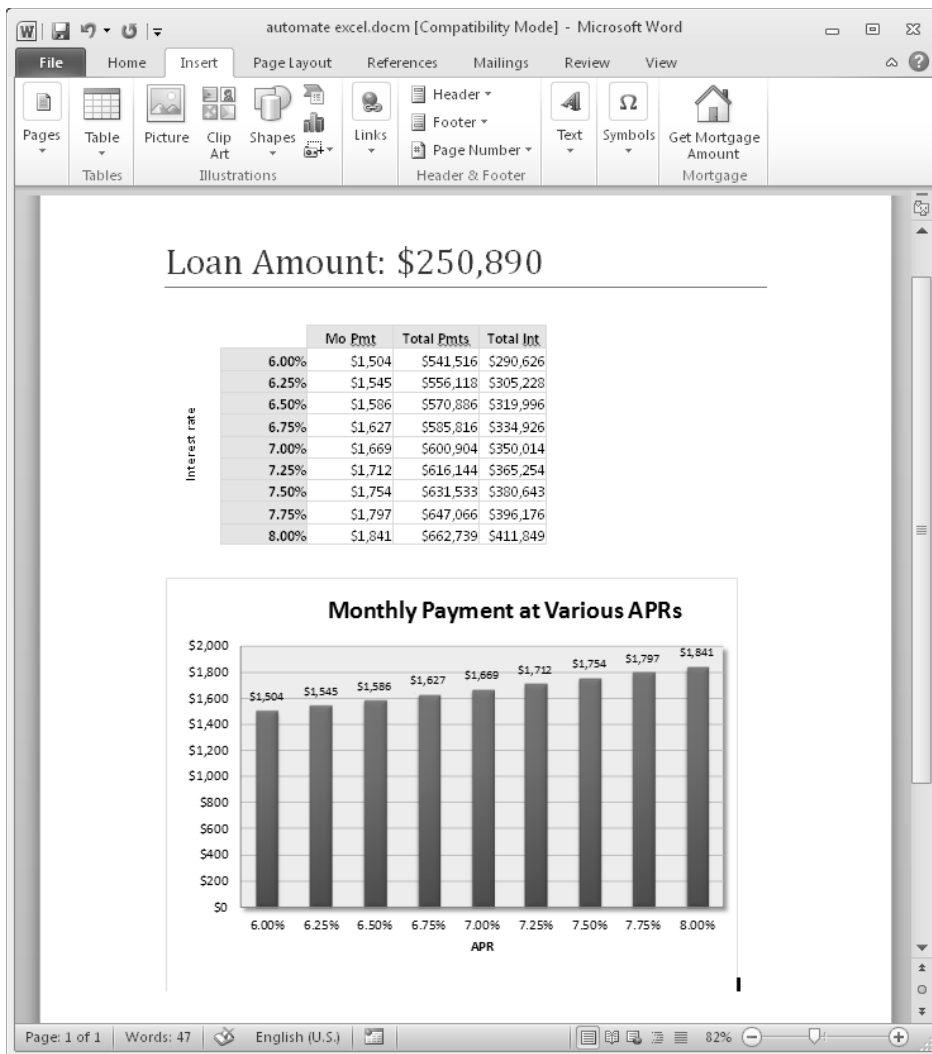


Figure 20-9: The Word VBA procedure uses Excel to create this document.

Sending Personalized E-Mail via Outlook

The example in this section demonstrates automation with Microsoft Outlook.

Figure 20-10 shows a worksheet that contains data used in the e-mail messages: name, e-mail address, and bonus amount. The `SendMail` procedure loops through the rows in the worksheet, retrieves the data, and creates an individualized message (stored in the `Msg` variable).

	A	B	C	D
1	Name	Email	Bonus	
2	John Jones	jjones@zx-prrtgfw.com	\$2,000	
3	Bob Smith	bsmith@zx-prrtgfw.com	\$3,500	
4	Fred Simpson	fsimpson@zx-prrtgfw.com	\$1,250	
5				
6				
7				
8				

Figure 20-10: This information is used in the Outlook e-mail messages.

```

Sub SendEmail()
    'Uses early binding
    'Requires a reference to the Outlook Object Library
    Dim OutlookApp As Outlook.Application
    Dim MItem As Outlook.MailItem
    Dim cell As Range
    Dim Subj As String
    Dim EmailAddr As String
    Dim Recipient As String
    Dim Bonus As String
    Dim Msg As String

    'Create Outlook object
    Set OutlookApp = New Outlook.Application

    'Loop through the rows
    For Each cell In Columns("B").Cells.SpecialCells(xlCellTypeConstants)
        If cell.Value Like "*@*" Then
            'Get the data
            Subj = "Your Annual Bonus"
            Recipient = cell.Offset(0, -1).Value
            EmailAddr = cell.Value
            Bonus = Format(cell.Offset(0, 1).Value, "$0,000.")

            'Compose message
            Msg = "Dear " & Recipient & vbCrLf & vbCrLf
            Msg = Msg & "I am pleased to inform you that your annual bonus is "
            Msg = Msg & Bonus & vbCrLf & vbCrLf
            Msg = Msg & "William Rose" & vbCrLf
            Msg = Msg & "President"

            'Create Mail Item and send it
            Set MItem = OutlookApp.CreateItem(olMailItem)
            With MItem
                .To = EmailAddr
                .Subject = Subj
                .Body = Msg
                .Send
            End With
        End If
    Next cell
End Sub

```

```

End With
End If
Next
End Sub

```

Figure 20-11 shows one of the e-mail messages displayed in Outlook.

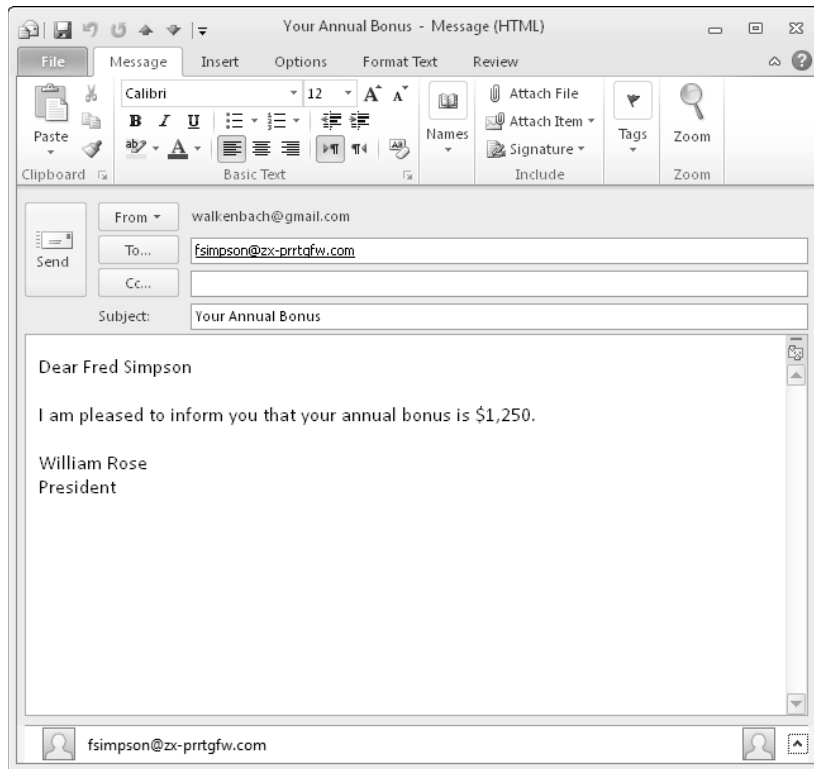


Figure 20-11: An Outlook e-mail message created by Excel.

This example uses early binding, so it requires a reference to the Outlook Object Library. Notice that two objects are involved: an Outlook object and a MailItem object. The Outlook object is created with this statement:

```
Set OutlookApp = New Outlook.Application
```

The MailItem object is created with this statement:

```
Set MItem = OutlookApp.CreateItem(olMailItem)
```

The code sets the `To`, `Subject`, and `Body` properties and then uses the `Send` method to send each message.



Tip

To save the messages in your Draft folder (rather than send them), use the `Save` method instead of the `Send` method. This change is particularly useful while you're testing and debugging the code.

Unless you've changed your security settings, you'll probably see the dialog box shown in Figure 20-12 for each message that's sent. To eliminate this dialog box, activate Outlook, choose **Office→Outlook Options→Trust Center**, and click the **Trust Center Settings** button. In the **Trust Center** dialog box, click the **Programmatic Access** tab and choose the option labeled **Never Warn Me about Suspicious Activity (Not Recommended)**. But do this at your own risk.



Figure 20-12: Using Excel to send e-mail via Outlook normally causes a warning message from Outlook.



On the CD

This example, named `personalized_email - outlook.xlsm`, is available on the companion CD-ROM. You must have Microsoft Outlook installed. The CD also contains a slightly modified version that uses late binding: `personalized_email - outlook (late binding).xlsm`.



Note

Subsequent sections in this chapter describe other ways of sending e-mail through Excel. See “Sending E-Mail Attachments from Excel” and “Using SendKeys.”

Sending E-Mail Attachments from Excel

As you probably know, Excel has the ability to send a workbook via e-mail as an attachment. And, of course, you can use VBA to automate these types of tasks. The following procedure uses the `SendMail` method to send the active workbook (as an attachment) to `joeblow@zx-prrtgfw.com`, using the default e-mail client (if any). The e-mail message has the subject `My Workbook`.

```
Sub SendWorkbook()  
    ActiveWorkbook.SendMail "joeblow@zx-prrtgfw.com", "My Workbook"  
End Sub
```


**Note**

The `SendMail` method uses the default e-mail client.

If you'd like to e-mail only a single sheet from a workbook, you need to copy the sheet to a new (temporary) workbook, send that workbook as an attachment, and then close the temporary file. Here's an example that sends `Sheet1` from the active workbook, attached to an e-mail with the subject, `My Workbook`. Note that the copied sheet becomes the active workbook.

```
Sub Sendasheet()  
    ActiveWorkbook.Worksheets("sheet1").Copy  
    ActiveWorkbook.SendMail "joeblow@zx-prrtgfw.com", "My Workbook"  
    ActiveWorkbook.Close False  
End Sub
```

In the preceding example, the file will have the default workbook name (for example, `Book2.xlsx`). If you'd like to give the single-sheet workbook attachment a more meaningful name, you need to save the temporary workbook and then delete it after it's sent. The following procedure saves `Sheet1` to a file named `my file.xlsx`. After sending this temporary workbook as an e-mail attachment, the code uses VBA's `Kill` statement to delete the file.

```
Sub SendOneSheet()  
    Dim Filename As String  
    Filename = "my file.xlsx"  
    ActiveWorkbook.Worksheets("sheet1").Copy  
    ActiveWorkbook.SaveAs Filename  
    ActiveWorkbook.SendMail "joeblow@zx-prrtgfw.com", "My Workbook"  
    ActiveWorkbook.Close False  
    Kill Filename  
End Sub
```

**Note**

Unfortunately, Excel doesn't provide a way to automate saving a workbook as a PDF file and sending it as an attachment. You can, however, automate part of the process. The following `SendSheetAsPDF` procedure saves the active sheet as a PDF file and then displays the compose message window from your default e-mail client (with the PDF file attached) so that you can fill in the recipient's name and click Send:

```
Sub SendSheetAsPDF()  
    CommandBars.ExecuteMso ("FileEmailAsPdfEmailAttachment")  
End Sub
```

When Excel is lacking powers, it's time to call on Outlook. The procedure that follows saves the active workbook as a PDF file and automates Outlook to create an e-mail message with the PDF file as an attachment.

```
Sub SendAsPDF()
' Uses early binding
' Requires a reference to the Outlook Object Library
Dim OutlookApp As Outlook.Application
Dim MItem As Object
Dim Recipient As String, Subj As String
Dim Msg As String, Fname As String

' Message details
Recipient = "myboss@xrediyh.com"
Subj = "Sales figures"
Msg = "Hey boss, here's the PDF file you wanted."
Msg = Msg & vbNewLine & vbNewLine & "-Frank"
Fname = Application.DefaultFilePath & "\" & _
    ActiveWorkbook.Name & ".pdf"

' Create the attachment
ActiveSheet.ExportAsFixedFormat _
    Type:=xlTypePDF, _
    Filename:=Fname

' Create Outlook object
Set OutlookApp = New Outlook.Application

' Create Mail Item and send it
Set MItem = OutlookApp.CreateItem(olMailItem)
With MItem
    .To = Recipient
    .Subject = Subj
    .Body = Msg
    .Attachments.Add Fname
    .Save 'to Drafts folder
    .Send
End With
Set OutlookApp = Nothing

' Delete the file
Kill Fname
End Sub
```



On the CD

This example, named `send pdf via outlook.xlsm`, is available on the companion CD-ROM.

Using SendKeys

Not all applications support Automation. In some cases, you can still control some aspects of the application even if it doesn't support Automation. You can use Excel's `SendKeys` method to send keystrokes to an application, simulating actions that a live human might perform.

Although using the `SendKeys` method may seem like a good solution, you'll find that it can be very tricky and not completely reliable. In fact, it may not work at all. A potential problem is that it relies on a specific user interface. If a later version of the program that you're sending keystrokes to has a different user interface, your application might no longer work. Consequently, you should use `SendKeys` only as a last resort.

Following is a very simple example. This procedure runs the Windows Calculator program and displays its Scientific mode: That is, it executes the View→Scientific command.

```
Sub TestKeys()  
    Shell "calc.Exe", vbNormalFocus  
    Application.SendKeys "%vs"  
End Sub
```

In this example, the code sends out Alt+V (the percent sign represents the Alt key) followed by S. `SendKeys` is documented in the Help system, which describes how to send nonstandard keystrokes, such as Alt and Ctrl key combinations.



Note

As I was finalizing this chapter, I tried the `TestKeys` procedure on a system with Windows 7 installed. Although the Windows 7 calculator uses the same menu accelerator key, the procedure did not work. After a bit of research, I learned that Windows 7 supports `SendKeys` only if User Account Control (a security feature) is turned off. That's a good example of why you should use `SendKeys` only as a last resort.

Creating and Using Add-Ins

In This Chapter

- Getting the scoop on add-ins
- Exploring Excel's Add-In Manager
- Create an add-in
- Comparing XLSA add-in files to XLSM files
- Viewing VBA code that manipulates add-ins
- Detecting whether an add-in is installed properly

What Is an Add-In?

One of Excel's most useful features for developers is the ability to create add-ins. Creating add-ins adds a professional touch to your work, and add-ins offer several key advantages over standard workbook files.

Generally speaking, a *spreadsheet add-in* is something added to a spreadsheet to give it additional functionality. For example, Excel ships with several add-ins. One of the most popular is the *Analysis ToolPak*, which adds statistical and analysis capabilities that are not built into Excel.

Some add-ins also provide new worksheet functions that you can use in formulas. With a well-designed add-in, the new features blend in well with the original interface, so they appear to be part of the program.

Comparing an add-in with a standard workbook

Any knowledgeable Excel user can create an add-in from an Excel workbook file; no additional software or programming tools are required. You can convert any workbook file to an add-in, but not every workbook is appropriate for an add-in. An Excel add-in is basically a normal XLSM workbook with the following differences:

- The `IsAddin` property of the `ThisWorkbook` object is `True`. By default, this property is `False`.
- The workbook window is hidden in such a way that it can't be unhidden by choosing the `View→Window→Unhide` command. This means that you can't display worksheets or chart sheets contained in an add-in unless you write code to copy the sheet to a standard workbook.
- An add-in isn't a member of the `Workbooks` collection. Rather, it's a member of the `AddIns` collection. However, you *can* access an add-in via the `Workbooks` collection (see "XLAM file VBA collection membership," later in this chapter).
- You can install and uninstall add-ins by using the Add-Ins dialog box. To display this dialog box, choose `File→Options→Add-Ins`. Then, in the Excel Options dialog box, choose Excel Add-Ins from the Manage drop-down list and click Go. After an add-in is installed, it remains installed across Excel sessions.
- The Macro dialog box (invoked by choosing `Developer→Code→Macros` or `View→Macros→Macros`) doesn't display the names of the macros contained in an add-in.
- You can use a custom worksheet function stored within an add-in in formulas without having to precede its name with the source workbook's filename.

**Note**

In the past, Excel allowed you to use any extension for an add-in. Beginning with Excel 2007, you can still use any extension for an add-in, but if it's not XLA or XLAM, you see the warning shown in Figure 21-1. This prompt occurs even if it's an installed add-in that opens automatically when Excel starts.

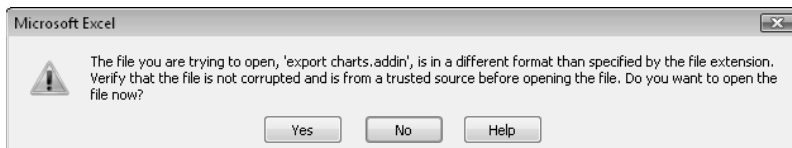


Figure 21-1: Excel warns you if an add-in uses a non-standard file extension.

Why create add-ins?

You might decide to convert your Excel application into an add-in for any of the following reasons:

- **To restrict access to your code and worksheets:** When you distribute an application as an add-in and you protect its VBA project with a password, users can't view or modify the sheets or the VBA code in the workbook. Therefore, if you use proprietary techniques in your application, you can prevent anyone from copying the code — or at least make it more difficult to do so.

- **To avoid confusion:** If a user loads your application as an add-in, the file isn't visible and is, therefore, less likely to confuse novice users or get in the way. Unlike a hidden workbook, an add-in can't be unhidden.
- **To simplify access to worksheet functions:** Custom worksheet functions stored within an add-in don't require the workbook name qualifier. For example, if you store a custom function named `MOVAVG` in a workbook named `Newfuncs.xlsx`, you must use a syntax like the following to use this function in a formula that's in a different workbook:

```
=Newfuncs.xlsx!MOVAVG(A1:A50)
```

But if this function is stored in an add-in file that's open, you can use a much simpler syntax because you don't need to include the file reference:

```
=MOVAVG(A1:A50)
```

- **To provide easier access for users:** After you identify the location of your add-in, it appears in the Add-Ins dialog box with a friendly name and a description of what it does.
- **To gain better control over loading:** Add-ins can be opened automatically when Excel starts, regardless of the directory in which they are stored.
- **To avoid displaying prompts when unloading:** When an add-in is closed, the user never sees the Do you want to save change? prompt.



Note

The ability to use add-ins is determined by the user's security settings in the Add-Ins tab of the Trust Center dialog box. To display this dialog box, choose **Developer**→**Code**→**Macro Security**. Or, if the **Developer** tab isn't displayed, choose **Office**→**Excel Options**→**Trust Center** and then click the **Trust Center Settings** button.



About COM add-ins

Excel also supports COM (Component Object Model) add-ins. These files have a `.dll` or `.exe` file extension. A COM add-in can be written so it works with all Office applications that support add-ins. An additional advantage is that the code is compiled, so the original source isn't viewable. Unlike XLAM add-ins, a COM add-in can't contain Excel sheets or charts. COM add-ins are developed in Visual Basic .NET. Discussion of creating COM add-in procedures is well beyond the scope of this book.

Understanding Excel's Add-In Manager

The most efficient way to load and unload add-ins is with Excel's Add-Ins dialog box, which you access by choosing File→Options→Add-Ins. Then, in the Excel Options dialog box, choose Excel Add-Ins from the Manage drop-down box and click Go.



Tip

The Alt+Tl shortcut key sequence used in earlier versions of Excel is a quicker way to display the Add-Ins dialog box. In addition, Excel 2010 includes the Add-Ins command on the Developer tab.

Figure 21-2 shows the Add-Ins dialog box. The list contains the names of all add-ins that Excel knows about, and check marks identify add-ins that are installed. You can open and close add-ins from this dialog box by clearing or marking the check boxes.

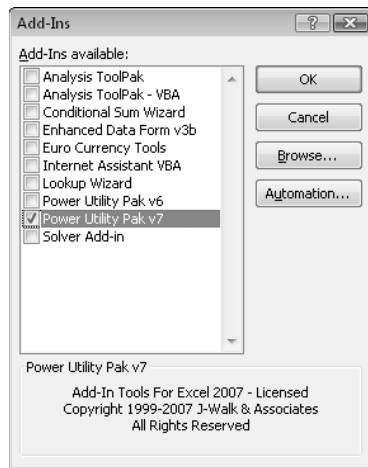


Figure 21-2: The Add-Ins dialog box.



Caution

You can also open most add-in files by choosing the File→Open command. Because an add-in is never the active workbook, however, you can't close an add-in by choosing File→Close. You can remove the add-in only by exiting and restarting Excel or by executing VBA code to close the add-in. For example:

```
Workbooks ("myaddin.xlam").Close
```

Opening an add-in with the File→Open command opens the file, but the add-in isn't officially installed.

When you open an add-in, you might notice something different about Excel. In almost every case, the user interface changes in some way: Excel displays either a new command in the Ribbon or new menu items on a shortcut menu. For example, when the Analysis ToolPak add-in

is installed, it gives you a new command: Data→Analysis→Data Analysis. When you install Excel's Euro Currency Tools add-in, you get a new group in the Formulas tab: Solutions.

If the add-in contains only custom worksheet functions, the new functions appear in the Insert Function dialog box and also in the Function Library group in the Ribbon.



Note

If you open an add-in created in a version prior to Excel 2007, any user interface modifications made by the add-in won't appear as they were intended to appear. Rather, you must access the user interface items (menus and toolbars) by choosing Add-Ins→Menu Commands or Add-Ins→Custom Toolbars.

Creating an Add-in

You can convert any workbook to an add-in, but not all workbooks are appropriate candidates for add-ins. First, an add-in must contain macros. (Otherwise, it's useless.)

Generally, a workbook that benefits most from being converted to an add-in is one that contains general-purpose macro procedures. A workbook that consists only of worksheets would be inaccessible as an add-in because worksheets within add-ins are hidden from the user. You can, however, write code that copies all or part of a sheet from your add-in to a visible workbook.

Creating an add-in from a workbook is simple. The following steps describe the general procedure for creating an add-in from a normal workbook file:

1. Develop your application and make sure that everything works properly.
2. Include a way to execute the macro or macros in the add-in (see Chapters 22 and 23 for more information about modifying Excel's user interface).
3. Activate the Visual Basic Editor (VBE) and select the workbook in the Project window.
4. Choose Tools→xxx Properties (where xxx represents the name of the project), click the Protection tab, and select the Lock Project for Viewing check box and then enter a password (twice). Click OK.

This step is necessary only if you want to prevent others from viewing or modifying your macros or UserForms.

5. Reactivate Excel and choose Developer→Modify→Document Panel to display the Document Properties panel.
6. Enter a brief descriptive title in the Title field and a longer description in the Comments field.

This step isn't required, but it makes the add-in easier to use by displaying descriptive text in the Add-Ins dialog box.

7. Choose File→Save As to display the Save As dialog box.

8. In the Save As dialog box, select Excel Add-In (*.xlam) from the Save as Type drop-down list.
9. Click Save.

A copy of the workbook is saved (with an .xlam extension), and the original workbook remains open.

10. Close the original workbook and then install the add-in version.
11. Test the add-in to make sure it works correctly.

If your add-in doesn't work, make changes to your code. And don't forget to save your changes.



Caution

A workbook being converted to an add-in must have at least one worksheet. For example, if your workbook contains only chart sheets or Excel 5/95 dialog sheets, the Excel Add-In (*.xlam) option doesn't appear in the Save As dialog box. Also, this option appears only when a worksheet is active when you choose the Office→Save As command.

An Add-In Example

In this section, I discuss the steps involved in creating a useful add-in. The example uses a utility I created that exports charts to separate graphic files. The utility adds a new group to the Chart Tools→Design contextual tab. Figure 21-3 shows the main dialog box for this utility. This is a fairly complicated utility, and you might want to take some time to see how it works.

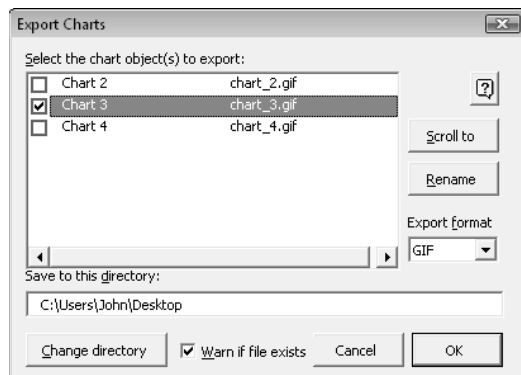


Figure 21-3: The Export Charts workbook will make a useful add-in.



The XLSM version of the Export Charts utility (named `export_charts.xlsm`) is available on the companion CD-ROM. You can use this file to create the described add-in.



A few words about passwords

Microsoft has never promoted Excel as a product that creates applications in which the source code is secure. The password feature provided in Excel is sufficient to prevent casual users from accessing parts of your application that you'd like to keep hidden. Excel 2002 and later versions include stronger security than previous versions, but your passwords can be cracked. If you must be absolutely sure that no one ever sees your code or formulas, Excel isn't your best choice as a development platform.

In this example, you'll be working with a workbook that has already been developed and debugged. The workbook consists of the following items:

- **A worksheet named `Sheet1`:** This sheet is not used, but it must be present because every add-in must have at least one worksheet.
- **A UserForm named `UserForm1`:** This dialog box serves as the primary user interface. The code module for this UserForm contains several event-handler procedures.
- **A UserForm named `UserForm2`:** This dialog box is displayed when the user clicks the Rename button to change the filename of a chart to be exported.
- **A UserForm named `UserForm3`:** This dialog box is displayed when the workbook is opened. It briefly describes how to access the Export Charts utility. It also contains a `Don't Show This Message Again` check box.
- **A VBA module named `Module1`:** This module contains several procedures, including a procedure that displays the `UserForm1` UserForm.
- **`ThisWorkbook` code module:** This module contains a `Workbook_Open` procedure that reads the saved settings and displays a start-up message.
- **XML code to customize the Ribbon:** This customization was done outside of Excel. See Chapter 22 for more information about customizing the Ribbon by using RibbonX.

Adding descriptive information for the example add-in

To enter a title and description for your add-in, choose Developer→Modify→Document Panel, which displays the Document Properties panel below the Ribbon.

Enter a title for the add-in in the Title field. This text appears in the list in the Add-Ins dialog box. In the Comments field, enter a description of the add-in. This information appears at the bottom of the Add-Ins dialog box when the add-in is selected.

Adding a title and description for the add-in is optional but highly recommended.

Creating an add-in

To create an add-in, do the following:

1. Activate the VBE and select the future add-in workbook in the Project window.
2. Choose Debug→Compile.

This step forces a compilation of the VBA code and also identifies any syntax errors so that you can correct them. When you save a workbook as an add-in, Excel creates the add-in even if it contains syntax errors.
3. Choose Tools→xxx Properties (where *xxx* represents the name of the project) to display the Project Properties dialog box, click the General tab, and enter a new name for the project.

By default, all VB projects are named *VBProject*. In this example, the project name is changed to *ExpCharts*. This step is optional but recommended.
4. Save the workbook one last time using its *.XLSM name.

Strictly speaking, this step isn't really necessary, but it gives you an XLSM backup (with no password) of your XLAM add-in file.
5. With the Project Properties dialog box still displayed, click the Protection tab, select the Lock Project for Viewing check box, and enter a password (twice).

The code will remain viewable, and the password protection will take effect the next time the file is opened.
6. Click OK.

If you don't need to protect the project, you can skip Steps 5 and 6.
7. In Excel, choose File→Save As.

Excel displays its Save As dialog box.
8. In the Save as Type drop-down list, select Excel Add-In (*.xlam).
9. Click Save.

A new add-in file is created, and the original XLSM version remains open.

Add-ins can be located in any directory.

Installing an add-in

To avoid confusion, close the XLSM workbook before installing the add-in created from that workbook.



About Excel's Add-In Manager

You install and uninstall add-ins by using Excel's Add-Ins dialog box. To display this dialog box, choose **File**→**Excel Options**→**Add-Ins**. Then, in the Excel Options dialog box, choose **Excel Add-Ins** from the **Manage** drop-down list and click **Go**. Or use **Developer**→**Add-Ins**→**Add-Ins** to display the Add-Ins dialog box. This dialog box lists the names of all the available add-ins. Those that are checked are open.

In VBA terms, the Add-In dialog box lists the `Title` property of each `AddIn` object in the `AddIns` collection. Each add-in that appears with a check mark has its `Installed` property set to `True`.

You can install an add-in by marking its check box, and you can clear an installed add-in by removing the check mark from its box. To add an add-in to the list, use the **Browse** button to locate its file. By default, the Add-In dialog box lists files of the following types:

- **XLAM:** An Excel 2007 or Excel 2010 add-in created from an XLSM file
- **XLA:** A pre-Excel 2007 add-in created from an XLS file
- **XLL:** A stand-alone compiled DLL file

If you click the **Automation** button, you can browse for COM add-ins. Note that the **Automation Servers** dialog box will probably list many files, and the file list isn't limited to COM add-ins that work with Excel.

You can enroll an add-in file into the `AddIns` collection with the `Add` method of VBA's `AddIns` collection, but you can't remove one by using VBA. You can also open an add-in from within VBA code by setting the `AddIn` object's `Installed` property to `True`. Setting it to `False` closes the add-in.

The Add-In Manager stores the installed status of the add-ins in the Windows Registry when you exit Excel. Therefore, all add-ins that are installed when you close Excel are automatically opened the next time you start Excel.

To install an add-in, do the following:

1. Choose **File**→**Options**, and click the **Add-Ins** tab.
2. Choose **Excel Add-Ins** from the **Manage** drop-down list and click **Go** (or press **Alt+TI**). Excel displays the Add-Ins dialog box.
3. Click the **Browse** button and locate and double-click the add-in that you just created.
After you find your new add-in, the Add-Ins dialog box displays the add-in in its list. As shown in Figure 21-4, the Add-Ins dialog box also displays the descriptive information that you provided in the Document Properties panel.
4. Click **OK** to close the dialog box and open the add-in.

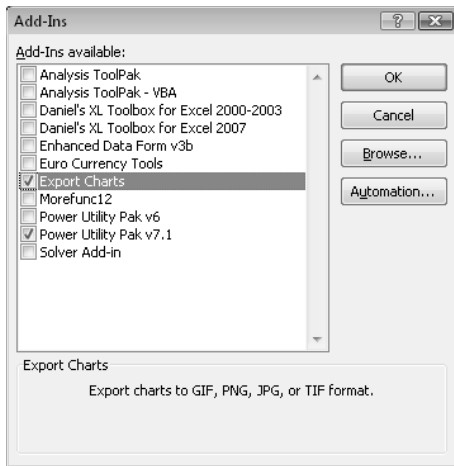


Figure 21-4: The Add-Ins dialog box with the new add-in selected.

When the Export Charts add-in is opened, the Chart Tools→Design contextual tab displays a new group, Export Charts, with two controls. One control displays the Export Charts dialog box, the other displays the Help file. Note that the Chart Tools→Design contextual tab is visible only when a chart (or chart sheet) is selected.

Testing the add-in

After installing the add-in, it's a good idea to perform some additional testing. For this example, open a new workbook and create some charts to try out the various features in the Export Charts utility. Do everything you can think of to try to make it fail. Better yet, seek the assistance of someone unfamiliar with the application to give it a crash test.

If you discover any errors, you can correct the code in the add-in (the original file is not required). After making changes, save the file by choosing File→Save in the VBE.

Distributing an add-in

You can distribute this add-in to other Excel users simply by giving them a copy of the XLAM file (they don't need the XLSM version) along with instructions on how to install it. If you locked the file with a password, your macro code cannot be viewed or modified by others unless they know the password.



Creating an add-in: A checklist

Before you release your add-in to the world, take a few minutes to run through this checklist:

- Did you test your add-in with all supported platforms and Excel versions?
- Did you give your VB project a new name? By default, every project is named `VBProject`. It's a good idea to give your project a more meaningful name.
- Does your add-in make any assumptions about the user's directory structure or directory names?
- When you use the Add-Ins dialog box to load your add-in, are its name and description correct and appropriate?
- If your add-in uses VBA functions that aren't designed to be used in a worksheet, have you declared the functions as `Private`? If not, these functions will appear in the Insert Function dialog box.
- Did you remember to remove all `Debug.Print` statements from your code?
- Did you force a recompile of your add-in to ensure that it contains no syntax errors?
- Did you account for any international issues?
- Is your add-in file optimized for speed? See "Optimizing the Performance of Add-Ins" later in this chapter.

Modifying an add-in

If you need to modify an add-in, first open it and then unlock the VB project if you applied a password. To unlock it, activate the VBE and then double-click its project's name in the Project window. You'll be prompted for the password. Make your changes and then save the file from the VBE (choose **File**→**Save**).

If you create an add-in that stores its information in a worksheet, you must set its `IsAddIn` property to `False` before you can view that workbook in Excel. You do this in the Properties window shown in Figure 21-5 when the `ThisWorkbook` object is selected. After you make your changes, set the `IsAddIn` property back to `True` before you save the file. If you leave the `IsAddIn` property set to `False`, Excel won't let you save the file with the XLAM extension.

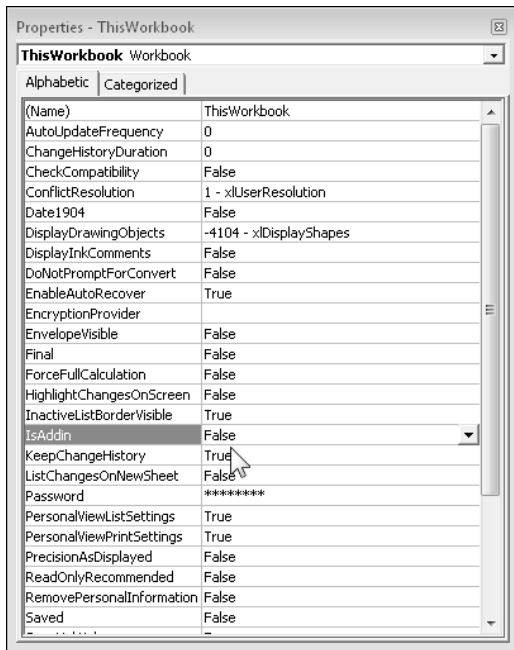


Figure 21-5: Making an add-in not an add-in.

Comparing XLAM and XLSM Files

This section begins by comparing an XLAM add-in file with its XLSM source file. Later in this chapter, I discuss methods that you can use to optimize the performance of your add-in. I describe a technique that might reduce its file size, which makes it load more quickly and use less disk space and memory.

For starters, an add-in based on an XLSM source file is exactly the same size as the original. The VBA code in XLAM files isn't optimized in any way, so faster performance isn't among the benefits of using an add-in.

XLAM file VBA collection membership

An add-in is a member of the `AddIns` collection but isn't an official member of the `Workbooks` collection. However, you *can* refer to an add-in by using the `Workbooks` method of the `Application` object and supplying the add-in's filename as its index. The following instruction creates an object variable that represents an add-in named `myaddin.xlam`:

```
Dim TestAddin As Workbook
Set TestAddin = Workbooks("myaddin.xlam")
```


Add-ins cannot be referenced by an index number in the `Workbooks` collection. If you use the following code to loop through the `Workbooks` collection, the `myaddin.xlam` workbook isn't displayed:

```
Dim w as Workbook
For Each w in Application.Workbooks
    MsgBox w.Name
Next w
```

The following `For-Next` loop, on the other hand, displays `myaddin.xlam` — assuming that Excel “knows” about it — in the Add-Ins dialog box:

```
Dim a as Addin
For Each a in Application.AddIns
    MsgBox a.Name
Next a
```

Visibility of XLSM and XLAM files

Ordinary workbooks are displayed in one or more windows. For example, the following statement displays the number of windows for the active workbook:

```
MsgBox ActiveWorkbook.Windows.Count
```

You can manipulate the visibility of each window for a workbook by choosing the **View→Window→Hide** command or by changing the `Visible` property using VBA. The following code hides all windows for the active workbook:

```
Dim Win As Window
For Each Win In ActiveWorkbook.Windows
    Win.Visible = False
Next Win
```

Add-in files are never visible, and they don't officially have windows, even though they have unseen worksheets. Consequently, add-ins don't appear in the windows list when you choose the **View→Window→Switch Windows** command. If `myaddin.xlam` is open, the following statement returns 0:

```
MsgBox Workbooks("myaddin.xlam").Windows.Count
```

Worksheets and chart sheets in XLSM and XLAM files

Add-in files, like normal workbook files, can have any number of worksheets or chart sheets. But, as I note earlier in this chapter, an XLSM file must have at least one worksheet in order for it to be converted to an add-in. In many cases, this worksheet will be empty.

When an add-in is open, your VBA code can access its sheets as if it were an ordinary workbook. Because add-in files aren't part of the `Workbooks` collection, however, you must always reference an add-in by its name and not by an index number. The following example displays the value in cell A1 of the first worksheet in `myaddin.xla`, which is assumed to be open:

```
MsgBox Workbooks("myaddin.xlam").Worksheets(1).Range("A1").Value
```

If your add-in contains a worksheet that you'd like the user to see, you can either copy the sheet to an open workbook or create a new workbook from the sheet.

The following code, for example, copies the first worksheet from an add-in and places it in the active workbook (as the last sheet):

```
Sub CopySheetFromAddin()  
    Dim AddinSheet As Worksheet  
    Dim NumSheets As Long  
    Set AddinSheet = Workbooks("myaddin.xlam").Sheets(1)  
    NumSheets = ActiveWorkbook.Sheets.Count  
    AddinSheet.Copy After:=ActiveWorkbook.Sheets(NumSheets)  
End Sub
```

Note that this procedure works even if the VBA project for the add-in is protected with a password.

Creating a new workbook from a sheet within an add-in is even simpler:

```
Sub CreateNewWorkbook()  
    Workbooks("myaddin.xlam").Sheets(1).Copy  
End Sub
```



Note

The preceding examples assume that the code is in a file other than the add-in file. VBA code within an add-in should always use `ThisWorkbook` to qualify references to sheets or ranges within the add-in. For example, the following statement is assumed to be in a VBA module in an add-in file. This statement displays the value in cell A1 on Sheet 1:

```
MsgBox ThisWorkbook.Sheets("Sheet1").Range("A1").Value
```

Accessing VBA procedures in an add-in

Accessing the VBA procedures in an add-in is a bit different from accessing procedures in a normal XLSM workbook. First of all, when you choose the View→Macros→Macros command, the Macro dialog box doesn't display the names of macros that are in open add-ins. It's almost as if Excel is trying to prevent you from accessing them.



Tip

If you know the name of the procedure in the add-in, you can enter it directly into the Macro dialog box and click Run to execute it. The `Sub` procedure must be in a general VBA module and not in a code module for an object.

Because procedures contained in an add-in aren't listed in the Macro dialog box, you must provide other means to access them. Your choices include direct methods (such as shortcut keys, Ribbon commands, and shortcut menu items) as well as indirect methods (such as event handlers). One such candidate, for example, may be the `OnTime` method, which executes a procedure at a specific time of day.

You can use the `Run` method of the `Application` object to execute a procedure in an add-in. For example,

```
Application.Run "myaddin.xlam!DisplayNames"
```

Another option is to use the Tools→References command in the VBE to enable a reference to the add-in. Then you can refer directly to one of its procedures in your VBA code without the file-name qualifier. In fact, you don't need to use the `Run` method; you can call the procedure directly as long as it's not declared as `Private`. The following statement executes a procedure named `DisplayNames` in an add-in that has been added as a reference:

```
Call DisplayNames
```



Note

Even when a reference to the add-in has been established, its macro names don't appear in the Macro dialog box.

Function procedures defined in an add-in work just like those defined in an XLSM workbook. They're easy to access because Excel displays their names in the Insert Function dialog box under the User Defined category (by default). The only exception is if the `Function` procedure was declared with the `Private` keyword; then the function doesn't appear there. That's why it's a good idea to declare custom functions as `Private` if they will be used only by other VBA procedures and aren't designed to be used in worksheet formulas.



An example of an add-in that does *not* declare its functions as `Private` is Microsoft's Lookup Wizard add-in (included with earlier versions of Excel, and downloadable from Microsoft's Web site). After installing this add-in, click the Insert Function button. You'll find more than three-dozen nonworksheet functions listed in the User Defined category of the Insert Function dialog box (see Figure 21-6). These functions are not intended to be used in a worksheet formula, but it appears that the programmer forgot to declare them as `Private`.

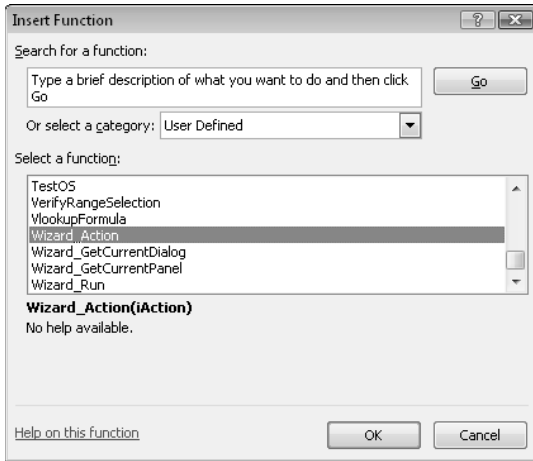


Figure 21-6: These functions should not be listed here and should have been declared as `Private`.

You can use worksheet functions contained in add-ins without the workbook name qualifier. For example, if you have a custom function named `MOVAVG` stored in the file `newfuncs.xlsm`, you'd use the following instruction to address the function from a worksheet that's in a different workbook:

```
=newfuncs.xlsm!MOVAVG(A1:A50)
```

But if this function is stored in an add-in file that's open, you can omit the file reference and write the following instead:

```
=MOVAVG(A1:A50)
```


continued

4. Select various items in the Classes list to see what class they are and the members that they contain.

You see that this add-in has 3 UserForms, 6 VBA modules, and 19 worksheets. Excel allows you to copy sheets from protected add-ins, so if you'd like to take a look at one of the worksheets, use the Immediate window and copy the worksheet to a new workbook using a statement like this:

```
Workbooks("eurotool.xlam").Sheets(1).Copy
```

Or, to examine all the worksheets, execute this statement, which converts the add-in to a standard workbook:

```
Workbooks("eurotool.xlam").IsAddin = False
```

The following figure shows a portion of the worksheet copied from EUROTOOL.XLAM. This sheet (and the others) contain information used to localize the add-in for different languages.

	A	B
1	frmEuro	
2	Accelerator	Caption
3		歐元轉換
4		歐元轉換公式的資料
5	S	來源範圍: (S)
6	D	目的範圍: (D)
7		貨幣轉換
8	F	由: (F)
9	T	至: (T)
10	O	輸出格式: (O)
11	A	進階 (A)
12		確定
13		取消
14		<unused>

That's interesting, but it doesn't help identify the procedure name we're seeking.

This add-in has many procedures; I tried executing several likely candidates, but none of them displayed the dialog box. Then I looked at the members listed in the `ThisWorkbook` code module and noticed a procedure called `EuroConversionWizard`. I tried to execute it, but I got an error. Then I tried another command:

```
Application.Run "eurotool.xlam!ThisWorkbook.EuroConversionWizard"
```

Success! Executing this statement displays the Euro Conversion dialog box.

Armed with this information, you can write VBA code to display the Euro Conversion dialog box — assuming, of course, that you can think of a reason to do so.

Manipulating Add-Ins with VBA

In this section, I present information that can help you write VBA procedures that manipulate add-ins.

The `AddIns` collection consists of all add-ins that Excel knows about. These add-ins can either be installed or not. The Add-Ins dialog box lists all members of the `AddIns` collection. Those entries accompanied by a check mark are installed.



Excel 2010 includes an additional collection: `AddIns2`. This collection is the same as the `AddIns` collection, but it also includes add-ins that were opened using the File→Open command. In the past, accessing these add-ins required an XLM macro.

Adding an item to the `AddIns` collection

The add-in files that make up the `AddIns` collection can be stored anywhere. Excel maintains a partial list of these files and their locations in the Windows Registry. For Excel 2010, this list is stored at

```
HKEY_CURRENT_USER\Software\Microsoft\Office\14.0\Excel\Add-in Manager
```

You can use the Windows Registry Editor (`regedit.exe`) to view this Registry key. Note that the standard add-ins that are shipped with Excel do not appear in this Registry key. In addition, add-in files stored in the following directory also appear in the list but aren't listed in the Registry:

```
C:\Program Files\Microsoft Office\Office14\Library
```

You can add a new `AddIn` object to the `AddIns` collection either manually or programmatically by using VBA. To add a new add-in to the collection manually, display the Add-Ins dialog box, click the Browse button, and locate the add-in.

To add a new member to the `AddIns` collection with VBA, use the collection's `Add` method. Here's an example:

```
Application.AddIns.Add "c:\files\newaddin.xlam"
```

After the preceding instruction is executed, the `AddIns` collection has a new member, and the Add-Ins dialog box shows a new item in its list. If the add-in already exists in the collection, nothing happens, and an error isn't generated.

If the add-in is on removable media (for example, a CD-ROM), you can also copy the file to Excel's library directory with the `Add` method. The following example copies `myaddin.xlam` from drive E and adds it to the `AddIns` collection. The second argument (`True`, in this case) specifies whether the add-in should be copied. If the add-in resides on a hard drive, the second argument can be ignored.

```
Application.AddIns.Add "e:\myaddin.xla", True
```



Note

Adding a new file to the `AddIns` collection does not install it. To install the add-in, set its `Installed` property to `True`.



Caution

The Windows Registry doesn't actually get updated until Excel closes normally. Therefore, if Excel ends abnormally (that is, if it crashes), the add-in's name won't get added to the Registry, and the add-in won't be part of the `AddIns` collection when Excel restarts.

Removing an item from the AddIns collection

Oddly, there is no direct way to remove an add-in from the `AddIns` collection. The `AddIns` collection doesn't have a `Delete` or `Remove` method. One way to remove an add-in from the Add-Ins dialog box is to edit the Windows Registry database (using `regedit.exe`). After you do this, the add-in won't appear in the Add-Ins dialog box the next time that you start Excel. Note that this method isn't guaranteed to work with all add-in files.

Another way to remove an add-in from the `AddIns` collection is to delete, move, or rename its XLAM (or XLA) file. You'll get a warning like the one in Figure 21-7 the next time you try to install or uninstall the add-in, along with an opportunity to remove it from the `AddIns` collection.

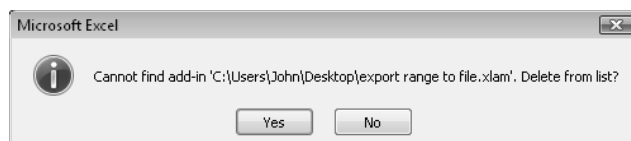


Figure 21-7: One way to remove a member of the `AddIns` collection.

AddIn object properties

An `AddIn` object is a single member of the `AddIns` collection. For example, to display the file-name of the first member of the `AddIns` collection, use the following:

```
Msgbox AddIns(1).Name
```


An `AddIn` object has 14 properties, which you can read about in the Help system. Five of these properties are hidden properties. Some of the terminology is a bit confusing, so I discuss a few of the more important properties in the sections that follow.

The Name property of an addin object

This property holds the filename of the add-in. `Name` is a read-only property, so you can't change the name of the file by changing the `Name` property.

The Path property of an addin object

This property holds the drive and path where the add-in file is stored. It doesn't include a final backslash or the filename.

The FullName property of an addin object

This property holds the add-in's drive, path, and filename. This property is a bit redundant because this information is also available from the `Name` and `Path` properties. The following instructions produce exactly the same message:

```
MsgBox AddIns(1).Path & "\" & AddIns(1).Name  
MsgBox AddIns(1).FullName
```

The Title property of an addin object

This hidden property holds a descriptive name for the add-in. The `Title` property is what appears in the Add-Ins dialog box. This property is read-only, and the only way to add or change the `Title` property of an add-in is to use the Document Properties panel (choose the **Developer→Modify→Document** command). You must use this menu command with the XLSM version of the file before converting it to an add-in. Another option is to right-click the add-in file in Windows Explorer and choose **Properties** from the shortcut menu. Then click the **Details** tab and make the change. This method won't work if the file is open in Excel.

Typically, a member of a collection is addressed by way of its `Name` property setting. The `AddIns` collection is different; it uses the `Title` property instead. The following example displays the filename for the Analysis ToolPak add-in (that is, `analys32.xll`), whose `Title` property is "Analysis ToolPak".

```
Sub ShowName()  
    MsgBox AddIns("Analysis Toolpak").Name  
End Sub
```

You can, of course, also reference a particular add-in with its index number if you happen to know it. But in the vast majority of cases, you will want to refer to an add-in by using its `Name` property.

The Comments property of an addin object

This property stores text that is displayed in the Add-Ins dialog box when a particular add-in is selected. `Comments` is a read-only property. To change it, use the Document Properties panel before you convert the workbook to an add-in. Or, use Windows Explorer, as described earlier for the `Title` property. Comments can be as long as 255 characters, but the Add-Ins dialog box can display only about 100 characters.

If your code attempts to read the `Comments` property of an add-in that has no comments, you get an error.

The Installed property of an addin object

The `Installed` property is `True` if the add-in is currently installed — that is, if it is checked in the Add-Ins dialog box. Setting the `Installed` property to `True` opens the add-in. Setting it to `False` unloads it. Here's an example of how to install (that is, open) the Analysis ToolPak add-in with VBA:

```
Sub InstallATP()
    AddIns("Analysis ToolPak").Installed = True
End Sub
```

After this procedure is executed, the Add-Ins dialog box displays a check mark next to Analysis ToolPak. If the add-in is already installed, setting its `Installed` property to `True` has no effect. To remove this add-in (uninstall it), simply set the `Installed` property to `False`.



Caution

If an add-in was opened with the File→Open command, it isn't considered to be officially installed. Consequently, its `Installed` property is `False`. An add-in is installed only if it appears in the Add-Ins dialog box, with a check mark next to its name.

The `ListAllAddIns` procedure that follows creates a table that lists all members of the `AddIns` collection and displays the following properties: `Name`, `Title`, `Installed`, `Comments`, and `Path`.

```
Sub ListAllAddins()
    Dim ai As AddIn
    Dim Row As Long
    Dim Table1 As ListObject
    Cells.Clear
    Range("A1:E1") = Array("Name", "Title", "Installed", _
        "Comments", "Path")
    Row = 2
    On Error Resume Next
    For Each ai In Application.AddIns
        Cells(Row, 1) = ai.Name
        Cells(Row, 2) = ai.Title
        Cells(Row, 3) = ai.Installed
        Cells(Row, 4) = ai.Comments
```

```

Cells(Row, 5) = ai.Path
Row = Row + 1
Next ai
On Error GoTo 0
Range("A1").Select
ActiveSheet.ListObjects.Add
ActiveSheet.ListObjects(1).TableStyle = _
    "TableStyleMedium2"
End Sub

```

Figure 21-8 shows the result of executing this procedure. If you modify the code to use the `AddIns2` collection, the table will also include add-ins that were opened using the **File**→**Open** command (if any). The `AddIns2` collection is available only in Excel 2010.



On the CD

This procedure is available on the companion CD-ROM. The filename is `list add-in information.xlsm`.

	A	B	C	D	E
1	Name	Title	Installed	Comments	Path
2	ANALYS32.XLL	Analysis ToolPak	TRUE		C:\Program Files\Microsoft Office\Office14\Library\Analysis
3	ATPVBAEN.XLAM	Analysis ToolPak - VBA	FALSE		C:\Program Files\Microsoft Office\Office14\Library\Analysis
4	sumif.xlam	Conditional Sum Wizard	FALSE		C:\Program Files\Microsoft Office\Office12\Library
5	dataform3.xlam	Enhanced Data Form v3b	FALSE	Enhanced Alternative to Excel's Data Form (Version 3.0b) Copyright 1997-2008, J-Walk & Associates	C:\Users\John\Documents\Excel\dataform 2007
6	EUROTOOL.XLAM	Euro Currency Tools	FALSE		C:\Program Files\Microsoft Office\Office14\Library
7	html.xlam	Internet Assistant VBA	FALSE		C:\Program Files\Microsoft Office\Office12\Library
8	lookup.xlam	Lookup Wizard	FALSE		C:\Program Files\Microsoft Office\Office12\Library
9	pup6.xla	Power Utility Pak v6	FALSE	Add-In Tools For Excel - Licensed © 1999-2005 J-Walk & Associates. All Rights Reserved.	C:\Program Files\pup6
10	pup7.xlam	Power Utility Pak v7	FALSE	Add-In Tools For Excel 2007 - Licensed Copyright 1999-2007 J-Walk & Associates All Rights Reserved	C:\Program Files\pup7
11	SOLVER.XLAM	Solver Add-in	FALSE		C:\Program Files\Microsoft Office\Office14\Library\SOLVER
12	text tools.xlam	Text Tools	FALSE	Adds text manipulation features to Excel	C:\Users\John\Documents\Word Files\Excel 2010 Power Prog

Figure 21-8: A table that lists all members of the `AddIns` collection.



Note

You can determine whether a particular workbook is an add-in by accessing its `IsAddIn` property. This property isn't read-only, so you can also convert a workbook to an add-in by setting the `IsAddIn` property to `True`.

And, conversely, you can convert an add-in to a workbook by setting the `IsAddIn` property to `False`. After doing so, the add-in's worksheets will be visible in Excel — even if the add-in's VBA project is protected. By using this technique, I learned that most of the dialog boxes in `SOLVER.XLAM` are Excel 5/95 dialog sheets, not `UserForms`.

Accessing an add-in as a workbook

You can open an add-in file by using the Add-Ins dialog box or by choosing the **File**→**Open** command. The former method is the preferred method for the following reason: When you open an

add-in with the File→Open command, its `Installed` property is *not* set to `True`. Therefore, you can't close the file by using the Add-Ins dialog box. In fact, the only way to close such an add-in is with a VBA statement such as the following:

```
Workbooks("myaddin.xlam").Close
```



Caution

Using the `Close` method on an installed add-in removes the add-in from memory, but it does *not* set its `Installed` property to `False`. Therefore, the Add-Ins dialog box still lists the add-in as installed, which can be very confusing. The proper way to remove an installed add-in is to set its `Installed` property to `False`.

As you may have surmised, Excel's add-in capability is a bit quirky. This component (except for the addition of the `AddIns2` collection) hasn't been improved in many years. Therefore, as a developer, you need to pay particular attention to issues involving installing and uninstalling add-ins.

AddIn object events

An `AddIn` object has two events: `AddInInstall` (raised when the add-in is installed) and `AddInUninstall` (raised when it is uninstalled). You can write event-handler procedures for these events in the `ThisWorkbook` code module for the add-in.

The following example is displayed as a message when the add-in is installed:

```
Private Sub Workbook_AddInInstall()  
    MsgBox ThisWorkbook.Name & _" add-in has been installed."  
End Sub
```



Caution

Don't confuse the `AddInInstall` event with the `Open` event. The `AddInInstall` event occurs only when the add-in is first installed — not every time it is opened. If you need to execute code every time the add-in is opened, use a `Workbook_Open` procedure.



Cross-Ref

For additional information about events, see Chapter 19.

Optimizing the Performance of Add-ins

If you ask a dozen Excel programmers to automate a particular task, chances are that you'll get a dozen different approaches. Most likely, not all these approaches will perform equally well.

Following are a few tips that you can use to ensure that your code runs as quickly as possible. These tips apply to all VBA code, not just the code in add-ins.

- **Set the `Application.ScreenUpdating` property to `False`** when writing data to a worksheet or performing any other actions that cause changes to the display.
- **Declare the data type for all variables used and avoid variants whenever possible.** Use an `Option Explicit` statement at the top of each module to force yourself to declare all variables.
- **Create object variables to avoid lengthy object references.** For example, if you're working with a `Series` object for a chart, create an object variable by using code like this:

```
Dim S1 As Series
Set S1 = ActiveWorkbook.Sheets(1).ChartObjects(1). _
    Chart.SeriesCollection(1)
```

- **Whenever possible, declare object variables as a specific object type** — not `As Object`.
- **Use the `With-End With` construct**, when appropriate, to set multiple properties or call multiple methods for a single object.
- **Remove all extraneous code.** This is especially important if you've used the macro recorder to create procedures.
- If possible, **manipulate data with VBA arrays rather than worksheet ranges.** Reading and writing to a worksheet take much longer than manipulating data in memory. This is not a firm rule, however. For best results, test both options.
- If your code writes lots of data to worksheets, **consider setting the calculation mode to `Manual`.** Doing so may increase the speed significantly. Here's a statement that changes the calculation mode:

```
Application.Calculation = xlCalculationManual
```

- **Avoid linking UserForm controls to worksheet cells.** Doing so may trigger a recalculation whenever the user changes the UserForm control.
- **Compile your code before creating the add-in.** This may increase the file size slightly, but it eliminates the need for Excel to compile the code before executing the procedures.

Special Problems with Add-Ins

Add-ins are great, but you should realize by now that there's no free lunch. Add-ins present their share of problems — or should I say *challenges*? In this section, I discuss some issues that you need to know about if you'll be developing add-ins for widespread user distribution.

Ensuring that an add-in is installed

In some cases, you may need to ensure that your add-in is installed properly — that is, opened using the Add-Ins dialog box and not the `File→Open` command. This section describes a

technique that determines how an add-in was opened and gives the user an opportunity to install the add-in if it is not properly installed.

If the add-in isn't properly installed, the code displays a message (see Figure 21-9). Clicking Yes installs the add-in. Clicking No leaves the file open but doesn't install it. Clicking Cancel closes the file.

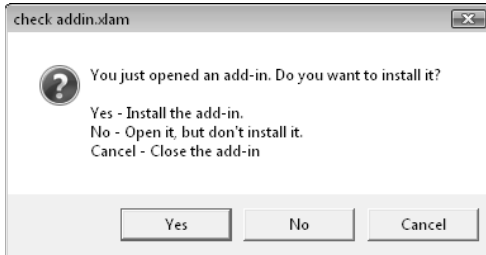


Figure 21-9: When attempting to open the add-in incorrectly, the user sees this message.

The code that follows is the code module for the add-in's `ThisWorkbook` object. This technique relies on the fact that the `AddInInstall` event occurs before the `Open` event for the workbook.

```
Dim InstalledProperly As Boolean
Private Sub Workbook_AddinInstall()
    InstalledProperly = True
End Sub
Private Sub Workbook_Open()
    Dim ai As AddIn, NewAi As AddIn
    Dim M As String
    Dim Ans As Integer
    'Was just installed using the Add-Ins dialog box?
    If InstalledProperly Then Exit Sub

    'Is it in the AddIns collection?
    For Each ai In AddIns
        If ai.Name = ThisWorkbook.Name Then
            If ai.Installed Then
                MsgBox "This add-in is properly installed.", _
                    vbInformation, ThisWorkbook.Name
                Exit Sub
            End If
        End If
    Next ai

    'It's not in AddIns collection, prompt user.
    M = "You just opened an add-in. Do you want to install it?"
    M = M & vbCrLf
    M = M & vbCrLf & "Yes - Install the add-in. "
    M = M & vbCrLf & "No - Open it, but don't install it."
    M = M & vbCrLf & "Cancel - Close the add-in"
```

```

Ans = MsgBox(M, vbQuestion + vbYesNoCancel, _
    ThisWorkbook.Name)
Select Case Ans
    Case vbYes
        ' Add it to the AddIns collection and install it.
        Set NewAi = _
            Application.AddIns.Add(ThisWorkbook.FullName)
        NewAi.Installed = True
    Case vbNo
        'no action, leave it open
    Case vbCancel
        ThisWorkbook.Close
End Select
End Sub

```

The procedure covers the following possibilities:

- The add-in was opened automatically because it's an installed add-in listed (and checked) in the Add-Ins dialog box. The user doesn't see a message.
- The user uses the Add-Ins dialog box to install the add-in. The user doesn't see a message.
- The add-in was opened manually (by using File→Open), and it's not a member of the `AddIns` collection. The user sees the message and must take one of the three actions.
- The add-in was opened manually, and it's a member of the `AddIns` collection — but it's not installed (not checked). The user sees the message and must take one of the three actions.

By the way, you can also use this code as a way to simplify the installation of an add-in that you give to someone. Just tell them to double-click the add-in's filename (which opens it in Excel) and respond Yes to the prompt. Better yet, modify the code so that the add-in is installed without a prompt.



On the CD

This add-in, named `check addin.xlam`, is available on the companion CD-ROM. Try opening it using both methods (the Add-Ins dialog box and by choosing File→Open).

Referencing other files from an add-in

If your add-in uses other files, you need to be especially careful when distributing the application. You can't assume anything about the storage structure of the system that users will run the application on. The easiest approach is to insist that all files for the application be copied to a single directory. Then you can use the `Path` property of your application's workbook to build path references to all other files.

For example, if your application uses a custom help file, be sure that the help file is copied to the same directory as the application itself. Then you can use a procedure like the following to make sure that the help file can be located:

```
Sub GetHelp()  
    Application.Help ThisWorkbook.Path & "\userhelp.chm"  
End Sub
```

If your application uses Application Programming Interface (API) calls to standard Windows DLLs, you can assume that these can be found by Windows. But if you use custom DLLs, the best practice is to make sure that they're installed in the `Windows\System` directory (which might or might not be named `Windows\System`). You'll need to use the `GetSystemDirectory` Windows API function to determine the exact path of the System directory.

Detecting the proper Excel version for your add-in

As you may know, those who use an earlier version of Excel can open Excel 2007 (and later) files if they've installed Microsoft's Compatibility Pak. If your add-in uses any features unique to Excel 2007 or Excel 2010, you'll want to warn users who attempt to open the add-in with an earlier version. The following code does the trick:

```
Sub CheckVersion()  
    If Val(Application.Version) < 12 Then  
        MsgBox "This works only with Excel 2007 or later"  
        ThisWorkbook.Close  
    End If  
End Sub
```

The `Version` property of the `Application` object returns a string. For example, this might return `12.0a`. This procedure uses VBA's `Val` function, which ignores everything after the first alphabetic character.



Cross-Ref

See Chapter 26 for additional information about compatibility.

PART

VI

Developing Applications

CHAPTER 22

Working with the Ribbon

CHAPTER 23

Working with Shortcut Menus

CHAPTER 24

Providing Help for Your Applications

CHAPTER 25

Developing User-Oriented Applications

Working with the Ribbon

In This Chapter

- Looking at the Excel Ribbon UI from a user's perspective
- Using VBA to work with the Ribbon
- Customizing the Ribbon with RibbonX code
- Looking at examples of workbooks that modify the Ribbon
- Using boiler-plate code for creating an old-style toolbar

Ribbon Basics

Beginning with Microsoft Office 2007, the time-honored menu-and-toolbar user interface was scrapped and replaced with a new *tab-and-Ribbon* interface. Although the new interface kind of resembles the old-fashioned menus-and-toolbars interface, you'll find that it's radically different.

Long-time Excel users probably noticed that the menu system had become increasingly complicated with each new version. In addition, the number of toolbars had become almost overwhelming. After all, every new feature must be accessible. In the past, this access meant adding more items to the menus and building new toolbars. The Microsoft designers set out to solve this overcrowding problem, and the Ribbon interface was their solution.

Reactions to the Office Ribbon interface can best be described as mixed. As with anything new, some people love it, and others hate it. Count me among the former group. After using Excel 2007 for more than three years, it's painful for me to go back to the confusing menu system in Excel 2003.

Many experienced Excel users suffered from a mild case of bewilderment when they realized that all their familiar command sequences no longer worked. Beginning users, on the other hand, are usually able to get up to speed much more quickly because they aren't overwhelmed with irrelevant menus and toolbars.

For the benefit of Ribbon newcomers, I provide some additional user-oriented information in the sections that follow.

The commands available in the Ribbon vary, depending on which tab is selected. The Ribbon is arranged into groups of related commands. Here's a quick overview of Excel's tabs:

- **Home:** You'll probably spend most of your time in the Home tab. This tab contains the basic Clipboard commands, formatting commands, style commands, commands to insert and delete rows and columns, plus an assortment of worksheet-editing commands.
- **Insert:** Select this tab when you need to insert something in a worksheet — a table, a diagram, a chart, a symbol, and so on.
- **Page Layout:** This tab contains commands that affect the overall appearance of your worksheet, including settings that deal with printing.
- **Formulas:** Use this tab to insert a formula, name a range, access the formula-auditing tools, or control how Excel performs calculations.
- **Data:** Excel's data-related commands are on this tab.
- **Review:** This tab contains tools to check spelling, translate words, add comments, and protect sheets.
- **View:** The View tab contains commands that control various aspects of how a sheet is viewed. Some commands on this tab are also available on the status bar.
- **Developer:** This tab isn't visible by default. It contains commands that are useful for programmers. To display the Developer tab, right-click the Ribbon and choose Customize The Ribbon. In the Customize Ribbon tab of the Excel Options dialog box, place a check mark next to Developer.
- **Add-Ins:** This tab is visible only if you've loaded a workbook or add-in that customizes the menu or toolbars (by using the `CommandBars` object). Because menus and toolbars are no longer available, these customizations appear in the Add-Ins tab.

The appearance of the commands on the Ribbon varies, depending on the width of the Excel window. When the window is too narrow to display everything, the commands adapt and may seem to be missing, but the commands are still available. Figure 22-1 shows three views of the Home tab of the Ribbon. In the top image, all controls are fully visible. In the middle image, Excel's window is made narrower. Notice that some of the descriptive text is gone, and some of the icons are smaller. The bottom image shows the extreme case in which the window is very narrow. Some groups display a single icon. However, if you click the icon, all the group commands are available to you.



Tip

If you'd like to hide the Ribbon to increase your worksheet view, just double-click any of the tabs. The Ribbon goes away (but the tabs remain), and you're able to see about five additional rows of your worksheet. When you need to use the Ribbon again, just click a tab, and it comes back temporarily. To permanently restore the Ribbon, double-click a tab. You can also press Ctrl+F1 to toggle the Ribbon display on and off, or use the ^ icon (next to the Help icon in the Excel title bar).

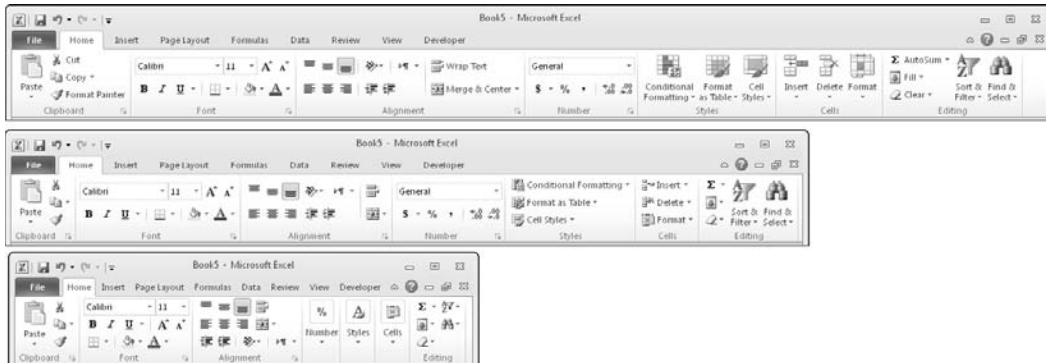


Figure 22-1: The Home tab of the Ribbon, with varying widths of the Excel window.



The CommandBar Object in Excel 2010

Excel 97 introduced a completely new way of handling toolbars and menus. These UI elements are `CommandBar` objects. What's commonly called a toolbar is actually one of three types of command bars:

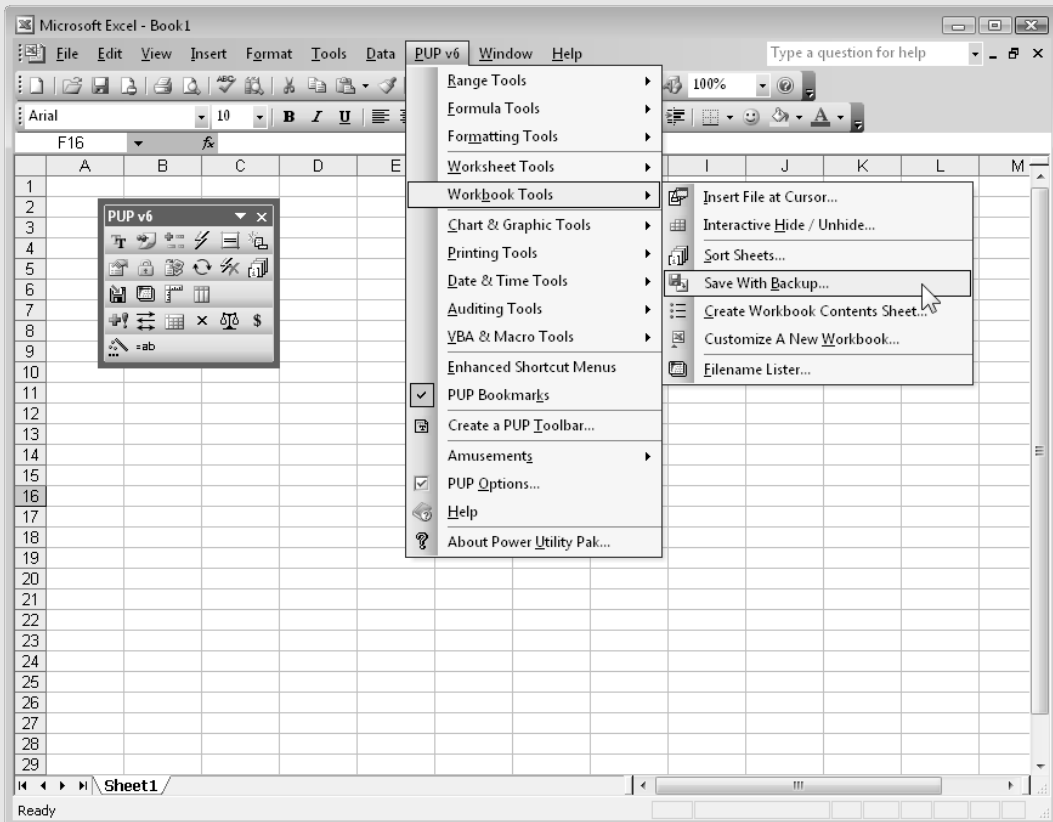
- **Toolbar:** This is a bar with one or more clickable controls.
- **Menu bar:** The two built-in menu bars are the Worksheet menu bar and the Chart menu bar.
- **Shortcut menu:** This is the menu that pops up when you right-click an object.

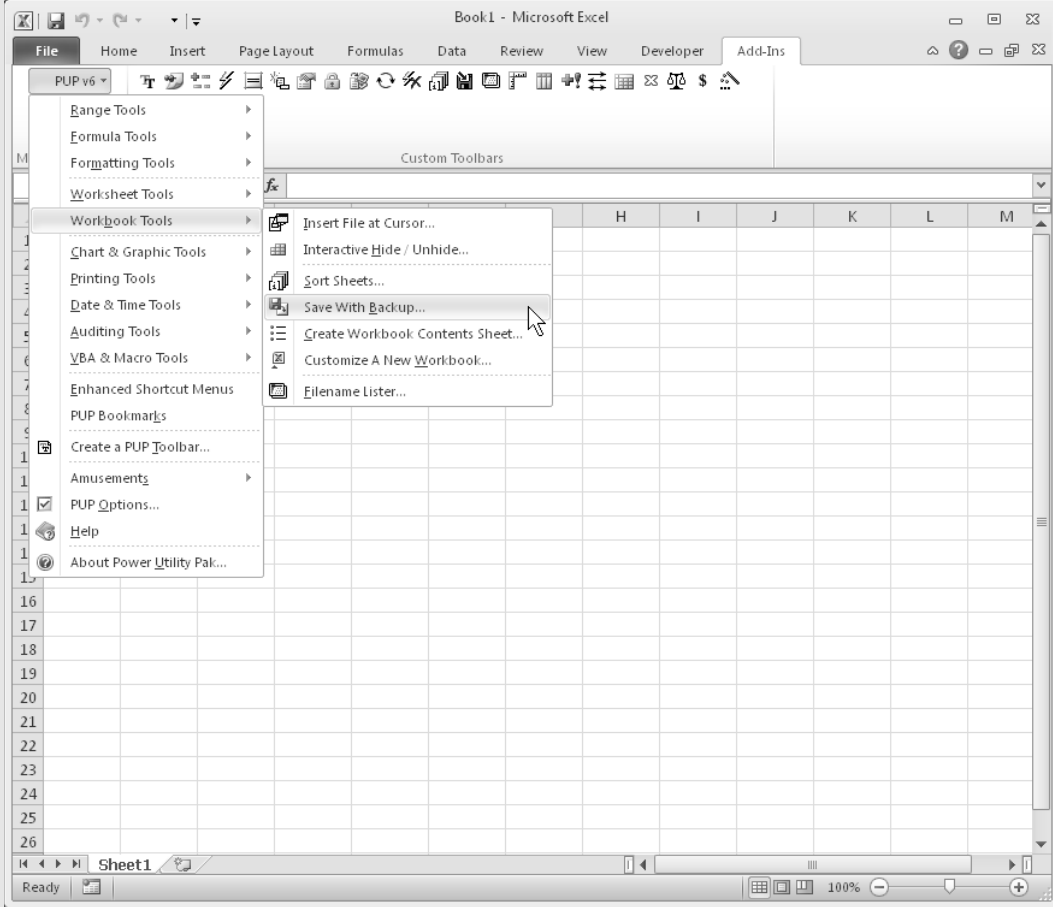
For compatibility purposes, Excel 2007 and Excel 2010 still support the `CommandBar` object — but its functionality has been significantly deprecated. It's no longer possible for an end user to create a custom toolbar. However, a VBA programmer can still create and work with `CommandBar` objects (see “Creating an Old-Style Toolbar,” later in this chapter). The problem, however, is that many of the `CommandBar` properties and methods are simply ignored in Excel 2007 and Excel 2010. For example, every toolbar or customized menu appears in the Add-Ins tab of the Ribbon. Properties that control a toolbar's dimensions and position no longer work. In addition, floating toolbars are no longer possible.

continued

continued

The accompanying figures show a customized menu and toolbar in Excel 2003, and the same menu and toolbar in Excel 2010. Although these UI elements are still functional in Excel 2010, it's clearly not what the developer (me!) had in mind. Needless to say, many VBA developers will want to redo the UI for their older applications.





In this chapter, I present a simple example of creating a custom toolbar by using the `CommandBar` object (see “Creating an Old-Style Toolbar”). For complete details on creating custom menus and toolbars with the `CommandBar` object, consult the Excel 2003 edition of this book.

Customizing shortcut menus is still supported in Excel 2010, and I cover that topic in Chapter 23.

Using VBA with the Ribbon

Now, the big question: What can a VBA programmer do with the Ribbon? The simple answer is this: not much.

Following is a list of what you can do with the Ribbon using VBA:

- Determine whether a particular control is enabled.
- Determine whether a particular control is visible.
- Determine whether a particular control is pressed (for toggle buttons and check boxes).
- Get a control's label, screen tip, or supertip (a more detailed description of the control).
- Display the image associated with a control.
- Execute the command associated with a particular control.

Following is a list of things that you might like to do with the Ribbon but that aren't possible:

- Determine which tab is currently selected.
- Activate a particular tab.
- Add a new tab.
- Add a new group to a tab.
- Add a new control.
- Remove a control.
- Disable a control.
- Hide a control.



New Feature

In Excel 2010, the user can make modifications to the Ribbon by using the **Customize Ribbon** tab of the Excel Options dialog box. Unfortunately, you can't use VBA to make these changes.

Accessing a Ribbon control

All told, Excel has more than 1,700 Ribbon controls. Every Ribbon control has a name, and you use that name when you work with the control using VBA.

For example, the statement that follows displays a message box that shows the Enabled status of the `ViewCustomViews` control. (This control is located in the **View**→**Workbook Views** group.)

```
MsgBox Application.CommandBars.GetEnabledMso("ViewCustomViews")
```

Normally, this control is enabled. But (inexplicably), if the workbook contains a table (created by **Insert**→**Tables**→**Table**), the `ViewCustomViews` control is disabled.

Determining the name of a particular control is a manual task. First, display the Customize Ribbon tab of the Excel Options dialog box. Locate the control in the list box on the left and then hover the mouse pointer over the item. The control's name appears in a pop-up screen tip, in parentheses (see Figure 22-2).

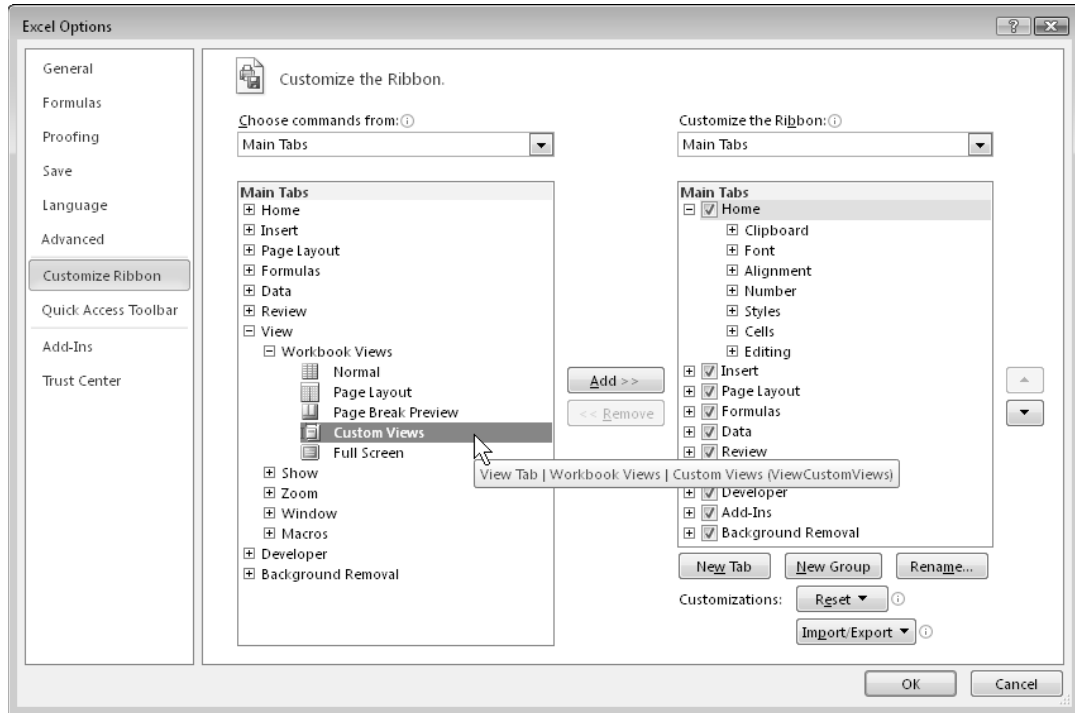


Figure 22-2: Using the Customize Ribbon tab of the Excel Options dialog box to determine the name of a control.

Unfortunately, it's not possible to write VBA code to loop through all the controls on the Ribbon and display a list of their names.



On the CD

The companion CD-ROM contains a workbook with the names of all Excel controls. The workbook also displays additional information about each control, including the control type, the tab name, and the group name. Figure 22-3 shows a portion of this file, which is named `ribbon control names.xlsx`.

	A	B	C	D	E	
1	Control Name	Control Type	Tab Set Name	Tab Name	Group Name	Parent
2	FileNewDefault	button	None (Quick Access Toolbar)	Quick Access Toolbar		
3	FileOpen	button	None (Quick Access Toolbar)	Quick Access Toolbar		
4	FileSave	button	None (Quick Access Toolbar)	Quick Access Toolbar		
5	FileSendAsAttachment	button	None (Quick Access Toolbar)	Quick Access Toolbar		
6	FilePrintQuick	button	None (Quick Access Toolbar)	Quick Access Toolbar		
7	FilePrintPreview	button	None (Quick Access Toolbar)	Quick Access Toolbar		
8	Spelling	button	None (Quick Access Toolbar)	Quick Access Toolbar		
9	Undo	gallery	None (Quick Access Toolbar)	Quick Access Toolbar		
10	Redo	gallery	None (Quick Access Toolbar)	Quick Access Toolbar		
11	SortAscendingExcel	button	None (Quick Access Toolbar)	Quick Access Toolbar		
12	SortDescendingExcel	button	None (Quick Access Toolbar)	Quick Access Toolbar		
13	FileOpenRecentFile	button	None (Quick Access Toolbar)	Quick Access Toolbar		
14	TabHome	tab	None (Core Tab)			
15	GroupClipboard	group	None (Core Tab)	TabHome		
16	PasteMenu	splitButton	None (Core Tab)	TabHome	GroupClipboard	
17	Paste	button	None (Core Tab)	TabHome	GroupClipboard	Paste
18	PasteGallery	gallery	None (Core Tab)	TabHome	GroupClipboard	Paste
19	PasteUsingTextImportWizard	button	None (Core Tab)	TabHome	GroupClipboard	Paste
20	PasteRefreshableWebQuery	button	None (Core Tab)	TabHome	GroupClipboard	Paste
21	PasteSpecialDialog	button	None (Core Tab)	TabHome	GroupClipboard	Paste
22	Cut	button	None (Core Tab)	TabHome	GroupClipboard	
23	CopySplitButton	splitButton	None (Core Tab)	TabHome	GroupClipboard	
24	Copy	button	None (Core Tab)	TabHome	GroupClipboard	Copy
25	Copy	button	None (Core Tab)	TabHome	GroupClipboard	Copy
26	CopyAsPicture	button	None (Core Tab)	TabHome	GroupClipboard	Copy
27	FormatPainter	control	None (Core Tab)	TabHome	GroupClipboard	
28	ShowClipboard	button (dialogBox)	None (Core Tab)	TabHome	GroupClipboard	
29	GroupFont	group	None (Core Tab)	TabHome		
30	Font	comboBox	None (Core Tab)	TabHome	GroupFont	
31	FontSize	comboBox	None (Core Tab)	TabHome	GroupFont	
32	FontSizeIncrease	button	None (Core Tab)	TabHome	GroupFont	

Figure 22-3: A workbook that displays information about each Ribbon control.

Working with the Ribbon

In the previous section I provided an example of using the `GetEnabledMso` method of the `CommandBars` object. Following is a list of all the methods that are relevant to working with the Ribbon via the `CommandBars` object. All these methods take one argument: `idMso`, which represents the name of the command.

- `ExecuteMso`: Executes a control
- `GetEnabledMso`: Returns `True` if the specified control is enabled
- `GetImageMso`: Returns the image for a control
- `GetLabelMso`: Returns the label for a control
- `GetPressedMso`: Returns `True` if the specified control is pressed (applies to check box and toggle button controls)

- `GetScreentipMso`: Returns the screen tip for a control (the text that appears in the control)
- `GetSupertipMso`: Returns the supertip for a control (the description of the control that appears when you hover the mouse pointer over the control)

Some of these methods are fairly useless. Why would a VBA programmer need to determine the screen tip for a control? I can't think of a reason.

The VBA statement that follows toggles the Selection pane (a feature introduced in Excel 2007 that facilitates selecting objects on a worksheet):

```
Application.CommandBars.ExecuteMso("SelectionPane")
```

The following statement displays the Paste Special dialog box (and will display an error message if the Windows Clipboard is empty):

```
Application.CommandBars.ExecuteMso("PasteSpecialDialog")
```

Here's a command that tells you whether the formula bar is visible (it corresponds to the state of the Formula Bar control in the View→Show group):

```
MsgBox Application.CommandBars.GetPressedMso("ViewFormulaBar")
```

Note, however, that your code can't change the visibility of the formula bar by accessing the Ribbon control. Rather, use the `DisplayFormulaBar` property of the `Application` object:

```
Application.DisplayFormulaBar = True
```

The statement that follows displays `True` if the Merge & Center control is enabled. (This control is disabled if the sheet is protected or if the active cell is within a table.)

```
MsgBox Application.CommandBars.GetEnabledMso("MergeCenter")
```

The following VBA code adds an ActiveX Image control to the active worksheet and uses the `GetImageMso` method to display the “binoculars” icon from the Find & Select control in the Home→Editing group:

```
Sub ImageOnSheet()  
    Dim MyImage As OLEObject  
    Set MyImage = ActiveSheet.OLEObjects.Add _  
        (ClassType:="Forms.Image.1", _
```

```

        Left:=50, _
        Top:=50)
    With MyImage.Object
        .AutoSize = True
        .BorderStyle = 0
        .Picture = Application.CommandBars. _
            GetImageMso("FindDialog", 32, 32)
    End With
End Sub

```

To display the Ribbon icon in an Image control (named Image1) on a UserForm, use this procedure:

```

Private Sub UserForm_Initialize()
    With Image1
        .Picture = Application.CommandBars. _
            GetImageMso("FindDialog", 32, 32)
        .AutoSize = True
    End With
End Sub

```

Activating a tab

Microsoft provides no direct way to activate a Ribbon tab from VBA. But if you really need to do so, using `SendKeys` is your only option. The `SendKeys` method simulates keystrokes. The keystrokes required to activate the Home tab are Alt, followed by H. These keystrokes display the keytips in the Ribbon. To hide the keytips, press F6. Using this information, the following statement sends the keystrokes required to activate the Home tab:

```
Application.SendKeys "%h{F6}"
```

The `SendKeys` arguments for the other tabs are

- **Insert:** "%n{F6}"
- **Page Layout:** "%p{F6}"
- **Formulas:** "%m{F6}"
- **Data:** "%a{F6}"
- **Review:** "%r{F6}"
- **View:** "%w{F6}"
- **Developer:** "%l{F6}"
- **Add-Ins:** "%x{F6}"



Storing UI changes

In Excel 2010, a user can make changes to the Ribbon and the Quick Access toolbar. In fact, you can easily add commands to the Quick Access toolbar or Ribbon. How does Excel keep track of these changes?

Quick Access toolbar and Ribbon modifications are stored in a file named `Excel.officeUI`. The location of this file varies. On my system, it's here:

```
C:\Users\<username>\AppData\Local\Microsoft\Office
```

I provide more information about the `Excel.officeUI` file in Chapter 4.

Using `SendKeys` may not be perfectly reliable. For example, if you execute the previous example while a UserForm is displayed, the keystrokes will be sent to the UserForm, not to the Ribbon.

Customizing the Ribbon

You can't perform any Ribbon modifications using VBA. Rather, you must write RibbonX code and insert the code into the workbook file — which is done outside of Excel. You can, however, create VBA callback procedures. A *callback procedure* is a VBA macro that is executed when a custom Ribbon control is activated.

RibbonX code is XML markup that describes the controls, where in the Ribbon they're displayed, what they look like, and what happens when they're activated. This book does not cover RibbonX — it's complex enough to be the subject of an entire book. I do, however, provide a few simple examples so that you can understand what's involved in modifying the Excel UI and decide whether it's something you'd like to learn.



Cross-Ref

For information about Excel's file structure, refer to Chapter 4. That section describes how to view the information inside of an XLSX workbook file.

A simple RibbonX example

This section contains a step-by-step walkthrough that will give you a feel for what it takes to modify Excel's Ribbon. This example creates a new Ribbon group (named Custom) on the Data tab. It also creates two buttons in the new Ribbon group, labeled Hello World and Goodbye World. Clicking either of these buttons executes a VBA macro.



Note

The instructions that follow are tedious and error-prone. In reality, most developers don't use this method. Rather, they use software designed to make the process much easier.



See your errors

Before you do any work with Ribbon customization, you should enable the display of RibbonX errors. Access the Office→Excel Options dialog box and click the Advanced tab. Scroll down to the General section and place a check mark next to Show Add-in User Interface Errors.

When this setting is enabled, RibbonX errors (if any) are displayed when the workbook opens — which is very helpful for debugging.

Follow these steps to create a workbook that contains RibbonX code that modifies the Ribbon:

1. Create a new Excel workbook, insert a VBA module, and enter the two callback procedures that follow.

These procedures are the ones that execute when the buttons are clicked:

```
Sub HelloWorld(control As IRibbonControl)
    MsgBox "Hello World!"
End Sub
Sub GoodbyeWorld(control As IRibbonControl)
    ThisWorkbook.Close
End Sub
```

2. Save the workbook and name it `ribbon_modification.xlsm`.
3. Close the workbook.
4. Locate the folder that contains the `ribbon_modification.xlsm` file and create a folder named `customUI`.
5. Inside the `customUI` folder, use a text editor (such as Windows Notepad) to create a text file named `customUI.xml` with the following RibbonX XML code:



If your system is set up to hide extensions of known file types, you should turn off that option so that you always see file extensions. In Windows Explorer, use Tools→Folder Options, and select the View tab in the Folder Options dialog box. Remove the check mark from Hide Extensions For Known File Types.

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/
  customui">
  <ribbon>
  <tabs>
  <tab idMso="TabData">
    <group id="Group1" label="Custom">
      <button id="Button1"
        label="Hello World"
        size="normal"
```

```

        onAction="HelloWorld"
        imageMso="HappyFace" />
    <button id="Button2"
        label="Goodbye World"
        size="normal"
        onAction="GoodbyeWorld"
        imageMso="DeclineInvitation" />
    </group>
</tab>
</tabs>
</ribbon>
</customUI>

```

6. Using Windows Explorer, add a .zip extension to the ribbon modification.xlsm file in Windows Explorer.

The filename should now be ribbon modification.xlsm.zip.

7. Drag the customUI folder you created in Step 4 into the ribbon modification.xlsm.zip file.

Windows treats Zip files as if they were folders, so drag-and-drop operations are allowed.

8. Double-click the ribbon modification.xlsm.zip file to open it.

Figure 22-4 shows the contents of the Zip file. As you see, the file contains several folders.

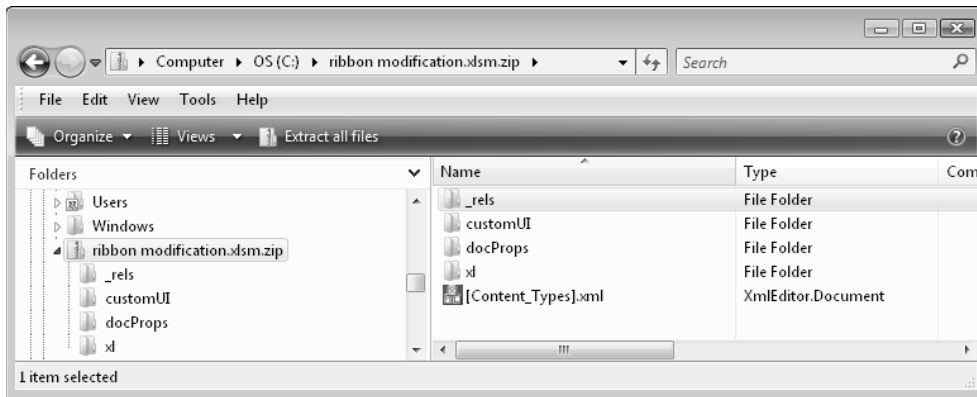


Figure 22-4: An Excel workbook, displayed as a Zip file.

9. Double-click the _rels folder within the Zip file.
This folder contains one file, named .rels.
10. Drag the .rels file to a location outside the Zip file (to your desktop, for example).
11. Open the .rels file (which is an XML file) with a text editor, such as Notepad.

12. Add the following line to the `.rels` file, before the `</Relationships>` tag:

```
<Relationship Type="http://schemas.microsoft.com/office/2006/relationships/ui/extensibility" Target="/customUI/customUI.xml" Id="12345" />
```

13. Save the `.rels` file and drag it back into the Zip file, overwriting the original version.
14. Remove the `.zip` extension so that the file is back to its original name: `ribbon modification.xlsm`.

Open the workbook in Excel. If all went well, you should see a new group with two buttons in the Data tab (see Figure 22-5).

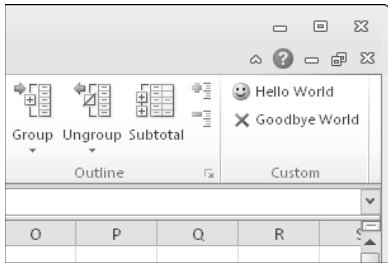


Figure 22-5: RibbonX code created a new group with two buttons.



On the CD

This workbook, named `ribbon modification.xlsm`, is available on the companion CD-ROM.

It's important to understand that the Ribbon modification is document-specific. In other words, the new Ribbon group is displayed only when the workbook that contains the RibbonX code is the active workbook. This is a major departure from how UI modifications worked in versions prior to Excel 2007.



Tip

To display Ribbon customizations when any workbook is active, convert the workbook to an add-in file or add the RibbonX code to your Personal Macro Workbook.

If you've concluded that modifying Excel's Ribbon isn't worth the effort, don't despair. Tools are available that make the process much less tedious than I've described.

A simple Ribbon example, take 2

This section provides step-by-step instructions for making the same Ribbon modification described in the previous section. In this example, I use the Custom UI Editor for Microsoft Office. This program still requires that you create the RibbonX code manually, but it will validate the code for you. It also eliminates all the tedious manual file manipulations. And finally, it can generate the VBA callback procedure declarations, which you can copy and paste to your VBA module.

You can download a free copy of the Custom UI Editor for Microsoft Office from

<http://openxmldeveloper.org/articles/customuieditor.aspx>

To add the new group and buttons (as described in the previous section) using the Custom UI Editor:

1. In Excel, create a new workbook and save it as a macro-enabled XLSM file.
2. Close the workbook.
3. Launch the Custom UI Editor For Microsoft Office.
4. Choose File→Open and locate the workbook you saved in Step 1.
5. Choose Insert→Office 2007 Custom UI Part.

Choosing this option will make the file compatible with both Excel 2007 and Excel 2010.

6. Enter the RibbonX code shown in Figure 22-6.

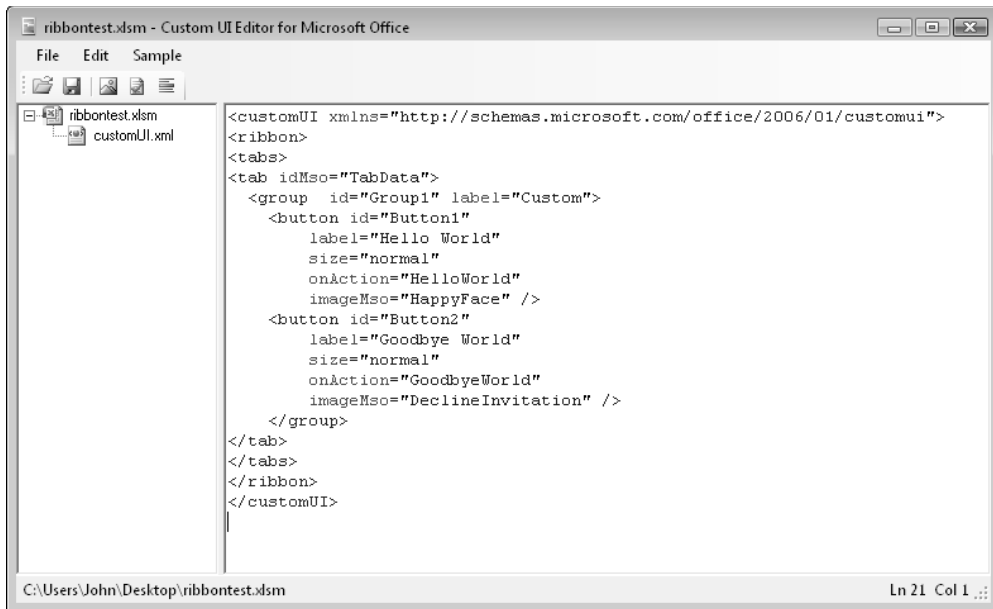


Figure 22-6: The Custom UI Editor for Microsoft Office.

7. Click the validate button to check for errors.
8. Click the Generate Callbacks button and copy the code that appears.

The Custom UI Editor generates two VBA callback procedures (see Figure 22-7). Select and copy this code; you will later paste it into a VBA module the workbook.

9. Click the customUI.xml node in the tree diagram on the left.
10. Choose File→Save and then File→Close.



Figure 22-7: The Custom UI Editor generated two VBA callback procedures.

11. Activate Excel and open the workbook.
12. Press Alt+F11 to activate the VB Editor.
13. Insert a VBA module and paste the code you copied in Step 8.
14. Add a `MsgBox` statement to each of the two procedures so that you can verify that they're being executed.

As you can see, working with the Custom UI Editor is much easier than manipulating a file manually. Figure 22-6 shows the Custom UI Editor.

The CUSTOM UI Part

In Step 5 of the preceding instructions, you inserted a `customUI` part for Office 2007. This choice makes the workbook compatible with Excel 2007 and Excel 2010. The other option on the Insert menu is Office 2010 Custom UI Part. If you put the RibbonX code in and Office 2010 Custom UI Part, the workbook won't be compatible with Excel 2007.

If your application doesn't use any commands that are unique to Excel 2010, using the Office 2007 custom UI part is the best solution. Also, keep in mind that a single file can have both an Office 2007 part and an Office 2010 part. You use two parts if you want to load version-specific RibbonX code for the UI. For example, you might write code to a command to the Excel 2010 Backstage View. Excel 2007 doesn't have Backstage View, so you'd write different code to add a command to the Excel 2007 Office button.

Note that the first statement in the RibbonX code must be changed for an Office 2010 Custom UI Part. The code must refer to this namespace:

```
<customUI xmlns='http://schemas.microsoft.com/office/2009/07/customui'>
```

If you use the wrong `customUI` tag, the Custom UI Editor will let you know when you validate the code.

VBA callback procedures

Recall that the workbook contains two VBA procedures, `HelloWorld` and `GoodbyeWorld`. These procedure names correspond to the `onAction` parameters in the RibbonX code. The `onAction` parameter is one way to link the RibbonX code to your VBA code.

Both the VBA procedures contain an argument named `control`, which is an `IRibbonControl` object. This object has three properties, which you can access in your VBA code:

- **Context:** A handle to the active window containing the Ribbon that triggered the callback. For example, use the following expression to get the name of the workbook that contains the RibbonX code:

```
control.Context.Caption
```

- **Id:** Contains the name of the control, specified as its `Id` parameter.
- **Tag:** Contains any arbitrary text that's associated with the control.

The VBA callback procedures can be as complex as necessary.

The .rels file

Inserting the file that contains the RibbonX code has no effect unless you specify a relationship between the document file and the customization file. These relationships, written in XML, are stored in the `.rels` file, which is in the `_rels` folder. Here's the relationship for the example presented in the previous section:

```
<Relationship Type="http://schemas.microsoft.com/office/2006/relationships/ui/extensibility" Target="/customUI/customUI.xml" Id="12345" />
```

The `Target` parameter points to the `customUI.xml` file that contains the RibbonX code. The `Id` parameter contains an arbitrary text string. The string can contain anything, as long as it's unique to the file (that is, as long as no other `<Relationship>` tag uses the same `Id`).

If you use the Custom UI Editor, you need not be concerned with the `.rels` file. Changes to this file are made automatically.

The RibbonX code

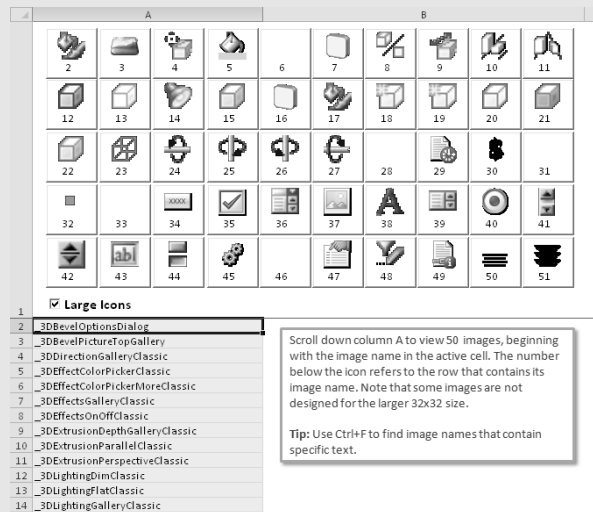
And now, the tricky part. Writing the XML code that defines your UI modification is no easy task. As I've noted, this is not the book that will teach you how to write RibbonX code. You'll find a few simple examples here, but you'll need to consult other sources for the fine points.

When you're starting out, it's best to start with examples that work (search the Web) and then make small modifications, testing frequently along the way. It can be very frustrating to spend an hour working on code that appears to be perfect in every way — and then realize that XML is case-sensitive. *ID* is not the same as *Id*.

Using imageMso images

Microsoft Office 2010 provides more than 1,000 named images that are associated with various commands. You can specify any of these images for your custom Ribbon controls — if you know the image's name.

The accompanying figure shows a workbook that contains the names of all the `imageMso` images. Scroll through the image names, and you see 50 images at a time (in small or large size), beginning with the image name in the active cell. This workbook, named `mso_image_browser.xlsx`, is available on the companion CD-ROM.



You can also use these images in an Image control placed on a UserForm. The following statement assigns the `imageMso` image named `ReviewAcceptChanges` to the `Picture` property of a UserForm Image control named `Image1`. The size of the image is specified as 32 x 32 pixels.

```
Image1.Picture = Application.CommandBars._
    GetImageMso("ReviewAcceptChange", 32, 32)
```



Note

You may be curious about the `imageMso` parameter, which determines which icon is displayed next to the control. Microsoft Office includes more than 1,000 icons that you can use with Ribbon controls. Each is accessed by its name. For more information, see the sidebar “Using `imageMso` images.”

Another RibbonX example

This section contains another example of using RibbonX to modify the UI. This workbook creates a new group on the Page Layout tab and adds a check box control that toggles the display of page breaks.



Note

Although Excel has more than 1,700 commands, it doesn’t have a command that toggles the page break display. After printing or previewing a worksheet, the only way to hide the page break display is to use the Excel Options dialog box. Therefore, this example also has some practical value.

This example is a bit tricky because it requires that the new Ribbon control be in synch with the active sheet. For example, if you activate a worksheet that doesn’t display page breaks, the check box control should be in its unchecked state. If you activate a worksheet that displays page breaks, the control should be checked. Furthermore, page breaks aren’t relevant for a chart sheet, so the control should be disabled if you activate a chart sheet.

The RibbonX Code

The RibbonX code that adds a new group (with a `CheckBox` control) to the Page Layout tab follows:

```
<customUI
  xmlns="http://schemas.microsoft.com/office/2006/01/customui"
  onLoad="Initialize">
<ribbon>
<tabs>
<tab idMso="TabPageLayoutExcel">
  <group id="Group1" label="Custom">
    <checkBox id="Checkbox1"
      label="Page Breaks"
      onAction="TogglePageBreakDisplay"
      getPressed="GetPressed"
      getEnabled="GetEnabled"/>
  </group>
</tab>
</tabs>
</ribbon>
</customUI>
```

This RibbonX code references four VBA callback procedures (each of which is described later):

- **Initialize:** Executed when the workbook is opened.
- **TogglePageBreakDisplay:** Executed when the user clicks the check box control.
- **GetPressed:** Executed when the control is invalidated (the user activates a different sheet).
- **GetEnabled:** Executed when the control is invalidated (the user activates a different sheet).

Figure 22-8 shows the new control.

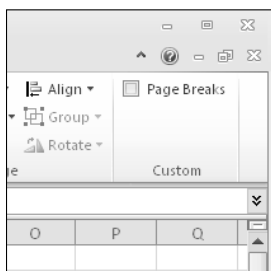


Figure 22-8: This check box control is always in synch with the page break display of the active sheet.

The VBA Code

The CustomUI tag includes an `onLoad` parameter, which specifies the `Initialize` VBA callback procedure, as follows (this code is in a standard VBA module):

```
Public MyRibbon As IRibbonUI
Sub Initialize(Ribbon As IRibbonUI)
'   Executed when the workbook loads
    Set MyRibbon = Ribbon
End Sub
```

The `Initialize` procedure creates an `IRibbonUI` object named `MyRibbon`. Notice that `MyRibbon` is a `Public` variable, so it's accessible from other procedures in the module.

I created a simple event procedure that is executed whenever a worksheet is activated. This procedure, which is located in the `ThisWorkbook` code module, calls the `CheckPageBreakDisplay` procedure:

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    Call CheckPageBreakDisplay
End Sub
```

The `CheckPageBreakDisplay` procedure *invalidates* the check box control. In other words, it destroys any data associated with that control.

```
Sub CheckPageBreakDisplay()  
' Executed when a sheet is activated  
  MyRibbon.InvalidateControl ("Checkbox1")  
End Sub
```

When a control is invalidated, the `GetPressed` and `GetEnabled` procedures are called.

```
Sub GetPressed(control As IRibbonControl, ByRef returnedVal)  
' Executed when the control is invalidated  
  On Error Resume Next  
  returnedVal = ActiveSheet.DisplayPageBreaks  
End Sub  
Sub GetEnabled(control As IRibbonControl, ByRef returnedVal)  
' Executed when the control is invalidated  
  returnedVal = TypeName(ActiveSheet) = "Worksheet"  
End Sub
```

Notice that the `returnedVal` argument is passed `ByRef`. This means that your code is able to change the value. And that's exactly what happens. In the `GetPressed` procedure, the `returnedVal` variable is set to the status of the `DisplayPageBreaks` property of the active sheet. The result is that the control's `Pressed` parameter is `True` if page breaks are displayed (and the control is checked). Otherwise, the control isn't checked.

In the `GetEnabled` procedure, the `returnedVal` variable is set to `True` if the active sheet is a worksheet (as opposed to a chart sheet). Therefore, the control is enabled only when the active sheet is a worksheet.

The only other VBA procedure is the `onAction` procedure, `TogglePageBreakDisplay`, which is executed when the user checks or unchecks the check box:

```
Sub TogglePageBreakDisplay(control As IRibbonControl, pressed As Boolean)  
' Executed when check box is clicked  
  On Error Resume Next  
  ActiveSheet.DisplayPageBreaks = pressed  
End Sub
```

This `pressed` argument is `True` if the user checks the check box and `False` if he unchecks the check box. The code sets the `DisplayPageBreaks` property accordingly.



On the CD

This workbook, named `page break display.xlsm`, is available on the companion CD-ROM. The CD also contains an add-in version of this workbook (named `page break display add-in.xlam`), which makes the new UI command available for all workbooks. The add-in version uses a class module to monitor sheet activation events for all workbooks. Refer to Chapter 19 for more information about events, and Chapter 29 for more information about class modules.

Ribbon controls demo

Figure 22-9 shows a custom Ribbon tab (My Stuff) with four groups of controls. In this section, I briefly describe the RibbonX code and the VBA callback procedures.

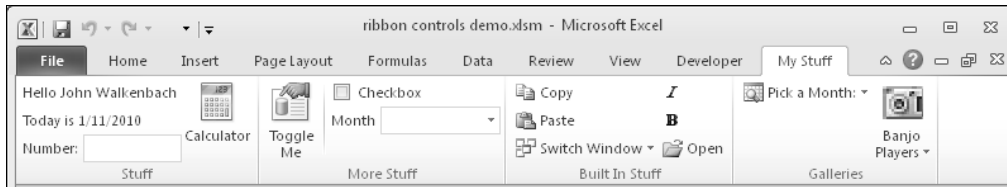


Figure 22-9: A new Ribbon tab with four groups of controls.



On the CD

This workbook, named `ribbon controls demo.xlsm`, is available on the companion CD-ROM.

Creating a new tab

The RibbonX code that creates the new tab is

```
<ribbon>
  <tabs>
    <tab id="CustomTab" label="My Stuff">
    </tab>
  </tabs>
</ribbon>
```



Tip

If you'd like to create a minimal UI, the `ribbon` tag has a `startFromScratch` attribute. If set to `True`, all the built-in tabs are hidden.

```
<ribbon startFromScratch="true" >
```


Creating a Ribbon group

The code in the `ribbon_controls_demo.xlsm` example creates four groups on the My Stuff tab. Here's the code that creates the four groups:

```
<group id="Group1" label="Stuff">
</group>
<group id="Group2" label="More Stuff">
</group>
<group id="Group3" label="Built In Stuff">
</group>
<group id="Group4" label="Galleries">
</group>
```

These pairs of `<group>` and `</group>` tags are located within the `<tab>` and `</tab>` tags that create the new tab.

Creating controls

Following is the RibbonX code that creates the controls in the first group (Stuff), shown in Figure 22-10. Notice that the controls are defined within the first set of `<group>` `</group>` tags.



Figure 22-10: A Ribbon group with four controls.

```
<group id="Group1" label="Stuff">
  <labelControl id="Label1" getLabel="getLabel1" />
  <labelControl id="Label2" getLabel="getLabel2" />

  <editBox id="EditBox1"
    showLabel="true"
    label="Number:"
    onChange="EditBox1_Change" />
  <button id="Button1"
    label="Calculator"
    size="large"
    onAction="ShowCalculator"
    imageMso="Calculator" />
</group>
```

Two label controls each have an associated VBA callback procedure (named `getLabel1` and `getLabel2`). These procedures are:

```
Sub getLabel1(control As IRibbonControl, ByRef returnedVal)
    returnedVal = "Hello " & Application.UserName
End Sub
Sub getLabel2(control As IRibbonControl, ByRef returnedVal)
    returnedVal = "Today is " & Date
End Sub
```

When the RibbonX code is loaded, these two procedures are executed, and the captions of the label controls are dynamically updated with the username and the date.

The editBox control has an onChange callback procedure named `EditBox1_Change`, which displays the square root of the number entered (or an error message if the square root can't be calculated). The `EditBox1_Change` procedure is

```
Sub EditBox1_Change(control As IRibbonControl, text As String)
    Dim squareRoot As Double
    On Error Resume Next
    squareRoot = Sqr(text)
    If Err.Number = 0 Then
        MsgBox "The square root of " & text & " is: " & squareRoot
    Else
        MsgBox "Enter a positive number.", vbCritical
    End If
End Sub
```

The last control in the Stuff group is a simple button. Its `onAction` parameter executes a VBA procedure named `ShowCalculator` — which uses the VBA `Shell` function to display the Windows calculator:

```
Sub ShowCalculator(control As IRibbonControl)
    On Error Resume Next
    Shell "calc.exe", vbNormalFocus
    If Err.Number <> 0 Then MsgBox "Can't start calc.exe"
End Sub
```

Figure 22-11 shows the controls in the second group, labeled More Stuff.

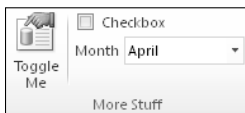


Figure 22-11: Three controls in a custom Ribbon group.

The RibbonX code for the second group is as follows:

```
<group id="Group2" label="More Stuff">
  <toggleButton id="ToggleButton1"
    size="large"
    imageMso="FileManageMenu"
    label="Toggle Me"
    onAction="ToggleButton1_Click" />
  <separator id="sep1" />
  <checkBox id="Checkbox1"
    label="Checkbox"
    onAction="Checkbox1_Change" />
  <comboBox id="Combo1"
    label="Month"
    onChange="Combo1_Change">
    <item id="Month1" label="January" />
    <item id="Month2" label="February" />
    <item id="Month3" label="March" />
    <item id="Month4" label="April" />
    <item id="Month5" label="May" />
    <item id="Month6" label="June" />
    <item id="Month7" label="July" />
    <item id="Month8" label="August" />
    <item id="Month9" label="September" />
    <item id="Month10" label="October" />
    <item id="Month11" label="November" />
    <item id="Month12" label="December" />
  </comboBox>
</group>
```

The group contains a `toggleButton`, a `separator`, a `checkBox`, and a `comboBox` control. These controls are fairly straightforward. Except for the `separator` control (which inserts a vertical line), each has an associated callback procedure that simply displays the status of the control:

```
Sub ToggleButton1_Click(control As IRibbonControl, ByRef returnedVal)
  MsgBox "Toggle value: " & returnedVal
End Sub
Sub Checkbox1_Change(control As IRibbonControl, pressed As Boolean)
  MsgBox "Checkbox value: " & pressed
End Sub
Sub Combo1_Change(control As IRibbonControl, text As String)
  MsgBox text
End Sub
```



Note

The `comboBox` control also accepts user-entered text. If you would like to limit the choices to those that you provide, use a `dropDown` control.

The controls in the third group consist of built-in controls (see Figure 22-12). To include a built-in control in a custom group, you just need to know its name (the `idMso` parameter).

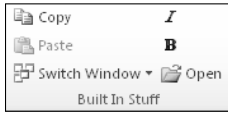


Figure 22-12: This group contains built-in controls.

The RibbonX code is

```
<group id="Group3" label="Built In Stuff">
  <control idMso="Copy" label="Copy" />
  <control idMso="Paste" label="Paste" enabled="true" />
  <control idMso="WindowSwitchWindowsMenuExcel"
    label="Switch Window" />
  <control idMso="Italic" />
  <control idMso="Bold" />
  <control idMso="FileOpen" />
</group>
```

These controls don't have callback procedures because they perform the standard action.

Figure 22-13 shows the final group of controls, which consists of two galleries.

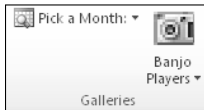


Figure 22-13: This Ribbon group contains two galleries.

The RibbonX code for these two gallery controls is

```
<group id="Group4" label="Galleries">
  <gallery id="Gallery1"
    imageMso="ViewAppointmentInCalendar"
    label="Pick a Month:"
    columns="2" rows="6"
    onAction="MonthSelected" >
    <item id="January" label="January" imageMso="QuerySelectQueryType"/>
    <item id="February" label="February" imageMso="QuerySelectQueryType"/>
    <item id="March" label="March" imageMso="QuerySelectQueryType"/>
    <item id="April" label="April" imageMso="QuerySelectQueryType"/>
    <item id="May" label="May" imageMso="QuerySelectQueryType"/>
    <item id="June" label="June" imageMso="QuerySelectQueryType"/>
    <item id="July" label="July" imageMso="QuerySelectQueryType"/>
    <item id="August" label="August" imageMso="QuerySelectQueryType"/>
    <item id="September" label="September" imageMso="QuerySelectQueryType"/>
  </gallery>
</group>
```

```

<item id="October" label="October" imageMso="QuerySelectQueryType" />
<item id="November" label="November" imageMso="QuerySelectQueryType" />
<item id="December" label="December" imageMso="QuerySelectQueryType" />
<button id="Today"
    label="Today..."
    imageMso="ViewAppointmentInCalendar"
    onAction="ShowToday" />
</gallery>
<gallery id="Gallery2"
    label="Banjo Players"
    size="large"
    columns="4"
    itemWidth="100" itemHeight="125"
    imageMso="Camera"
    onAction="OnAction">
<item id="bp01" image="bp01" />
<item id="bp02" image="bp02" />
<item id="bp03" image="bp03" />
<item id="bp04" image="bp04" />
<item id="bp05" image="bp05" />
<item id="bp06" image="bp06" />
<item id="bp07" image="bp07" />
<item id="bp08" image="bp08" />
<item id="bp09" image="bp09" />
<item id="bp10" image="bp10" />
<item id="bp11" image="bp11" />
<item id="bp12" image="bp12" />
<item id="bp13" image="bp13" />
<item id="bp14" image="bp14" />
<item id="bp15" image="bp15" />
</gallery>
</group>

```

Figure 22-14 shows the first gallery, a list of month names in two columns. The `onAction` parameter executes the `MonthSelected` callback procedure, which displays the selected month (which is stored as the `id` parameter):

```

Sub MonthSelected(control As IRibbonControl, _
    id As String, index As Integer)
    MsgBox "You selected " & id
End Sub

```

The Pick a Month gallery also contains a button control with its own callback procedure (labeled Today) at the bottom:

```

Sub ShowToday(control As IRibbonControl)
    MsgBox "Today is " & Date
End Sub

```

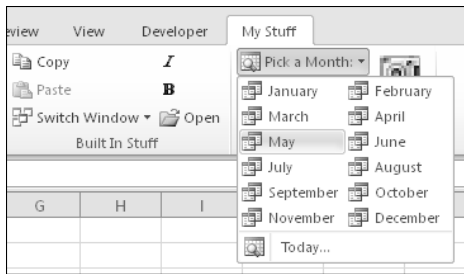


Figure 22-14: A gallery that displays month names, plus a button.

The second gallery, shown in Figure 22-15, displays 15 photos.

These photos are stored in the workbook file, in a folder named `images`, within the `customUI` folder. Adding images also requires a `_rels` folder, with a list of relationships. To see how this works, add a `.zip` extension to the workbook and then examine its contents.

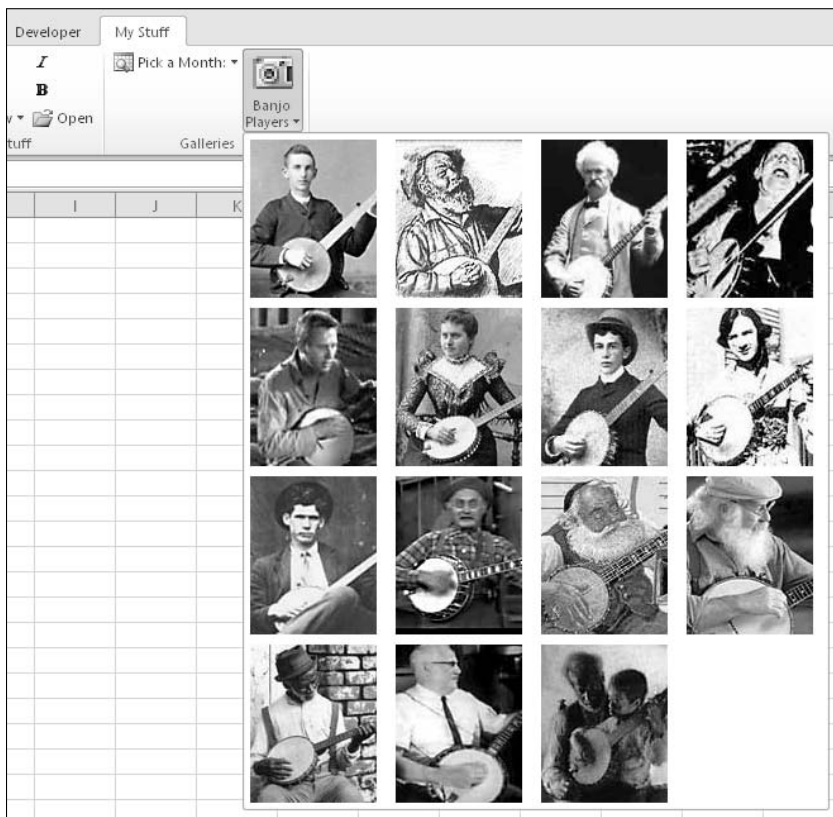


Figure 22-15: A gallery of photos.

A DynamicMenu Control Example

One of the most interesting Ribbon controls is the `dynamicMenu` control. This control lets your VBA code feed XML data into the control — which provides the basis for menus that change based on context.

Setting up a `dynamicMenu` control isn't a simple task, but this control probably offers the most flexibility in terms of using VBA to modify the Ribbon dynamically.

I created a simple `dynamicMenu` control demo that displays a different menu for each of the three worksheets in a workbook. Figure 22-16 shows the menu that appears when Sheet1 is active. When a sheet is activated, a VBA procedure sends XML code specific for the sheet. For this demo, I stored the XML code directly in the worksheets to make it easier to read. Alternatively, the XML markup can be stored as a string variable in your code.

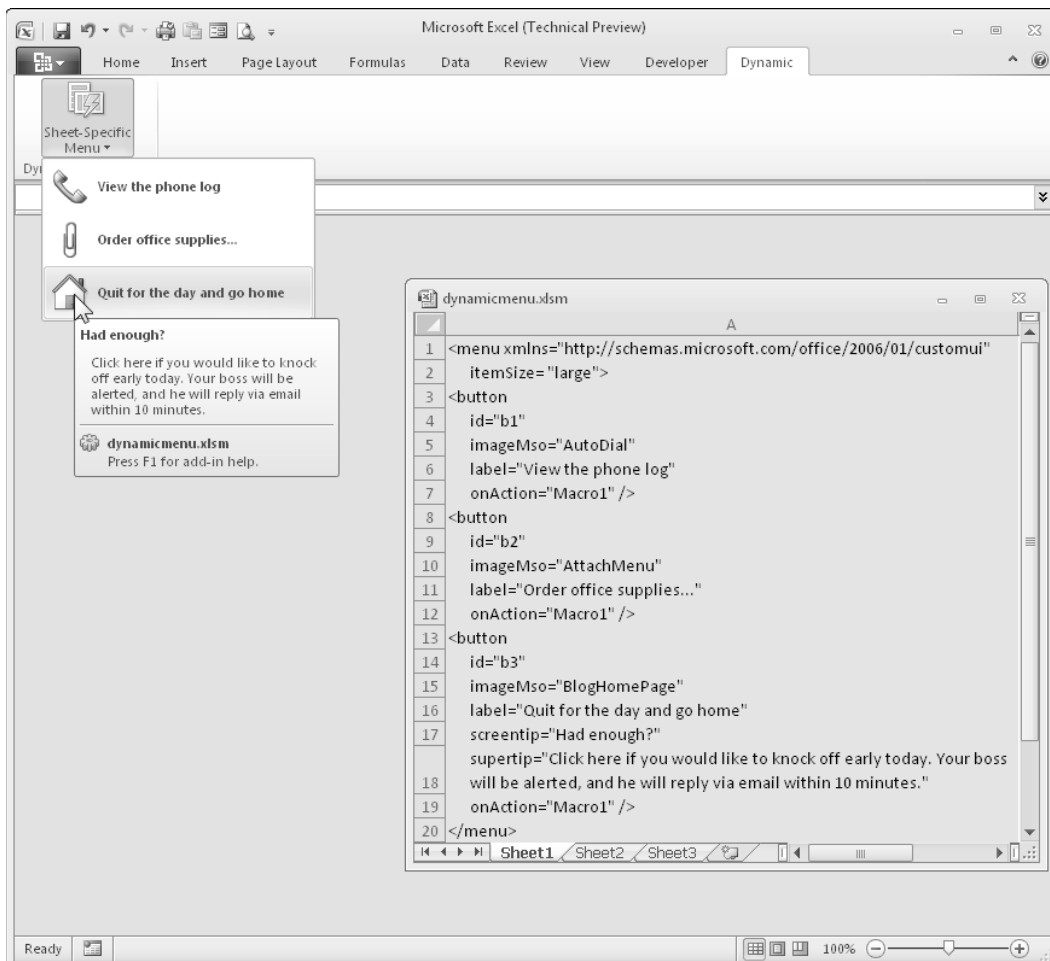


Figure 22-16: The `dynamicMenu` control lets you create a menu that varies depending on the context.

The RibbonX code that creates the new tab, the new group, and the dynamicMenu control follows:

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/customui"
  onLoad="ribbonLoaded">
  <ribbon>
  <tabs>
    <tab id="CustomTab" label="Dynamic">
      <group id="group1" label="Dynamic Menu Demo">
        <dynamicMenu id="DynamicMenu"
          getContent="dynamicMenuContent"
          imageMso="RegionLayoutMenu"
          size = "large"
          label="Sheet-Specific Menu"/>
      </group>
    </tab>
  </tabs>
</ribbon>
</customUI>
```

This example needs a way to invalidate the Ribbon whenever the user activates a new sheet. I use the same method I used for the page break display example earlier in this chapter (see “Another RibbonX example”): I declared a Public variable, `MyRibbon`, of type `IRibbonUI`. I used a `Workbook_SheetActivate` procedure that called the `UpdateDynamicRibbon` procedure whenever a new sheet is activated:

```
Sub UpdateDynamicRibbon()
'   Invalidate the Ribbon to force a call to dynamicMenuContent
  On Error Resume Next
  MyRibbon.Invalidate
  If Err.Number <> 0 Then
    MsgBox "Lost the Ribbon object. Save and reload."
  End If
End Sub
```

The `UpdateDynamicRibbon` procedure invalidates the `MyRibbon` object, which forces a call to the VBA callback procedure named `dynamicMenuContent` (a procedure referenced by the `getContent` parameter in the RibbonX code). Notice the error-handling code. Some edits to your VBA code destroy the `MyRibbon` object, which is created when the workbook is opened. Attempting to invalidate an object that doesn't exist causes an error, and the message box informs the user that the workbook must be saved and reopened. Unfortunately, reopening the workbook is the only way to re-create the `MyRibbon` object.

The `dynamicMenuContent` procedure follows. This procedure loops through the cells in column A of the active sheet, reads the XML code, and stores it in a variable named `XMLcode`. When all the XML has been appended, it's passed to the `returnedVal` argument. The net effect is that the `dynamicMenu` control has new code, so it displays a different set of menu options.


```

Sub dynamicMenuContent(control As IRibbonControl, _
    ByRef returnedVal)
    Dim r As Long
    Dim XMLcode As String
    ' Read the XML markup from the active sheet
    For r = 1 To Application.CountA(Range("A:A"))
        XMLcode = XMLcode & ActiveSheet.Cells(r, 1) & " "
    Next r
    returnedVal = XMLcode
End Sub

```



On the CD

The workbook that contains this example is available on the companion CD-ROM. The filename is `dynamicmenu.xlsm`.

More on Ribbon customization

I conclude this section with some additional points to keep in mind as you explore the wonderful world of Excel Ribbon customization:

- When you're working with the Ribbon, make sure that you turn on error message display. Refer to the "See your errors" sidebar, earlier in this chapter.
- Remember that RibbonX code is case-sensitive.
- All the named control IDs are in English, and they're the same across all language versions of Excel. Therefore, Ribbon modifications work regardless of what language version of Excel is used.
- Ribbon modifications appear only when the workbook that contains the RibbonX code is active. To make Ribbon modifications appear for all workbooks, the RibbonX code must be in an add-in.
- The built-in controls scale themselves when the Excel window is resized. In Excel 2007, custom controls do not scale, but they do in Excel 2010.
- Adding or removing controls from a built-in Ribbon group is not possible.
- You can, however, hide tabs. The RibbonX code that follows hides three tabs:

```

<customUI xmlns="http://schemas.microsoft.com/office/2006/01/
    customui">
  <ribbon>
    <tabs>
      <tab idMso="TabPageLayoutExcel" visible="false" />
      <tab idMso="TabData" visible="false" />
      <tab idMso="TabReview" visible="false" />
    </tabs>
  </ribbon>
</customUI>

```

- You can also hide groups within a tab. Here's RibbonX code that hides four groups on the Insert tab (leaving only the Charts group):

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/
  customui">
  <ribbon>
    <tabs>
      <tab idMso="TabInsert">
        <group idMso="GroupInsertTablesExcel" visible="false" />
        <group idMso="GroupInsertIllustrations" visible="false" />
        <group idMso="GroupInsertLinks" visible="false" />
        <group idMso="GroupInsertText" visible="false" />
      </tab>
    </tabs>
  </ribbon>
</customUI>
```

- You can assign your own macro to a built-in control. This is known as *repurposing the control*. The RibbonX code that follows intercepts three built-in commands:

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/
  customui">
  <commands>
    <command idMso="FileSave" onAction="mySave" />
    <command idMso="FilePrint" onAction="myPrint" />
    <command idMso="FilePrintQuick" onAction="myPrint" />
  </commands>
</customUI>
```

- You can also write RibbonX code to disable one or more built-in controls. The code that follows disables the Insert ClipArt command:

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/
  customui">
  <commands>
    <command idMso="ClipArtInsert" enabled="false" />
  </commands>
</customUI>
```

- If you have two or more workbooks (or add-ins) that add controls to the same custom Ribbon group, you must make sure that they both use the same namespace. Do this in the <CustomUI> tag at the top of the RibbonX code.

Creating an Old-Style Toolbar

If you find that customizing the Ribbon is just too much work, you may be content to create a simple custom toolbar using the pre-Excel 2007 `CommandBar` object. This technique is perfectly

suitable for any workbook that only you will be using. It's an easy way to provide quick access to a number of macros.

In this section, I provide boilerplate code that you can adapt as needed. I don't offer much in the way of explanation. For more information about `CommandBar` objects, search the Web or consult a previous edition of this book. `CommandBar` objects can be much more powerful than the example presented here.

Limitations of old-style toolbars in Excel 2010

If you decide to create a toolbar for Excel 2010, be aware of the following limitations:

- The toolbar can't be free-floating.
- It will always appear in the Add-Ins→Custom Toolbars group (along with any other toolbars).
- Some of the `CommandBar` properties and methods are ignored by Excel.

Code to create a toolbar

The code in this section assumes that you have a workbook with two macros (named `Macro1` and `Macro2`). It also assumes that you want the toolbar to be created when the workbook is opened, and deleted when the workbook is closed.



Note

Unlike Ribbon modifications, custom toolbars are visible regardless of which workbook is active.

In the `ThisWorkbook` code module, enter the following procedures. The first one calls the procedure that creates the toolbar when the workbook is opened. The second calls the procedure to delete the toolbar when the workbook is closed:

```
Private Sub Workbook_Open()  
    Call CreateToolbar  
End Sub  
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call DeleteToolbar  
End Sub
```



Cross-Ref

In Chapter 19, I describe a potentially serious problem with the `Workbook_BeforeClose` event. Excel's "Do you want to save . . ." prompt displays *after* the `Workbook_BeforeClose` event handler runs. So if the user clicks `Cancel`, the workbook remains open, but the custom menu items have already been deleted. In Chapter 19, I also present a way to get around this problem.

The CreateToolbar procedure follows:

```
Const TOOLBARNAME As String = "MyToolbar"
Sub CreateToolbar()
    Dim TBar As CommandBar
    Dim Btn As CommandBarButton

    ' Delete existing toolbar (if it exists)
    On Error Resume Next
    CommandBars(TOOLBARNAME).Delete
    On Error GoTo 0

    ' Create toolbar
    Set TBar = CommandBars.Add
    With TBar
        .Name = TOOLBARNAME
        .Visible = True
    End With

    ' Add a button
    Set Btn = TBar.Controls.Add(Type:=msoControlButton)
    With Btn
        .FaceId = 300
        .OnAction = "Macro1"
        .Caption = "Macro1 Tooltip goes here"
    End With

    ' Add another button
    Set Btn = TBar.Controls.Add(Type:=msoControlButton)
    With Btn
        .FaceId = 25
        .OnAction = "Macro2"
        .Caption = "Macro2 Tooltip goes here"
    End With
End Sub
```



On the CD

A workbook that contains this code is available on the companion CD-ROM. The file-name is `old-style toolbar.xlsm`.

Figure 22-17 shows the two-button toolbar.

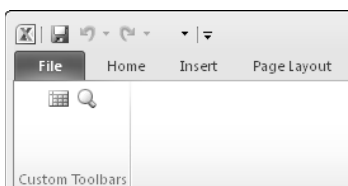


Figure 22-17: An old-style toolbar, located in the Custom Toolbars group of the Add-Ins tab.

I use a module-level constant, `TOOLBAR`, which stores the toolbar's name. This name is also used in the `DeleteToolbar` procedure, so using a constant ensures that both procedures work with the same name.

The procedure starts by deleting the existing toolbar that has the same name (if such a toolbar exists). Including this statement is useful during development and also eliminates the error you get if you attempt to create a toolbar using a duplicate name.

The toolbar is created by using the `Add` method of the `CommandBars` object. The two buttons are added by using the `Add` method of the `Controls` object. Each button has three properties:

- **FaceID:** A number that determines the image displayed on the button. Chapter 23 contains more information about `FaceID` images.
- **OnAction:** The macro that is executed when the button is clicked.
- **Caption:** The `ScreenTip` that appears when you hover the mouse pointer over the button.



Tip

Rather than set the `FaceID` property, you can set the `Picture` property using any of the `imageMso` images. For example, the statement below displays a green check mark:

```
.Picture = Application.CommandBars.GetImageMso _  
("AcceptInvitation", 16, 16)
```

For more information about `imageMso` images, see the sidebar, “Using `imageMso` images.”

When the workbook is closed, the `Workbook_BeforeClose` event procedure fires, which calls `DeleteToolbar`:

```
Sub DeleteToolbar()  
    On Error Resume Next  
    CommandBars(TOOLBARNAME).Delete  
    On Error GoTo 0  
End Sub
```


Working with Shortcut Menus

In This Chapter

- Identifying shortcut menus
- Customizing the shortcut menus
- Disabling shortcut menus
- Using events in conjunction with shortcut menus
- Creating a completely new shortcut menu

CommandBar Overview

A `CommandBar` object is used for three Excel user interface elements:

- Custom toolbars
- Custom menus
- Custom shortcut (right-click) menus

Beginning with Excel 2007, the `CommandBar` object is in a rather odd position. If you write VBA code to customize a menu or a toolbar, Excel intercepts that code and ignores many of your commands. As I describe in Chapter 22, menu and toolbar customizations performed with the `CommandBar` object appear in the Add-Ins→Menu Commands or the Add-Ins→Custom Toolbars group. So, for all practical purposes, the `CommandBar` object in Excel is now limited to shortcut menu operations.

In this section, I provide some background information about CommandBars.

CommandBar types

Excel supports three types of CommandBars, differentiated by their `Type` property. The `Type` property can be any of these three values:

- `msoBarTypeNormal`: A toolbar (`Type = 0`)
- `msoBarTypeMenuBar`: A menu bar (`Type = 1`)
- `msoBarTypePopUp`: A shortcut menu (`Type = 2`)

Even though toolbars and menu bars aren't used in Excel 2010, these UI elements are still included in the object model for compatibility with older applications. However, attempting to display a CommandBar of Type 0 or 1 has no effect in Excel 2010. In Excel 2003, for example, the following statement displays the Standard toolbar:

```
CommandBars("Standard").Visible = True
```

In Excel 2010, that statement is ignored.

This chapter focuses exclusively on Type 2 CommandBars (shortcut menus).

Listing shortcut menus

Excel 2010 has 65 shortcut menus. How do I know that? I ran the `ShowShortcutMenuNames` procedure that follows, which loops through all CommandBars. If the `Type` property is `msoBarTypePopUp` (a built-in constant that has a value of 2), it displays the CommandBar's index and name in a worksheet.

```
Sub ShowShortcutMenuNames()  
    Dim Row As Long  
    Dim cbar As CommandBar  
    Row = 1  
    For Each cbar In CommandBars  
        If cbar.Type = msoBarTypePopUp Then  
            Cells(Row, 1) = cbar.Index  
            Cells(Row, 2) = cbar.Name  
            Row = Row + 1  
        End If  
    Next cbar  
End Sub
```

Figure 23-1 shows part of the output from this procedure. The shortcut menu index values range from 21 to 148. Also, notice that not all the names are unique. For example, CommandBar 35 and CommandBar 38 both have a Name of `Cell`. This is because right-clicking a cell gives a different shortcut menu when the worksheet is in Page Break Preview mode.

	A	B	C
1	21	PivotChart Menu	
2	34	Workbook tabs	
3	35	Cell	
4	36	Column	
5	37	Row	
6	38	Cell	
7	39	Column	
8	40	Row	
9	41	Ply	
10	42	XLM Cell	
11	43	Document	
12	44	Desktop	
13	45	Nondefault Drag and Drop	
14	46	AutoFill	
15	47	Button	
16	48	Dialog	
17	49	Series	
18	50	Plot Area	
19	51	Floor and Walls	
20	52	Trendline	
21	53	Chart	
22	54	Format Data Series	
23	55	Format Axis	

Figure 23-1: A simple macro generates a list of all shortcut menus.



On the CD

This example is available on the companion CD-ROM. The filename is `show shortcut menu names.xlsm`.

Referring to CommandBars

You can reference a particular `CommandBar` object by its `Index` or by its `Name` property. For example, the expressions that follow both refer to the shortcut menu that displays when you right-click the Excel desktop (the area that's visible when no documents are open):

```
Application.CommandBars (44)
Application.CommandBars ("Desktop")
```

The `CommandBars` collection is a member of the `Application` object. When you reference this collection in a regular VBA module or in a module for a sheet, you can omit the reference to the `Application` object. For example, the following statement (contained in a standard VBA module) displays the name of the object in the `CommandBars` collection that has an index of 44:

```
MsgBox CommandBars (44) .Name
```

When you reference the `CommandBars` collection from a code module for a `ThisWorkbook` object, you must precede it with a reference to the `Application` object, like this:

```
MsgBox Application.CommandBars(44).Name
```



Caution

Unfortunately, the index numbers have not always remained constant across the different Excel versions. For example, in Excel 2007, `CommandBar 36` and `CommandBar 39` have the `Name` of `Cell`. In Excel 2010, these two index numbers have the `Name` of `Column`. Therefore, it's best to use names rather than index numbers.

Referring to controls in a CommandBar

A `CommandBar` object contains `Control` objects, which are buttons or menus. You can refer to a control by its `Index` property or by its `Caption` property. Here's a simple procedure that displays the caption of the first menu item on the `Cell` shortcut menu:

```
Sub ShowCaption()  
    MsgBox Application.CommandBars("Cell"). _  
        Controls(1).Caption  
End Sub
```

The following procedure displays the `Caption` property for each control in the shortcut menu that appears when you right-click a sheet tab (that shortcut menu is named `Ply`):

```
Sub ShowCaptions()  
    Dim txt As String  
    Dim ctl As CommandBarControl  
    For Each ctl In CommandBars("Ply").Controls  
        txt = txt & ctl.Caption & vbCrLf  
    Next ctl  
    MsgBox txt  
End Sub
```

When you execute this procedure, you see the message box shown in Figure 23-2. The ampersand is used to indicate the underlined letter in the text — the keystroke that will execute the menu item.

In some cases, `Control` objects on a shortcut menu contain other `Control` objects. For example, the `Filter` control on the `Cell` right-click menu contains other controls. The `Filter` control is a submenu, and the additional items are submenu items.

The statement that follows displays the first submenu item in the `Filter` submenu:

```
MsgBox CommandBars("Cell").Controls("Filter").Controls(1).Caption
```



Finding a control

If you're writing code that will be used by a different language version of Excel, avoid using the `Caption` property to access a particular shortcut menu item. The `Caption` property is language-specific, so your code will fail if the user has a different language version of Excel.

Instead, use the `FindControl` method in conjunction with the ID of the control (which is language-independent). For example, assume that you want to disable the `Rename` menu on the shortcut menu that appears when you right-click a sheet tab. If your workbook will be used only by people who have the English version of Excel, this statement will do the job:

```
CommandBars("Ply").Controls("Rename").Enabled = False
```

To ensure that the command will work with non-English versions, you need to know the ID of the control. The following statement will tell you that the ID is 889:

```
MsgBox CommandBars("Ply").Controls("Rename").ID
```

Then, to disable that control, use this statement:

```
CommandBars.FindControl(ID:=889).Enabled = False
```

The `CommandBar` names are not internationalized, so a reference to `CommandBars("Desktop")` will always work.



Figure 23-2: Displaying the `Caption` property for controls.

Properties of CommandBar controls

`CommandBar` controls have a number of properties that determine how the controls look and work. This list contains some of the more useful properties for `CommandBar` controls:

- **Caption:** The text displayed for the control. If the control shows only an image, the `Caption` appears when you move the mouse over the control.
- **ID:** A unique numeric identifier for the control.

- **FaceID:** A number that represents a graphic image displayed next to the control's text.
- **Type:** A value that determines whether a control is a button (`msoControlButton`) or a submenu (`msoControlPopup`).
- **Picture:** A graphics image displayed next to the control's text.
- **BeginGroup:** True if a separator bar appears before the control.
- **OnAction:** The name of a VBA macro that executes when the user clicks the control.
- **BuiltIn:** True if the control is an Excel built-in control.
- **Enabled:** True if the control can be clicked.
- **Visible:** True if the control is visible. Many of the shortcut menus contain hidden controls.
- **ToolTipText:** Text that appears when the user moves the mouse pointer over the control. (Not applicable for shortcut menus.)

Displaying all shortcut menu items

The `ShowShortcutMenuItems` procedure that follows creates a table that lists all the first-level controls on every shortcut menu. For each control, the table includes the shortcut menu's Index and Name, plus the ID, Caption, Type, Enabled, and Visible property values.

```
Sub ShowShortcutMenuItems()
    Dim Row As Long
    Dim Cbar As CommandBar
    Dim ctl As CommandBarControl
    Range("A1:G1") = Array("Index", "Name", "ID", "Caption", _
        "Type", "Enabled", "Visible")
    Row = 2
    Application.ScreenUpdating = False
    For Each Cbar In Application.CommandBars
        If Cbar.Type = 2 Then
            For Each ctl In Cbar.Controls
                Cells(Row, 1) = Cbar.Index
                Cells(Row, 2) = Cbar.Name
                Cells(Row, 3) = ctl.ID
                Cells(Row, 4) = ctl.Caption
                If ctl.Type = 1 Then
                    Cells(Row, 5) = "Button"
                Else
                    Cells(Row, 5) = "Submenu"
                End If
                Cells(Row, 6) = ctl.Enabled
                Cells(Row, 7) = ctl.Visible
                Row = Row + 1
            Next ctl
        Next Cbar
    End Sub
```

```

Next ctl
End If
Next Cbar
End Sub

```

Figure 23-3 shows a portion of the output.

	A	B	C	D	E	F	G
	Index	Name	ID	Caption	Type	Enabled	Visible
2	21	PivotChart Menu	460	Field Setti&ngs	Button	TRUE	TRUE
3	21	PivotChart Menu	1604	&Options...	Button	FALSE	TRUE
4	21	PivotChart Menu	459	&Refresh Data	Button	TRUE	TRUE
5	21	PivotChart Menu	3956	&Hide PivotChart Field Buttons	Button	FALSE	TRUE
6	21	PivotChart Menu	30254	For&mulas	Submenu	TRUE	TRUE
7	21	PivotChart Menu	5416	Remo&ve Field	Button	FALSE	TRUE
8	34	Workbook tabs	957	Sheet1	Button	TRUE	TRUE
9	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
10	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
11	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
12	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
13	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
14	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
15	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
16	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
17	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
18	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
19	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
20	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
21	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
22	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
23	34	Workbook tabs	957	&Sheet List	Button	TRUE	FALSE
24	35	Cell	21	Cu&t	Button	TRUE	TRUE
25	35	Cell	19	&Copy	Button	TRUE	TRUE
26	35	Cell	22	&Paste	Button	TRUE	TRUE
27	35	Cell	21998	Paste &Special...	Button	TRUE	TRUE
28	35	Cell	3624	&Paste Table	Button	TRUE	TRUE
29	35	Cell	3181	&Insert...	Button	TRUE	TRUE
30	35	Cell	292	&Delete...	Button	TRUE	TRUE
31	35	Cell	3125	Clear Co&ntents	Button	TRUE	TRUE

Figure 23-3: Listing the items in all shortcut menus.

If you run the ShowShortcutMenuItems macro, you see that many of the shortcut menus contain hidden or disabled controls. These hidden or disabled menu items represent items that aren't available because of the current context. For example, the Desktop shortcut menu (Index 44) contains the following menu items:

- &New...
- &Open...

- Save & Workspace...
- &Calculate Now
- F&ull Screen



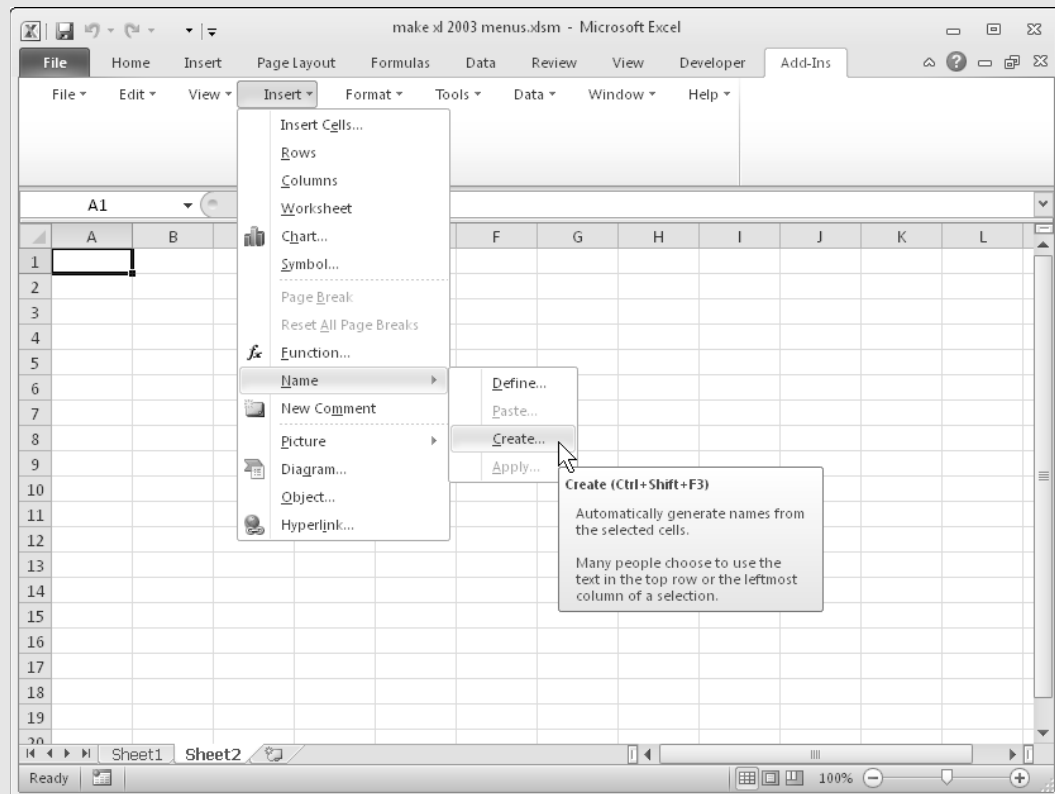
Displaying Excel 2003 menus

One of the built-in shortcut menus is named Built-In Menus, and it contains the menu items used in Excel 2003 (the final pre-Ribbon version of Excel). This shortcut menu isn't attached to an object, but you can display it using this VBA command:

```
Application.CommandBars("Built-in Menus").ShowPopup
```

The companion CD-ROM has an example (named `make xl 2003 menus.xlsm`) that contains code to copy those shortcut menus to a toolbar. The toolbar is displayed in the Ribbon when the Add-Ins tab is active. The result is that you can use the Excel 2003 menu with Excel 2010.

The accompanying figure shows how it looks.



The Full Screen menu item is normally hidden — unless Excel is in full-screen mode. In such a case, the menu item is made visible and its caption is changed to &Close Full Screen.



On the CD

This example, named `show shortcut menu items.xlsm`, is available on the companion CD-ROM.

Using VBA to Customize Shortcut Menus

In this section, I present some practical examples of VBA code that manipulates Excel's shortcut menus. These examples give you an idea of the types of things you can do with shortcut menus, and they can all be modified to suit your needs.

Resetting a shortcut menu

The `Reset` method restores a shortcut menu to its original, default condition. The following procedure resets the Cell shortcut menu to its normal state:

```
Sub ResetCellMenu()  
    CommandBars("Cell").Reset  
End Sub
```

As I noted earlier, Excel has two shortcut menus named Cell. The preceding code resets only the first one (index of 35). To reset the second Cell shortcut menu, you can use its index number (38) instead of its name. But remember, the index numbers aren't consistent across Excel versions. Here's a better procedure to reset both instances of the Cell shortcut menu:

```
Sub ResetCellMenu()  
    Dim cbar As CommandBar  
    For Each cbar In Application.CommandBars  
        If cbar.Name = "Cell" Then cbar.Enabled = False  
    Next cbar  
End Sub
```

The following procedure resets all built-in toolbars to their original states:

```
Sub ResetAll()  
    Dim cbar As CommandBar  
    For Each cbar In Application.CommandBars  
        If cbar.Type = msoBarTypePopup Then  
            cbar.Reset  
            cbar.Enabled = True  
        End If  
    Next cbar  
End Sub
```

**Note**

If your application adds items to a shortcut menu, it's a good practice to remove the items individually when your application closes. If you simply reset the shortcut menu, it will delete customizations made by other applications.

Disabling a Shortcut Menu

The `Enabled` property lets you disable an entire shortcut menu. For example, you can set this property so that right-clicking a cell does not display the normal shortcut menu. The following statement disables the Cell shortcut menu:

```
Application.CommandBars("Cell").Enabled = False
```

To re-enable the shortcut menu, set its `Enabled` property to `True`.

If you want to disable *all* shortcut menus, use the following procedure:

```
Sub DisableAllShortcutMenus()  
    Dim cb As CommandBar  
    For Each cb In CommandBars  
        If cb.Type = msoBarTypePopup Then _  
            cb.Enabled = False  
    Next cb  
End Sub
```

**Caution**

Disabling shortcut menus “sticks” between sessions. Therefore, you’ll probably want to restore the shortcut menus before closing Excel. To restore the shortcut menus, modify the preceding procedure to set the `Enabled` property to `True`.

Disabling shortcut menu items

You may want to disable one or more shortcut menu items on certain shortcut menus while your application is running. When an item is disabled, its text appears in light gray, and clicking it has no effect. The following procedure disables the Hide menu item from the Row and Column shortcut menus:

```
Sub DisableHideMenuItems()  
    CommandBars("Column").Controls("Hide").Enabled = False  
    CommandBars("Row").Controls("Hide").Enabled = False  
End Sub
```


Adding a new item to the Cell shortcut menu

The `AddToShortcut` procedure that follows adds a new menu item to the Cell shortcut menu: Toggle Word Wrap. Recall that Excel has two Cell shortcut menus. This procedure modifies the normal right-click menu, but not the right-click menu that appears in Page Break Preview mode.

```
Sub AddToShortCut()  
' Adds a menu item to the Cell shortcut menu  
Dim Bar As CommandBar  
Dim NewControl As CommandBarButton  
DeleteFromShortcut  
Set Bar = CommandBars("Cell")  
Set NewControl = Bar.Controls.Add _  
    (Type:=msoControlButton, _  
     temporary:=True)  
With NewControl  
    .Caption = "Toggle &Word Wrap"  
    .OnAction = "ToggleWordWrap"  
    .Picture = Application.CommandBars.GetImageMso _  
        ("WrapText", 16, 16)  
    .Style = msoButtonIconAndCaption  
End With  
End Sub
```

Figure 23-4 shows the new menu item displayed after right-clicking a cell.

The first actual command after the declaration of a couple of variables calls the `DeleteFromShortcut` procedure (listed later in this section). This statement ensures that only one Toggle Word Wrap menu item appears on the shortcut Cell menu. Notice that the underlined hot key for this menu item is W, not T. That's because T is already used by the Cut menu item.

The `Picture` property is set by referencing the image used in the Ribbon for the Wrap Text command. Refer to Chapter 22 for more information about images used in Ribbon commands.

The macro that is executed when the menu item is select is specified by the `OnAction` property. In this case, the macro is named `ToggleWordWrap`:

```
Sub ToggleWordWrap()  
    CommandBars.ExecuteMso ("WrapText")  
End Sub
```

This procedure simply executes the `WrapText` Ribbon command.

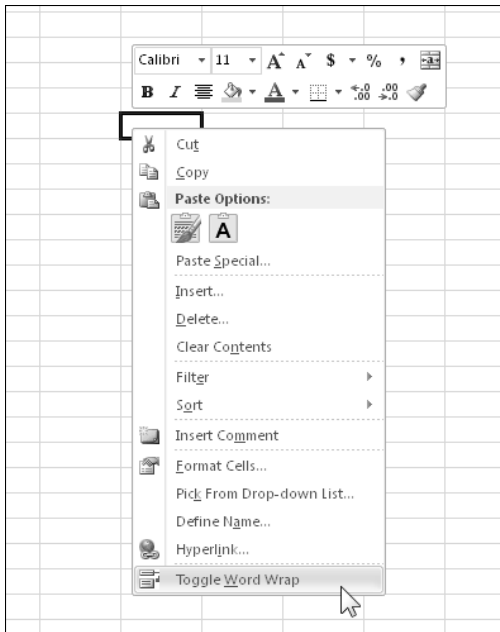


Figure 23-4: The Cell shortcut menu with a custom menu item.



Note

When you modify a shortcut menu, that modification remains in effect until you restart Excel. In other words, modified shortcut menus don't reset themselves when you close the workbook that contains the VBA code. Therefore, if you write code to modify a shortcut menu, you almost always write code to reverse the effect of your modification.

The `DeleteFromShortcut` procedure removes the new menu item from the Cell shortcut menu.

```
Sub DeleteFromShortcut()  
    On Error Resume Next  
    CommandBars("Cell").Controls _  
        ("Toggle &Word Wrap").Delete  
End Sub
```

In most cases, you want to add and remove the shortcut menu additions automatically: Add the shortcut menu item when the workbook is opened and delete the menu item when the workbook is closed. Just add these two event procedures to the `ThisWorkbook` code module:

```
Private Sub Workbook_Open()  
    Call AddToShortCut  
End Sub  
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call DeleteFromShortcut  
End Sub
```

The `Workbook_Open` procedure is executed when the workbook is opened, and the `Workbook_BeforeClose` procedure is executed before the workbook is closed. Just what the doctor ordered.



Note

Menu items added to a shortcut menu are available in all workbooks, not just the workbook that creates the menu items.



On the CD

The workbook described in this section is available on the companion CD-ROM. The filename is `add to cell shortcut.xlsm`.

Adding a submenu to a shortcut menu

The example in this section adds a submenu with three options to the Cells shortcut menu. Figure 23-5 shows the worksheet after right-clicking a row. Each of the submenu items executes a macro that changes the case of text in the selected cells.

The code that creates the submenu and submenu items is as follows:

```
Sub AddSubmenu()
'   Adds a submenu to the six shortcut menus
    Dim Bar As CommandBar
    Dim NewMenu As CommandBarControl
    Dim NewSubmenu As CommandBarButton

    DeleteSubmenu
    Set Bar = CommandBars("Cell")
'   Add submenu
    Set NewMenu = Bar.Controls.Add _
        (Type:=msoControlPopup, _
         temporary:=True)
    NewMenu.Caption = "Change Case"
    NewMenu.BeginGroup = True
'   Add first submenu item
    Set NewSubmenu = NewMenu.Controls.Add _
        (Type:=msoControlButton)
    With NewSubmenu
        .FaceId = 38
        .Caption = "&Upper Case"
        .OnAction = "MakeUpperCase"
    End With
'   Add second submenu item
    Set NewSubmenu = NewMenu.Controls.Add _
        (Type:=msoControlButton)
    With NewSubmenu
        .FaceId = 40
        .Caption = "&Lower Case"
        .OnAction = "MakeLowerCase"
    End With
End Sub
```

```

' Add third submenu item
Set NewSubmenu = NewMenu.Controls.Add _
    (Type:=msoControlButton)
With NewSubmenu
    .FaceId = 476
    .Caption = "&Proper Case"
    .OnAction = "MakeProperCase"
End With
End Sub

```

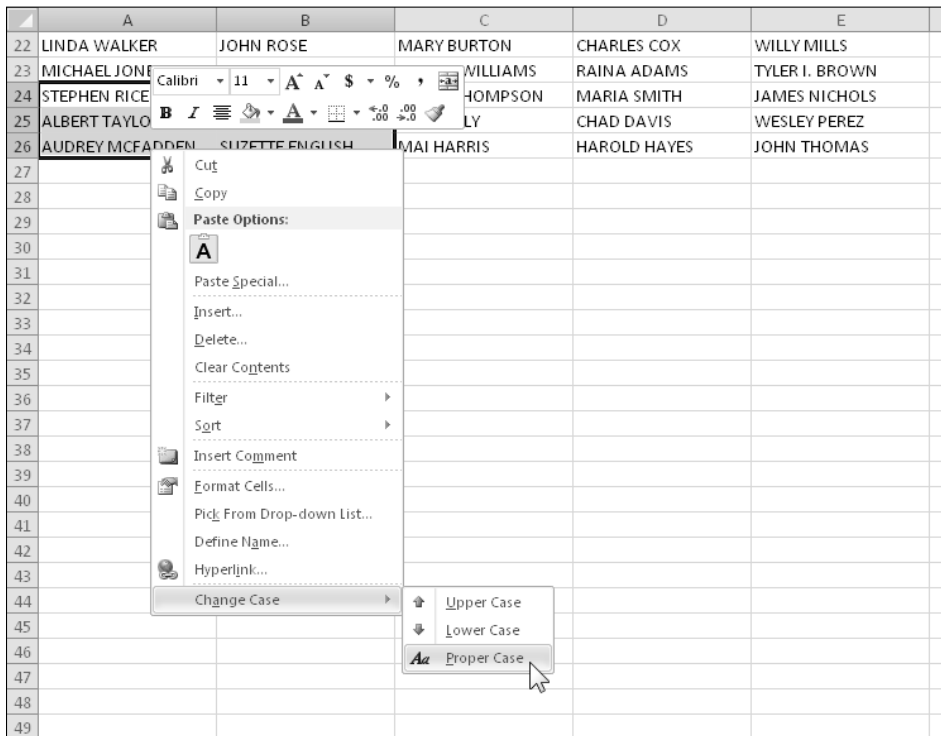


Figure 23-5: This shortcut menu has a submenu with three submenu items.

The submenu is added first, and its `Type` property is `msoControlPopup`. Then the three submenu items are added, and each has a different `OnAction` property.

The code to delete the submenu is much simpler:

```

Sub DeleteSubmenu()
    On Error Resume Next
    CommandBars("Cell").Controls("Change Case").Delete
End Sub

```

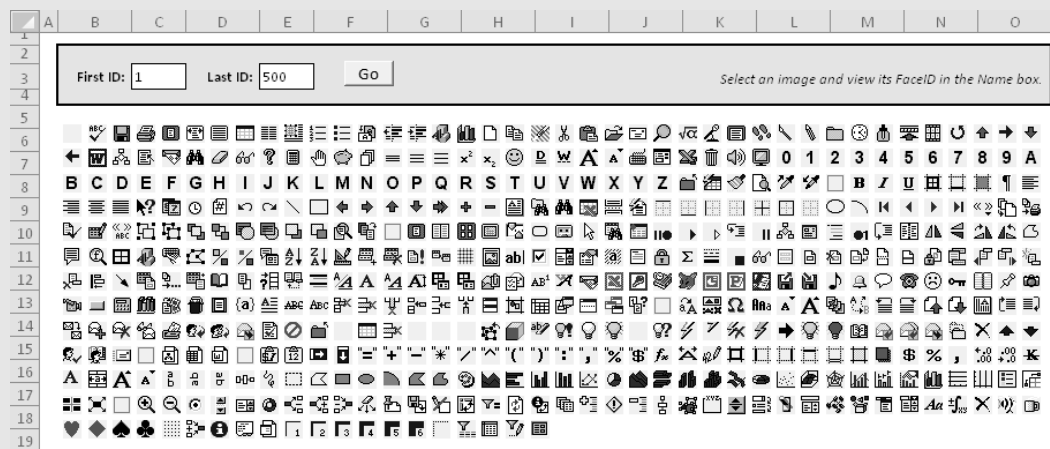


Finding FaceID images

The icon that's displayed on a shortcut menu item is determined by one of two property settings:

- **Picture:** This option lets you use an `imageMso` from the Ribbon. For an example, see “Adding a new item to the Cell shortcut menu,” earlier in this chapter.
- **FaceID:** This is the easiest option because the `FaceID` property is just a numeric value that represents one of hundreds of images.

But how do you find out which number corresponds to a particular `FaceID` image? Excel doesn't provide a way, so I created an application that lets you enter beginning and ending `FaceID` numbers. Click a button, and the images are displayed in the worksheet. Each image has a name that corresponds to its `FaceID` value. See the accompanying figure, which shows `FaceID` values from 1 to 500. This workbook, named `show_faceids.xlsx`, is available on the companion CD-ROM.



On the CD

The workbook described in this section is available on the companion CD-ROM. The filename is `shortcut with submenu.xlsx`.

Shortcut Menus and Events

The examples in this section demonstrate various shortcut-menu programming techniques used in conjunction with events.



Cross-Ref

I discuss event programming in depth in Chapter 19.

Adding and deleting menus automatically

If you need to modify a shortcut menu when a workbook is opened, use the `Workbook_Open` event. The following code, stored in the code module for the `ThisWorkbook` object, executes the `ModifyShortcut` procedure (not shown here):

```
Private Sub Workbook_Open()  
    Call ModifyShortcut  
End Sub
```

To return the shortcut back to its state before the modification, use a procedure such as the following. This procedure is executed before the workbook closes, and it executes the `RestoreShortcut` procedure (not shown here):

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call RestoreShortcut  
End Sub
```

A problem could arise, however, if the workbook isn't saved when the user closes it. Excel's "Do you want to save the changes?" prompt occurs *after* the `Workbook_BeforeClose` event handler runs. So if the user clicks Cancel, the workbook remains open, but your custom menu has already been deleted!

One solution to this problem is to bypass Excel's prompt and write your own code in the `Workbook_BeforeClose` procedure to ask the user to save the workbook. The following code demonstrates how:

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    If Not Me.Saved Then  
        Msg = "Do you want to save the changes you made to "  
        Msg = Msg & Me.Name & "?"  
        Ans = MsgBox(Msg, vbQuestion + vbYesNoCancel)  
        Select Case Ans  
            Case vbYes  
                Me.Save  
            Case vbNo  
                Me.Saved = True  
            Case vbCancel  
                Cancel = True  
                Exit Sub  
        End Select  
    End If  
End Sub
```

```
End If
Call RestoreShortcut
End Sub
```

This procedure determines whether the workbook has been saved. If it has been saved, no problem; the `RestoreShortcut` procedure is executed, and the workbook is closed. But if the workbook hasn't been saved, the procedure displays a message box that duplicates the one Excel normally shows. If the user clicks Yes, the workbook is saved, the menu is deleted, and the workbook is closed. If the user clicks No, the code sets the `Saved` property of the `Workbook` object to `True` (without actually saving the file) and deletes the menu. If the user clicks Cancel, the `BeforeClose` event is canceled, and the procedure ends without restoring the shortcut menu.

Disabling or hiding shortcut menu items

When a shortcut menu item is disabled, its text appears in a faint shade of gray, and clicking it has no effect. When a menu item is hidden, it doesn't appear on the shortcut menu. You can, of course, write VBA code to enable or disable shortcut menu items. Similarly, you can write code to hide shortcut menu items. The key, of course, is tapping into the correct event.

The following code, for example, disables the Change Case shortcut menu item (which was added to the Cells menu) when Sheet2 is activated. This procedure is located in the code module for Sheet2:

```
Private Sub Worksheet_Activate()
    CommandBars("Cell").Controls("Change Case").Enabled = False
End Sub
```

To enable the menu item when Sheet2 is deactivated, add this procedure. The net effect is that the Change Case menu item is available at all times except when Sheet2 is active.

```
Private Sub Worksheet_Deactivate()
    CommandBars("Cell").Controls("Change Case").Enabled = True
End Sub
```

to hide the menu item rather than disable it, simply access the `Visible` property instead of the `Enabled` property.

Creating a context-sensitive shortcut menu

You can create an entirely new shortcut menu and display it in response to a particular event. The code that follows creates a shortcut menu named `MyShortcut` and adds six menu items to it. These menu items have their `OnAction` property set to execute a simple procedure that displays one of the tabs in the Format Cells dialog box (see Figure 23-6).

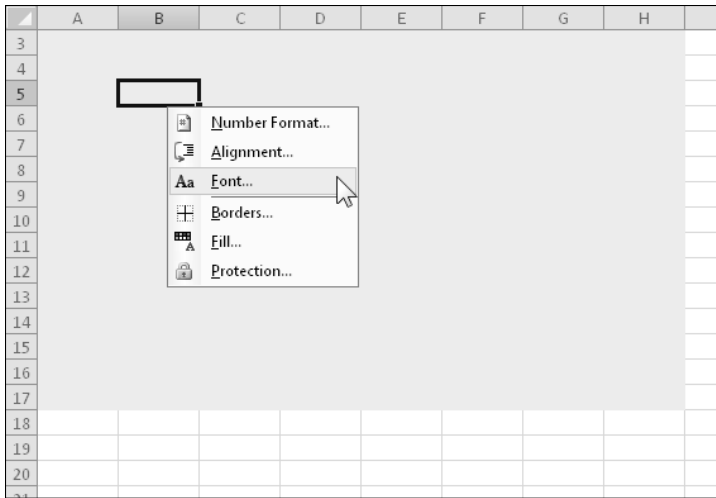


Figure 23-6: A new shortcut menu appears only when the user right-clicks a cell in the shaded area of the worksheet.

```
Sub CreateShortcut()
    Set myBar = CommandBars.Add _
        (Name:="MyShortcut", Position:=msoBarPopup, _
        Temporary:=True)

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Number Format..."
        .OnAction = "ShowFormatNumber"
        .FaceId = 1554
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Alignment..."
        .OnAction = "ShowFormatAlignment"
        .FaceId = 217
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Font..."
        .OnAction = "ShowFormatFont"
        .FaceId = 291
    End With
End Sub
```



```

    End With
'   Add a menu item
Set myItem = myBar.Controls.Add(Type:=msoControlButton)
With myItem
    .Caption = "&Borders..."
    .OnAction = "ShowFormatBorder"
    .FaceId = 149
    .BeginGroup = True
End With

'   Add a menu item
Set myItem = myBar.Controls.Add(Type:=msoControlButton)
With myItem
    .Caption = "&Patterns..."
    .OnAction = "ShowFormatPatterns"
    .FaceId = 1550
End With

'   Add a menu item
Set myItem = myBar.Controls.Add(Type:=msoControlButton)
With myItem
    .Caption = "Pr&otection..."
    .OnAction = "ShowFormatProtection"
    .FaceId = 2654
End With
End Sub

```

After the shortcut menu is created, you can display it by using the `ShowPopup` method. The following procedure, located in the code module for a `Worksheet` object, is executed when the user right-clicks a cell:

```

Private Sub Worksheet_BeforeRightClick _
    (ByVal Target As Excel.Range, Cancel As Boolean)
    If Union(Target.Range("A1"), Range("data")).Address = _
        Range("data").Address Then
        CommandBars("MyShortcut").ShowPopup
        Cancel = True
    End If
End Sub

```

If the active cell is within a range named `data` when the user right-clicks, the `MyShortcut` menu appears. Setting the `Cancel` argument to `True` ensures that the normal shortcut menu isn't displayed. Note that the mini toolbar isn't displayed.

You can also display this shortcut menu without even using the mouse. Create a simple procedure and assign a shortcut key by using the Options button in the Macro dialog box.

```
Sub ShowMyShortcutMenu()  
    ' Ctrl+Shift+M shortcut key  
    CommandBars("MyShortcut").ShowPopup  
End Sub
```



On the CD

The companion CD-ROM contains an example (named `context-sensitive shortcut menu.xlsm`) that creates a new shortcut menu and displays it in place of the normal Cell shortcut menu.

Providing Help for Your Applications

In This Chapter

- Providing user help for your applications
- Using only the components supplied with Excel to provide help
- Displaying help files created with the HTML Help system
- Associating a help file with your application
- Displaying HTML Help in other ways

Help for Your Excel Applications

If you develop a nontrivial application in Excel, you may want to consider building in some sort of help for end users. Doing so makes the users feel more comfortable with the application and could eliminate many of those time-wasting phone calls from users with basic questions. Another advantage is that help is always available: That is, the instructions can't be misplaced or buried under a pile of books.

You can provide help for your Excel applications in a number of ways, ranging from simple to complex. The method that you choose depends on your application's scope and complexity and how much effort you're willing to put into this phase of development. Some applications might require only a brief set of instructions on how to start them. Others may benefit from a full-blown, searchable Help system. Most often, applications need something in between.

This chapter classifies user help into two categories:

- **Unofficial Help system:** This method of displaying help uses standard Excel components (such as a UserForm).
- **Official Help system:** This Help system uses a compiled CHM file produced by Microsoft's HTML Help Workshop.

Online help?

In the past, I've referred to Excel's on-screen assistance as *online help*. In fact, that's the common name for this type of assistance. But in recent years, the term *online* has come to refer to information available via the Internet. Some people were confused by the expression *online help* because the help information is actually stored on their local drives.

Therefore, I now use the expression *Help system* to refer to assistance provided by an application. But, beginning with Excel 2003, things have come full circle. The Help system for Excel 2003 and later is (optionally) truly online. You can view locally stored help information or (with an Internet connection) search for more up-to-date information at the Microsoft Web site.

Creating a compiled help file isn't a trivial task, but it is worth the effort if your application is complex or if it will be used by a large number of people.



Note

Beginning with Microsoft Office 2007, Microsoft abandoned CHM help files in their Office product, and used a completely different (and much more complicated) Help system called MS Help 2. This Help system isn't covered in this book.



On the CD

All the examples in this chapter are available on the companion CD-ROM. Because most examples consist of multiple files, each example is in a separate directory on the CD.

Help Systems That Use Excel Components

Perhaps the most straightforward method of providing help to your users is to use the features contained in Excel itself. The primary advantage of this method is that you don't need to learn how to create HTML help files — which can be a major undertaking and might take longer to develop than your application.

In this section, I provide an overview of some help techniques that use the following built-in Excel components:

- **Cell comments:** Using comments is about as simple as it gets.
- **A text box control:** A short macro is all it takes to toggle the display of a text box that shows help information.
- **A worksheet:** An easy way to add help is to insert a worksheet, enter your help information, and name its tab *Help*. When the user clicks the tab, the worksheet is activated.
- **A custom UserForm:** A number of techniques involve displaying help text in a UserForm.



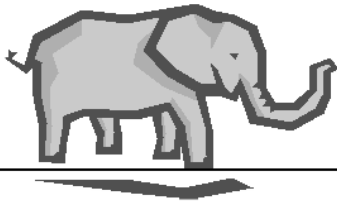
About the examples in this chapter

Many of the examples in this chapter use a common workbook application to demonstrate various ways of providing help. The application uses data stored in a worksheet to generate and print form letters.

As you can see in the following figure, cells display the total number of records in the database (C2, calculated by a formula), the current record number (C3), the first record to print (C4), and the last record to print (C5). To display a particular record, the user enters a value into cell C3. To print a series of form letters, the user specifies the first and last record numbers in cells C4 and C5.

	A	B	C	D	E	F	G	H	I
1									
2			Total No. Records:	6					
3			Current Record:	6					
4			First Record to Print:	1					
5			Last Record to Print:	3					
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
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34									
35									

Print the Form Letters
View or Edit Data
Help



Elephants 4U

P.O. Box 1211
San Diego, CA 92111

November 2, 2009

Michelle White
101 Yolinda Dr.
Orlando, FL 32837

Dear Michelle,

Thanks for your interest in adopting an elephant. Demand currently exceeds supply, so each request is being carefully evaluated. We will inform you of our decision in approximately six to eight weeks.

Please be aware, Michelle, that caring for an elephant requires a significant investment in time. Also, we've found that elephants usually don't adapt well in urban areas, and they positively dislike living in high-rise apartments.

Sincerely,

James R. Jones

James R. Jones
Director

continued

continued

The application is very simple, but it does consist of several discrete components. I use this example to demonstrate various ways of displaying context-sensitive help.

The form letter workbook consists of the following components:

- **Form**: A worksheet that contains the text of the form letter.
- **Data**: A worksheet that contains a seven-field database table.
- **HelpSheet**: A worksheet that's present only in the examples that store help text on a worksheet.
- **PrintMod**: A VBA module that contains macros to print the form letters.
- **HelpMod**: A VBA module that contains macros that control the help display. The content of this module varies depending on the type of help being demonstrated.
- **UserForm1**: A UserForm is present only if the help technique involves a UserForm.

Using cell comments for help

Perhaps the simplest way to provide user help is to use cell comments. This technique is most appropriate for describing the type of input that's expected in a cell. When the user moves the mouse pointer over a cell that contains a comment, that comment appears in a small window, like a ToolTip (see Figure 24-1). Another advantage is that this technique doesn't require any macros.

Automatic display of cell comments is an option. The following VBA instruction, which can be placed in a `Workbook_Open` procedure, ensures that cell comment indicators are displayed for cells that contain comments:

```
Application.DisplayCommentIndicator = xlCommentIndicatorOnly
```



On the CD

A workbook that demonstrates the use of cell comments is available on the companion CD-ROM. The filename is `cell comments\formletter.xlsm`.



Tip

Most users don't realize it, but a comment can also display an image. Right-click the comment's border and choose **Format Comment from the shortcut menu. In the **Format Comment** dialog box, select the **Colors and Lines** tab. Click the **Color** drop-down list and select **Fill Effects**. In the **Fill Effects** dialog box, click the **Picture** tab and then click the **Select Picture** button to choose the image file.**

Another option is to use Excel's **Data→Data Tools→Data Validation** command, which displays a dialog box that lets you specify validation criteria for a cell or range. You can just ignore the data validation aspect and use the **Input Message** tab of the **Data Validation** dialog box to specify a message that's displayed when the cell is activated. This text is limited to approximately 250 characters.

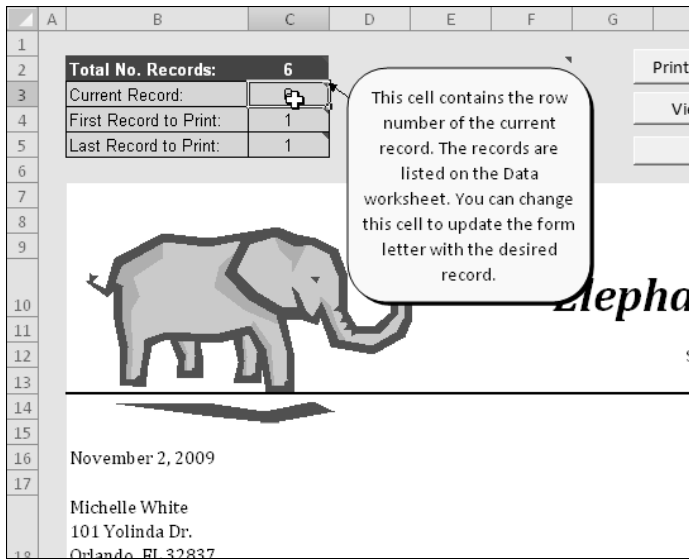


Figure 24-1: Using cell comments to display help.

Using a text box for help

Using a text box to display help information is also easy to implement. Simply create a text box by choosing **Insert→Text→Text Box**, enter the help text, and format it to your liking.



Tip

In lieu of a text box, you can use a different shape and add text to it. Choose **Insert→Illustrations→Shapes** and choose a shape. Then just start typing the text.

Figure 24-2 shows an example of a shape set up to display help information. I added a shadow effect to make the object appear to float above the worksheet.

Most of the time, you won't want the text box to be visible. Therefore, you can add a button to your application to execute a macro that toggles the `Visible` property of the text box. An example of such a macro follows. In this case, the `TextBox` is named `HelpText`.

```
Sub ToggleHelp()  
    ActiveSheet.TextBoxes("HelpText").Visible = _  
        Not ActiveSheet.TextBoxes("HelpText").Visible  
End Sub
```



On the CD

A workbook that demonstrates using a text box for help is available on the companion CD-ROM. The filename is `textbox\formletter.xlsm`.

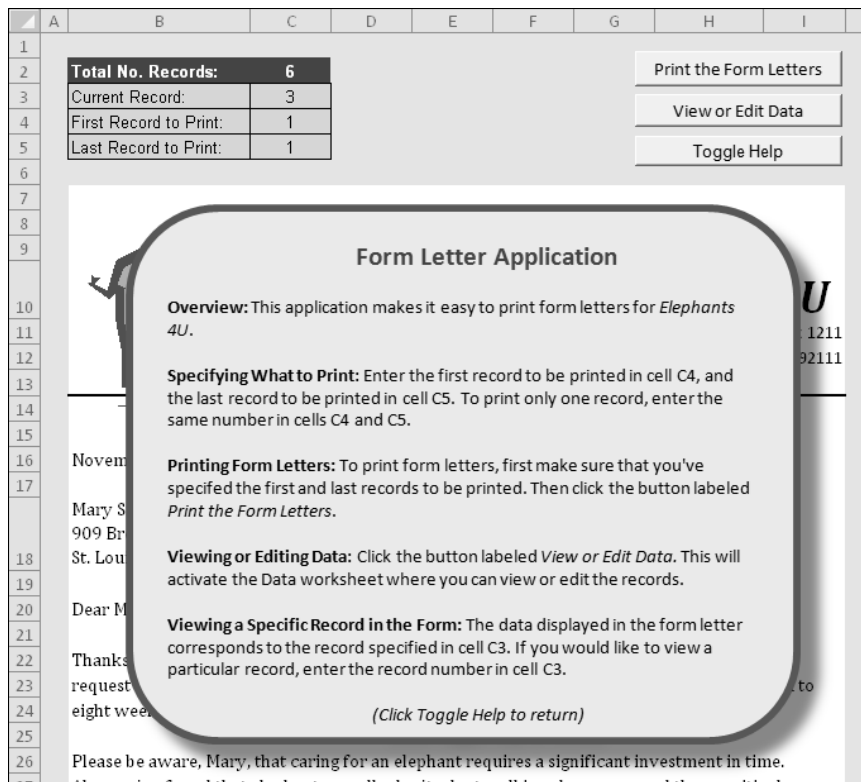


Figure 24-2: Using a shape object with text to display help for the user.

Using a worksheet to display help text

Another easy way to add help to your application is to create a macro that activates a separate worksheet that holds the help information. Just attach the macro to a button control, and voilà! . . . quick-and-dirty help.

Figure 24-3 shows a sample help worksheet. I designed the range that contains the help text to simulate a page from a yellow notebook pad — a fancy touch that you may or may not like.

To keep the user from scrolling around the `HelpSheet` worksheet, the macro sets the `ScrollArea` property of the worksheet. Because this property isn't stored with the workbook, it's necessary to set it when the worksheet is activated. I also protected the worksheet to prevent the user from changing the text and selecting cells, and I "froze" the first row so that the Return to the Form button is always visible, regardless of how far down the sheet the user scrolls.

The main disadvantage of using this technique is that the help text isn't visible along with the main work area. One possible solution is to write a macro that opens a new window to display the sheet.

Return to the Form

Instructions	
<input checked="" type="radio"/>	Overview This application makes it easy to print form letters for Elephants 4U.
<input checked="" type="radio"/>	Specifying What to Print Enter the first record to be printed in cell C4, and the last record to be printed in cell C5. To print only one record, enter the same number in cells C4 and C5.
<input checked="" type="radio"/>	Printing Form Letters To print form letters, first make sure that you've specified the first and last records to be printed. Then click the button labeled Print the Form Letters.
<input checked="" type="radio"/>	Viewing or Editing Data Viewing or Editing Data: Click the button labeled View or Edit Data. This will activate the Data worksheet where you can view or edit the records.
<input checked="" type="radio"/>	Viewing a Specific Record in the Form Viewing a Specific Record in the Form: The data displayed in the form letter corresponds to the record specified in cell C3. If you would like to view a particular record, enter the record number in cell C3.
	<i>End of Help</i>
<input type="radio"/>	

Figure 24-3: Putting user help in a separate worksheet is an easy way to go.



The companion CD-ROM contains a workbook named `worksheet\formletter.xlsm` that demonstrates using a worksheet for help.

Displaying help in a UserForm

Another way to provide help to the user is to display the text in a UserForm. In this section, I describe several techniques that involve UserForms.

Using Label controls to display help text

Figure 24-4 shows a UserForm that contains two `Label` controls: one for the title and one for the actual help text. A `SpinButton` control enables the user to navigate among the topics. The

text itself is stored in a worksheet, with topics in column A and text in column B. A macro transfers the text from the worksheet to the `Label` controls.

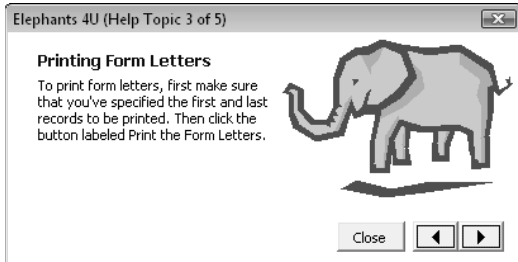


Figure 24-4: Clicking one of the arrows on the SpinButton changes the text displayed in the Labels.

Clicking the `SpinButton` control executes the following procedure. This procedure simply sets the `Caption` property of the two `Label` controls to the text in the appropriate row of the worksheet (named `HelpSheet`).

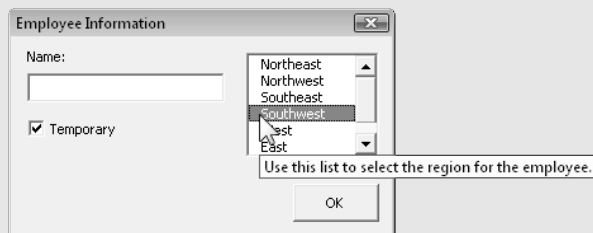
```
Private Sub SpinButton1_Change()
    HelpTopic = SpinButton1.Value
    LabelTopic.Caption = Sheets("HelpSheet"). _
        Cells(HelpTopic, 1)
    LabelText.Caption = Sheets("HelpSheet").Cells(HelpTopic, 2)
    Me.Caption = APPNAME & " (Help Topic " & HelpTopic & " of " & _
        & SpinButton1.Max & ")"
End Sub
```

Here, `APPNAME` is a global constant that contains the application's name.



Using Control tips in a UserForm

Every UserForm control has a `ControlTipText` property, which can store brief descriptive text. When the user moves the mouse pointer over a control, the Control tip (if any) is displayed in a pop-up window. See the accompanying figure.





A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `userform1\formletter.xlsm`.

Using a scrolling Label to display help text

This technique displays help text in a single `Label` control. Because a `Label` control can't contain a vertical scroll bar, the `Label` is placed inside a `Frame` control, which *can* contain a scroll bar. Figure 24-5 shows an example of a `UserForm` set up in this manner. The user can scroll through the text by using the `Frame`'s scroll bar.

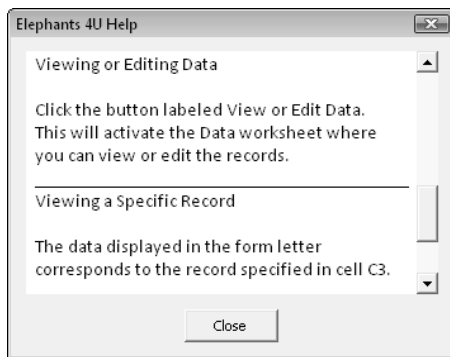


Figure 24-5: Inserting a `Label` control inside a `Frame` control adds scrolling to the `Label`.

The text displayed in the `Label` is read from a worksheet named `HelpSheet` when the `UserForm` is initialized. Here's the `UserForm_Initialize` procedure for this worksheet:

```
Private Sub UserForm_Initialize()
    Dim LastRow As Long
    Dim r As Long
    Dim txt As String
    Me.Caption = APPNAME & " Help"
    LastRow = Sheets("HelpSheet").Cells(Rows.Count, 1).End(xlUp).Row
    txt = ""
    For r = 1 To LastRow
        txt = txt & Sheets("HelpSheet").Cells(r, 1) _
            .Text & vbCrLf
    Next r
    With Label1
        .Top = 0
        .Caption = txt
        .Width = 260
        .AutoSize = True
    End With
End Sub
```

```
With Frame1
    .ScrollHeight = Label1.Height
    .ScrollTop = 0
End With
End Sub
```

Notice that the code adjusts the Frame's `ScrollHeight` property to ensure that the scrolling covers the complete height of the Label. Again, `APPNAME` is a global constant that contains the application's name.

Because a Label can't display formatted text, I used underscore characters in the `HelpSheet` worksheet to delineate the Help topic titles.



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM as a file named `userform2\formletter.xlsm`.

Using a ComboBox control to select a Help topic

The example in this section improves upon the previous example. Figure 24-6 shows a UserForm that contains a `ComboBox` control and a `Label` control. The user can select a topic from the drop-down `ComboBox` or view the topics sequentially by clicking the Previous or Next button.

This example is a bit more complex than the example in the previous section, but it's also much more flexible. It uses the label-within-a-scrolling-frame technique (described previously) to support help text of any length.

The help text is stored in a worksheet named `HelpSheet` in two columns (A and B). The first column contains the topic headings, and the second column contains the text. The `ComboBox` items are added in the `UserForm_Initialize` procedure. The `CurrentTopic` variable is a module-level variable that stores an integer that represents the Help topic.

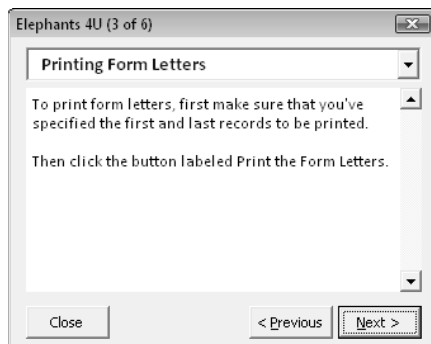


Figure 24-6: Using a drop-down list control to select a Help topic.

```

Private Sub UpdateForm()
    ComboBoxTopics.ListIndex = CurrentTopic - 1
    Me.Caption = HelpFormCaption & _
        " (" & CurrentTopic & " of " & TopicCount & ")"

    With LabelText
        .Caption = HelpSheet.Cells(CurrentTopic, 2)
        .AutoSize = False
        .Width = 212
        .AutoSize = True
    End With
    With Frame1
        .ScrollHeight = LabelText.Height + 5
        .ScrollTop = 1
    End With

    If CurrentTopic = 1 Then
        NextButton.SetFocus
    ElseIf CurrentTopic = TopicCount Then
        PreviousButton.SetFocus
    End If
    PreviousButton.Enabled = CurrentTopic <> 1
    NextButton.Enabled = CurrentTopic <> TopicCount
End Sub

```



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `userform3\formletter.xlsm`.

Displaying Help in a Web Browser

This section describes two ways to display user help in a Web browser.

Using HTML files

Yet another way to display help for an Excel application is to create one or more HTML files and provide a hyperlink that displays the file in the default Web browser. The HTML files can be stored locally or on your corporate intranet. You can create the hyperlink to the help file in a cell (macros not required). Figure 24-7 shows an example of help in a browser.

Easy-to-use HTML editors are readily available, and your HTML-based Help system can be as simple or as complex as necessary. A disadvantage is that you may need to distribute a large number of HTML files. One solution to this problem is to use an MHTML file, which I describe next.

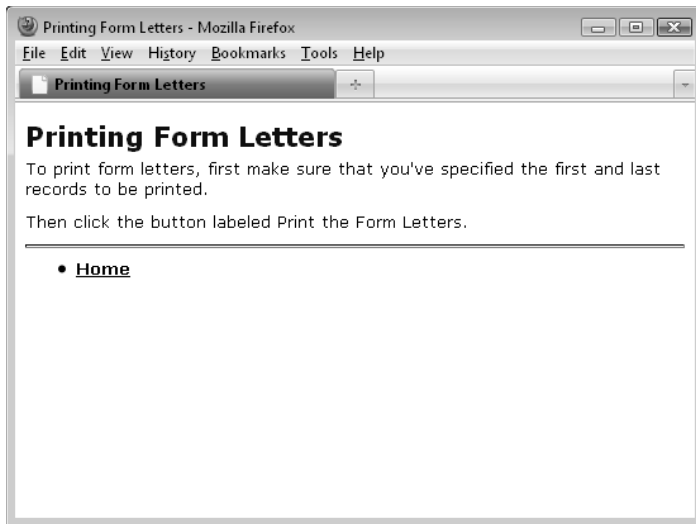


Figure 24-7: Displaying help in a Web browser.



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `web browser\formletter.xlsm`.

Using an MHTML file

MHTML, which stands for MIME Hypertext Markup Language, is a Web archive format. MHTML files can be displayed by Microsoft Internet Explorer (and a few other browsers).

The nice thing about using an MHTML file for an Excel Help system is that you can create these files in Excel. Just create your help text using any number of worksheets. Then, choose **File**→**Save As**, click the **Save As Type** drop-down list, and select **Single File Web Page (*.mht; *.mhtml)**. VBA macros aren't saved in this format.

Figure 24-8 shows an MHTML file displayed in Internet Explorer.



Caution

Apparently, some versions of Internet Explorer won't display an MHTML file hyperlinked from Excel if the filename or path includes space characters.

In Excel, you can create a hyperlink to display the MHTML file.



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `mhtml_file\formletter.xlsm`.



Note

If you save a multisheet Excel workbook as an MHTML file, the file will contain JavaScript code — which may generate a security warning when the file is opened.

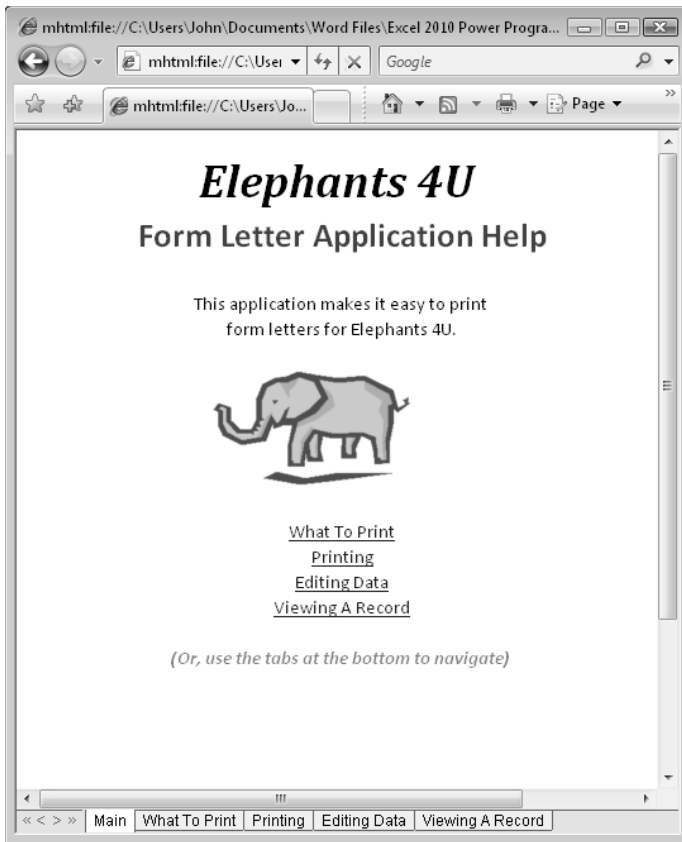


Figure 24-8: Displaying an MHTML file in a Web browser.

Using the HTML Help System

One of the most common Help systems used in Windows applications is HTML Help, which uses CHM files. This system replaces the old Windows Help system (WinHelp), which used Hlp files (see the sidebar, “Microsoft’s Help system evolution”). Both of these Help systems enable the developer to associate a context ID with a particular Help topic. This makes it possible to display a particular Help topic in a context-sensitive manner.

In this section, I briefly describe the HTML help-authoring system. Details on creating such Help systems are well beyond the scope of this book. However, you’ll find lots of information and examples online.



Note

If you plan to develop a large-scale Help system, I strongly recommend that you purchase a help-authoring software product to make your job easier. Help-authoring software makes it much easier to develop help files because the software takes care of lots of the tedious details for you. Many products are available, including freeware, shareware, and commercial offerings.



Microsoft's Help system evolution

Over the years, Microsoft has incorporated four different Help systems in its applications and operating systems:

- **WinHelp:** Based on RTF (rich-text formatting) files. This Help system was first used in Windows 3.0, in 1990. Multiple RTF files are compiled into a single help file with an `.hlp` extension. Versions of Microsoft Office prior to Office 2000 use WinHelp.
- **HTML Help:** Based on HTML (HyperText Markup Language) files. This Help system was first used in Internet Explorer 4.0, in 1997. Multiple HTML files are compiled into a single help file with a `.chm` extension. Office 2000 was the first version of Office to use HTML Help.
- **Microsoft Help 2:** Supports HTML, DHTML, XML, VBScript, and JavaScript. Multiple files are compiled into an `.hscx` file. This is the Help technology used in Office 2007. This Help system is intended for large-scale applications.
- **Assistance Platform Help:** AP Help is the Help system used by Windows Vista and Windows 7.

A compiled HTML Help system transforms a series of HTML files into a compact Help system. Additionally, you can create a combined table of contents and index as well as use keywords for advanced hyperlinking capability. HTML Help can also use additional tools such as graphics files, ActiveX controls, scripting, and DHTML (Dynamic HTML). Figure 24-9 shows an example of a simple HTML help system.



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `html_help\formletter.xlsm`.

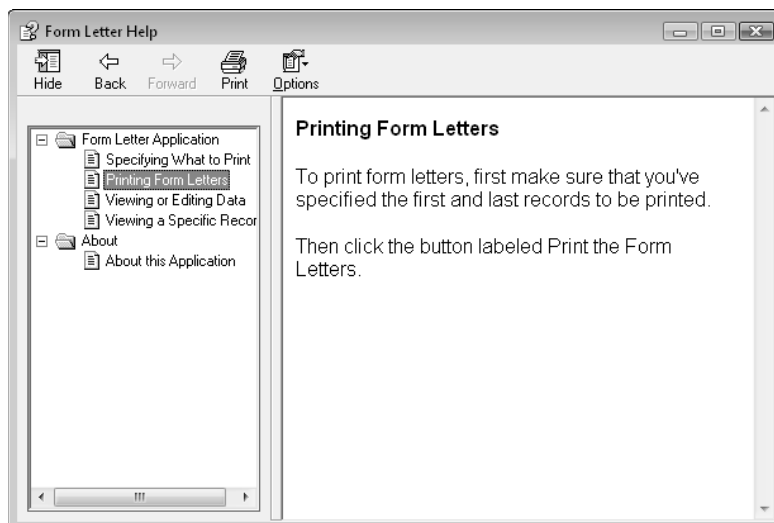


Figure 24-9: An example of HTML Help.

HTML Help is displayed by the HTML Help Viewer, which uses the layout engine of Internet Explorer. The information is displayed in a window, and the table of contents, index, and search tools are displayed in a separate pane. In addition, the help text can contain standard hyperlinks that display another topic or even a document on the Internet. It's also important that HTML Help can access files stored on a Web site. This is ideal for directing users to a source of up-to-date information that might not have been available when the Help system was created.

You need a special compiler to create an HTML Help system. The HTML Help Workshop, along with lots of additional information, is available free from Microsoft's MSDN Web site. Navigate to this address and search for *HTML Help Workshop*:

<http://msdn.microsoft.com>

Figure 24-10 shows the HTML Help Workshop with the project file that created the Help system shown in Figure 24-9.

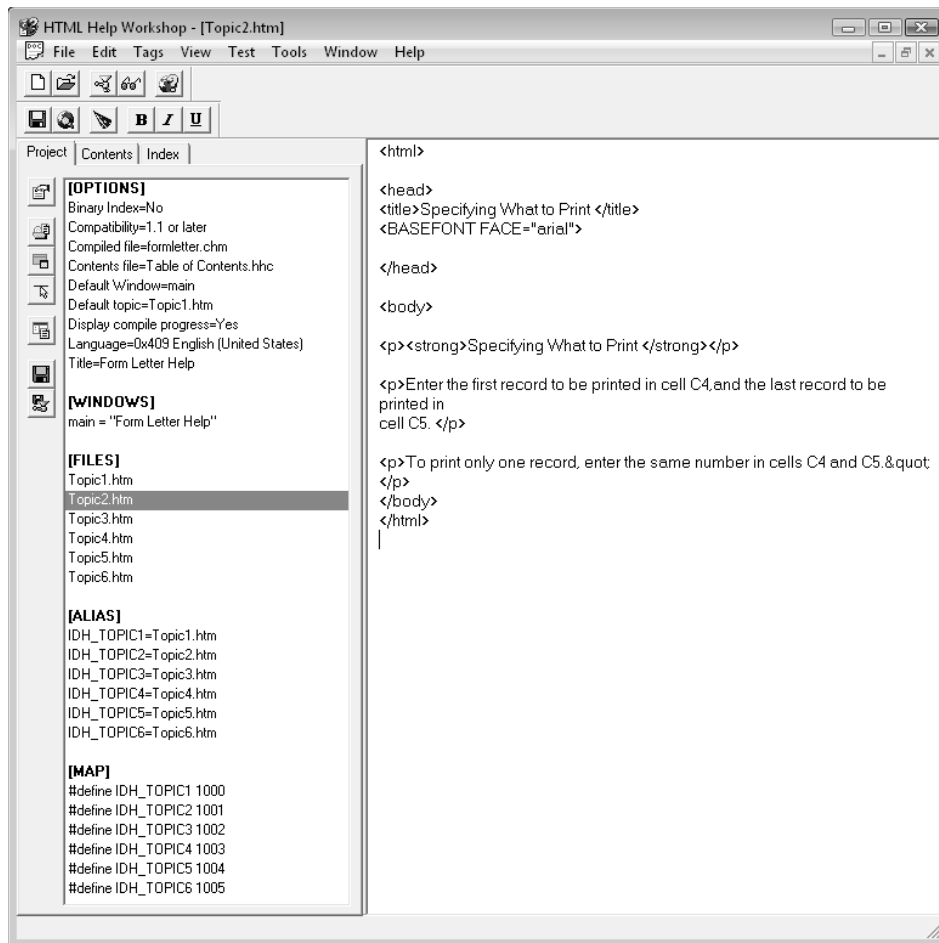


Figure 24-10: Using the HTML Help Workshop to create a help file.



Displaying an Excel Help topic

In some cases, you may want your VBA code to display a particular topic from Excel's Help system. For example, assume that you'd like to give the user the option to view Excel's Help system information on chart types.

First, make sure that the Excel Help window is displaying help from your computer (not from Office.com). (Use the control in the bottom-right corner of the Help window to change the connection status.) Next, you need to determine the Topic ID number of the topic. To do so, locate the topic in the Help system; then right-click and choose Properties. The Address (URL) field contains the Topic ID embedded in the URL. (It's a 10-character string that begins with the letter H.) Make a note of the Topic ID, and use it in a VBA statement like this:

```
Application.Assistance.ShowHelp " HA10342187 "
```

In Excel 2007, this technique works only if the user's Help system is set up to display local contents only (that is, the Help system is in Offline mode). In Excel 2010, however, the correct Help topic is displayed regardless of the setting.

Another option is to use the SearchHelp method. Just supply a search term, and the user will see a list of matching Help topics. Here's an example:

```
Application.Assistance.SearchHelp "format chart elements"
```

Using the Help method to display HTML Help

Use the Help method of the Application object to display a help file — either a WinHelp HLP file or an HTML Help CHM file. This method works even if the help file doesn't have any context IDs defined.

The syntax for the Help method is as follows:

```
Application.Help(helpFile, helpContextID)
```

Both arguments are optional. If the name of the help file is omitted, Excel's help file is displayed. If the context ID argument is omitted, the specified help file is displayed with the default topic.

The following example displays the default topic of myapp.chm, which is assumed to be in the same directory as the workbook that it's called from. Note that the second argument is omitted.

```
Sub ShowHelpContents()  
    Application.Help ThisWorkbook.Path & "\myapp.chm"  
End Sub
```

The following instruction displays the Help topic with a context ID of 1002 from an HTML help file named `myapp.chm`:

```
Application.Help ThisWorkbook.Path & "\myapp.chm", 1002
```

Associating a Help File with Your Application

You can associate a particular HTML help file with your Excel application in one of two ways: by using the Project Properties dialog box or by writing VBA code.

In the Visual Basic Editor (VBE), choose **Tools**→**xxx Properties** (where **xxx** corresponds to your project's name). In the Project Properties dialog box, click the General tab and specify a compiled HTML help file for the project. This file should have a `.chm` extension.

The statement that follows demonstrates how to associate a help file with your application by using a VBA statement. The following instruction sets up an association to `myfuncs.chm`, which is assumed to be in the same directory as the workbook:

```
ThisWorkbook.VBProject.HelpFile = ThisWorkbook.Path & "\myfuncs.chm"
```



Note

If this statement generates an error, you must enable programmatic access to VBA projects. In Excel, choose **Developer→**Code**→**Macro Security** to display the Trust Center dialog box. Then uncheck the option labeled **Trust Access to the VBA Project Object Model**.**

When a help file is associated with your application, you can call up a particular Help topic in the following situations:

- When the user presses F1 while a custom worksheet function is selected in the Insert Function dialog box.
- When the user presses F1 while a UserForm is displayed. The Help topic associated with the control that has the focus is displayed.

Associating a Help topic with a VBA function

If you create custom worksheet functions with VBA, you might want to associate a help file and context ID with each function. After these items are assigned to a function, the Help topic can be displayed from the Insert Function dialog box by pressing F1.

To specify a context ID for a custom worksheet function, follow these steps:

1. Create the function as usual.
2. Make sure that your project has an associated help file (refer to the preceding section).
3. In the VBE, press F2 to activate the Object Browser.
4. Select your project from the Project/Library drop-down list.
5. In the Classes window, select the module that contains your function.
6. In the Members Of window, select the function.
7. Right-click the function and then select Properties from the shortcut menu.

This displays the Member Options dialog box, shown in Figure 24-11.

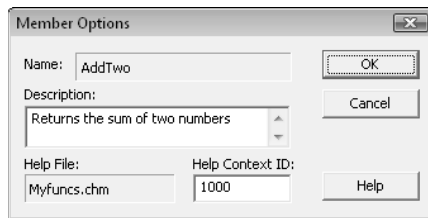


Figure 24-11: Specify a context ID for a custom function in the Member Options dialog box.

8. Enter the context ID of the Help topic for the function.

You can also enter a description of the function.



Note

The Member Options dialog box doesn't let you specify the help file. It always uses the help file associated with the project.

You may prefer to write VBA code that sets up the context ID and help file for your custom functions. You can do this by using the `MacroOptions` method.

The following procedure uses the `MacroOptions` method to specify a description, help file, and context ID for two custom functions (`AddTwo` and `Squared`). You need to execute this macro only one time.

```
Sub SetOptions()
' Set options for the AddTwo function
Application.MacroOptions Macro:="AddTwo", _
    Description:="Returns the sum of two numbers", _
    HelpFile:=ThisWorkbook.Path & "\myfuncs.chm", _
    HelpContextID:=1000, _
    ArgumentDescriptions:=Array("The first number to add", _
```

```
        "The second number to add")

'    Set options for the Squared function
Application.MacroOptions Macro="Squared", _
    Description="Returns the square of an argument", _
    HelpFile:=ThisWorkbook.Path & "\myfuncs.chm", _
    HelpContextID:=2000, _
    ArgumentDescriptions:=Array("The number to be squared")
End Sub
```

After executing these procedures, the user can get help directly from the Insert Function dialog box by pressing F1 or by clicking the Help on This Function hyperlink.



New Feature

The preceding example also demonstrates a new argument for the `MacroOptions` method. Excel 2010 accepts the `ArgumentDescriptions` argument. You can use this argument to provide a description of each argument in your function. These descriptions appear in the Function Arguments dialog box, which is displayed after the Insert Function dialog box.



On the CD

A workbook that demonstrates this technique is available on the companion CD-ROM. The filename is `function help\myfuncs.xlsm`.

Developing User-Oriented Applications

In This Chapter

- Describing a user-oriented application
- Looking at the Loan Amortization Wizard, which generates a worksheet with an amortization schedule for a fixed-rate loan
- Demonstrating application development concepts and techniques by the Loan Amortization Wizard
- Reviewing an application development checklist

What is a User-Oriented Application?

I use the term *user-oriented application* for an Excel application that someone with minimal training can use. These applications produce useful results even for users who know virtually nothing about Excel.

The Loan Amortization Wizard discussed in this chapter qualifies as a user-oriented application because it's designed in such a way that the end user doesn't need to know the intimate details of Excel to use it. Replying to a few simple prompts produces a useful and flexible worksheet complete with formulas.

The Loan Amortization Wizard

The Loan Amortization Wizard generates a worksheet that contains an amortization schedule for a fixed-rate loan. An amortization schedule projects month-by-month details for a loan. The details include the monthly payment amount, the amount of the payment that goes toward interest, the amount that goes toward reducing the principal, and the new loan balance.

An alternative to creating an amortization schedule using a wizard is to create a template file. As you'll see, this wizard approach offers several advantages.

Figure 25-1 shows an amortization schedule generated by the Loan Amortization Wizard.

	A	B	C	D	E	F	G
1	Amortization Schedule						
2	Prepared by John Walkenbach						
3	Generated Tuesday, January 12, 2010						
4							
5	Purchase Price:	\$378,000.00					
6	Down Pmt Pct:	20.0%					
7	Down Pmt:	\$75,600.00					
8	Loan Amount:	\$302,400.00					
9	Term (Months):	360					
10	Interest Rate:	6.25%					
11	First Payment:	3/1/2010					
12							
13	Pmt No.	Year	Month	Payment	Interest	Principal	Balance
14	1	2010	3	\$1,861.93	\$1,575.00	\$286.93	\$302,113.07
15	2	2010	4	\$1,861.93	\$1,573.51	\$288.42	\$301,824.65
16	3	2010	5	\$1,861.93	\$1,572.00	\$289.93	\$301,534.72
17	4	2010	6	\$1,861.93	\$1,570.49	\$291.44	\$301,243.29
18	5	2010	7	\$1,861.93	\$1,568.98	\$292.95	\$300,950.33
19	6	2010	8	\$1,861.93	\$1,567.45	\$294.48	\$300,655.85
20	7	2010	9	\$1,861.93	\$1,565.92	\$296.01	\$300,359.84
21	8	2010	10	\$1,861.93	\$1,564.37	\$297.55	\$300,062.29
22	9	2010	11	\$1,861.93	\$1,562.82	\$299.10	\$299,763.18
23	10	2010	12	\$1,861.93	\$1,561.27	\$300.66	\$299,462.52
24	2010 Total			\$18,619.29	\$15,681.81	\$2,937.48	\$299,462.52
25	11	2011	1	\$1,861.93	\$1,559.70	\$302.23	\$299,160.29
26	12	2011	2	\$1,861.93	\$1,558.13	\$303.80	\$298,856.49
27	13	2011	3	\$1,861.93	\$1,556.54	\$305.38	\$298,551.11
28	14	2011	4	\$1,861.93	\$1,554.95	\$306.98	\$298,244.13
29	15	2011	5	\$1,861.93	\$1,553.35	\$308.57	\$297,935.56
30	16	2011	6	\$1,861.93	\$1,551.75	\$310.18	\$297,625.38
31	17	2011	7	\$1,861.93	\$1,550.13	\$311.80	\$297,313.58
32	18	2011	8	\$1,861.93	\$1,548.51	\$313.42	\$297,000.16
33	19	2011	9	\$1,861.93	\$1,546.88	\$315.05	\$296,685.10
34	20	2011	10	\$1,861.93	\$1,545.23	\$316.69	\$296,368.41
35	21	2011	11	\$1,861.93	\$1,543.59	\$318.34	\$296,050.07

Figure 25-1: This amortization schedule shows details for a 30-year mortgage.



The Loan Amortization Wizard is available on the CD-ROM that accompanies this book. It's an unprotected add-in named `loan amortization wizard.xlam`.

Using the Loan Amortization Wizard

The Loan Amortization Wizard consists of a five-step dialog box sequence that collects information from the user. Typical of a wizard, this enables the user to go forward and backward through the steps. Clicking the Finish button creates the new worksheet. If all the steps haven't been completed when the user clicks Finish, default values are used. Clicking the Cancel button closes the UserForm, and no action is taken.

This application uses a single UserForm with a `MultiPage` control to display the five steps, shown in Figures 25-2 through 25-6.

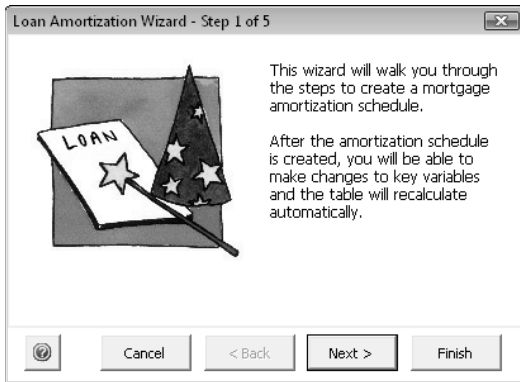


Figure 25-2: Step 1 of the Loan Amortization Wizard.

Figure 25-3: Step 2 of the Loan Amortization Wizard.

Figure 25-4: Step 3 of the Loan Amortization Wizard.

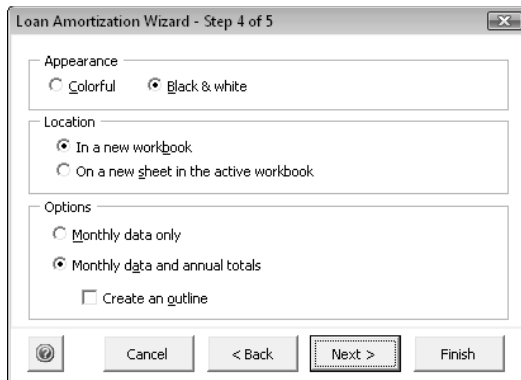


Figure 25-5: Step 4 of the Loan Amortization Wizard.

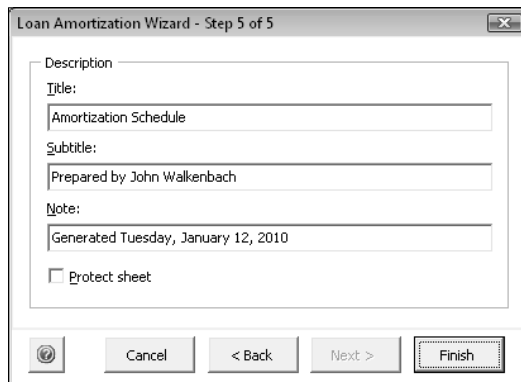


Figure 25-6: Step 5 of the Loan Amortization Wizard.

The Loan Amortization Wizard workbook structure

The Loan Amortization Wizard consists of the following components:

- **FormMain:** A UserForm that serves as the primary user interface.
- **FormHelp:** A UserForm that displays online help.
- **FormMessage:** A UserForm that displays a message when the add-in is opened. The user can disable this display.
- **HelpSheet:** A worksheet that contains the text used in the online help.
- **ModMain:** A VBA module that contains a procedure that displays the main UserForm.
- **ThisWorkbook:** The code module for this object contains the `Workbook_Open` event-handler procedure.

In addition, the workbook file contains some simple RibbonX XML code that creates the Loan Amortization Wizard button in the Insert tab of the Ribbon.



Creating the Loan Amortization Wizard

The Loan Amortization Wizard application started out as a simple concept and evolved into a relatively complex project. My primary goal was to demonstrate as many development concepts as possible and still have a useful end product. I would like to say that I clearly envisioned the end result before I began developing the application, but I'd be lying.

My basic idea was much less ambitious. I simply wanted to create an application that gathered user input and created a worksheet. But, after I got started, I began thinking of ways to enhance my simple program. I eventually stumbled down several blind alleys. Some folks would consider my wanderings time-wasting, but those false starts became a vital part of the development process.

I completed the entire project in one (long) day, and I spent a few more hours fine-tuning and testing it. I added a few more accouterments for the version included in this edition of the book.

How the Loan Amortization Wizard works

The Loan Amortization Wizard is an add-in, so you should install it by using the Add-Ins dialog box. To display this dialog box, choose File→Options→Add-Ins. Then, in the Excel Options dialog box, choose Excel Add-Ins from the Manage drop-down list and click Go. Use the Browse button to locate the add-in file. After it's installed, an add-in remains installed across Excel sessions. The add-in works perfectly well, however, if it's opened with the File→Open command.

Modifying the user interface

Every add-in needs a way to allow the user to access the procedures. I added some RibbonX code to the file that adds a button to a new group in the Insert tab (see Figure 25-7). Clicking this button executes the `StartAmortizationWizard` procedure, which displays the `FormMain` `UserForm`.

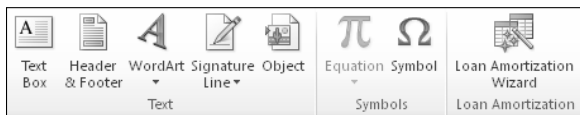


Figure 25-7: A new group on the Insert tab contains one control.

The RibbonX code that creates the Ribbon control is

```
<customUI xmlns="http://schemas.microsoft.com/office/2006/01/customui">
  <ribbon>
    <tabs>
      <tab idMso="TabInsert">
        <group id="gpUtils" label="Loan Amortization">
          <button id="b1">
```

```

        size="large"
        imageMso="CreateQueryFromWizard"
        label="Loan Amortization Wizard"
        supertip="Click here to create an amortization schedule."
        onAction="StartAmortizationWizard"/>
    </group>
</tab>
</tabs>
</ribbon>
</customUI>

```



Cross-Ref

Refer to Chapter 22 for information about modifying the Ribbon.

Displaying an initial message

I've installed many Excel add-ins over the years, and I've found that many of them don't provide a clue as to how to access the add-in. To make this application as user-friendly as possible, I added a UserForm that is displayed when the workbook is opened. This form tells the user how to start the wizard. Figure 25-8 shows the UserForm.

To prevent it from become annoying, this UserForm includes an option to turn off the message in the future.

Following is the `Workbook_Open` procedure that displays the dialog box:

```

Private Sub Workbook_Open()
    If GetSetting(APPNAME, "Defaults", "ShowMessage", "Yes") = "Yes" Then
        FormMessage.Show
    End If
End Sub

```



Figure 25-8: This form is displayed when the Loan Amortization Wizard is opened.

The user's choice regarding the future display of the UserForm is stored in the Windows Registry. The Registry key is specified by the application's name (a global constant, `APPNAME`). The default value is "Yes," so the UserForm will display at least one time.

Following is the code that is executed when the user clicks the OK button:

```
Private Sub OKButton_Click()
    If cbMessage Then
        SaveSetting APPNAME, "Defaults", "ShowMessage", "No"
    Else
        SaveSetting APPNAME, "Defaults", "ShowMessage", "Yes"
    End If
    Unload Me
End Sub
```

If the user checks the check box control, then the registry setting is set to “No,” and the UserForm won’t be displayed again.

Initializing FormMain for the wizard

The `UserForm_Initialize` procedure for `FormMain` does quite a bit of work:

- It sets the `MultiPage` control’s `Style` property to `fmTabStyleNone`. The tabs are present in the Visual Basic Editor to make the UserForm easier to edit.
- It sets the `MultiPage` control’s `Value` property to 0. This ensures that it displays the first page, regardless of its value when the workbook was last saved.
- It adds items to three `ComboBox` controls used on the form.
- It calls the `GetDefaults` procedure, which retrieves the most recently used setting from the Windows Registry (see the upcoming section “Saving and retrieving default settings”).
- It checks whether a workbook is active. If no workbook is active, the code disables the `OptionButton` that enables the user to create the new worksheet in the active workbook.
- If a workbook is active, an additional check determines whether the workbook’s structure is protected. If so, the procedure disables the `OptionButton` that enables the user to create the worksheet in the active workbook.

Processing events while the UserForm is displayed

The code module for the `FormMain` UserForm contains several event-handler procedures that respond to the `Click` and `Change` events for the controls on the UserForm.



Cross-Ref

Clicking the Back and Next buttons determines which page of the `MultiPage` control is displayed. The `MultiPage1_Change` procedure adjusts the UserForm’s caption and enables and disables the Back and Next buttons as appropriate. See Chapter 15 for more information about programming a wizard.

Displaying help in the wizard

You have several options when it comes to displaying online help. I chose a technique that displays help text in the UserForm shown in Figure 25-9 to display text stored in a worksheet. You'll notice that this help is context-sensitive. When the user clicks the Help button, the Help topic displayed is relevant to the current page of the `MultiPage` control.

Worksheets in an add-in aren't visible. To view the worksheet that contains the help text for this add-in, you need to temporarily set the workbook's `IsAddin` property to `False`. One way to accomplish this is to select the project in the Project window and execute this statement in the Immediate window:

```
ThisWorkbook.IsAddin = False
```

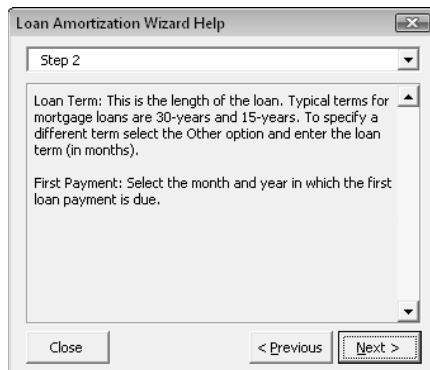


Figure 25-9: User help is presented in a UserForm that copies text stored in a worksheet.



Cross-Ref

For more information about the technique of transferring worksheet text to a UserForm, refer to Chapter 24.

Creating the new worksheet

When the user clicks the Finish button, the action begins. The `Click` event-handler procedure for this button performs the following actions:

- It calls a function named `DataIsValid`, which checks the user's input to ensure that it's valid. If all the entries are valid, the function returns `True`, and the procedure continues. If an invalid entry is encountered, `DataIsValid` sets the focus to the control that needs to be corrected and returns a descriptive error message (see Figure 25-10).
- If the user's responses are valid, the procedure creates a new worksheet either in the active workbook or in a new workbook, per the user's request.

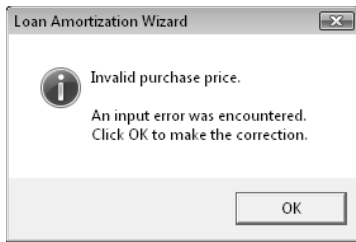


Figure 25-10: If an invalid entry is made, the focus is set back to the control that contains the error.

- The loan *parameters* (purchase price, down payment information, loan amount, term, and interest rate) are written to the worksheet. This requires the use of some `IF` statements because the down payment can be expressed as a percentage of the purchase price or as a fixed amount.
- The column headers are written to the worksheet.
- The first row of formulas is written below the column headers. The first row is different from the remaining rows because its formulas refer to data in the loan parameters section. The other formulas all refer to the previous row. Notice that I use named ranges in the formulas. These are sheet-level names, so the user can store more than one amortization schedule in the same workbook.
- For unnamed references, I use row number and column number notation, which is much easier than trying to determine actual cell addresses.
- The second row of formulas is written to the worksheet and then copied down one row for each month.
- If the user requested annual totals as opposed to simply monthly data, the procedure uses the `Subtotal` method to create subtotals. This, by the way, is an example of how using a native feature in Excel can save *lots* of coding.
- Because subtotaling the Balance column isn't appropriate, the procedure replaces formulas in the Balance column with a formula that returns the year-end balance.
- When Excel adds subtotals, it also creates an outline. If the user didn't request an outline, the procedure uses the `ClearOutline` method to remove it. If an outline was requested, the procedure hides the outline symbols.
- Next, the procedure applies formatting to the cells: number formatting, plus an `AutoFormat` if the user requested color output.
- The amortization schedule is then converted to a table, and a style is applied based on the user's choice of black-and-white or color.
- The procedure then adjusts the column widths, freezes the titles just below the header row, and protects the formulas and a few other key cells that shouldn't be changed.
- If the Protect Sheet option is specified in Step 5, the sheet is protected (but not with a password).

- Finally, the `SaveDefaults` procedure writes the current values of the `UserForm`'s controls to the Windows registry. These values will be the new default settings the next time the user creates an amortization schedule. (See the following section.)

Saving and retrieving default settings

If you run this application, you'll notice that the `FormMain` `UserForm` always displays the setting that you most recently used. In other words, it remembers your last choices and uses them as the new default values. This step makes it very easy to generate multiple *what-if* amortization schedules that vary in only a single parameter. The code remembers the user input by storing the values in the Windows Registry and then retrieving them when the `UserForm` is initialized. When the application is used for the first time, the Registry doesn't have any values, so it uses the default values stored in the `UserForm` controls.

The following `GetDefaults` procedure loops through each control on the `UserForm`. If the control is a `TextBox`, `ComboBox`, `OptionButton`, `CheckBox`, or `SpinButton`, it calls VBA's `GetSetting` function and reads the value to the Registry. Note that the third argument for `GetSetting` is the value to use if the setting isn't found. In this case, it uses the value of the control specified at design time. `APPNAME` is a global constant that contains the name of the application.

```
Sub GetDefaults()
'   Reads default settings from the registry
    Dim ctl As Control
    Dim CtrlType As String

    For Each ctl In Me.Controls
        CtrlType = TypeName(ctl)
        If CtrlType = "TextBox" Or _
            CtrlType = "ComboBox" Or _
            CtrlType = "OptionButton" Or _
            CtrlType = "CheckBox" Or _
            CtrlType = "SpinButton" Then
            ctl.Value = GetSetting _
                (APPNAME, "Defaults", ctl.Name, ctl.Value)
        End If
    Next ctl
End Sub
```

Figure 25-11 shows how these values appear in the Registry, as displayed by the Windows Registry Editor program.

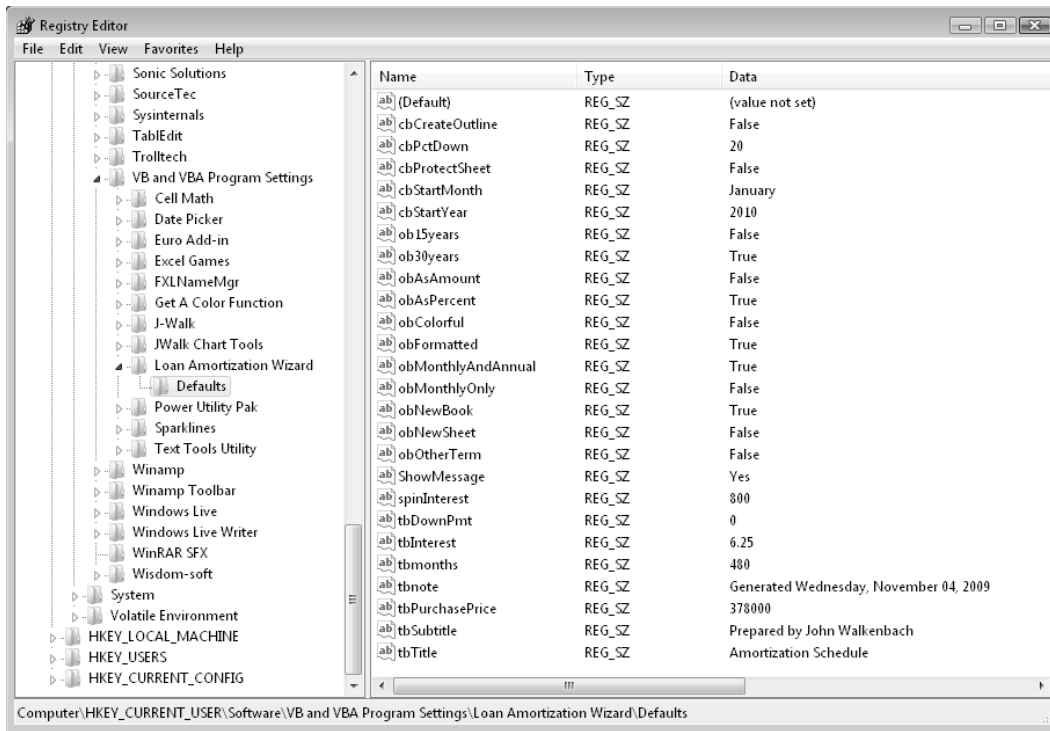


Figure 25-11: The Windows Registry stores the default values for the wizard.

The following `SaveDefaults` procedure is similar to the `GetDefaults` procedure. It uses VBA's `SaveSetting` statement to write the current values to the Registry:

```
Sub SaveDefaults()
'   Writes current settings to the registry
Dim ctl As Control
Dim CtrlType As String

For Each ctl In Me.Controls
    CtrlType = TypeName(ctl)
    If CtrlType = "TextBox" Or _
        CtrlType = "ComboBox" Or _
        CtrlType = "OptionButton" Or _
        CtrlType = "CheckBox" Or _
        CtrlType = "SpinButton" Then
        SaveSetting APPNAME, "Defaults", ctl.Name, CStr(ctl.Value)
    End If
Next ctl
End Sub
```

Notice that the code uses the `CStr` function to convert each setting to a string. This function helps avoid problems for those who use non-English regional settings. Without the string conversion, `True` and `False` are translated to the user's language before they're stored in the Registry. But they're *not* translated back to English when the setting is retrieved — which causes an error.

The `SaveSetting` statement and the `GetSetting` function always use the following Registry key:

```
HKEY_CURRENT_USER\Software\VB and VBA Program Settings\
```

Potential enhancements for the Loan Amortization Wizard

It's been said that you never finish writing an application — you just stop working on it. Without even thinking too much about it, I can come up with several enhancements for the Loan Amortization Wizard:

- An option to display cumulative totals for interest and principal
- An option to work with adjustable-rate loans and make projections based on certain interest rate scenarios
- More formatting options (for example, no decimal places, no dollar signs, and so on)
- Options to enable the user to specify page headers or footers

Application Development Concepts

Following the logic in an application developed by someone other than yourself is often difficult. To help you understand my work, I included lots of comments in the code and described the general program flow in the preceding sections. But, if you really want to understand this application, I suggest that you use the Debugger to step through the code.

At the very least, the Loan Amortization Wizard demonstrates some useful techniques and concepts that are important for Excel developers:

- Modifying the Ribbon.
- Using a wizard-like UserForm to gather information.
- Setting the `Enabled` property of a control dynamically.
- Linking a `TextBox` control and a `SpinButton` control.
- Displaying online help to a user.
- Naming cells with VBA.
- Writing and copying formulas with VBA.
- Reading from and writing to the Windows Registry.



Application development checklist

When developing user-oriented applications, you need to keep in mind many things. Let the following checklist serve as a reminder:

- **Do the dialog boxes all work from the keyboard?** Don't forget to add hot keys and check the tab order carefully.
- **Did you make any assumptions about directories?** If your application reads or writes files, you can't assume that a particular directory exists or that it's the current directory.
- **Did you make provisions for canceling all dialog boxes?** You can't assume that the user will end a dialog box by clicking the OK button.
- **Did you assume that no other worksheets are open?** If your application is the only workbook open during testing, you could overlook something that happens when other workbooks are open.
- **Did you assume that a workbook is visible?** It's possible, of course, to use Excel with no workbooks visible.
- **Did you attempt to optimize the speed of your application?** For example, you often can speed up your application by declaring variable types and defining object variables.
- **Are your procedures adequately documented?** Will you understand your code if you revisit it in six months?
- **Did you include appropriate end-user documentation?** Doing so often eliminates (or at least reduces) the number of follow-up questions.
- **Did you allow time to revise your application?** Chances are the application won't be perfect the first time out. Build in some time to fix it.

Developing user-oriented applications in Excel isn't easy. You must be keenly aware of how people will use (and abuse) the application in real life. Although I tried to make this application completely bulletproof, I did not do extensive real-world testing, so I wouldn't be surprised if it fails under some conditions.

Other Topics

CHAPTER 26

Compatibility Issues

CHAPTER 27

Manipulating Files with VBA

CHAPTER 28

Manipulating Visual Basic Components

CHAPTER 29

Understanding Class Modules

CHAPTER 30

Working with Colors

CHAPTER 31

Frequently Asked Questions about Excel Programming

Compatibility Issues

In This Chapter

- Increasing the probability that your Excel 2010 applications will also work with previous versions of Excel
- Declaring API functions that work with 32-bit Excel 2010, 64-bit Excel 2010, and earlier versions of Excel
- Being aware of issues if you're developing Excel applications for international use

What Is Compatibility?

Compatibility is an oft-used term among computer people. In general, it refers to how well software performs under various conditions. These conditions might be defined in terms of hardware, software, or a combination of the two. For example, software written for Windows will not run directly on other operating systems, such as Mac OS X or Linux.

In this chapter, I discuss a more specific compatibility issue involving how your Excel 2010 applications will work with earlier versions of Excel for Windows and Excel for Macintosh. The fact that two versions of Excel might use the same file format isn't always enough to ensure complete compatibility between the contents of their files. For example, Excel 97, Excel 2000, Excel 2002, Excel 2003, and Excel 2007 for Macintosh all use the same file format, but compatibility problems are rampant. Just because a particular version of Excel can open a worksheet file or an add-in doesn't guarantee that that version of Excel can carry out the VBA macro instructions contained in it. Another example: Excel 2010 and Excel 2007 both use the same file format. If your application uses features that were introduced in Excel 2010, you can't expect that Excel 2007 users will magically have access to these new features.

Excel is a moving target, and there is really no way that you can guarantee complete compatibility. Unfortunately, cross-version compatibility doesn't happen automatically. In most cases, you need to do quite a bit of additional work to achieve compatibility.

Types of Compatibility Problems

You need to be aware of several categories of potential compatibility problems. These issues are listed here and discussed further in this chapter:

- **File format issues:** You can save workbooks in several different Excel file formats. Earlier versions of Excel might not be able to open workbooks that were saved in a later version's file format. For more information about sharing Excel 2010 (and Excel 2007) files, see the sidebar, "The Microsoft Office Compatibility Pack."
- **New feature issues:** It should be obvious that you can't use a feature introduced in a particular version of Excel in previous versions of Excel.
- **Microsoft issues:** For whatever reason, Microsoft itself is responsible for some types of compatibility issues. For example, as I note in Chapter 23, index numbers for shortcut menus haven't remained consistent across Excel versions.
- **Windows versus Macintosh issues:** If your application must work on both platforms, plan to spend lots of time ironing out various compatibility problems. Excel for Macintosh no longer supports VBA, so it's likely that you'll be forced to create a separate version for the Macintosh.
- **Bit issues:** Excel 2010 is the first version of Excel that's available in both 32-bit and 64-bit editions. If your VBA code uses API functions, you'll need to be aware of some potential problems if the code must run in both 32-bit and 64-bit Excel, as well as other versions of Excel.
- **International issues:** If your application will be used by those who use a different language version of Excel, you must address a number of additional issues.

After reading this chapter, it should be clear that there is only one way to ensure compatibility: You must test your application on every target platform and with every target version of Excel. Often, this amount of testing is simply not feasible. However, you, as a developer, can take certain measures to help ensure that your application works with different versions of Excel.



Note

If you're reading this chapter in search of a complete list of specific compatibility issues among the various versions of Excel, you will be disappointed. As far as I know, no such list exists, and it would be virtually impossible to compile one. These types of issues are far too numerous and complex.



Tip

A good source for information about potential compatibility problems is Microsoft's support site. The URL is

[http:// support.microsoft.com](http://support.microsoft.com)

Information at this site can often help you identify bugs that appear in a particular version of Excel.



The Microsoft Office Compatibility Pack

If you plan to share your Excel 2010 application with others who haven't upgraded to Excel 2010 (or Excel 2007), you have two choices:

- Always save your files in the older XLS file format.
- Make sure the recipients of your files have installed the Microsoft Office Compatibility Pack.

The Microsoft Office Compatibility Pack is a free download available at www.microsoft.com. When installed, Office XP and Office 2003 users can open, edit, and save documents, workbooks, and presentations in the new file formats for Word, Excel, and PowerPoint.

Keep in mind that this compatibility pack doesn't endow earlier versions of Excel with any of the new features in Excel 2007 or Excel 2010. It simply allows those users to open and save files in the new file format.

Avoid Using New Features

If your application must work with both Excel 2010 and earlier versions, you need to avoid any features that were added after the earliest Excel version that you will support. Another alternative is to incorporate the new features selectively. In other words, your code can determine which version of Excel is being used and then take advantage of the new features or not.

VBA programmers must be careful not to use any objects, properties, or methods that aren't available in earlier versions. In general, the safest approach is to develop your application for the lowest version number. For compatibility with Excel 2000 and later, you should use Excel 2000 for development; then test thoroughly by using the later versions.

A very useful feature that was introduced in Excel 2007 is the Compatibility Checker, shown in Figure 26-1. Display this dialog box by choosing **File**→**Info**→**Check For Issues**→**Check Compatibility**. The Compatibility Checker identifies any compatibility issues that might cause a problem if the file is opened using an earlier version of Excel.

Unfortunately, the Compatibility Checker doesn't even look at the VBA code — which is a prime candidate for compatibility problems. However, you can download the Microsoft Office Code Compatibility Inspector (search for it at <http://Microsoft.com>). This tool installs as an add-in and adds new commands to the Developer tab. It may help you locate potential compatibility problems in your VBA code. As I write this book, the Microsoft Office Code Compatibility Inspector was available as beta software — and it wasn't very helpful. Perhaps the final version will be more useful.



Determining Excel's version number

The `Version` property of the `Application` object returns the version of Excel. The returned value is a string, so you might need to convert it to a value. Use VBA's `Val` function to make the conversion. The following function, for example, returns `True` if the user is running Excel 2007 or later:

```
Function XL12OrLater()  
    XL12OrLater = Val(Application.Version) >= 12  
End Function
```

Excel 2007 is version 12, and Excel 2010 is version 14. There is no version 13, presumably because some people think it's an unlucky number.

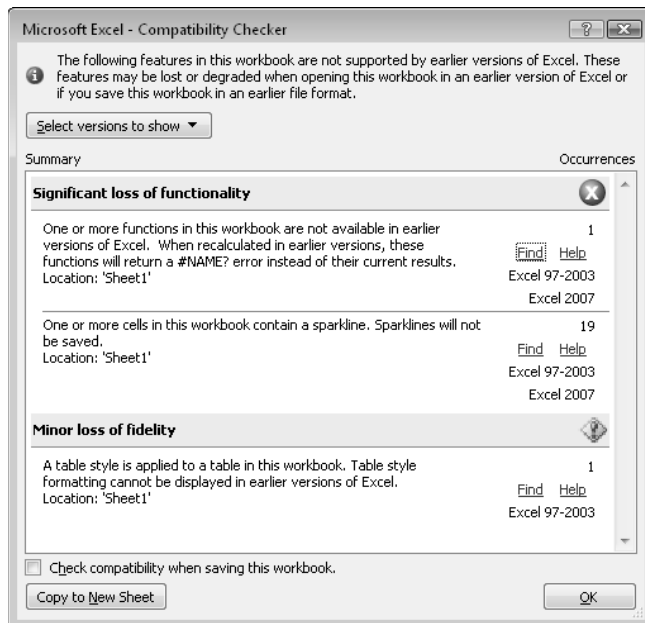


Figure 26-1: The Compatibility Checker.

But Will It Work on a Mac?

A common problem that I hear about is Macintosh compatibility. Excel for Macintosh represents a very small proportion of the total Excel market, and many developers choose simply to ignore it. The good news is that the old Excel XLS file format is compatible across both platforms. The bad news is that the features supported aren't identical, and VBA macro compatibility is far from perfect. In fact, the current version of Excel for Macintosh doesn't even support VBA.

**Note**

The remainder of this section assumes that you're working with an older version of Excel for Macintosh — a version that still supports VBA.

You can write VBA code to determine which platform your application is running. The following function accesses the `OperatingSystem` property of the `Application` object and returns `True` if the operating system is any version of Windows (that is, if the returned string contains the text "Win"):

```
Function WindowsOS() As Boolean
    If Application.OperatingSystem like "*Win*" Then
        WindowsOS = True
    Else
        WindowsOS = False
    End If
End Function
```

Many subtle (and not so subtle) differences exist between the Windows versions and the Mac versions of Excel. Many of those differences are cosmetic (for example, different default fonts), but others are much more serious. For example, Excel for Macintosh doesn't include ActiveX controls. Also, it uses the 1904 date system as the default, so workbooks that use dates could be off by four years. Excel for Windows, by default, uses the 1900 date system. On the Macintosh, a date serial number of 1 refers to January 1, 1904; in Excel for Windows, that same serial number represents January 1, 1900.

Another limitation concerns Windows API functions: They won't work with Excel for Macintosh. If your application depends on such functions, you need to develop a workaround.

If your code deals with paths and filenames, you need to construct your path with the appropriate path separator (a colon for the Macintosh, a backslash for Windows). A better approach is to avoid hard-coding the path separator character and use VBA to determine it. The following statement assigns the path separator character to a variable named `PathSep`:

```
PathSep = Application.PathSeparator
```

After this statement is executed, your code can use the `PathSep` variable in place of a hard-coded colon or backslash.

Rather than try to make a single file compatible with both platforms, most developers choose to develop on one platform (typically Excel for Windows) and then modify the application so that it works on the Mac platform. In other words, you'll probably need to maintain two separate versions of your application.

There is only one way to make sure that your application is compatible with the Macintosh version of Excel: You must test it thoroughly on a Macintosh — and be prepared to develop some workarounds for procedures that don't work correctly.

Dealing with 64-bit Excel

You can install Excel 2010 as a 32-bit application or as a 64-bit application. The latter works only if you're running a 64-bit version of Windows. The 64-bit version can handle much larger workbooks because it takes advantage of the larger address space in 64-bit Windows.

Most users don't need the 64-bit version of Excel because they don't work with massive amounts of data in a workbook. And remember, the 64-bit version offers no performance boost. Some operations may actually be slower in the 64-bit version.

In general, workbooks created using the 32-bit version will work fine in the 64-bit version. The only potential problem is if the workbook contains VBA code that uses Windows API functions. The 32-bit API function declarations won't compile in the 64-bit version.

For example, the following declaration works with 32-bit Excel versions, but causes a compile error with 64-bit Excel 2010:

```
Declare Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

The following declaration works with Excel 2010 (both 32-bit and 64-bit), but causes a compile error in previous versions of Excel:

```
Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

To use this API function in both 32-bit and 64-bit Excel, you must declare two versions of the function by using two conditional compiler directives:

- `VBA7` returns `True` if your code is using Version 7 of VBA (which is included in Office 2010).
- `Win64` returns `True` if the code is running in 64-bit Excel.



Note

Only one version of VBA can be installed on a system. So, if you have older versions of Excel installed and then install Excel 2010, the older versions will all be running VBA 7. Unfortunately, if you activate the VB Editor in one of these older versions and choose Help→About Microsoft Visual Basic, the dialog box won't report that it's running VBA 7.

Here's an example of how to use these directives to declare an API function that's compatible with 32-bit and 64-bit Excel:

```
#If VBA7 And Win64 Then  
    Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
        (ByVal lpBuffer As String, ByVal nSize As Long) As Long  
#Else
```

```
Declare Function GetWindowsDirectoryA Lib "kernel32" _
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
#End If
```

The first `Declare` statement is used when `VBA7` and `Wind64` are both `True` — which is the case only for 16-Bit Excel 2010. In all other versions, the second `Declare` statement is used.

Creating an International Application

The final compatibility concern deals with language issues and international settings. Excel is available in many different language versions. The following statement displays the country code for the version of Excel:

```
MsgBox Application.International(xlCountryCode)
```

The United States/English version of Excel has a country code of 1. Other country codes are listed in Table 26-1.

Table 26-1: Excel Country Codes

Country	Country Code
English	1
Russian	7
Greek	30
Dutch	31
French	33
Spanish	34
Hungarian	36
Italian	39
Czech	42
Danish	45
Swedish	46
Norwegian	47
Polish	48
German	49
Portuguese (Brazil)	55
Thai	66
Japanese	81

continued

Table 26-1: Excel Country Codes (*continued*)

Country	Country Code
Korean	82
Vietnamese	84
Simplified Chinese	86
Turkish	90
Indian	91
Urdu	92
Portuguese	351
Finnish	358
Traditional Chinese	886
Arabic	966
Hebrew	972
Farsi	982

Excel also supports language packs, so a single copy of Excel can actually display any number of different languages. The language comes into play in two areas: the user interface and the execution mode.

You can determine the current language used by the user interface by using a statement such as:

```
Msgbox Application.LanguageSettings.LanguageID(msoLanguageIDUI)
```

The language ID for English is 1033.

If your application will be used by those who speak another language, you need to ensure that the proper language is used in your dialog boxes. Also, you need to identify the user's decimal and thousands separator characters. In the United States, these are almost always a period and a comma, respectively. However, users in other countries might have their systems set up to use other characters. Yet another issue is date and time formatting: The United States is one of the few countries that use the (illogical) month/day/year format.

If you're developing an application that will be used only by people within your company, you probably won't need to be concerned with international compatibility. But, if your company has offices throughout the world, or if you plan to distribute your application outside your country, you need to address a number of issues to ensure that your application will work properly. I discuss these issues in the following sections.

Multilanguage applications

An obvious consideration involves the language that is used in your application. For example, if you use one or more dialog boxes, you probably want the text to appear in the language of the

user. Fortunately, changing the language isn't too difficult (assuming, of course, that you can translate your text or know someone who can).



On the CD

The companion CD-ROM contains an example that demonstrates how to allow the user to choose from three languages in a dialog box: English, Spanish, or German. The file-name is `multilingual wizard.xlsm`.

The first step of the multilingual wizard (found on the CD) contains three `OptionButtons` that enable the user to select a language. The text for the three languages is stored in a worksheet.

The `UserForm_Initialize` procedure contains code that attempts to guess the user's language by checking the `International` property:

```
Select Case Application.International(xlCountryCode)
    Case 34 'Spanish
        UserLanguage = 2
    Case 49 'German
        UserLanguage = 3
    Case Else 'default to English
        UserLanguage = 1 'default
End Select
```

Figure 26-2 shows the UserForm displaying text in all three languages.

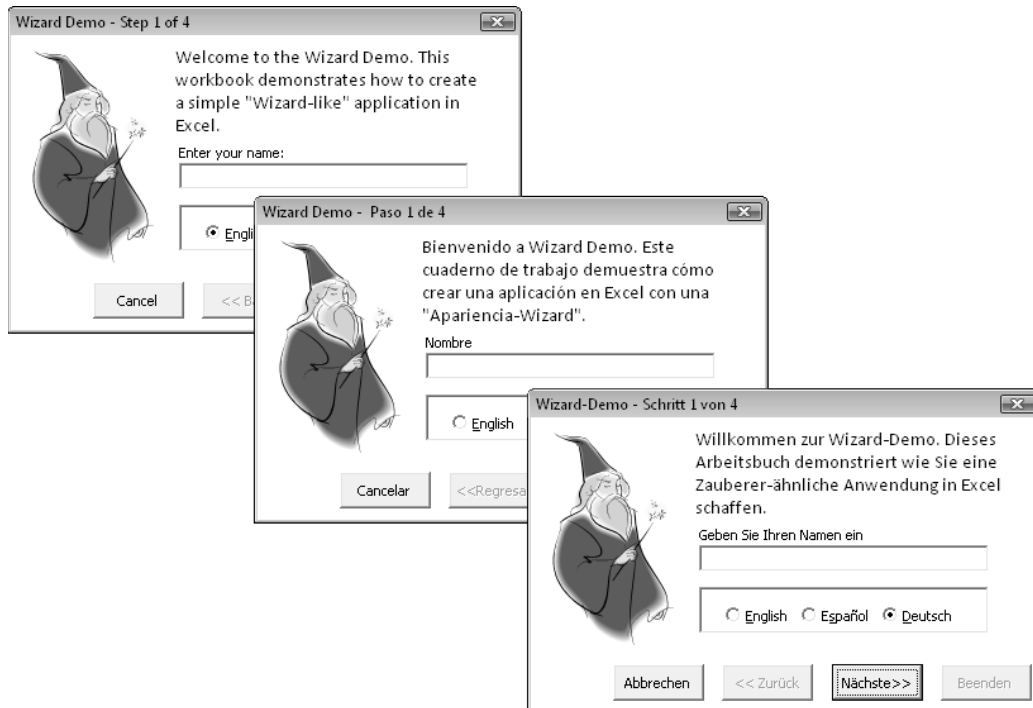


Figure 26-2: The Wizard Demo in English, Spanish, and German.

VBA language considerations

In general, you need not be concerned with the language in which you write your VBA code. Excel uses two object libraries: the Excel object library and the VBA object library. When you install Excel, it registers the English language version of these object libraries as the default libraries. (This is true regardless of the language version of Excel.)

Using local properties

If your code will display worksheet information, such as a formula or a range address, you probably want to use the local language. For example, the following statement displays the formula in cell A1:

```
MsgBox Range("A1").Formula
```

For international applications, a better approach is to use the `FormulaLocal` property rather than the `Formula` property:

```
MsgBox Range("A1").FormulaLocal
```

Several other properties also have local versions. These are shown in Table 26-2 (refer to the Help system for specific details).

Table 26-2: Properties That Have Local Versions

Property	Local Version	Return Contents
Address	AddressLocal	An address
Category	CategoryLocal	A function category (XLM macros only)
Formula	FormulaLocal	A formula
FormulaR1C1	FormulaR1C1Local	A formula, using R1C1 notation
Name	NameLocal	A name
NumberFormat	NumberFormatLocal	A number format
RefersTo	RefersToLocal	A reference
RefersToR1C1	RefersToR1C1Local	A reference, using R1C1 notation

Identifying system settings

Generally, you can't assume that the end user's system is set up like the system on which you develop your application. For international applications, you need to be aware of the following settings:

- **Decimal separator:** The character used to separate the decimal portion of a value.
- **Thousands separator:** The character used to delineate every three digits in a value.
- **List separator:** The character used to separate items in a list.

You can determine the current separator settings by accessing the `International` property of the `Application` object. For example, the following statement displays the decimal separator, which won't always be a period:

```
MsgBox Application.International(xlDecimalSeparator)
```

The 45 international settings that you can access with the `International` property are listed in Table 26-3.

Table 26-3: Constants for the `International` Property

Constant	What It Returns
<code>xlCountryCode</code>	Country version of Microsoft Excel.
<code>xlCountrySetting</code>	Current country setting in the Windows Control Panel.
<code>xlDecimalSeparator</code>	Decimal separator.
<code>xlThousandsSeparator</code>	Thousands separator.
<code>xlListSeparator</code>	List separator.
<code>xlUpperCaseRowLetter</code>	Uppercase row letter (for R1C1-style references).
<code>xlUpperCaseColumnLetter</code>	Uppercase column letter.
<code>xlLowerCaseRowLetter</code>	Lowercase row letter.
<code>xlLowerCaseColumnLetter</code>	Lowercase column letter.
<code>xlLeftBracket</code>	Character used instead of the left bracket ([) in R1C1-style relative references.
<code>xlRightBracket</code>	Character used instead of the right bracket (]) in R1C1-style references.
<code>xlLeftBrace</code>	Character used instead of the left brace ({) in array literals.
<code>xlRightBrace</code>	Character used instead of the right brace (}) in array literals.
<code>xlColumnSeparator</code>	Character used to separate columns in array literals.
<code>xlRowSeparator</code>	Character used to separate rows in array literals.
<code>xlAlternateArraySeparator</code>	Alternate array item separator to be used if the current array separator is the same as the decimal separator.
<code>xlDateSeparator</code>	Date separator (/).
<code>xlTimeSeparator</code>	Time separator (:).
<code>xlYearCode</code>	Year symbol in number formats (y).

continued

Table 26-3: Constants for the International Property (*continued*)

Constant	What It Returns
xlMonthCode	Month symbol (m).
xlDayCode	Day symbol (d).
xlHourCode	Hour symbol (h).
xlMinuteCode	Minute symbol (m).
xlSecondCode	Second symbol (s).
xlCurrencyCode	Currency symbol.
xlGeneralFormatName	Name of the General number format.
xlCurrencyDigits	Number of decimal digits to be used in currency formats.
xlCurrencyNegative	A value that represents the currency format for negative currency values.
xlNoncurrencyDigits	Number of decimal digits to be used in noncurrency formats.
xlMonthNameChars	Always returns three characters for backward-compatibility; abbreviated month names are read from Microsoft Windows and can be any length.
xlWeekdayNameChars	Always returns three characters for backward-compatibility; abbreviated weekday names are read from Microsoft Windows and can be any length.
xlDateOrder	An integer that represents the order of date elements.
xl24HourClock	True if the system is using 24-hour time; False if the system is using 12-hour time.
xlNonEnglishFunctions	True if the system isn't displaying functions in English.
xlMetric	True if the system is using the metric system; False if the system is using the English measurement system.
xlCurrencySpaceBefore	True if a space is added before the currency symbol.
xlCurrencyBefore	True if the currency symbol precedes the currency values; False if it follows them.
xlCurrencyMinusSign	True if the system is using a minus sign for negative numbers; False if the system is using parentheses.
xlCurrencyTrailingZeros	True if trailing zeros are displayed for zero currency values.
xlCurrencyLeadingZeros	True if leading zeros are displayed for zero currency values.
xlMonthLeadingZero	True if a leading zero is displayed in months (when months are displayed as numbers).
xlDayLeadingZero	True if a leading zero is displayed in days.
xl4DigitYears	True if the system is using four-digit years; False if the system is using two-digit years.
xlMDY	True if the date order is month-day-year for dates displayed in the long form; False if the date order is day/month/year.
xlTimeLeadingZero	True if a leading zero is displayed in times.

Date and time settings

If your application writes formatted dates and will be used in other countries, you might want to make sure that the date is in a format familiar to the user. The best approach is to specify a date by using VBA's `DateSerial` function and let Excel take care of the formatting details. (It will use the user's short date format.)

The following procedure uses the `DateSerial` function to assign a date to the `StartDate` variable. This date is then written to cell A1 with the local short date format.

```
Sub WriteDate()  
    Dim StartDate As Date  
    StartDate = DateSerial(2010, 4, 15)  
    Range("A1") = StartDate  
End Sub
```

If you need to do any other formatting for the date, you can write code to do so after the date has been entered into the cell. Excel provides several named date and time formats, plus quite a few named number formats. The online help describes all these formats (search for *named date/time formats* or *named numeric formats*).

Manipulating Files with VBA

In This Chapter

- Getting a basic overview of VBA text file manipulation features
- Performing common file operations
- Opening a text file
- Displaying extended file information, such as details for media files
- Reading and writing a text file with VBA
- Exporting a range to HTML and XML format
- Zipping and unzipping files
- Using ActiveX Data Objects to import data

Performing Common File Operations

Many applications that you develop for Excel require working with external files. For example, you might need to get a listing of files in a directory, delete files, rename files, and so on. Excel, of course, can import and export several types of text files. In many cases, however, Excel's built-in text file handling isn't sufficient. For example, you might want to paste a list of filenames into a range, or export a range of cells to a simple HyperText Markup Language (HTML) file.

In this chapter, I describe how to use Visual Basic for Applications (VBA) to perform common (and not so common) file operations and work directly with text files.

Excel provides two ways to perform common file operations:

- **Use traditional VBA statements and functions.** This method works for all versions of Excel.
- **Use the `FileSystemObject` object, which uses the Microsoft Scripting Library.** This method works for Excel 2000 and later.



Caution

Some earlier versions of Excel also supported the use of the `FileSearch` object. That feature was removed, beginning with Excel 2007. If you execute an old macro that uses the `FileSearch` object, the macro will fail.

In the sections that follow, I discuss these two methods and present examples.

Using VBA file-related statements

The VBA statements that you can use to work with files are summarized in Table 27-1. Most of these statements are straightforward, and all are described in the Help system.

Table 27-1: VBA File-Related Statements

Command	What It Does
<code>ChDir</code>	Changes the current directory.
<code>ChDrive</code>	Changes the current drive.
<code>Dir</code>	Returns a filename or directory that matches a specified pattern or file attribute.
<code>FileCopy</code>	Copies a file.
<code>FileDateTime</code>	Returns the date and time when a file was last modified.
<code>FileLen</code>	Returns the size of a file, in bytes.
<code>GetAttr</code>	Returns a value that represents an attribute of a file.
<code>Kill</code>	Deletes a file.
<code>MkDir</code>	Creates a new directory.
<code>Name</code>	Renames a file or directory.
<code>RmDir</code>	Removes an empty directory.
<code>SetAttr</code>	Changes an attribute for a file.

The remainder of this section consists of examples that demonstrate some of the file manipulation commands.

A VBA function to determine whether a file exists

The following function returns `True` if a particular file exists and `False` if it doesn't exist. If the `Dir` function returns an empty string, the file couldn't be found, so the function returns `False`.

```
Function FileExists(fname) As Boolean
    FileExists = Dir(fname) <> ""
End Function
```

The argument for the `FileExists` function consists of a full path and filename. The function can be either used in a worksheet or called from a VBA procedure. Here's an example:

```
MyFile = "c:\budgeting\2011 budget notes.docx"
Msgbox FileExists(MyFile)
```

A VBA function to determine whether a path exists

The following function returns `True` if a specified path exists and `False` otherwise:

```
Function PathExists(pname) As Boolean
'   Returns TRUE if the path exists
'   On Error Resume Next
    PathExists = (GetAttr(pname) And vbDirectory) = vbDirectory
End Function
```

The `pname` argument is a string that contains a directory (without a filename). The trailing backslash in the pathname is optional. Here's an example of calling the function:

```
MyFolder = "c:\users\john\desktop\downloads\"
MsgBox PathExists(MyFolder)
```



On the CD

The `FileExists` and `PathExists` functions are available on the CD-ROM. The filename is `file functions.xlsm`.

A VBA procedure to display a list of files in a directory

The following procedure displays (in the active worksheet) a list of files contained in a particular directory, along with the file size and date:

```
Sub ListFiles()
    Dim Directory As String
    Dim r As Long
    Dim f As String
    Dim FileSize As Double
    Directory = "f:\excelfiles\budgeting\"
    r = 1
'   Insert headers
    Cells(r, 1) = "FileName"
    Cells(r, 2) = "Size"
    Cells(r, 3) = "Date/Time"
    Range("A1:C1").Font.Bold = True
'   Get first file
```

```

f = Dir(Directory, vbReadOnly + vbHidden + vbSystem)
Do While f <> ""
    r = r + 1
    Cells(r, 1) = f
    'Adjust for filesize > 2 gigabytes
    FileSize = FileLen(Directory & f)
    If FileSize < 0 Then FileSize = FileSize + 4294967296#
    Cells(r, 2) = FileSize
    Cells(r, 3) = FileDateTime(Directory & f)
    ' Get next file
    f = Dir()
Loop
End Sub

```

Figure 27-1 shows an example of the output of the `ListFiles` subroutine.



Note

VBA's `FileLen` function uses the `Long` data type. Consequently, it will return an incorrect size (a negative number) for files larger than about 2 gigabytes. The code checks for a negative value from the `FileLen` function, and makes an adjustment if necessary.

	A	B	C	D
1	Files in C:\Program Files\Mozilla Firefox\	Size	Date/Time	
2	.autoreg	0	10/5/2008 9:42	
3	AccessibleMarshal.dll	17912	10/29/2009 10:11	
4	application.ini	2126	10/29/2009 10:11	
5	blocklist.xml	2067	7/15/2009 11:09	
6	browserconfig.properties	232	7/15/2009 11:10	
7	crashreporter-override.ini	583	7/15/2009 11:10	
8	crashreporter.exe	120312	10/29/2009 10:11	
9	crashreporter.ini	3801	7/15/2009 11:10	
10	firefox.exe	908280	10/29/2009 10:11	
11	freebl3.chk	478	10/29/2009 10:11	
12	freebl3.dll	249856	10/29/2009 10:11	
13	install.log	44726	7/17/2009 10:16	
14	js3250.dll	919544	10/29/2009 10:11	
15	LICENSE	31393	7/15/2009 11:09	
16	mozcert19.dll	722424	10/29/2009 10:11	
17	nspr4.dll	169464	10/29/2009 10:11	
18	nss3.dll	636408	10/29/2009 10:11	
19	nssckbi.dll	316920	10/29/2009 10:11	
20	nssdbm3.chk	478	10/29/2009 10:11	
21	nssdbm3.dll	98304	10/29/2009 10:11	

Figure 27-1: Output from the `ListFiles` procedure.

Notice that the procedure uses the `Dir` function twice. The first time (used with an argument), it retrieves the first filename found. Subsequent calls (without an argument) retrieve additional filenames. When no more files are found, the `Dir` function returns an empty string.



On the CD

The companion CD-ROM contains a version of this procedure which allows you to select a directory from a dialog box. The filename is `create file list.xlsm`.

The `Dir` function also accepts wildcard file specifications in its first argument. To get a list of Excel files, for example, you could use a statement such as this:

```
f = Dir(Directory & "*.xl??", vbReadOnly + vbHidden + vbSystem)
```

This statement retrieves the name of the first `*.xl??` file in the specified directory. The wildcard specification returns a four-character extension that begins with `XL`. For example, the extension could be `.xlsx`, `.xltx`, or `.xlsm`. The second argument for the `Dir` function lets you specify the attributes of the files (in terms of built-in constants). In this example, the `Dir` function retrieves filenames that have no attributes, read-only files, hidden files, and system files.

Table 27-2 lists the built-in constants for the `Dir` function.

Table 27-2: File Attribute Constants for the `Dir` Function

Constant	Value	Description
<code>vbNormal</code>	0	Files with no attributes. This is the default setting and is always in effect.
<code>vbReadOnly</code>	1	Read-only files.
<code>vbHidden</code>	2	Hidden files.
<code>vbSystem</code>	4	System files.
<code>vbVolume</code>	8	Volume label. If any other attribute is specified, this attribute is ignored.
<code>vbDirectory</code>	16	Directories. This attribute doesn't work. Calling the <code>Dir</code> function with the <code>vbDirectory</code> attribute doesn't continually return subdirectories.



Caution

If you use the `Dir` function to loop through files and call another procedure to process the files, make sure that the other procedure doesn't use the `Dir` function. Only one "set" of `Dir` calls can be active at any time.

A recursive VBA procedure to display a list of files in nested directories

The example in this section creates a list of files in a specified directory, including all of its subdirectories. This procedure is unusual because it calls itself — a concept known as *recursion*.

```
Public Sub RecursiveDir(ByVal CurrDir As String, Optional ByVal Level As Long)
    Dim Dirs() As String
    Dim NumDirs As Long
    Dim FileName As String
    Dim PathAndName As String
```

```

Dim i As Long
Dim Filesize As Double
' Make sure path ends in backslash
If Right(CurrDir, 1) <> "\" Then CurrDir = CurrDir & "\"
' Put column headings on active sheet
Cells(1, 1) = "Path"
Cells(1, 2) = "Filename"
Cells(1, 3) = "Size"
Cells(1, 4) = "Date/Time"
Range("A1:D1").Font.Bold = True

' Get files
FileName = Dir(CurrDir & ".*", vbDirectory)
Do While Len(FileName) <> 0
    If Left(FileName, 1) <> "." Then 'Current dir
        PathAndName = CurrDir & FileName
        If (GetAttr(PathAndName) And vbDirectory) = vbDirectory Then
            'store found directories
            ReDim Preserve Dirs(0 To NumDirs) As String
            Dirs(NumDirs) = PathAndName
            NumDirs = NumDirs + 1
        Else
            'Write the path and file to the sheet
            Cells(WorksheetFunction.CountA(Range("A:A")) + 1, 1) = _
                CurrDir
            Cells(WorksheetFunction.CountA(Range("B:B")) + 1, 2) = _
                FileName
            'adjust for filesize > 2 gigabytes
            Filesize = FileLen(PathAndName)
            If Filesize < 0 Then Filesize = Filesize + 4294967296#
            Cells(WorksheetFunction.CountA(Range("C:C")) + 1, 3) = Filesize
            Cells(WorksheetFunction.CountA(Range("D:D")) + 1, 4) = _
                FileDateTime(PathAndName)
        End If
    End If
    FileName = Dir()
Loop
' Process the found directories, recursively
For i = 0 To NumDirs - 1
    RecursiveDir Dirs(i), Level + 2
Next i
End Sub

```

The procedure takes one argument, `CurrDir`, which is the directory being examined. Information for each file is displayed in the active worksheet. As the procedure loops through the files, it stores the subdirectory names in an array named `Dirs`. When no more files are found, the procedure calls itself using an entry in the `Dirs` array for its argument. When all of the directories in the `Dirs` array have been processed, the procedure ends.

Because the `RecursiveDir` procedure uses an argument, it must be executed from another procedure by using a statement like this:

```
Call RecursiveDir("c:\directory\")
```



On the CD

The companion CD-ROM contains a version of this procedure that allows you to select a directory from a dialog box. The filename is `recursive file list.xlsm`.

Using the `FileSystemObject` object

The `FileSystemObject` object is a member of the Windows Scripting Host and provides access to a computer's file system. This object is often used in script-oriented Web pages (for example, VBScript and JavaScript) and can be used with Excel 2000 and later versions.



Caution

The Windows Scripting Host is sometimes used as a way to spread computer viruses and other malware. Consequently, the Windows Scripting Host may be disabled on some systems. Therefore, use caution if you're designing an application that will be used on many different systems.

The name `FileSystemObject` is a bit misleading because it actually includes a number of objects, each designed for a specific purpose:

- **Drive:** Represents a drive or a collection of drives.
- **File:** Represents a file or a collection of files.
- **Folder:** Represents a folder or a collection of folders.
- **TextStream:** Represents a stream of text that is read from, written to, or appended to a text file.

The first step in using the `FileSystemObject` object is to create an instance of the object. You can do this task in two ways: early binding and late binding.

The late binding method uses two statements, like this:

```
Dim FileSys As Object  
Set FileSys = CreateObject("Scripting.FileSystemObject")
```

Note that the `FileSys` object variable is declared as a generic `Object` rather than as an actual object type. The object type is resolved at runtime.

The early binding method of creating the object requires that you set up a reference to the Windows Scripting Host Object Model. You do this by using **Tools**→**References** in the VBE (see

Figure 27-2). After you've established the reference, create the object by using statements like these:

```
Dim FileSys As FileSystemObject
Set FileSys = CreateObject("Scripting.FileSystemObject")
```

Using the early binding method enables you to take advantage of the VBE's Auto List Members feature to help you identify properties and methods as you type. In addition, you can use the Object Browser (by pressing F2) to learn more about the object model.

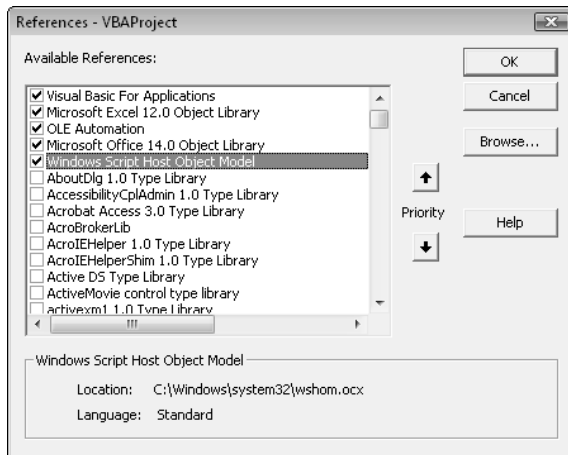


Figure 27-2: Creating a reference to the Windows Script Host Object Model.

The examples that follow demonstrate various tasks using the `FileSystemObject` object.

Using `FileSystemObject` to determine whether a file exists

The `Function` procedure that follows accepts one argument (the path and filename) and returns `True` if the file exists:

```
Function FileExists3(fname) As Boolean
    Dim FileSys As Object 'FileSystemObject
    Set FileSys = CreateObject("Scripting.FileSystemObject")
    FileExists3 = FileSys.FileExists(fname)
End Function
```

The function creates a new `FileSystemObject` object named `FileSys` and then accesses the `FileExists` property for that object.

Using FileSystemObject to determine whether a path exists

The Function procedure that follows accepts one argument (the path) and returns `True` if the path exists:

```
Function PathExists2(path) As Boolean
    Dim FileSys As Object 'FileSystemObject
    Set FileSys = CreateObject("Scripting.FileSystemObject")
    PathExists2 = FileSys.FolderExists(path)
End Function
```

Using FileSystemObject to list information about all available disk drives

The example in this section uses `FileSystemObject` to retrieve and display information about all disk drives. The procedure loops through the `Drives` collection and writes various property values to a worksheet.

Figure 27-3 shows the results when the procedure is executed on a system with 12 drives. The data shown is the drive letter, whether the drive is “ready,” the drive type, the volume name, the total size, and the available space.

	A	B	C	D	E	F	G
	Drive	Ready	Type	Vol. Name	Size	Available	
1	C	TRUE	Fixed	OS	2.39211E+11	89392947200	
2	D	TRUE	Fixed	RECOVERY	10737414144	6999592960	
3	E	FALSE	CD-ROM				
4	F	FALSE	CD-ROM				
5	G	TRUE	Fixed	MUSIC DRIVE	3.0001E+11	27079540736	
6	H	TRUE	Fixed	MUSICBACKUP	3.0001E+11	9165373440	
7	I	TRUE	Removable	NIKON DSLR	2062516224	2045313024	
8	J	FALSE	Removable				
9	K	FALSE	Removable				
10	L	FALSE	Removable				
11	M	TRUE	Removable	Kindle	1594953728	1449467904	
12	Z	TRUE	Network		2.39211E+11	89392947200	
13							
14							
15							

Figure 27-3: Output from the `ShowDriveInfo` procedure.



This workbook, named `show drive info.xlsm`, is available on the companion CD-ROM.

```
Sub ShowDriveInfo()
    Dim FileSys As FileSystemObject
    Dim Drv As Drive
    Dim Row As Long
    Set FileSys = CreateObject("Scripting.FileSystemObject")
```

```

Cells.ClearContents
Row = 1
' Column headers
Range("A1:F1") = Array("Drive", "Ready", "Type", "Vol. Name", _
    "Size", "Available")
On Error Resume Next
' Loop through the drives
For Each Drv In FileSystem.Drives
    Row = Row + 1
    Cells(Row, 1) = Drv.DriveLetter
    Cells(Row, 2) = Drv.IsReady
    Select Case Drv.DriveType
        Case 0: Cells(Row, 3) = "Unknown"
        Case 1: Cells(Row, 3) = "Removable"
        Case 2: Cells(Row, 3) = "Fixed"
        Case 3: Cells(Row, 3) = "Network"
        Case 4: Cells(Row, 3) = "CD-ROM"
        Case 5: Cells(Row, 3) = "RAM Disk"
    End Select
    Cells(Row, 4) = Drv.VolumeName
    Cells(Row, 5) = Drv.TotalSize
    Cells(Row, 6) = Drv.AvailableSpace
Next Drv
' Make a table
ActiveSheet.ListObjects.Add xlSrcRange, _
    Range("A1").CurrentRegion, , xlYes
End Sub

```



Cross-Ref

Chapter 11 describes another method of getting drive information by using Windows API functions.

Displaying Extended File Information

The example in this section displays extended file properties for all files in a specified directory. The information that's available depends on the file type. For example, image files have properties such as Camera Model and Dimensions; audio files have properties such as Artist, Title, Duration, and so on.

The actual properties available depends on the version of Windows. Windows Vista supports 267 properties and Windows 7 supports even more. Here's a procedure that creates a list of file properties in the active worksheet:

```

Sub ListFileProperties()
    Dim i As Long
    Dim objShell As Object 'IShellDispatch4
    Dim objFolder As Object 'Folder3

```

```

' Create the object
Set objShell = CreateObject("Shell.Application")
' Specify any folder
Set objFolder = objShell.Namespace("C:\")
' List the properties
For i = 0 To 500
    Cells(i + 1, 1) = _
        objFolder.GetDetailsOf(objFolder.Items, i)
Next i
End Sub

```

**Caution**

Unfortunately, the property values aren't consistent across Windows versions. For example, in Windows 2000, the Title property is stored as number 11. In Windows XP, the Title property is stored as number 10. In Windows Vista, the Title property is number 21.

The FileInfo procedure, which uses the Windows Shell.Application object, follows. This procedure prompts for a directory using the GetDirectory function (not shown here) and then lists the first 41 properties of each file in the directory.

```

Sub FileInfo()
    Dim c As Long, r As Long, i As Long
    Dim FileName As Object 'FolderItem2
    Dim objShell As Object 'IShellDispatch4
    Dim objFolder As Object 'Folder3

    ' Create the object
    Set objShell = CreateObject("Shell.Application")

    ' Prompt for the folder
    Set objFolder = objShell.Namespace(GetDirectory)
    ' Insert headers on active sheet
    Worksheets.Add
    c = 0
    For i = 0 To 40
        c = c + 1
        Cells(1, c) = objFolder.GetDetailsOf(objFolder.Items, i)
    Next i
    ' Loop through the files
    r = 1
    For Each FileName In objFolder.Items
        c = 0
        r = r + 1
        For i = 0 To 40
            c = c + 1
            Cells(r, c) = objFolder.GetDetailsOf(FileName, i)
        Next i
    Next FileName
    ' Make it a table

```

```
ActiveSheet.ListObjects.Add xlSrcRange, _
    Range("A1").CurrentRegion
End Sub
```

Figure 27-4 shows part of the output of this procedure, for a directory that contains MP3 audio files.

	A	B	C	D	E	F	L	N	O	P
1	Name	Size	Type	Date modified	Date create	Date accesse	Kinds	Artists	Album	Year
2	01 - Amish Town.mp3	3.27 MB	Winamp media	9/26/2009 8:37	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
3	02 - Old Missouri.mp3	5.32 MB	Winamp media	9/26/2009 8:37	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
4	03 - Ten Cents.mp3	4.48 MB	Winamp media	9/26/2009 8:37	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
5	04 - Charlie Wyler's Tune.mp3	4.46 MB	Winamp media	9/26/2009 8:38	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
6	05 - D & G Polka.mp3	5.96 MB	Winamp media	9/26/2009 8:38	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
7	06 - Chase the Banshee.mp3	4.91 MB	Winamp media	9/26/2009 8:39	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
8	07 - Lost Indian.mp3	2.96 MB	Winamp media	9/27/2009 10:54	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
9	08 - Old Red.mp3	2.82 MB	Winamp media	9/26/2009 8:40	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
10	09 - Fishin' Limber.mp3	5.46 MB	Winamp media	9/26/2009 8:40	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
11	10 - Grotts.mp3	6.19 MB	Winamp media	9/26/2009 8:40	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
12	11 - Elie's Waltz.mp3	5.60 MB	Winamp media	9/26/2009 8:41	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
13	12 - Down in Little Egypt.mp3	4.33 MB	Winamp media	9/26/2009 8:41	9/26/2009 8:23	11/4/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
14	13 - Joke On the Puppy.mp3	4.75 MB	Winamp media	9/26/2009 8:42	9/26/2009 8:23	11/3/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
15	14 - Rolling the Logs.mp3	4.40 MB	Winamp media	9/26/2009 8:42	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
16	15 - Bowling Green.mp3	4.73 MB	Winamp media	9/26/2009 8:43	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
17	16 - White's Polka.mp3	4.21 MB	Winamp media	9/26/2009 8:43	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
18	17 - Polish Tune (Kujawiak).mp3	5.20 MB	Winamp media	9/26/2009 8:43	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
19	18 - Hop-Scotch Polka.mp3	4.10 MB	Winamp media	9/26/2009 8:43	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
20	19 - Tippin' Back the Corn.mp3	5.63 MB	Winamp media	9/26/2009 8:44	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
21	20 - Mr. Fisher's Old German Waltz	5.39 MB	Winamp media	9/26/2009 8:44	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003
22	21 - Illinois Cotillion.mp3	5.77 MB	Winamp media	9/26/2009 8:44	9/26/2009 8:23	11/1/2009 0:00	Music	Lynn 'chirps' Smith	Down in Little Egypt	2003

Figure 27-4: A table of information about the files in a directory.

This example uses late binding to create a `Shell.Application` object, so the objects are declared generically. To use early binding, use the VBE Tools→References command and create a reference to Microsoft Shell Controls and Automation.



On the CD

This example, named `file information.xlsm`, is available on the companion CD-ROM.

Working with Text Files

VBA contains a number of statements that allow low-level manipulation of files. These Input/Output (I/O) statements give you much more control over files than Excel's normal text file import and export options.

You can access a file in any of three ways:

- **Sequential access:** By far the most common method. This type allows reading and writing individual characters or entire lines of data.
- **Random access:** Used only if you're programming a database application — something that's not really appropriate for VBA.
- **Binary access:** Used to read or write to any byte position in a file, such as storing or displaying a bitmap image. This access method is rarely used in VBA.

Because random and binary access files are rarely used with VBA, this chapter focuses on sequential access files, which are accessed sequentially. In other words, your code starts reading from the beginning of the file and reads each line sequentially. For output, your code writes data to the end of the file.



Note

The method of reading and writing text files discussed in this book is the traditional data-channel approach. Another option is to use the object approach. The `FileSystemObject` object contains a `TextStream` object that can be used to read and write text files. The `FileSystemObject` object is part of the Windows Scripting Host. This scripting service is disabled on some systems because of the malware potential.

Opening a text file

VBA's `Open` statement (not to be confused with the `Open` method of the `Workbooks` object) opens a file for reading or writing. Before you can read from or write to a file, you must open it.

The `Open` statement is quite versatile and has a rather complex syntax:

```
Open pathname For mode [Access access] [lock] _  
As [#]filenumber [Len=reclength]
```

- **pathname:** (Required) The `pathname` part of the `Open` statement is quite straightforward. It simply contains the name and path (optional) of the file to be opened.
- **mode:** (Required) The file mode must be one of the following:
 - **Append:** A sequential access mode that either allows the file to be read or allows data to be appended to the end of the file.
 - **Input:** A sequential access mode that allows the file to be read but not written to.
 - **Output:** A sequential access mode that allows the file to be read or written to. In this mode, a new file is always created. (An existing file with the same name is deleted.)
 - **Binary:** A random access mode that allows data to be read or written to on a byte-by-byte basis.
 - **Random:** A random access mode that allows data to be read or written in units determined by the `reclength` argument of the `Open` statement.
- **access:** (Optional) The `access` argument determines what can be done with the file. It can be `Read`, `Write`, or `Read Write`.
- **lock:** (Optional) The `lock` argument is useful for multiuser situations. The options are `Shared`, `Lock Read`, `Lock Write`, and `Lock Read Write`.

- **filenumber:** (Required) A file number ranging from 1 to 511. You can use the `FreeFile` function to get the next available file number. (Read about `FreeFile` in the upcoming section, “Getting a file number.”)
- **reclength:** (Optional) The record length (for random access files) or the buffer size (for sequential access files).

Reading a text file

The basic procedure for reading a text file with VBA consists of the following steps:

1. Open the file by using the `Open` statement.
2. Specify the position in the file by using the `Seek` function (optional).
3. Read data from the file (by using the `Input`, `Input #`, or `Line Input #` statements).
4. Close the file by using the `Close` statement.

Writing a text file

The basic procedure for writing a text file is as follows:

1. Open or create the file by using the `Open` statement.
2. Specify the position in the file by using the `Seek` function (optional).
3. Write data to the file by using the `Write #` or `Print #` statement.
4. Close the file by using the `Close` statement.

Getting a file number

Most VBA programmers simply designate a file number in their `Open` statement. For example:

```
Open "myfile.txt" For Input As #1
```

Then you can refer to the file in subsequent statements as `#1`.

If a second file is opened while the first is still open, you'd designate the second file as `#2`:

```
Open "another.txt" For Input As #2
```



Excel's text file import and export features

Excel supports three types of text files:

- **CSV (Comma-Separated Value) files:** Columns of data are separated by a comma, and each row of data ends in a carriage return. For some non-English versions of Excel, a semi-colon rather than a comma is used.
- **PRN:** Columns of data are aligned by character position, and each row of data ends in a carriage return. These files are also known as *fixed width files*.
- **TXT (Tab-delimited) files:** Columns of data are separated by Tab characters, and each row of data ends in a carriage return.

When you attempt to open a text file with the File→Open command, the Text Import Wizard might appear in order to help you delineate the columns. If the text file is tab-delimited or comma-delimited, Excel usually opens the file without displaying the Text Import Wizard. If the data isn't interpreted correctly, close the file and try renaming it to use a .txt extension.

The Text to Columns Wizard (accessed by choosing Data→Data Tools→Text to Columns) is identical to the Text Import Wizard but works with data stored in a single worksheet column.

Another approach is to use VBA's `FreeFile` function to get a file handle. Then you can refer to the file by using a variable. Here's an example:

```
FileHandle = FreeFile
Open "myfile.txt" For Input As FileHandle
```

Determining or setting the file position

For sequential file access, you rarely need to know the current location in the file. If for some reason you need to know this information, you can use the `Seek` function.

Statements for reading and writing

VBA provides several statements to read and write data to a file.

Three statements are used for reading data from a sequential access file:

- `Input`: Reads a specified number of characters from a file.
- `Input #`: Reads data as a series of variables, with variables separated by a comma.
- `Line Input #`: Reads a complete line of data (delineated by a carriage return and/or linefeed character).

Two statements are used for writing data to a sequential access file:

- **Write #:** Writes a series of values, with each value separated by a comma and enclosed in quotes. If you end the statement with a semicolon, a carriage return/linefeed sequence is not inserted after each value. Data written with `Write #` is usually read from a file with an `Input #` statement.
- **Print #:** Writes a series of values, with each value separated by a Tab character. If you end the statement with a semicolon, a carriage return/linefeed sequence isn't inserted after each value. Data written with `Print #` is usually read from a file with a `Line Input #` or an `Input` statement.

Text File Manipulation Examples

This section contains a number of examples that demonstrate various techniques that manipulate text files.

Importing data in a text file

The code in the following example reads a text file and then places each line of data in a single cell (beginning with the active cell):

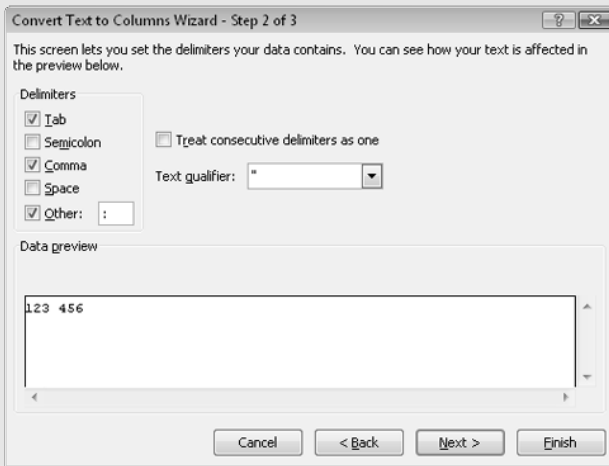
```
Sub ImportData()  
    Open "c:\data\textfile.txt" For Input As #1  
    r = 0  
    Do Until EOF(1)  
        Line Input #1, data  
        ActiveCell.Offset(r, 0) = data  
        r = r + 1  
    Loop  
    Close #1  
End Sub
```

In most cases, this procedure won't be very useful because each line of data is simply dumped into a single cell. It would be easier to just open the text file directly by using **File→Open**.



When Excel parses your data incorrectly

Have you ever imported a CSV file, or pasted data into a worksheet, only to find that Excel split up your data incorrectly? If so, the culprit is probably the Text To Columns feature. Here's Step 2 of the wizard that's used to split a single column of delimited data into multiple columns.



In this case, three delimiters are specified: tab, comma, and colon.

Splitting text into separate columns is a very useful feature. The problem is, Excel tries to be helpful by remembering these settings for subsequent CSV imports and paste operations. Sometimes remembering these settings really is helpful, but often, it's not. To clear these delimiters, you must display this dialog box, clear the settings, and click Cancel.

If you're importing or pasting via a macro, there's no direct way for your macro to check these settings or reset them. The solution is to "fake" a text-to-columns operation. The following procedure does that, with the effect of clearing all the settings from the Text To Columns dialog box (and making no changes to your workbook).

```
Sub ClearTextToColumns()
    On Error Resume Next
    If IsEmpty(Range("A1")) Then Range("A1") = "XYZZY"
    Range("A1").TextToColumns Destination:=Range("A1"), _
        DataType:=xlDelimited, _
        TextQualifier:=xlDoubleQuote, _
        ConsecutiveDelimiter:=False, _
        Tab:=False, _
        Semicolon:=False, _
        Comma:=False, _
        Space:=False, _
        Other:=False, _
        OtherChar:=""
    If Range("A1") = "XYZZY" Then Range("A1") = ""
    If Err.Number <> 0 Then MsgBox Err.Description
End Sub
```

This macro assumes that a worksheet is active, and it's not protected. Note that the contents of cell A1 won't be modified because no operations are specified for the `TextToColumns` method. If cell A1 is empty, the code inserts a temporary string (because the `TextToColumns` method will fail if the cell is empty). Before ending, the procedure deletes the temporary string.

Exporting a range to a text file

The example in this section writes the data in a selected worksheet range to a CSV text file. Excel, of course, can export data to a CSV file, but it exports the entire worksheet. This macro works with a specified range of cells.

```
Sub ExportRange()
    Dim Filename As String
    Dim NumRows As Long, NumCols As Integer
    Dim r As Long, c As Integer
    Dim Data
    Dim ExpRng As Range
    Set ExpRng = Selection
    NumCols = ExpRng.Columns.Count
    NumRows = ExpRng.Rows.Count
    Filename = Application.DefaultFilePath & "\textfile.csv"
    Open Filename For Output As #1
    For r = 1 To NumRows
        For c = 1 To NumCols
            Data = ExpRng.Cells(r, c).Value
            If IsNumeric(Data) Then Data = Val(Data)
            If IsEmpty(ExpRng.Cells(r, c)) Then Data = ""
            If c <> NumCols Then
                Write #1, Data;
            Else
                Write #1, Data
            End If
        Next c
    Next r
    Close #1
End Sub
```

Notice that the procedure uses two `Write #` statements. The first statement ends with a semicolon, so a carriage return/linefeed sequence isn't written. For the last cell in a row, however, the second `Write #` statement doesn't use a semicolon, which causes the next output to appear on a new line.

I use a variable named `Data` to store the contents of each cell. If the cell is numeric, the variable is converted to a value. This step ensures that numeric data won't be stored with quotation marks. If a cell is empty, its `Value` property returns 0. Therefore, the code also checks for a blank cell (by using the `IsEmpty` function) and substitutes an empty string instead of a zero.

Figure 27-5 shows the contents of the resulting file, viewed in Windows Notepad.



On the CD

This example and the example in the next section are available on the companion CD-ROM. The filename is `export and import csv.xlsm`.

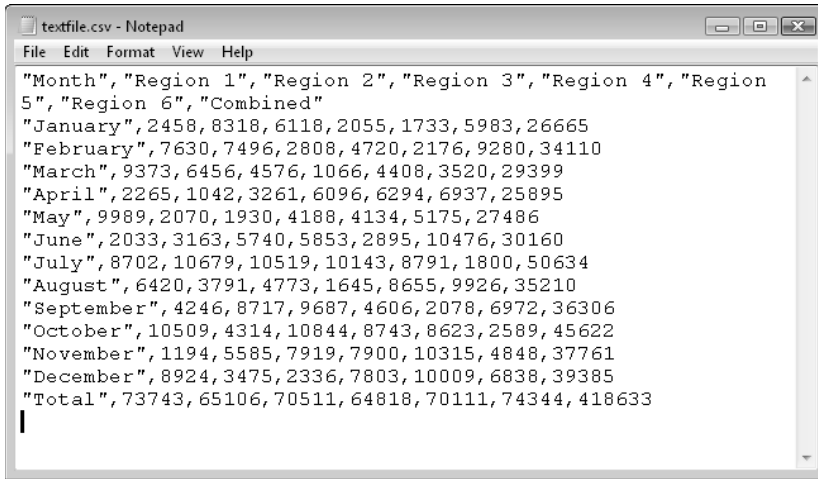


Figure 27-5: This text file was generated by VBA.

Importing a text file to a range

The example in this section reads the CSV file created in the previous example and then stores the values beginning at the active cell in the active worksheet. The code reads each character and essentially parses the line of data, ignoring quote characters and looking for commas to delineate the columns.

```
Sub ImportRange()
    Dim ImpRng As Range
    Dim Filename As String
    Dim r As Long, c As Integer
    Dim txt As String, Char As String * 1
    Dim Data
    Dim i As Integer

    Set ImpRng = ActiveCell
    On Error Resume Next
    Filename = Application.DefaultFilePath & "\textfile.csv"
    Open Filename For Input As #1
    If Err <> 0 Then
        MsgBox "Not found: " & Filename, vbCritical, "ERROR"
        Exit Sub
    End If
    r = 0
    c = 0
    txt = ""
    Application.ScreenUpdating = False
    Do Until EOF(1)
        Line Input #1, Data
        For i = 1 To Len(Data)
            Char = Mid(Data, i, 1)
            If Char = "," Then 'comma
```

```

        ActiveCell.Offset(r, c) = txt
        c = c + 1
        txt = ""
    ElseIf i = Len(Data) Then 'end of line
        If Char <> Chr(34) Then txt = txt & Char
        ActiveCell.Offset(r, c) = txt
        txt = ""
    ElseIf Char <> Chr(34) Then
        txt = txt & Char
    End If
Next i
c = 0
r = r + 1
Loop
Close #1
Application.ScreenUpdating = True
End Sub

```

**Note**

The preceding procedure works with most data, but it has a flaw: It doesn't handle data that contains a comma or a quote character. But commas resulting from formatting are handled correctly. (They're ignored.) In addition, an imported date will be surrounded by number signs: for example, #2007-05-12#.

Logging Excel usage

The example in this section writes data to a text file every time Excel is opened and closed. In order for this example to work reliably, the procedure must be located in a workbook that's opened every time you start Excel. Storing the macro in your Personal Macro Workbook is an excellent choice.

The following procedure, stored in the code module for the `ThisWorkbook` object, is executed when the file is opened:

```

Private Sub Workbook_Open()
    Open Application.DefaultFilePath & "\excelusage.txt" For Append As #1
    Print #1, "Started " & Now
    Close #1
End Sub

```

The procedure appends a new line to a file named `excelusage.txt`. The new line contains the current date and time and might look something like this:

```
Started 11/16/2010 9:27:43 PM
```


The following procedure is executed before the workbook is closed. It appends a new line that contains the word *Stopped* along with the current date and time.

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Open Application.DefaultFilePath & "\excelusage.txt" _
        For Append As #1
    Print #1, "Stopped " & Now
    Close #1
End Sub
```



On the CD

A workbook that contains these procedures is on the companion CD-ROM. The file is named `excel usage log.xlsm`.



Cross-Ref

Refer to Chapter 19 for more information about event-handler procedures such as `Workbook_Open` and `Workbook_BeforeClose`.

Filtering a text file

The example in this section demonstrates how to work with two text files at once. The `FilterFile` procedure that follows reads a text file (`infile.txt`) and copies only the rows that contain a specific text string ("January") to a second text file (`output.txt`).

```
Sub FilterFile()
    Open ThisWorkbook.Path & "\infile.txt" For Input As #1
    Open Application.DefaultFilePath & "\output.txt" For Output As #2
    TextToFind = "January"
    Do Until EOF(1)
        Line Input #1, data
        If InStr(1, data, TextToFind) Then
            Print #2, data
        End If
    Loop
    Close 'Close all files
End Sub
```



On the CD

This example, named `filter text file.xlsm`, is available on the companion CD-ROM.

Exporting a range to HTML format

The example in this section demonstrates how to export a range of cells to an HTML file. An *HTML file*, as you might know, is simply a text file that contains special formatting tags that describe how the information will be presented in a Web browser.

Why not use Excel's File→Save As command and choose the Web Page file type? The procedure listed here has a distinct advantage: It doesn't produce bloated HTML code. For example, I used the `ExportToHTML` procedure to export a range of 70 cells. The file size was 2.6KB. Then I used Excel's File→Save as Web Page command to export the sheet. The result was 15.8KB — more than six times larger.

But, on the other hand, the `ExportToHTML` procedure doesn't maintain all the cell formatting. In fact, the only formatting information that it produces is bold, italic, and horizontal alignment. However, the procedure is good enough for many situations, and it serves as the basis for additional enhancements.

```
Sub ExportToHTML()
    Dim Filename As Variant
    Dim TDOpenTag As String, TDCloseTag As String
    Dim CellContents As String
    Dim Rng As Range
    Dim r As Long, c As Integer

    ' Use the selected range of cells
    Set Rng = Application.Intersect(ActiveSheet.UsedRange, Selection)
    If Rng Is Nothing Then
        MsgBox "Nothing to export.", vbCritical
        Exit Sub
    End If

    ' Get a file name
    Filename = Application.GetSaveAsFilename( _
        InitialFileName:="myrange.htm", _
        fileFilter:="HTML Files (*.htm), *.htm")
    If Filename = False Then Exit Sub

    ' Open the text file
    Open Filename For Output As #1

    ' Write the tags
    Print #1, "<HTML>"
    Print #1, "<TABLE BORDER=0 CELLPADDING=3>"

    ' Loop through the cells
    For r = 1 To Rng.Rows.Count
        Print #1, "<TR>"
        For c = 1 To Rng.Columns.Count
            Select Case Rng.Cells(r, c).HorizontalAlignment
                Case xlHAlignLeft
                    TDOpenTag = "<TD ALIGN=LEFT>"
                Case xlHAlignCenter
                    TDOpenTag = "<TD ALIGN=CENTER>"
                Case xlHAlignGeneral
                    If IsNumeric(Rng.Cells(r, c)) Then
                        TDOpenTag = "<TD ALIGN=RIGHT>"
                    Else
                        TDOpenTag = "<TD ALIGN=LEFT>"
                    End If
                End Select
            CellContents = Rng.Cells(r, c).Text
            Print #1, TDOpenTag & CellContents & "<TD>"
        Next c
    Next r
    Print #1, "</TABLE>"
    Close #1
End Sub
```

```

        End If
        Case xlHAlignRight
            TDOpenTag = "<TD ALIGN=RIGHT>"
        End Select

        TDCloseTag = "</TD>"
        If Rng.Cells(r, c).Font.Bold Then
            TDOpenTag = TDOpenTag & "<B>"
            TDCloseTag = "</B>" & TDCloseTag
        End If
        If Rng.Cells(r, c).Font.Italic Then
            TDOpenTag = TDOpenTag & "<I>"
            TDCloseTag = "</I>" & TDCloseTag
        End If
        CellContents = Rng.Cells(r, c).Text
        Print #1, TDOpenTag & CellContents & TDCloseTag
    Next c
    Print #1, "</TR>"
Next r
' Close the table
Print #1, "</TABLE>"
Print #1, "</HTML>"
' Close the file
Close #1

' Tell the user
MsgBox Rng.Count & " cells were exported to " & Filename
End Sub

```

The procedure starts by determining the range to export. This is based on the intersection of the selected range and the used area of the worksheet. This ensures that entire rows or columns aren't processed. Next, the user is prompted for a filename, and the text file is opened. The bulk of the work is done within two `For-Next` loops. The code generates the appropriate HTML tags and writes the information to the text file. The only complicated part is determining the cell's horizontal alignment. (Excel doesn't report this information directly.) Finally, the file is closed, and the user sees a summary message.

Figure 27-6 shows a range in a worksheet, and Figure 27-7 shows how it looks in a Web browser after being converted to HTML.



On the CD

This example, named `export to HTML.xlsm`, is available on the companion CD-ROM.

	A	B	C	D	E	F	G
1							
2			New York	Los Angeles	Chicago	Total	
3		<i>January</i>	\$11,249.09	\$11,423.69	\$4,936.33	\$5,438.79	
4		<i>February</i>	\$9,265.44	\$10,778.64	\$10,519.65	\$5,044.97	
5		<i>March</i>	\$11,606.05	\$8,306.11	\$11,055.09	\$8,388.56	
6		<i>April</i>	\$7,956.91	\$11,509.05	\$6,951.02	\$8,965.71	
7		<i>May</i>	\$7,850.21	\$9,937.65	\$9,346.92	\$10,907.65	
8		<i>June</i>	\$8,399.23	\$6,456.32	\$8,669.86	\$4,898.50	
9		<i>July</i>	\$6,298.21	\$6,530.04	\$8,403.11	\$8,848.34	
10		<i>August</i>	\$5,013.93	\$7,690.16	\$9,527.34	\$7,327.38	
11		<i>September</i>	\$8,986.08	\$11,600.23	\$5,740.46	\$11,394.59	
12		<i>October</i>	\$5,574.59	\$5,011.99	\$9,417.73	\$10,519.65	
13		<i>November</i>	\$10,320.80	\$9,994.88	\$7,996.68	\$7,659.12	
14		<i>December</i>	\$11,436.30	\$6,500.94	\$10,557.48	\$10,421.68	
15		Total	\$103,956.84	\$105,739.70	\$103,121.67	\$312,818.21	
16							
17							

Figure 27-6: A worksheet range, ready to be converted to HTML.

	New York	Los Angeles	Chicago	Total
<i>January</i>	\$11,249.09	\$11,423.69	\$4,936.33	\$5,438.79
<i>February</i>	\$9,265.44	\$10,778.64	\$10,519.65	\$5,044.97
<i>March</i>	\$11,606.05	\$8,306.11	\$11,055.09	\$8,388.56
<i>April</i>	\$7,956.91	\$11,509.05	\$6,951.02	\$8,965.71
<i>May</i>	\$7,850.21	\$9,937.65	\$9,346.92	\$10,907.65
<i>June</i>	\$8,399.23	\$6,456.32	\$8,669.86	\$4,898.50
<i>July</i>	\$6,298.21	\$6,530.04	\$8,403.11	\$8,848.34
<i>August</i>	\$5,013.93	\$7,690.16	\$9,527.34	\$7,327.38
<i>September</i>	\$8,986.08	\$11,600.23	\$5,740.46	\$11,394.59
<i>October</i>	\$5,574.59	\$5,011.99	\$9,417.73	\$10,519.65
<i>November</i>	\$10,320.80	\$9,994.88	\$7,996.68	\$7,659.12
<i>December</i>	\$11,436.30	\$6,500.94	\$10,557.48	\$10,421.68
Total	\$103,956.84	\$105,739.70	\$103,121.67	\$312,818.21

Figure 27-7: The worksheet data after being converted to HTML.

Exporting a range to an XML file

This example exports an Excel range to a simple XML data file. As you might know, an XML file uses tags to wrap each data item. The procedure in this section uses the labels in the first row as the XML tags. Figure 27-8 shows the range in a worksheet table, and Figure 27-9 shows the XML file displayed in a Web browser.

	A	B	C	D	E	F	G	H	I	J
1	EmployeeID	LastName	FirstName	Title	BirthDate	HireDate	Address	City	Region	PostalCode
2	9001	Davolio	Nancy	Sales Representative	12/8/68	5/1/01	507 - 20th Ave. E. Apt. 2A	Seattle	WA	98122
3	9002	Fuller	Andrew	Vice President, Sales	2/19/52	8/14/02	908 W. Capital Way	Tacoma	WA	98401
4	9003	Leverling	Janet	Sales Representative	8/30/63	4/1/06	722 Moss Bay Blvd.	Kirkland	WA	98033
5	9004	Peacock	Margaret	Sales Representative	9/19/58	5/3/99	4110 Old Redmond Rd.	Redmond	WA	98073
6	9005	Buchanan	Steven	Sales Manager	3/4/55	10/17/93	14 Garrett Hill	London	SW	EC2 6DA
7	9006	Suyama	Michael	Sales Representative	7/2/63	10/17/97	Coventry House	Miner Rd.	London	EC2 6DA
8	9007	King	Robert	Sales Representative	5/29/60	1/2/98	Edgeham Hollow	Winchester Ws	London	RG2 9AT
9	9008	Callahan	Laura	Inside Sales Coordinat	1/9/58	3/5/94	4726 - 11th Ave. N.E.	Seattle	WA	98105
10	9009	Dodsworth	Anne	Sales Representative	7/2/69	11/15/03	7 Houndstooth Rd.	London	W6	7BA
11	9102	Jackson	Raymond	Sales Representative	2/16/52	3/4/00	11 Franklin Way	Portland	OR	97203
12										
13										

Figure 27-8: The data in this range will be converted to XML.

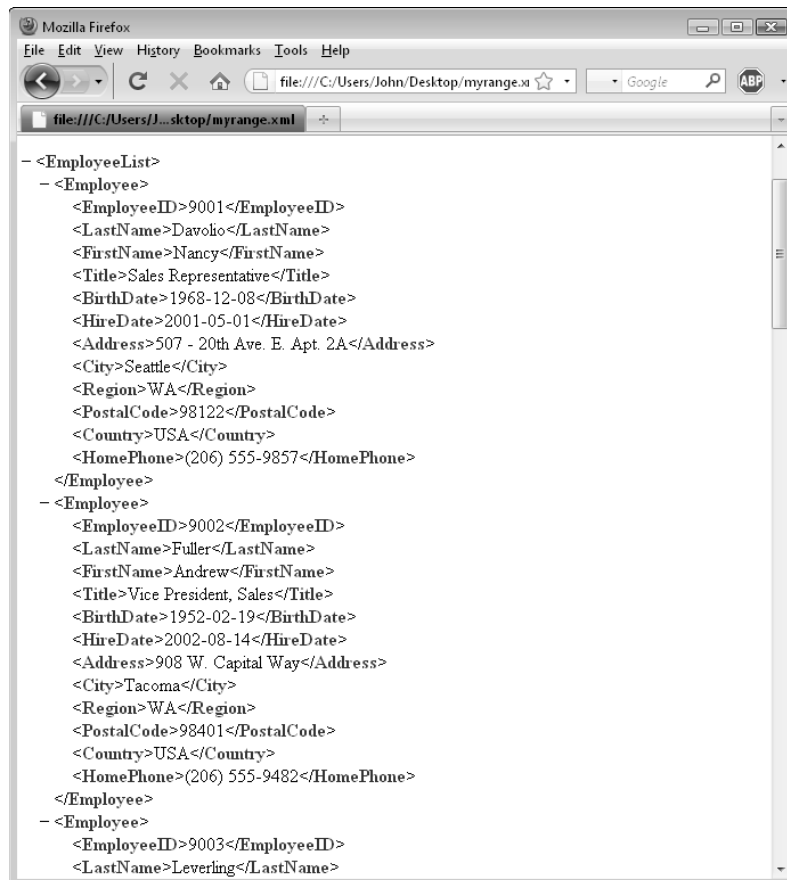


Figure 27-9: The worksheet data after being converted to XML.

**Note**

Although Excel 2003 introduced improved support for XML files, even Excel 2010 can't create an XML file from an arbitrary range of data unless you have a map file (schema) for the data.

The ExportToXML procedure follows. You'll notice that it has a quite a bit in common with the ExportToHTML procedure in the previous section.

```
Sub ExportToXML()
    Dim Filename As Variant
    Dim Rng As Range
    Dim r As Long, c As Long

    ' Set the range
    Set Rng = Range("Table1[#All]")
    ' Get a file name
    Filename = Application.GetSaveAsFilename( _
        InitialFileName:="myrange.xml", _
        fileFilter:="XML Files (*.xml), *.xml")
    If Filename = False Then Exit Sub

    ' Open the text file
    Open Filename For Output As #1

    ' Write the <xml> tags
    Print #1, "<?xml version=""1.0"" encoding=""UTF-8"" standalone=""yes""?>"
    Print #1, "<EmployeeList xmlns:xsi=""http://www.w3.org/2001/XMLSchema-
instance"">"

    ' Loop through the cells
    For r = 2 To Rng.Rows.Count
        Print #1, "<Employee>"
        For c = 1 To Rng.Columns.Count
            Print #1, "<" & Rng.Cells(1, c) & ">";
            If IsDate(Rng.Cells(r, c)) Then
                Print #1, Format(Rng.Cells(r, c), "yyyy-mm-dd");
            Else
                Print #1, Rng.Cells(r, c).Text;
            End If
            Print #1, "</" & Rng.Cells(1, c) & ">"
        Next c
        Print #1, "</Employee>"
    Next r

    ' Close the table
    Print #1, "</EmployeeList>"

    ' Close the file
    Close #1

    ' Tell the user
    MsgBox Rng.Rows.Count - 1 & " records were exported to " & Filename
End Sub
```



On the CD

This example, named `export to XML.xlsm`, is available on the companion CD-ROM.

You can open the exported XML file with Excel. When opening an XML file, you'll see the dialog box shown in Figure 27-10. If you choose the As an XML Table option, the file will be displayed as a table. Keep in mind that any formulas in the original table aren't preserved.

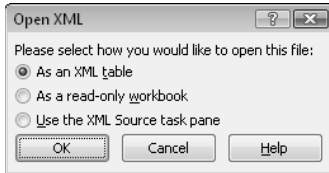


Figure 27-10: When opening an XML file, Excel offers three options.

Zippping and Unzipping Files

Perhaps the most commonly used type of file compression is the Zip format. Even Excel 2010 files are stored in the Zip format (although they don't use the `.zip` extension). A Zip file can contain any number of files, and even complete directory structures. The content of the files determines the degree of compression. For example, JPG image files and MP3 audio files are already compressed, so zippping these file types will have little effect on the file size.



On the CD

The examples in this section are available on the companion CD-ROM. The files are named `'zip files.xlsm'` and `'unzip a file.xlsm'`.

Zippping files

The example in this section demonstrates how to create a Zip file from a group of user-selected files. The `ZipFiles` procedure displays a dialog box so that the user can select the files. It then creates a Zip file named `compressed.zip` in Excel's default directory.

```
Sub ZipFiles()
    Dim ShellApp As Object
    Dim FileNameZip As Variant
    Dim FileNames As Variant
    Dim i As Long, FileCount As Long
    ' Get the file names
    FileNames = Application.GetOpenFilename _
        (FileFilter:="All Files (*.*)",*,*, _
        FilterIndex:=1, _
        Title:="Select the files to ZIP", _
        MultiSelect:=True)
```

```

' Exit if dialog box canceled
If Not IsArray(FileNames) Then Exit Sub

FileCount = UBound(FileNames)
FileNameZip = Application.DefaultFilePath & "\compressed.zip"

'Create empty Zip File with zip header
Open FileNameZip For Output As #1
Print #1, Chr$(80) & Chr$(75) & Chr$(5) & Chr$(6) & String(18, 0)
Close #1

Set ShellApp = CreateObject("Shell.Application")
'Copy the files to the compressed folder
For i = LBound(FileNames) To UBound(FileNames)
    ShellApp.Namespace(FileNameZip).CopyHere FileNames(i)
'Keep script waiting until Compressing is done
On Error Resume Next
Do Until ShellApp.Namespace(FileNameZip).items.Count = i
    Application.Wait (Now + TimeValue("0:00:01"))
Loop
Next i

If MsgBox(FileCount & " files were zipped to:" & _
    vbNewLine & FileNameZip & vbNewLine & vbNewLine & _
    "View the zip file?", vbQuestion + vbYesNo) = vbYes Then _
    Shell "Explorer.exe /e," & FileNameZip, vbNormalFocus
End Sub

```

Figure 27-11 shows the file selection dialog box generated by using the `GetOpenFilename` method of the `Application` object (see Chapter 12 for more information). This dialog box allows the user to select multiple files from a single directory.

The `ZipFiles` procedure creates a file named `compressed.zip` and writes a string of characters, which identify it as a Zip file. Next, a `Shell.Application` object is created, and the code uses its `CopyHere` method to copy the files into the Zip archive. The next section of the code is a `Do Until` loop, which checks the number of files in the Zip archive every second. This is necessary because copying the files could take some time, and, if the procedure ends before the files are copied, the Zip file will be incomplete (and probably corrupt). This loop slows the procedure considerably, but I haven't been able to figure out an alternative.

When the number of files in the Zip archive matches the number that should be there, the loop ends, and the user is presented with a message like the one shown in Figure 27-12. Clicking the Yes button opens a Windows Explorer window that shows the zipped files.



Caution

The `ZipFiles` procedure presented here was kept simple to make it easy to understand. The code does no error checking and is not very flexible. For example, there is no option to choose the Zip filename or location, and the current `compressed.zip` file is always overwritten without warning. It's certainly no replacement for the zipping tools built into Windows, but it's an interesting demonstration of what you can do with VBA.

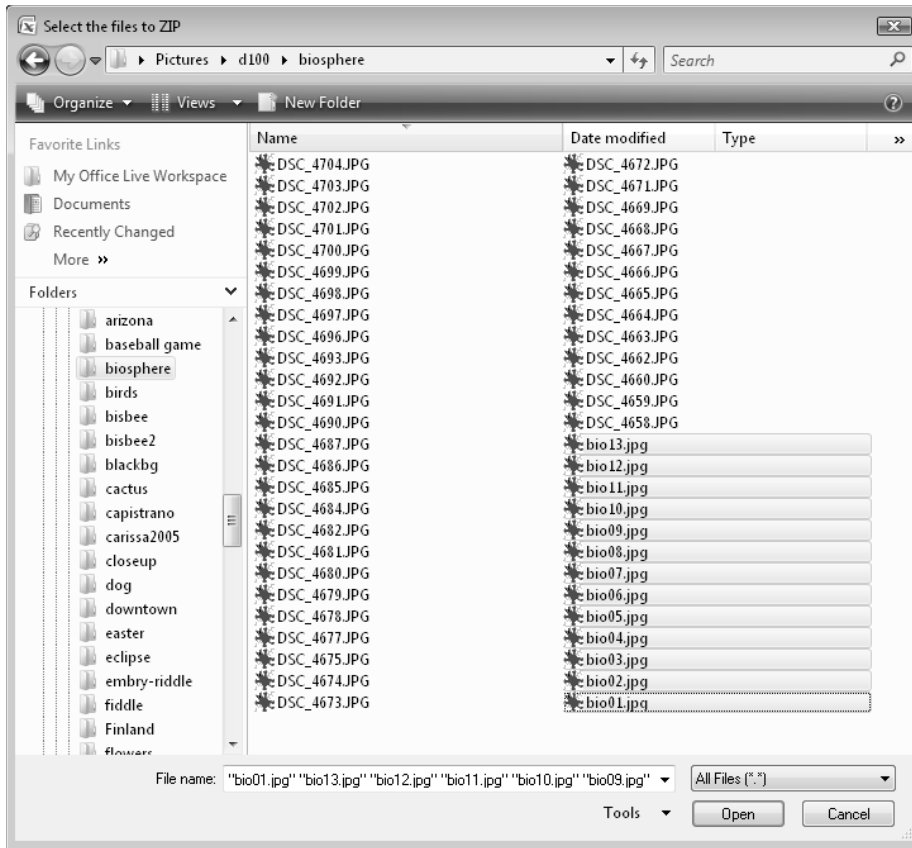


Figure 27-11: This dialog box lets the user select the files to be zipped.

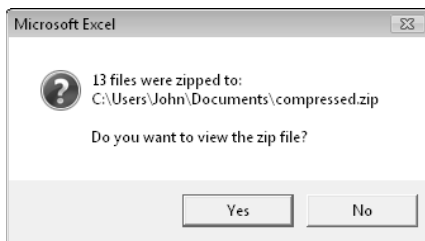


Figure 27-12: The user is informed when the Zip file is complete.

Unzipping a File

The example in this section performs the opposite function of the previous example. It asks the user for a ZIP filename and then unzips the files and puts them in a directory named `Unzipped`, located in Excel's default file directory.

```

Sub UnzipAFile()
    Dim ShellApp As Object
    Dim TargetFile
    Dim ZipFolder

    ' Target file & temp dir
    TargetFile = Application.GetOpenFilename _
        (FileFilter:="Zip Files (*.zip), *.zip")
    If TargetFile = False Then Exit Sub

    ZipFolder = Application.DefaultFilePath & "\Unzipped\"
    ' Create a temp folder
    On Error Resume Next
    RmDir ZipFolder
    Mkdir ZipFolder
    On Error GoTo 0
    ' Copy the zipped files to the newly created folder
    Set ShellApp = CreateObject("Shell.Application")
    ShellApp.Namespace(ZipFolder).CopyHere _
        ShellApp.Namespace(TargetFile).items
    If MsgBox("The files was unzipped to:" & _
        vbNewLine & ZipFolder & vbNewLine & vbNewLine & _
        "View the folder?", vbQuestion + vbYesNo) = vbYes Then _
        Shell "Explorer.exe /e," & ZipFolder, vbNormalFocus
End Sub

```

The `UnzipAFile` procedure uses the `GetOpenFilename` method to get the Zip file. It then creates the new folder and uses the `Shell.Application` object to copy the contents of the Zip file to the new folder. Finally, the user can choose to display the new directory.

Working with ADO

ADO (ActiveX Data Objects) is an object model that enables you to access data stored in a variety of formats (including common database formats and even text files). Importantly, this methodology allows you to use a single object model for all your data sources. ADO is currently the preferred data access methodology and shouldn't be confused with DAO (Data Access Objects).

This section presents a simple example that uses ADO to retrieve data from an Access database.



Note

ADO programming is a very complex topic. If you need to access external data in your Excel application, you'll probably want to invest in one or more books that cover this topic in detail.

The `ADO_Demo` example retrieves data from an Access database named `budget_data.accdb`. This database contains one table (named `Budget`). This example retrieves the data in which the `Item` field contains the text *Lease*, the `Division` field contains the text *N. America*, and the `Year` field contains *2008*. The qualifying data is stored in a `Recordset` object, and the data is then transferred to a worksheet (see Figure 27-13).

	A	B	C	D	E	F	G	H	I	J	K	L	
1	ID	SORT	DIVISION	DEPARTMENT	CATEGORY	ITEM	YEAR	MONTH	BUDGET	ACTUAL	VARIANCE		
2	10	10	N. America	Data Processing	Facility	Lease	2008	Jan	3450	2631	819		
3	34	34	N. America	Human Resources	Facility	Lease	2008	Jan	4353	3875	478		
4	58	58	N. America	Accounting	Facility	Lease	2008	Jan	3898	2979	919		
5	82	82	N. America	Training	Facility	Lease	2008	Jan	3185	3545	-360		
6	106	106	N. America	Security	Facility	Lease	2008	Jan	3368	4120	-752		
7	130	130	N. America	R&D	Facility	Lease	2008	Jan	3926	3432	494		
8	154	154	N. America	Operations	Facility	Lease	2008	Jan	3329	3715	-386		
9	178	178	N. America	Shipping	Facility	Lease	2008	Jan	4095	2892	1203		
10	202	202	N. America	Sales	Facility	Lease	2008	Jan	3242	2687	555		
11	226	226	N. America	Advertising	Facility	Lease	2008	Jan	3933	3580	353		
12	250	250	N. America	Public Relations	Facility	Lease	2008	Jan	4316	4328	-12		
13	1330	1330	N. America	Data Processing	Facility	Lease	2008	Feb	4440	4357	83		
14	1354	1354	N. America	Human Resources	Facility	Lease	2008	Feb	4210	3196	1014		
15	1378	1378	N. America	Accounting	Facility	Lease	2008	Feb	2860	3658	-798		
16	1402	1402	N. America	Training	Facility	Lease	2008	Feb	4468	3759	709		
17	1426	1426	N. America	Security	Facility	Lease	2008	Feb	3499	3568	-69		
18	1450	1450	N. America	R&D	Facility	Lease	2008	Feb	3394	4196	-802		
19	1474	1474	N. America	Operations	Facility	Lease	2008	Feb	4187	3074	1113		
20	1498	1498	N. America	Shipping	Facility	Lease	2008	Feb	2870	3751	-881		
21	1522	1522	N. America	Sales	Facility	Lease	2008	Feb	4046	4013	33		
22	1546	1546	N. America	Advertising	Facility	Lease	2008	Feb	3131	3864	-733		
23	1570	1570	N. America	Public Relations	Facility	Lease	2008	Feb	4153	3980	173		
24	2650	2650	N. America	Data Processing	Facility	Lease	2008	Mar	4166	3673	493		
25	2674	2674	N. America	Human Resources	Facility	Lease	2008	Mar	3739	3884	-145		
26	2698	2698	N. America	Accounting	Facility	Lease	2008	Mar	3796	4406	-610		
27	2722	2722	N. America	Training	Facility	Lease	2008	Mar	2587	3605	-1018		
28	2746	2746	N. America	Security	Facility	Lease	2008	Mar	2700	4162	-1462		

Figure 27-13: This data was retrieved from an Access database.

```

Sub ADO_Demo ()
'   This demo requires a reference to
'   the Microsoft ActiveX Data Objects 2.x Library

Dim DBFullName As String
Dim Cnct As String, Src As String
Dim Connection As ADODB.Connection
Dim Recordset As ADODB.Recordset
Dim Col As Integer
Cells.Clear
'   Database information
DBFullName = ThisWorkbook.Path & "\budget data.accdb"

'   Open the connection
Set Connection = New ADODB.Connection
Cnct = "Provider=Microsoft.ACE.OLEDB.12.0;"
Cnct = Cnct & "Data Source=" & DBFullName & ";"
Connection.Open ConnectionString:=Cnct

'   Create RecordSet
Set Recordset = New ADODB.Recordset
With Recordset
    Filter

```

```

    Src = "SELECT * FROM Budget WHERE Item = 'Lease' "
    Src = Src & "and Division = 'N. America' "
    Src = Src & "and Year = '2008'"
    .Open Source:=Src, ActiveConnection:=Connection
'    Write the field names
    For Col = 0 To Recordset.Fields.Count - 1
        Range("A1").Offset(0, Col).Value = _
            Recordset.Fields(Col).Name
    Next
'    Write the recordset
    Range("A1").Offset(1, 0).CopyFromRecordset Recordset
End With
Set Recordset = Nothing
Connection.Close
Set Connection = Nothing
End Sub

```



On the CD

This example (named `simple ado example.xlsm`), along with the Access database file (named `budget data.accdb`), is available on the companion CD-ROM. In addition, the CD-ROM contains an example of using ADO to query a CSV text file. The file named `simple ado example2.xlsm` uses a large CSV files named `music_list.csv`.

Manipulating Visual Basic Components

In This Chapter

- Getting an overview of the VBA Integrated Development Environment (IDE) and its object model
- Using VBA to add and remove modules from a project
- Writing VBA code that creates more VBA code
- Using VBA to help create UserForms
- Creating a UserForm on the fly

Introducing the IDE

This chapter covers a topic that some readers might find extremely useful: writing Visual Basic for Applications (VBA) code that manipulates components in a VBA project. The VBA IDE contains an object model that exposes key elements of your VBA projects, including the Visual Basic Editor (VBE) itself. This object model enables you to write VBA code that adds or removes modules, generates other VBA code, or even creates UserForms on the fly.

The *IDE* is essentially an Object Linking and Embedding (OLE) automation interface for the Visual Basic Editor. After you establish a reference to the object, you have access to all the VBE's objects, properties, and methods, and you can also declare objects from the IDE's member classes.

Use the VBE's Tools→References command to display the References dialog box, where you can add a reference to the Microsoft Visual Basic for Applications Extensibility Library (see Figure 28-1). This gives you access to an object called `VBIDE`. Creating a reference to `VBIDE` enables you to declare object variables contained in the `VBIDE` and also gives you access to a number of predefined constants that relate to the IDE. Actually, you can access the objects in the IDE *without* creating a reference, but you won't be able to use the constants in your code, nor will you be able to declare specific objects that refer to IDE components.

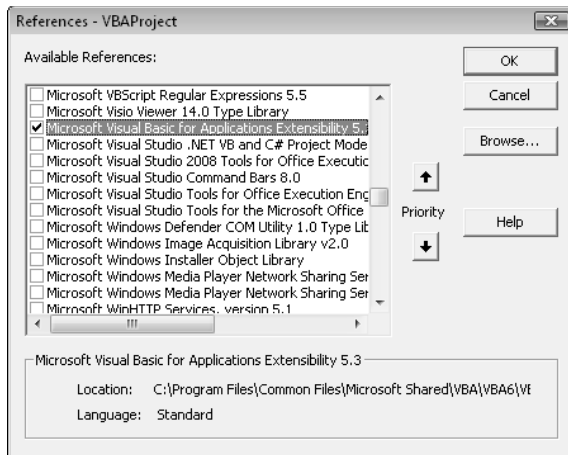


Figure 28-1: Adding a reference to the Microsoft Visual Basic for Applications Extensibility Library.



Cross-Ref

Refer to Chapter 20 for background information about OLE automation.

After you understand how the IDE object model works, you can write code to perform a variety of operations, including the following:

- Adding and removing VBA modules
- Inserting VBA code
- Creating UserForms
- Adding controls to a UserForm



An important security note

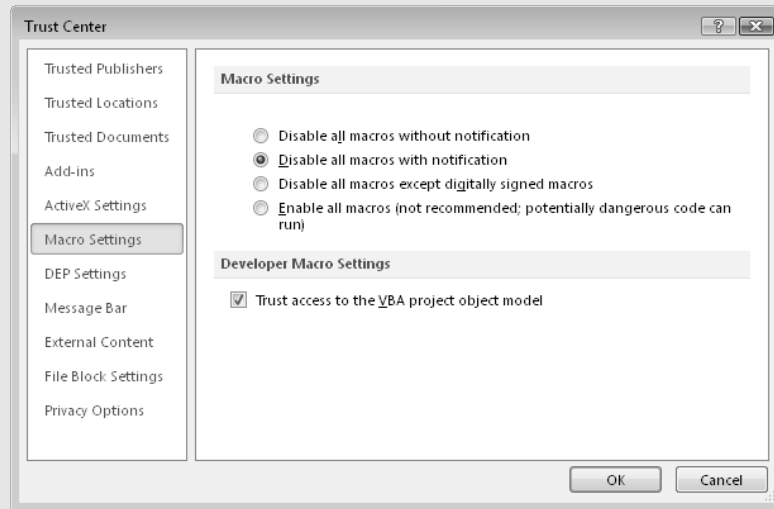
If you're using Excel to develop applications for others to use, be aware that the procedures in this chapter may not work. Because of the threat of macro viruses, Microsoft (beginning with Excel 2002) made it much more difficult for a VBA macro to modify components in a VBA project. If you attempt to execute any of the procedures in this chapter, you may see an error message.

Whether you see this error message depends on a setting in Excel's Trust Center dialog box. To view or change this setting:

1. Choose File→Options.
2. In the Excel options dialog box, click the Trust Center tab.
3. In the Trust Center Tab, click the Trust Center Settings button.
4. In the Trust Center dialog box, click the Macro Settings tab.

Or, you can use the Developer→Code→Macro Security command to go directly to this dialog box.

You'll find a check box labeled Trust Access to the VBA Project Object Model.



This setting is turned off by default. Even if the user chooses to trust the macros contained in the workbook, the macros can't modify the VBA project if this setting is turned off. Note that this setting applies to all workbooks and can't be changed for only a particular workbook.

You can't directly determine the value of this particular setting by using VBA. The only way to detect this setting is to attempt to access the `VBProject` object and then check for an error. The following code demonstrates:

```
On Error Resume Next
Set x = ActiveWorkbook.VBProject
If Err <> 0 Then
    MsgBox "Your security settings do not allow this macro to run."
    Exit Sub
End If
```

Not all the examples in this chapter are intended to be used by end users. Many of them are designed to help developers create projects. For these projects, you'll need to enable the Trust Access to Visual Basic Project setting.

The IDE Object Model

Programming the IDE requires an understanding of its object model. The top object in the object hierarchy is the VBE (Visual Basic Environment). As with Excel's object model, the VBE contains other objects. A simplified version of the IDE object hierarchy is as follows:

```
VBE
  VBProject
    VBComponent
      CodeModule
      Designer
      Property
    Reference
  Window
  CommandBar
```

**Note**

This chapter ignores the Extensibility Library's `Windows` collection and `CommandBars` collection, which aren't all that useful for Excel developers. Rather, the chapter focuses on the `VBProject` object, which can be *very* useful for developers — but make sure that you read the “An important security note” sidebar.

The VBProjects collection

Every open workbook or add-in is represented by a `VBProject` object. To access the `VBProject` object for a workbook using early binding, make sure that you've established a reference to the Microsoft Visual Basic for Applications Extensibility Library (see “Introducing the IDE,” earlier in this chapter).

The `VBProject` property of the `Workbook` object returns a `VBProject` object. The following instructions, for example, create an object variable that represents the `VBProject` object for the active workbook:

```
Dim VBP As VBProject
Set VBP = ActiveWorkbook.VBProject
```

**Note**

If you get an error message when VBA encounters the `Dim` statement, make sure that you've added a reference to Microsoft Visual Basic for Applications Extensibility Library.

Each `VBProject` object contains a collection of the VBA component objects in the project (UserForms, modules, class modules, and document modules). Not surprisingly, this collection is called `VBComponents`. A `VBProject` object also contains a `References` collection for the project, representing the libraries being referenced currently by the project.

You can't add a new member to the `VBProjects` collection directly. Rather, you do so indirectly by opening or creating a new workbook in Excel. Doing so automatically adds a new member to the `VBProjects` collection. Similarly, you can't remove a `VBProject` object directly; closing a workbook removes the `VBProject` object from the collection.

The VBComponents collection

To access a member of the `VBComponents` collection, use the `VBComponents` property with an index number or name as its argument. The following instructions demonstrate the two ways to access a VBA component and create an object variable:

```
Set VBC = ThisWorkbook.VBProject.VBComponents(1)
Set VBC = ThisWorkbook.VBProject.VBComponents("Module1")
```

The References collection

Every VBA project in Excel contains a number of references. You can view, add, or delete the references for a project by choosing the **Tools**→**References** command. (Refer to Figure 28-1 to see the References dialog box.) Every project contains some references (such as VBA itself, Excel, OLE Automation, and the Office object library), and you can add more references to a project as needed.

You can also manipulate the references for a project by using VBA. The `References` collection contains `Reference` objects, and these objects have properties and methods. The following procedure, for example, displays a message box that lists the `Name`, `Description`, and `FullPath` property for each `Reference` object in the active workbook's project:

```
Sub ListReferences()
    Dim Ref As Reference
    Msg = ""
    For Each Ref In ActiveWorkbook.VBProject.References
        Msg = Msg & Ref.Name & vbNewLine
        Msg = Msg & Ref.Description & vbNewLine
        Msg = Msg & Ref.FullPath & vbNewLine & vbNewLine
    Next Ref
    MsgBox Msg
End Sub
```

Figure 28-2 shows the result of running this procedure when a workbook that contains six references is active.



Note

Because it declares an object variable of type `Reference`, the `ListReferences` procedure requires a reference to the VBA Extensibility Library. If you declare `Ref` as a generic `Object`, the VBA Extensibility Library reference is not needed.

You can also add a reference programmatically by using either of two methods of the `Reference` class. The `AddFromFile` method adds a reference if you know its filename and path. `AddFromGuid` adds a reference if you know the reference's *globally unique identifier*, or GUID. Refer to the Help system for more information.

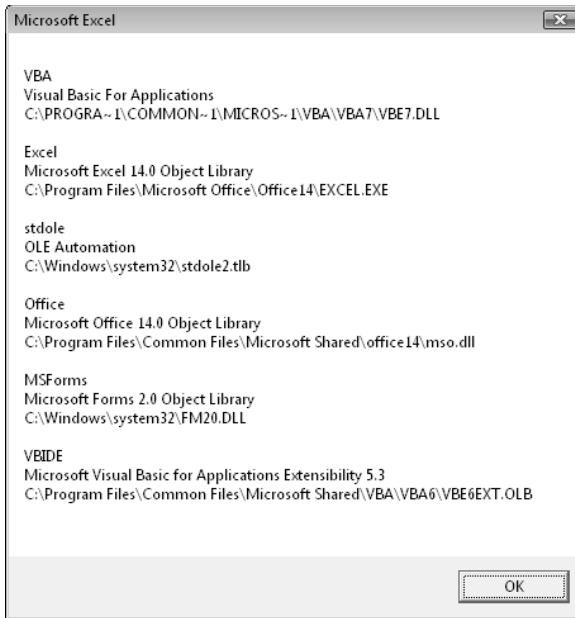


Figure 28-2: This message box displays information about the references for a project.

Displaying All Components in a VBA Project

The `ShowComponents` procedure, which follows, loops through each VBA component in the active workbook and writes the following information to a worksheet:

- The component's name
- The component's type
- The number of lines of code in the code module for the component

```
Sub ShowComponents()
    Dim VBP As VBIDE.VBProject
    Dim VBC As VBComponent
    Dim row As Long

    Set VBP = ActiveWorkbook.VBProject
    ' Write headers
    Cells.ClearContents
    Range("A1:C1") = Array("Name", "Type", "Code Lines")
    Range("A1:C1").Font.Bold = True
    row = 1
    ' Loop through the VB Components
    For Each VBC In VBP.VBComponents
        row = row + 1
```

```

'      Name
      Cells(row, 1) = VBC.Name
'      Type
      Select Case VBC.Type
        Case vbext_ct_StdModule
          Cells(row, 2) = "Module"
        Case vbext_ct_ClassModule
          Cells(row, 2) = "Class Module"
        Case vbext_ct_MSForm
          Cells(row, 2) = "UserForm"
        Case vbext_ct_Document
          Cells(row, 2) = "Document Module"
      End Select
'      Lines of code
      Cells(row, 3) = VBC.CodeModule.CountOfLines
    Next VBC
End Sub

```

Notice that I used built-in constants (for example, `vbext_ct_StdModule`) to determine the component type. These constants aren't defined unless you've established a reference to the Microsoft Visual Basic for Applications Extensibility Library.

Figure 28-3 shows the result of running the `ShowComponents` procedure. In this case, the VBA project contained six components, and only one of them had an empty code module.



On the CD

This code is available on the CD-ROM in a workbook named `list VB components.xlsm`. The workbook includes an enhancement that lets you choose from all open VB projects.

	A	B	C	D
1	Name	Type	Code Lines	
2	ThisWorkbook	Document Module	49	
3	Sheet1	Document Module	0	
4	Module1	Module	157	
5	FormAbout	UserForm	133	
6	Utilities	Module	111	
7	Bookmarks	Module	196	
8				
9				

Figure 28-3: The result of executing the `ShowComponents` procedure.

Listing All VBA Procedures in a Workbook

The `ListProcedures` macro in this section creates a list (in a message box) of all VBA procedures in the active workbook.

```

Sub ListProcedures()
    Dim VBP As VBIDE.VBProject
    Dim VBC As VBComponent
    Dim CM As CodeModule
    Dim StartLine As Long
    Dim Msg As String
    Dim ProcName As String

    ' Use the active workbook
    Set VBP = ActiveWorkbook.VBProject

    ' Loop through the VB components
    For Each VBC In VBP.VBComponents
        Set CM = VBC.CodeModule
        Msg = Msg & vbNewLine
        StartLine = CM.CountOfDeclarationLines + 1
        Do Until StartLine >= CM.CountOfLines
            Msg = Msg & VBC.Name & ": " & _
                CM.ProcOfLine(StartLine, vbext_pk_Proc) & vbNewLine
            StartLine = StartLine + CM.ProcCountLines _
                (CM.ProcOfLine(StartLine, vbext_pk_Proc), _
                vbext_pk_Proc)
        Loop
    Next VBC
    MsgBox Msg
End Sub

```

Figure 28-4 shows the result for a workbook that has nine procedures.

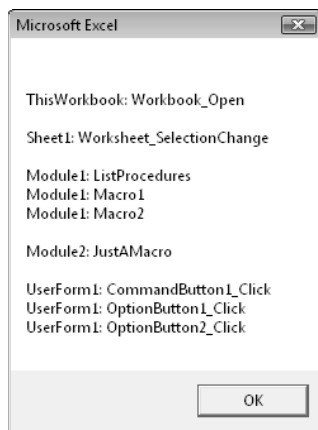


Figure 28-4: The message box lists all procedures in the active workbook.



This example, named `list all procedures.xlsm`, is available on the companion CD-ROM.

Replacing a Module with an Updated Version

The example in this section demonstrates how to replace a VBA module with a different VBA module. Besides demonstrating three VBAComponent methods (Export, Remove, and Import), the procedure also has a practical use. For example, you might distribute a workbook to a group of users and then later discover that a macro contains an error or needs to be updated. Because the users could have added data to the workbook, replacing the entire workbook isn't practical. The solution, then, is to distribute another workbook that contains a macro that replaces the VBA module with an updated version stored in a file.

This example consists of two workbooks:

- UserBook.xlsm: Contains a module (Module1) that needs to be replaced.
- UpdateUserBook.xlsm: Contains VBA procedures to replace Module1 in UserBook.xlsm with a later version of Module1 (which is stored in UpdateUserBook.xlsm).

The BeginUpdate procedure follows. This macro is contained in the UpdateUserBook.xlsm workbook, which would be distributed to users of UserBook.xlsm. This procedure ensures that UserBook.xlsm is open. It then informs the user of what is about to happen with the message shown in Figure 28-5.

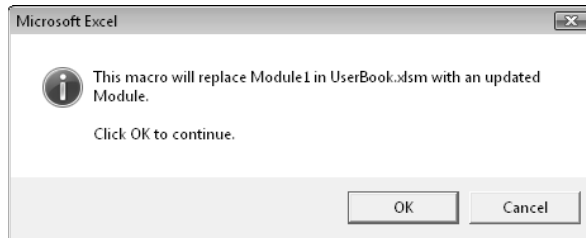


Figure 28-5: This message box informs the user that a module will be replaced.

```
Sub BeginUpdate()
    Dim Filename As String
    Dim Msg As String
    Filename = "UserBook.xlsm"

    ' Activate workbook
    On Error Resume Next
    Workbooks(Filename).Activate
    If Err <> 0 Then
        MsgBox Filename & " must be open.", vbCritical
        Exit Sub
    End If
    Msg = "This macro will replace Module1 in UserBook.xlsm "
    Msg = Msg & "with an updated Module." & vbCrLf & vbCrLf
End Sub
```

```

Msg = Msg & "Click OK to continue."
If MsgBox(Msg, vbInformation + vbOKCancel) = vbOK Then
    Call ReplaceModule
Else
    MsgBox "Module not replaced,", vbCritical
End If
End Sub

```

When the user clicks OK to confirm the replacement, the `ReplaceModule` procedure is called. This procedure replaces `Module1` in the `UserBook.xlsm` with the copy of `Module1` in the `UpdateUserBook.xlsm` file:

```

Sub ReplaceModule()
    Dim ModuleFile As String
    Dim VBP As VBIDE.VBProject
    ' Export Module1 from this workbook
    ModuleFile = Application.DefaultFilePath & "\tempmodxxx.bas"
    ThisWorkbook.VBProject.VBComponents("Module1") _
        .Export ModuleFile

    ' Replace Module1 in UserBook
    Set VBP = Workbooks("UserBook.xlsm").VBProject
    On Error GoTo ErrHandle
    With VBP.VBComponents
        .Remove VBP.VBComponents("Module1")
        .Import ModuleFile
    End With

    ' Delete the temporary module file
    Kill ModuleFile
    MsgBox "The module has been replaced.", vbInformation
    Exit Sub
ErrHandle:
    ' Did an error occur?
    MsgBox "ERROR. The module may not have been replaced.", _
        vbCritical
End Sub

```

This procedure performs the following actions:

1. It exports `Module1` (the updated module) to a file.
The file has an unusual name to reduce the likelihood of overwriting an existing file.
2. It removes `Module1` (the old module) from `UserBook.xlsm`, using the `Remove` method of the `VBComponents` collection.
3. It imports the module (saved in Step 1) to `UserBook.xlsm`.

4. It deletes the file saved in Step 1.
5. It reports the action to the user.

General error handling is used to inform the user that an error occurred.



This example is available on the companion CD-ROM. It requires two workbooks: UserBook.xlsm and UpdateUserBook.xlsm.

Using VBA to Write VBA Code

The example in this section demonstrates how you can write VBA code that writes more VBA code. The `AddButtonAndCode` procedure does the following:

1. Inserts a new worksheet.
2. Adds an ActiveX `CommandButton` control to the worksheet.
3. Adjusts the position, size, and caption of the `CommandButton`.
4. Inserts an event-handler procedure for the `CommandButton` named `CommandButton1_Click` in the sheet's code module.

This procedure simply activates `Sheet1`.

The `AddButtonAndCode` procedure follows.

```
Sub AddButtonAndCode()  
    Dim NewSheet As Worksheet  
    Dim NewButton As OLEObject  
  
    ' Add the sheet  
    Set NewSheet = Sheets.Add  
  
    ' Add a CommandButton  
    Set NewButton = NewSheet.OLEObjects.Add _  
        ("Forms.CommandButton.1")  
    With NewButton  
        .Left = 4  
        .Top = 4  
        .Width = 100  
        .Height = 24  
        .Object.Caption = "Return to Sheet1"  
    End With  
  
    ' Add the event handler code  
    Code = "Sub CommandButton1_Click()" & vbCrLf
```

```

Code = Code & "    On Error Resume Next" & vbCrLf
Code = Code & "    Sheets(" & "Sheet1" & ").Activate" & vbCrLf
Code = Code & "    If Err <> 0 Then" & vbCrLf
Code = Code & "        MsgBox " & "Cannot activate Sheet1." & "" _
    & vbCrLf
Code = Code & "    End If" & vbCrLf
Code = Code & "End Sub"

With ActiveWorkbook.VBProject. _
    VBComponents(NewSheet.Name).CodeModule
        NextLine = .CountOfLines + 1
        .InsertLines NextLine, Code
    End With
End Sub

```

Figure 28-6 shows the worksheet and the `CommandButton` control that were added by the `AddButtonAndCode` procedure.



On the CD

This example is available on the companion CD-ROM. The filename is `add button and code.xlsm`.

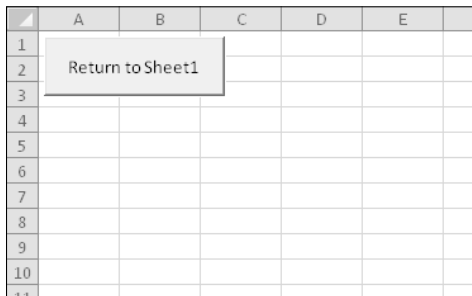


Figure 28-6: This sheet, the `CommandButton`, and its event handler were added by using VBA.

The tricky part of this procedure is inserting the VBA code into the code module for the new worksheet. The code is stored in a variable named `Code`, with each instruction separated by a carriage return and linefeed sequence. The `InsertLines` method adds the code to the code module for the inserted worksheet.

The `NextLine` variable stores the number of existing lines in the module incremented by one. This ensures that the procedure is added to the end of the module. If you simply insert the code beginning at line 1, it causes an error if the user's system is set up to add an `Option Explicit` statement to each module automatically.

Figure 28-7 shows the procedure that is created by the `AddButtonAndCode` procedure in its new home in the code window.

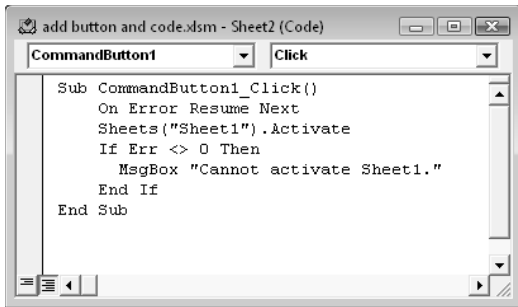


Figure 28-7: VBA generated this event-handler procedure.

Adding Controls to a UserForm at Design Time

If you've spent any time developing UserForms, you probably know that it can be quite tedious to add and adjust the controls so that they're aligned and sized consistently. Even if you take full advantage of the VBE formatting commands, it can still take a considerable amount of time to get the controls to look just right.

The UserForm shown in Figure 28-8 contains 100 CommandButtons, all of which are identical in size and positioned precisely on the form. Furthermore, each CommandButton has its own event-handler procedure. Adding these buttons manually and creating their event handlers would take some time — lots of time. Adding them automatically at design time by using a VBA procedure takes less than a second.

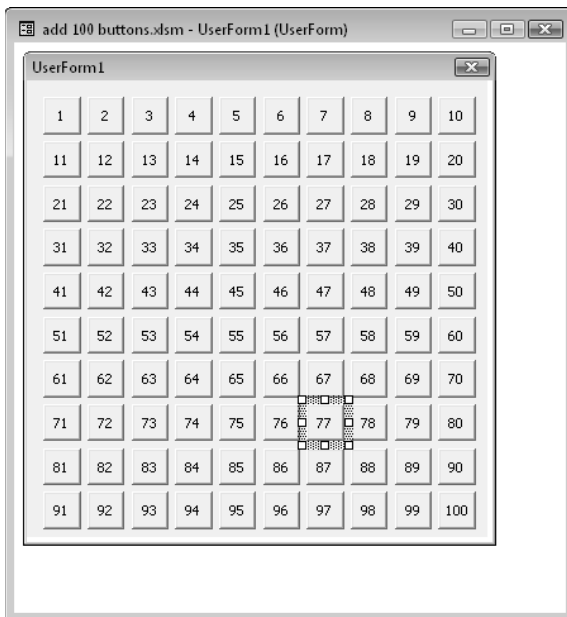


Figure 28-8: A VBA procedure added the CommandButtons on this UserForm.

Design-time versus runtime UserForm manipulations

It's important to understand the distinction between manipulating UserForms or controls at design time and manipulating these objects at runtime. Runtime manipulations are apparent when the UserForm is shown, but the changes made aren't permanent. For example, you might write code that changes the `Caption` property of the UserForm before the form is displayed. The new caption appears when the UserForm is shown, but when you return to the VBE, the UserForm displays its original caption. Runtime manipulation is very common, and Part IV of this book contains many examples of code that perform runtime manipulation of UserForms and controls.

Design-time manipulations, on the other hand, *are* permanent — just as if you made the changes manually by using the tools in the VBE. Normally, you perform design-time manipulations as a way to automate some of the tedious chores in designing a UserForm. To make design-time manipulations, you access the `Designer` object for the UserForm.

To demonstrate the difference between design-time and runtime manipulations, I developed two simple procedures that add a `CommandButton` to a UserForm. One procedure adds the button at runtime; the other adds it at design time.

The following `RunTimeButton` procedure is very straightforward. When used in a general (non-UserForm) module, it adds a `CommandButton` to the UserForm, changes a few of the `CommandButton`'s properties, and then displays the UserForm. The `CommandButton` appears on the form when the form is shown, but when you view the form in the VBE, the `CommandButton` isn't there.

```
Sub RunTimeButton()  
' Adds a button at runtime  
Dim Butn As CommandButton  
Set Butn = UserForm1.Controls.Add("Forms.CommandButton.1")  
With Butn  
    .Caption = "Added at runtime"  
    .Width = 100  
    .Top = 10  
End With  
UserForm1.Show  
End Sub
```

Following is the `DesignTimeButton` procedure. Unlike the previous example, this procedure uses the `Designer` object, which is contained in the `VBComponent` object. Specifically, it uses the `Add` method to add the `CommandButton` control. Because the `Designer` object was used, the `CommandButton` is added to the UserForm just as if you did it manually in the VBE.

```
Sub DesignTimeButton()  
' Adds a button at design time  
Dim Butn As CommandButton  
Set Butn = ThisWorkbook.VBProject. _  
    VBComponents("UserForm1") _
```

```

        .Designer.Controls.Add("Forms.CommandButton.1")
    With Butn
        .Caption = "Added at design time"
        .Width = 120
        .Top = 40
    End With
End Sub

```

Adding 100 CommandButtons at design time

The example in this section demonstrates how to take advantage of the `Designer` object to help you design a UserForm. In this case, the code adds 100 `CommandButtons` (perfectly spaced and aligned), sets the `Caption` property for each `CommandButton`, and also creates 100 event-handler procedures (one for each `CommandButton`).

```

Sub Add100Buttons()
    Dim UFvbc As VBComponent
    Dim CMod As CodeModule
    Dim ctl As Control
    Dim cb As CommandButton
    Dim n As Long, c As Long, r As Long
    Dim code As String

    Set UFvbc = ThisWorkbook.VBProject.VBComponents("UserForm1")
    ' Delete all controls, if any
    For Each ctl In UFvbc.Designer.Controls
        UFvbc.Designer.Controls.Remove ctl.Name
    Next ctl
    ' Delete all VBA code
    UFvbc.CodeModule.DeleteLines 1, UFvbc.CodeModule.CountOfLines
    ' Add 100 CommandButtons
    n = 1
    For r = 1 To 10
        For c = 1 To 10
            Set cb = UFvbc.Designer. _
                Controls.Add("Forms.CommandButton.1")
            With cb
                .Width = 22
                .Height = 22
                .Left = (c * 26) - 16
                .Top = (r * 26) - 16
                .Caption = n
            End With
            ' Add the event handler code
            With UFvbc.CodeModule
                code = ""
                code = code & "Private Sub CommandButton" & n & _

```

```

        "_Click" & vbCrLf
        code = code & "Msgbox ""This is CommandButton" & n & _
        """" & vbCrLf
        code = code & "End Sub"
        .InsertLines .CountOfLines + 1, code
    End With
    n = n + 1
Next c
Next r
End Sub

```



On the CD

This example is available on the companion CD-ROM. The file is named `add 100 buttons.xlsm`.

The `Add100Buttons` procedure requires a UserForm named `UserForm1`. You'll need to make the UserForm a bit larger than its default size so that the buttons will fit. The procedure starts by deleting all controls on the form by using the `Remove` method of the `Controls` collection and then deleting all the code in the code module by using the `DeleteLines` method of the `CodeModule` object. Next, the CommandButtons are added, and the event-handler procedures are created within two `For-Next` loops. These event handlers are very simple. Here's an example of such a procedure for `CommandButton1`:

```

Private Sub CommandButton1_Click()
    MsgBox "This is CommandButton1"
End Sub

```

If you'd like to show the form after adding the controls at design time, you need to add the following instruction right before the `End Sub` statement:

```
VBA.UserForms.Add("UserForm1").Show
```

It took me quite a while to figure out how to actually display the UserForm. When VBA generates the 100-button UserForm, it indeed exists in VBA's memory, but it isn't officially part of the project yet. So you need the `Add` method to formally enroll `UserForm1` into the collection of `UserForms`. The return value of this method is a reference to the form itself, which is why the `Show` method can be appended to the end of the `Add` method. So, as a rule, the UserForm must be added to the `UserForms` collection before it can be used.

Creating UserForms Programmatically

The final topic in this chapter demonstrates how to use VBA code to create UserForms at run-time. I present two examples. One is relatively simple, and the other is quite a bit more complex.

A simple runtime UserForm example

The example in this section isn't all that useful — in fact, it's completely useless. But it does demonstrate some useful concepts. The `MakeForm` procedure performs several tasks:

1. It creates a temporary UserForm in the active workbook by using the `Add` method of the `VBComponents` collection.
2. It adds a `CommandButton` control to the UserForm by using the `Designer` object.
3. It adds an event-handler procedure to the UserForm's code module (`CommandButton1_Click`).

This procedure, when executed, simply displays a message box and then unloads the form.
4. It displays the UserForm.
5. It deletes the UserForm.

The net result is a UserForm that's created on the fly, put to use, and then deleted. This example and the one in the next section both blur the distinction between modifying forms at design time and modifying forms at runtime. The form is created by using design-time techniques, but it all happens at runtime.

The following shows the `MakeForm` procedure:

```
Sub MakeForm()  
    Dim TempForm As Object  
    Dim NewButton As MsForms.CommandButton  
    Dim Line As Integer  
    Application.VBE.MainWindow.Visible = False  
    ' Create the UserForm  
    Set TempForm = ThisWorkbook.VBProject. _  
        VBComponents.Add(3) 'vbext_ct_MSForm  
    With TempForm  
        .Properties("Caption") = "Temporary Form"  
        .Properties("Width") = 200  
        .Properties("Height") = 100  
    End With  
    ' Add a CommandButton  
    Set NewButton = TempForm.Designer.Controls _  
        .Add("Forms.CommandButton.1")  
    With NewButton  
        .Caption = "Click Me"  
        .Left = 60  
        .Top = 40  
    End With  
    ' Add an event-handler sub for the CommandButton  
    With TempForm.CodeModule
```

```

Line = .CountOfLines
.InsertLines Line + 1, "Sub CommandButton1_Click()"
.InsertLines Line + 2, "  MsgBox ""Hello!"" "
.InsertLines Line + 3, "  Unload Me"
.InsertLines Line + 4, "End Sub"
End With
' Show the form
VBA.UserForms.Add(TempForm.Name).Show
'
' Delete the form
ThisWorkbook.VBProject.VBComponents.Remove TempForm
End Sub

```



On the CD

This example, named `create userform` on the `fly.xlsm`, is available on the companion CD-ROM.

The `MakeForm` procedure creates and shows the simple UserForm shown in Figure 28-9.

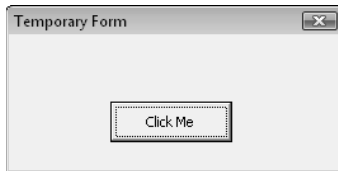


Figure 28-9: This UserForm and its underlying code were generated on the fly.



Note

The workbook that contains the `MakeForm` procedure doesn't need a reference to the VBA Extensibility Library because it declares `TempForm` as a generic `Object` (not specifically as a `VBComponent` object). Moreover, it doesn't use any built-in constants.

Notice that one of the first instructions hides the VBE window by setting its `Visible` property to `False`. This eliminates the on-screen flashing that might occur while the form and code are being generated.

A useful (but not so simple) dynamic UserForm example

The example in this section is both instructive and useful. It consists of a function named `GetOption` that displays a UserForm. Within this UserForm are a number of `OptionButtons` whose captions are specified as arguments to the function. The function returns a value that corresponds to the `OptionButton` selected by the user.



On the CD

The example in this section is available on the companion CD-ROM. The filename is `'getoption function.xlsm'`.

The GetOption function procedure follows.

```
Function GetOption(OpArray, Default, Title)
    Dim TempForm As Object
    Dim NewOptionButton As Msforms.OptionButton
    Dim NewCommandButton1 As Msforms.CommandButton
    Dim NewCommandButton2 As Msforms.CommandButton
    Dim i As Integer, TopPos As Integer
    Dim MaxWidth As Long
    Dim Code As String

    ' Hide VBE window to prevent screen flashing
    Application.VBE.MainWindow.Visible = False
    ' Create the UserForm
    Set TempForm = _
        ThisWorkbook.VBProject.VBComponents.Add(3)
    TempForm.Properties("Width") = 800

    ' Add the OptionButtons
    TopPos = 4
    MaxWidth = 0 'Stores width of widest OptionButton
    For i = LBound(OpArray) To UBound(OpArray)
        Set NewOptionButton = TempForm.Designer.Controls. _
            Add("Forms.OptionButton.1")
        With NewOptionButton
            .Width = 800
            .Caption = OpArray(i)
            .Height = 15
            .Accelerator = Left(.Caption, 1)
            .Left = 8
            .Top = TopPos
            .Tag = i
            .AutoSize = True
            If Default = i Then .Value = True
            If .Width > MaxWidth Then MaxWidth = .Width
        End With
        TopPos = TopPos + 15
    Next i

    ' Add the Cancel button
    Set NewCommandButton1 = TempForm.Designer.Controls. _
        Add("Forms.CommandButton.1")
    With NewCommandButton1
        .Caption = "Cancel"
        .Cancel = True
        .Height = 18
        .Width = 44
        .Left = MaxWidth + 12
        .Top = 6
    End With

    ' Add the OK button
```

```

Set NewCommandButton2 = TempForm.Designer.Controls. _
    Add("Forms.CommandButton.1")
With NewCommandButton2
    .Caption = "OK"
    .Default = True
    .Height = 18
    .Width = 44
    .Left = MaxWidth + 12
    .Top = 28
End With
' Add event-handler subs for the CommandButtons
Code = ""
Code = Code & "Sub CommandButton1_Click()" & vbCrLf
Code = Code & "    GETOPTION_RET_VAL=False" & vbCrLf
Code = Code & "    Unload Me" & vbCrLf
Code = Code & "End Sub" & vbCrLf
Code = Code & "Sub CommandButton2_Click()" & vbCrLf
Code = Code & "    Dim ctl" & vbCrLf
Code = Code & "    GETOPTION_RET_VAL = False" & vbCrLf
Code = Code & "    For Each ctl In Me.Controls" & vbCrLf
Code = Code & "        If TypeName(ctl) = "OptionButton"" _
    & " Then" & vbCrLf
Code = Code & "            If ctl Then GETOPTION_RET_VAL = " _
    & "ctl.Tag" & vbCrLf
Code = Code & "        End If" & vbCrLf
Code = Code & "    Next ctl" & vbCrLf
Code = Code & "    Unload Me" & vbCrLf
Code = Code & "End Sub"
With TempForm.CodeModule
    .InsertLines .CountOfLines + 1, Code
End With

' Adjust the form
With TempForm
    .Properties("Caption") = Title
    .Properties("Width") = NewCommandButton1.Left + _
        NewCommandButton1.Width + 10
    If .Properties("Width") < 160 Then
        .Properties("Width") = 160
        NewCommandButton1.Left = 106
        NewCommandButton2.Left = 106
    End If
    .Properties("Height") = TopPos + 24
End With
' Show the form
VBA.UserForms.Add(TempForm.Name).Show
' Delete the form
ThisWorkbook.VBProject.VBComponents.Remove VBComponent:=TempForm

' Pass the selected option back to the calling procedure
GetOption = GETOPTION_RET_VAL
End Function

```


The `GetOption` function is remarkably fast, considering all that's going on behind the scenes. On my system, the form appears almost instantaneously. The `UserForm` is deleted after it has served its purpose.

Using the `GetOption` function

The `GetOption` function takes three arguments:

- `OpArray`: A string array that holds the items to be displayed in the form as `OptionButtons`.
- `Default`: An integer that specifies the default `OptionButton` that is selected when the `UserForm` is displayed. If 0, none of the `OptionButtons` are selected (the user clicks `Cancel`).
- `Title`: The text to display in the title bar of the `UserForm`.

How `GetOption` works

The `GetOption` function performs the following operations:

1. Hides the VBE window to prevent any flashing that could occur when the `UserForm` is created or the code is added.
2. Creates a `UserForm` and assigns it to an object variable named `TempForm`.
3. Adds the `OptionButton` controls by using the array passed to the function via the `OpArray` argument.

It uses the `Tag` property of the control to store the index number. The `Tag` setting of the chosen option is the value that's eventually returned by the function.
4. Adds two `CommandButton` controls: the OK button and the Cancel button.
5. Creates an event handler procedure for each of the `CommandButtons`.
6. Does some final cleanup work.

It adjusts the position of the `CommandButtons` as well as the overall size of the `UserForm`.
7. Displays the `UserForm`.

When the user clicks OK, the `CommandButton1_Click` procedure is executed. This procedure determines which `OptionButton` is selected and also assigns a number to the `GETOPTION_RET_VAL` variable (a `Public` variable).
8. Deletes the `UserForm` after it's dismissed.
9. Returns the value of `GETOPTION_RET_VAL` as the function's result.

**Note**

A significant advantage of creating the UserForm on the fly is that the function is self-contained in a single module and doesn't even require a reference to the VBA Extensibility Library. Therefore, you can export this module (which is named `modOptionsForm`) and then import it into any of your workbooks, thus giving you access to the `GetOption` function.

The following procedure demonstrates how to use the `GetOption` function. In this case, the UserForm presents five options (contained in the `Ops` array).

```
Sub TestGetOption()  
    Dim Ops(1 To 5)  
    Dim UserOption  
    Ops(1) = "North"  
    Ops(2) = "South"  
    Ops(3) = "West"  
    Ops(4) = "East"  
    Ops(5) = "All Regions"  
    UserOption = GetOption(Ops, 5, "Select a region")  
    Debug.Print UserOption  
    MsgBox Ops(UserOption)  
End Sub
```

The `UserOption` variable contains the index number of the option selected by the user. If the user clicks Cancel (or presses Escape), the `UserOption` variable is set to `False`.

Notice that the `Accelerator` property is set to the first character of each option's caption, so the user can use an Alt+letter combination to make a choice. I made no attempt to avoid duplicate Accelerator keys, so the user may need to press the key combination multiple times to make a selection.

Figure 28-10 shows the UserForm that this function generates.

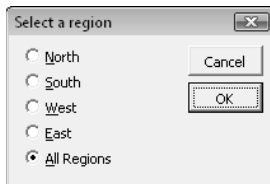


Figure 28-10: The `GetOption` function generated this UserForm.

**Note**

The UserForm adjusts its size to accommodate the number of elements in the array passed to it. Theoretically, the `UserOption` function can accept an array of any size. Practically speaking, however, you'll want to limit the number of options to keep the UserForm at a reasonable size. Figure 28-11 shows how the form looks when the options contain more text.



Figure 28-11: The UserForm adjusts its height and width to accommodate the number of options and the length of the text.

GetOption Event-Handler code

Following are the event-handler procedures for the two CommandButtons. This is the code generated within the `GetOption` function and placed in the code module for the temporary UserForm.

```
Sub CommandButton1_Click()
    GETOPTION_RET_VAL = False
    Unload Me
End Sub
Sub CommandButton2_Click()
    Dim ctl
    GETOPTION_RET_VAL = False
    For Each ctl In Me.Controls
        If TypeName(ctl) = "OptionButton" Then
            If ctl Then GETOPTION_RET_VAL = ctl.Tag
        End If
    Next ctl
    Unload Me
End Sub
```



Because the UserForm is deleted after it's used, you can't see what it looks like in the VBE. So, if you'd like to view the UserForm, convert the following instruction to a comment by typing an apostrophe (') in front of it:

```
ThisWorkbook.VBProject.VBComponents.Remove _
    VBComponent:=TempForm
```


Understanding Class Modules

In This Chapter

- Introducing class modules
- Exploring some typical uses for class modules
- Seeing examples that demonstrate some key concepts related to class modules

What is a Class Module?

For many VBA programmers, the concept of a class module is a mystery, even though this feature has been available in Visual Basic for many years — it was added to Excel beginning with Excel 97. The examples in this chapter may help to make this powerful feature less mysterious.

A *class module* is a special type of VBA module that you can insert into a VBA project. Basically, a class module enables the programmer (you) to create a new object class. As you should know by now, programming Excel really boils down to manipulating objects. A class module allows you to create new objects, along with corresponding properties, methods, and events.



Cross-Ref

Examples in previous chapters in this book use class modules. See Chapters 15, 18, 19, and 22.

At this point, you might be asking, “Do I really need to create new objects?” The answer is no. You don’t *need* to, but you might want to after you understand some of the benefits of doing so. In many cases, a class module simply serves as a substitute for functions or procedures, but it could be a more convenient and manageable alternative. In other cases, however, you’ll find that a class module is the only way to accomplish a particular task.

Following is a list of some typical uses for class modules:

- **To handle events associated with embedded charts.** (see Chapter 18 for an example.)
- **To monitor application-level events,** such as activating any worksheet. (See Chapters 19 and 22 for examples.)

- **To encapsulate a Windows Application Programming Interface (API) function to make it easier to use in your code.** For example, you can create a class that makes it easy to detect or set the state of the Num Lock or Caps Lock key. Or you can create a class that simplifies access to the Windows Registry.
- **To enable multiple objects in a UserForm to execute a single procedure.** Normally, each object has its own event handler. The example in Chapter 15 demonstrates how to use a class module so that multiple CommandButtons have a single `Click` event handler procedure.
- **To create reusable components that can be imported into other projects.** After you create a general-purpose class module, you can import it into other projects to reduce your development time.

Example: Creating a NumLock Class

In this section, I provide step-by-step instructions for creating a useful, albeit simple, class module. This class module creates a `NumLock` class that has one property (`Value`) and one method (`Toggle`).

Detecting or changing the state of the Num Lock key requires several Windows API functions. As you see, detecting the state of a particular toggle key is fairly complicated. The purpose of this class module is to simplify things. All the API declarations and code are contained in a class module (not in a normal VBA module). The benefits? Your code will be much easier to work with, and you can reuse this class module in your other projects.

After the class is created, your VBA code can determine the current state of the Num Lock key by using an instruction such as the following, which displays the `Value` property:

```
MsgBox NumLock.Value
```

Or your code can change the state of the Num Lock key by changing the `Value` property. The following instruction, for example, turns on the Num Lock key:

```
NumLock.Value = True
```

In addition, your code can toggle the Num Lock key by using the `Toggle` method:

```
NumLock.Toggle
```

It's important to understand that a class module contains the code that *defines* the object, including its properties and methods. You can then create an instance of this object in your VBA general code modules and manipulate its properties and methods.

To better understand the process of creating a class module, you might want to follow the instructions in the next sections. Start with an empty workbook.

Inserting a class module

Activate the Visual Basic Editor (VBE) and choose **Insert**→**Class Module**. This adds an empty class module named `Class1`. If the Properties window isn't displayed, press F4 to display it. Then change the name of the class module to `NumLockClass` (see Figure 29-1).

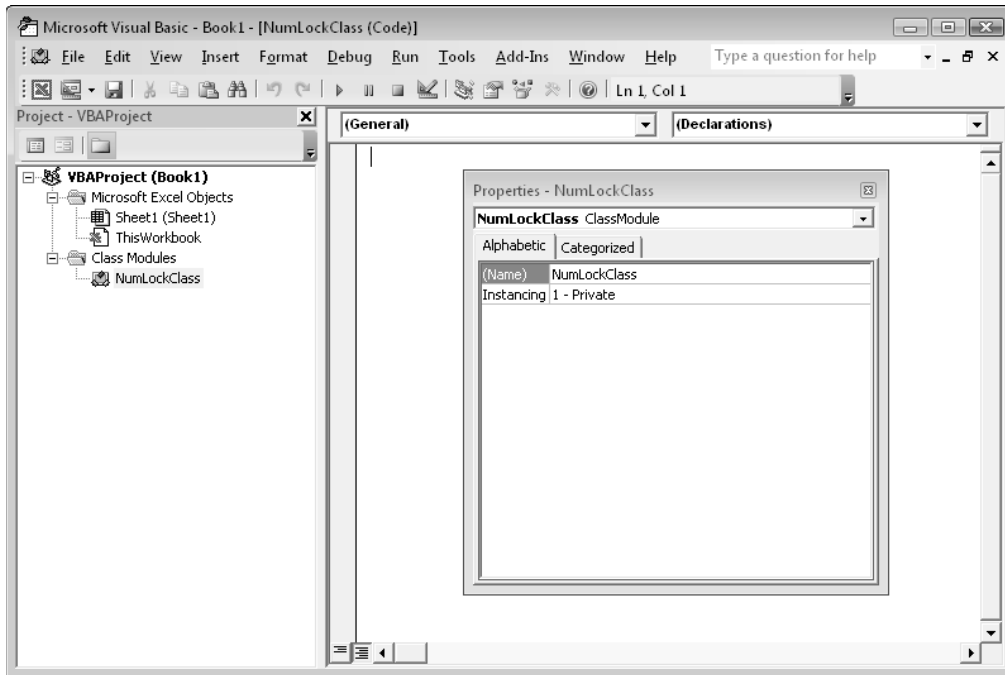


Figure 29-1: An empty class module named `NumLockClass`.

Adding VBA code to the class module

In this step, you create the code for the `Value` property. To detect or change the state of the Num Lock key, the class module needs the required Windows API declarations that are used to detect and set the Num Lock key. That code follows.



Note

The VBA code for this example was adapted from an example at the Microsoft Web site. The code shown here works only for Excel 2010. The version on the CD-ROM is compatible with previous versions of Excel.

```
' Type declaration
Private Type OSVERSIONINFO
    dwOSVersionInfoSize As Long
```

```

    dwMajorVersion As Long
    dwMinorVersion As Long
    dwBuildNumber As Long
    dwPlatformId As Long
    szCSDVersion As String * 128
End Type
' API declarations
Private Declare PtrSafe Function GetVersionEx Lib "Kernel32" _
    Alias "GetVersionExA" _
    (lpVersionInformation As OSVERSIONINFO) As Long
Private Declare PtrSafe Sub keybd_event Lib "user32" _
    (ByVal bVk As Byte, _
    ByVal bScan As Byte, _
    ByVal dwFlags As Long, ByVal dwExtraInfo As Long)
Private Declare PtrSafe Function GetKeyboardState Lib "user32" _
    (pbKeyState As Byte) As Long
Private Declare PtrSafe Function SetKeyboardState Lib "user32" _
    (lppbKeyState As Byte) As Long
'Constant declarations
Const VK_NUMLOCK = &H90
Const VK_SCROLL = &H91
Const VK_CAPITAL = &H14
Const KEYEVENTF_EXTENDEDKEY = &H1
Const KEYEVENTF_KEYUP = &H2

```

Next, you need a procedure that retrieves the current state of the Num Lock key. I'll call this the `Value` property of the object. You can use any name for the property, but `Value` seems like a good choice. To retrieve the state, insert the following `Property Get` procedure:

```

Property Get Value() As Boolean
'   Get the current state
    Dim keys(0 To 255) As Byte
    GetKeyboardState keys(0)
    Value = keys(VK_NUMLOCK)
End Property

```



Cross-Ref

The details of `Property` procedures are described later in this chapter. See “Programming properties of objects.”

This procedure, which uses the `GetKeyboardState` Windows API function to determine the current state of the Num Lock key, is called whenever VBA code reads the `Value` property of the object. For example, after the object is created, a VBA statement such as this executes the `Property Get` procedure:

```
MsgBox NumLock.Value
```


You now need a procedure that sets the Num Lock key to a particular state: either on or off. You can do this with the following `Property Let` procedure:

```
Property Let Value(boolVal As Boolean)
    Dim o As OSVERSIONINFO
    Dim keys(0 To 255) As Byte
    o.dwOSVersionInfoSize = Len(o)
    GetVersionEx o
    GetKeyboardState keys(0)
    ' Is it already in that state?
    If boolVal = True And keys(VK_NUMLOCK) = 1 Then Exit Property
    If boolVal = False And keys(VK_NUMLOCK) = 0 Then Exit Property
    ' Toggle it
    'Simulate Key Press
    keybd_event VK_NUMLOCK, &H45, KEYEVENTF_EXTENDEDKEY Or 0, 0
    'Simulate Key Release
    keybd_event VK_NUMLOCK, &H45, KEYEVENTF_EXTENDEDKEY Or _
        KEYEVENTF_KEYUP, 0
End Property
```

The `Property Let` procedure accepts one argument, which is either `True` or `False`. A VBA statement such as the following sets the `Value` property of the `NumLock` object to `True` by executing the `Property Let` procedure:

```
NumLock.Value = True
```

Finally, you need a procedure to toggle the `NumLock` state. I'll call this the `Toggle` method.

```
Sub Toggle()
    ' Toggles the state
    Dim o As OSVERSIONINFO
    o.dwOSVersionInfoSize = Len(o)
    GetVersionEx o
    Dim keys(0 To 255) As Byte
    GetKeyboardState keys(0)
    'Simulate Key Press
    keybd_event VK_NUMLOCK, &H45, KEYEVENTF_EXTENDEDKEY Or 0, 0
    'Simulate Key Release
    keybd_event VK_NUMLOCK, &H45, KEYEVENTF_EXTENDEDKEY Or _
        KEYEVENTF_KEYUP, 0
End Sub
```

Notice that `Toggle` is a standard `Sub` procedure (not a `Property Let` or `Property Get` procedure). A VBA statement such as the following one toggles the state of the `NumLock` object by executing the `Toggle` procedure:

```
NumLock.Toggle
```

Using the NumLockClass class

Before you can use the `NumLockClass` class module, you must create an instance of the object. The following statement, which resides in a regular VBA module (not the class module), does just that:

```
Dim NumLock As New NumLockClass
```

Notice that the object type is `NumLockClass` (that is, the name of the class module). The object variable itself can have any name, but `NumLock` certainly seems like a logical name for this.

The following procedure sets the `Value` property of the `NumLock` object to `True`, which results in the Num Lock key being turned on:

```
Sub NumLockOn()  
    Dim NumLock As New NumLockClass  
    NumLock.Value = True  
End Sub
```

The next procedure displays a message box that indicates the current state of the Num Lock key (`True` is on; `False` is off):

```
Sub GetNumLockState()  
    Dim NumLock As New NumLockClass  
    MsgBox NumLock.Value  
End Sub
```

The following procedure toggles the Num Lock key:

```
Sub ToggleNumLock()  
    Dim NumLock As New NumLockClass  
    NumLock.Toggle  
End Sub
```

Notice that there's another way to toggle the Num Lock key without using the `Toggle` method:

```
Sub ToggleNumLock2()  
    Dim NumLock As New NumLockClass  
    NumLock.Value = Not NumLock.Value  
End Sub
```

It should be clear that using the NumLock class is much simpler than using the API functions. After you create a class module, you can reuse it in any other project simply by importing the class module.



On the CD

The completed class module for this example is available on the companion CD-ROM. The workbook, named `keyboard_classes.xlsm`, also contains class modules to detect and set the state of the Caps Lock key and the Scroll Lock key.

More about Class Modules

The example in the preceding section demonstrates how to create a new object class with a single read/write property named `Value` and a single method named `Toggle`. An object class can contain any number of properties, methods, and events.

The name that you use for the class module in which you define the object class is also the name of the object class. By default, class modules are named `Class1`, `Class2`, and so on. Usually, you'll want to provide a more meaningful name for your object class.

Programming properties of objects

Most objects have at least one property, and you can give them as many as you need. After a property is defined and the object is created, you can use it in your code using the standard “dot” syntax:

```
object.property
```

The VBE Auto List Members option works with objects defined in a class module. This makes it easier to select properties or methods when writing code.

Properties for the object that you define can be read-only, write-only, or read/write. You define a read-only property with a single procedure — using the `Property Get` keyword. Here's an example of a `Property Get` procedure:

```
Property Get FileNameOnly() As String
    FileNameOnly = ""
    For i = Len(FullName) To 1 Step -1
        Char = Mid(FullName, i, 1)
        If Char = "\" Then
            Exit Function
        Else
            FileNameOnly = Char & FileNameOnly
        End If
    Next i
End Property
```

You may have noticed that a `Property Get` procedure works like a `Function` procedure. The code performs calculations and then returns a property value that corresponds to the procedure's name. In this example, the procedure's name is `FileNameOnly`. The property value returned is the filename part of a path string (contained in a `Public` variable named `FullName`). For example, if `FullName` is `c:\data\myfile.txt`, the procedure returns a property value of `myfile.txt`. The `FileNameOnly` procedure is called when VBA code references the object and property.

For read/write properties, you create two procedures: a `Property Get` procedure (which reads a property value) and a `Property Let` procedure (which writes a property value). The value being assigned to the property is treated as the final argument (or the only argument) of a `Property Get` procedure.

Two example procedures follow:

```
Dim XLFile As Boolean
Property Get SaveAsExcelFile() As Boolean
    SaveAsExcelFile = XLFile
End Property
Property Let SaveAsExcelFile(boolVal As Boolean)
    XLFile = boolVal
End Property
```



Note

Use `Property Set` in place of `Property Let` when the property is an object data type.

A `Public` variable in a class module can also be used as a property of the object. In the preceding example, the `Property Get` and `Property Let` procedures could be eliminated and replaced with this module-level declaration:

```
Public SaveAsExcelFile As Boolean
```

In the unlikely event that you need to create a write-only property, you create a single `Property Let` procedure with no corresponding `Property Get` procedure.

The preceding examples use a `Boolean` module-level variable named `XLFile`. The `Property Get` procedure simply returns the value of this variable as the property value. If the object were named `FileSys`, for example, the following statement would display the current value of the `SaveAsExcelFile` property:

```
MsgBox FileSys.SaveAsExcelFile
```

The `Property Let` statement, on the other hand, accepts an argument and uses the argument to change the value of a property. For example, you could write a statement such as the following to set the `SaveAsExcelFile` property to `True`:

```
FileSys.SaveAsExcelFile = True
```

In this case, the value `True` is passed to the `Property Let` statement, thus changing the property's value.

The preceding examples use a module-level variable named `XLFile` that actually stores the property value. You'll need to create a variable that represents the value for each property that you define within your class module.



Normal procedure-naming rules apply to property procedures, and you'll find that VBA won't let you use some names if they are reserved words. So, if you get a syntax error when creating a property procedure, try changing the name of the procedure.

Programming methods for objects

A method for an object class is programmed by using a standard `Sub` or `Function` procedure placed in the class module. An object might or might not use methods. Your code executes a method by using standard notation:

```
object.method
```

Like any other VBA method, a method that you write for an object class will perform some type of action. The following procedure is an example of a method that saves a workbook in one of two file formats, depending on the value of the `XLFile` variable. As you can see, there is nothing special about this procedure.

```
Sub SaveFile()  
    If XLFile Then  
        ActiveWorkbook.SaveAs FileName:=FName, _  
            FileFormat:=xlWorkbookNormal  
    Else  
        ActiveWorkbook.SaveAs FileName:=FName, _  
            FileFormat:=xlCSV  
    End If  
End Sub
```

The `CSVFileClass` example in the next section should clarify the concepts of properties and methods for object classes defined in a class module.

Class module events

Every class module has two events: `Initialize` and `Terminate`. The `Initialize` event occurs when a new instance of the object is created; the `Terminate` event occurs when the object is destroyed. You might want to use the `Initialize` event to set default property values.

The frameworks for these event-handler procedures are as follows:

```
Private Sub Class_Initialize()  
    ' Initialization code goes here  
End Sub  
Private Sub Class_Terminate()  
    ' Termination code goes here  
End Sub
```

An object is *destroyed* (and the memory it uses is freed) when the procedure or module in which it is declared finishes executing. You can destroy an object at any time by setting it to `Nothing`. The following statement, for example, destroys the object named `MyObject`:

```
Set MyObject = Nothing
```

Example: A CSV File Class

The example presented in this section defines an object class called `CSVFileClass`. This class has two properties and two methods:

➤ **Properties:**

- `ExportRange`: (Read/write) A worksheet range to be exported as a CSV file.
- `ImportRange`: (Read/write) The range into which a CSV file will be imported.

➤ **Methods:**

- `Import`: Imports the CSV file represented by the `CSVFileName` argument into the range represented by the `ImportRange` property.
- `Export`: Exports the range represented by the `ExportRange` property to a CSV file represented by the `CSVFileName` argument.



On the CD

The example in this section is available on the companion CD-ROM. The filename is 'csv class.xlsm'.

Class module–level variables for the CSVFileClass

A class module must maintain its own private variables that mirror the property settings for the class. The `CSVFileClass` class module uses two variables to keep track of the two property settings. These variables are declared at the top of the class module:

```
Private RangeToExport As Range
Private ImportToCell As Range
```

`RangeToExport` is a `Range` object that represents the range to be exported. `ImportToCell` is a `Range` object that represents the upper-left cell of the range into which the file will be imported. These variables are assigned values by the `Property Get` and `Property Let` procedures listed in the next section.

Property procedures for the CSVFileClass

The property procedures for the `CSVFileClass` class module follow. The `Property Get` procedures return the value of a variable, and the `Property Let` procedures set the value of a variable.

```
Property Get ExportRange() As Range
    Set ExportRange = RangeToExport
End Property
Property Let ExportRange(rng As Range)
    Set RangeToExport = rng
End Property
Property Get ImportRange() As Range
    Set ImportRange = ImportToCell
End Property
Property Let ImportRange(rng As Range)
    Set ImportToCell = rng
End Property
```

Method procedures for the CSVFileClass

The `CSVFileClass` class module contains two procedures that represent the two methods. These are listed and discussed in the sections that follow.

The Export procedure

The `Export` procedure is called when the `Export` method is executed. It takes one argument: the full name of the file receiving the exported range. The procedure provides some basic error handling. For example, it ensures that the `ExportRange` property has been set by checking the `RangeToExport` variable. The procedure sets up an error handler to trap other errors.

```

Sub Export(CSVFileName)
'   Exports a range to CSV file
If RangeToExport Is Nothing Then
    MsgBox "ExportRange not specified"
    Exit Sub
End If

On Error GoTo ErrHandle
Application.ScreenUpdating = False
Set ExpBook = Workbooks.Add(xlWorksheet)
RangeToExport.Copy
Application.DisplayAlerts = False

With ExpBook
    .Sheets(1).Paste
    .SaveAs FileName:=CSVFileName, FileFormat:=xlCSV
    .Close SaveChanges:=False
End With
Application.CutCopyMode = False
Application.ScreenUpdating = True
Application.DisplayAlerts = True
Exit Sub
ErrHandle:
ExpBook.Close SaveChanges:=False
Application.CutCopyMode = False
Application.ScreenUpdating = True
Application.DisplayAlerts = True
MsgBox "Error " & Err & vbCrLf & vbCrLf & Error(Err), _
    vbCritical, "Export Method Error"
End Sub

```

The `Export` procedure works by copying the range specified by the `RangeToExport` variable to a new temporary workbook, saving the workbook as a CSV text file, and closing the file. Because screen updating is turned off, the user doesn't see this happening. If an error occurs — for example, an invalid filename is specified — the procedure jumps to the `ErrHandle` section and displays a message box that contains the error number and description.

The Import procedure

The `Import` procedure imports a CSV file specified by the `CSVFileName` argument and copies its contents to a range specified by the `ImportToCell` variable, which maintains the `ImportRange` property. The file is then closed. Again, screen updating is turned off, so the user doesn't see the file being opened. Like the `Export` procedure, the `Import` procedure incorporates some basic error handling.

```

Sub Import(CSVFileName)
'   Imports a CSV file to a range
If ImportToCell Is Nothing Then

```



```

        MsgBox "ImportRange not specified"
    Exit Sub
End If

If CSVFileName = "" Then
    MsgBox "Import FileName not specified"
    Exit Sub
End If

On Error GoTo ErrHandle
Application.ScreenUpdating = False
Application.DisplayAlerts = False
Workbooks.Open CSVFileName
Set CSVFile = ActiveWorkbook
ActiveSheet.UsedRange.Copy Destination:=ImportToCell
CSVFile.Close SaveChanges:=False
Application.ScreenUpdating = True
Application.DisplayAlerts = True
Exit Sub
ErrHandle:
    CSVFile.Close SaveChanges:=False
    Application.ScreenUpdating = True
    Application.DisplayAlerts = True
    MsgBox "Error " & Err & vbCrLf & vbCrLf & Error(Err), _
        vbCritical, "Import Method Error"
End Sub

```

Using the CSVFileClass object

To create an instance of a CSVFileClass object in your code, start by declaring a variable as type CSVFileClass in a standard VBA module. Here's an example:

```
Dim CSVFile As New CSVFileClass
```

You might prefer to declare the object variable first and then create the object when needed. This requires a Dim statement and a Set statement:

```

Dim CSVFile As CSVFileClass
' other code may go here
Set CSVFile = New CSVFileClass

```

The advantage of using both a Dim statement and a Set statement is that the object isn't actually created until the Set statement is executed. You might want to use this technique to save memory by not creating an object if it's not needed. For example, your code might contain logic that determines whether the object is actually created. In addition, using the Set command enables you to create multiple instances of an object.

After creating an instance of the object, you can write other instructions to access the properties and methods defined in the class module.

As you can see in Figure 29-2, the VBE Auto List Members feature works just like any other object. After you type the variable name and a dot, you see a list of properties and methods for the object.

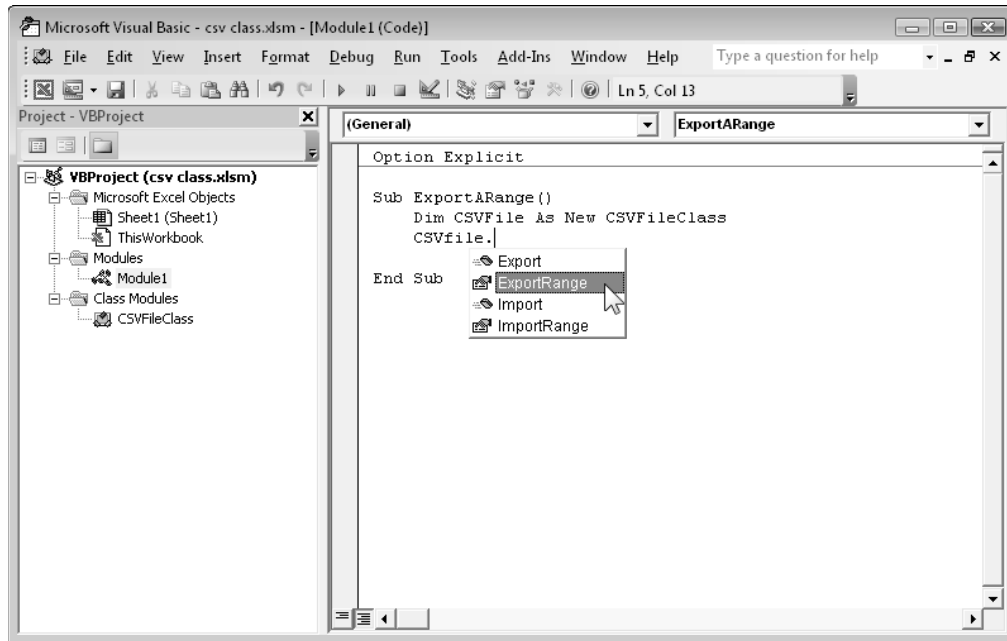


Figure 29-2: The Auto List Members feature displays the available properties and methods.

The following procedure demonstrates how to save the current range selection to a CSV file named `temp.csv`, which is stored in the same directory as the current workbook:

```
Sub ExportARange()
    Dim CSVFile As New CSVFileClass
    With CSVFile
        .ExportRange = ActiveWindow.RangeSelection
        .Export CSVFileName:=ThisWorkbook.Path & "\temp.csv"
    End With
End Sub
```

Using the `With-End With` structure isn't mandatory. For example, the procedure could be written as follows:

```
Sub ExportARange()  
    Dim CSVFile As New CSVFileClass  
    CSVFile.ExportRange = ActiveWindow.RangeSelection  
    CSVFile.Export CSVFileName:=ThisWorkbook.Path & "\temp.csv"  
End Sub
```

The following procedure demonstrates how to import a CSV file, beginning at the active cell:

```
Sub ImportAFile()  
    Dim CSVFile As New CSVFileClass  
    With CSVFile  
        On Error Resume Next  
        .ImportRange = ActiveCell  
        .Import CSVFileName:=ThisWorkbook.Path & "\temp.csv"  
    End With  
    If Err <> 0 Then _  
        MsgBox "Cannot import " & ThisWorkbook.Path & "\temp.csv" End Sub
```

Your code can work with more than one instance of an object. The following code, for example, creates an array of three `CSVFileClass` objects:

```
Sub Export3Files()  
    Dim CSVFile(1 To 3) As New CSVFileClass  
    CSVFile(1).ExportRange = Range("A1:A20")  
    CSVFile(2).ExportRange = Range("B1:B20")  
    CSVFile(3).ExportRange = Range("C1:C20")  
    For i = 1 To 3  
        CSVFile(i).Export CSVFileName:="File" & i & ".csv"  
    Next i  
End Sub
```


Working with Colors

In This Chapter

- Specifying colors in VBA code
- Using VBA conversion functions for various color models
- Converting colors to grayscale
- Working with document themes
- Modifying colors in Shape objects
- Modifying colors in charts

Specifying Colors

Dealing with color in Excel 2010 is no trivial matter. I'm the first to admit that it can be complicated. And often, recording a macro while you change the color of a cell or object only adds to the confusion.

One of the most significant changes introduced in Excel 2007 was the abandonment of the old 56-color workbook palette. Back in the pre-Excel 2007 days, a workbook stored a palette of 56-colors. These colors were the only ones available for cell backgrounds, cell text, and charts. You could modify any or all of those colors, but there was no way to exceed the 56-color limit for a workbook.

But things changed with the introduction of Excel 2007. You now have access to a virtually unlimited number of colors in a workbook — actually, the limit is 16,777,216 colors, but that certainly qualifies as virtually unlimited in my book.

In VBA, you can specify a color as a decimal color value, which is a number between 0 and 16,777,215. For example, the VBA statement that follows changes the background color of the active cell to a dark maroon:

```
ActiveCell.Interior.Color = 5911168
```

In addition, VBA has predefined constants for some common colors. For example, `vbRed` has a value of 255 (the decimal value for pure red), and `vbGreen` has a value of 65,280.

No one, of course, can keep track of nearly 17 million colors, and the predefined constants are limited. A better way to change a color is to specify the color in terms of its red, green, and blue components — the RGB color system.

The RGB color system

The RGB color system combines various levels of three colors: red, green, and blue. Each of these color values can range from 0 through 255. Therefore, the total number of possible colors is $256 \times 256 \times 256 = 16,777,216$. When all three color components are 0, the color is pure black. When all three components are 255, the color is pure white. When all three are 128 (the half-way point), the color is middle gray. The remaining 16,777,213 possible combinations of these three values represent other colors.

To specify a color using the RGB system in VBA, use the `RGB` function. This function accepts three arguments that represent the red, blue, and green components of a color. The function returns a decimal color value.

The statement that follows uses the `RGB` function to assign a color that's exactly the same as the one assigned in the preceding section (that dark maroon, 5911168):

```
ActiveCell.Interior.Color = RGB(128, 50, 90)
```

Table 30-1 shows the RGB values and the decimal color code of some common colors.

Table 30-1: Color Examples

Name	Red Component	Green Component	Blue Component	Color Value
Black 0		0	0	0
White 255		255	255	16777215
Red 255		0	0	255
Green 0		255	0	65280
Blue 0		0	255	16711680
Yellow 255		255	0	65535
Pink 255		0	255	16711935
Turquoise 0		255	255	16776960
Brown 153		51	0	13209
Indigo 51		51	153	10040115
80% Gray	51	51	51	3355443

The HSL color system

If you select the More Colors option when choosing a color in Excel, you see the Colors dialog box. Click the Custom tab, and you can choose from two color models to specify your color: RGB and HSL. Figure 30-1 shows the Colors dialog box with the HSL color model selected.

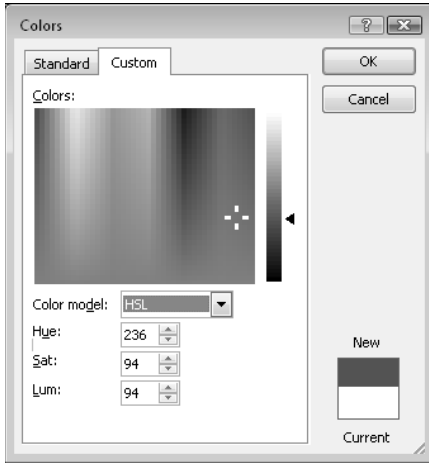


Figure 30-1: Choosing a color using the HSL color system.

In the HSL color system, colors are specified using three parameters: Hue, Saturation, and Luminance. As with RGB colors, each of these parameters can range from 0 to 255. Each RGB color has an equivalent HSL color, and each HSL color has an equivalent decimal color value. In other words, you can specify any of the 16,777,216 colors by using any of the three color systems: RGB, HSL, or decimal.

Although the Colors dialog box lets you specify a color using the HSL color model, this is actually the *only* area in which Excel supports the HSL color model. For example, when you specify a color using VBA, it must be a decimal color value. You can, of course, use the RGB function to return a decimal color value. However, VBA doesn't have a function that allows you to specify a color in terms of hue, saturation, and luminance.

Converting colors

If you know a color's red, green, and blue component values, converting the color to a decimal color is easy. Just use VBA's RGB function. Assume three variables (*r*, *g*, and *b*), each of which represents a color component value between 0 and 255. To calculate the equivalent decimal color value, use a statement like this:

```
DecimalColor = RGB(r, g, b)
```

To perform this conversion in a worksheet formula, create this simple VBA wrapper function:

```
Function RGB2DECIMAL(R, G, B) As Long
'   Converts from RGB to decimal color
    RGB2DECIMAL = RGB(R, G, B)
End Function
```

The following example worksheet formula assumes the three color values are in A1:C1:

```
=RGB2DECIMAL(A1,B1,C1)
```

Converting a decimal color to its red, green, and blue components is a bit more complicated. Here's a function that returns a three-element array:

```
Function DECIMAL2RGB(ColorVal) As Variant
'   Converts a color value to an RGB triplet
'   Returns a 3-element variant array
    DECIMAL2RGB = Array(ColorVal \ 256 ^ 0 And 255, _
        ColorVal \ 256 ^ 1 And 255, ColorVal \ 256 ^ 2 And 255)
End Function
```

To use the `DECIMAL2RGB` function in a worksheet formula, the formula must be entered as a three-cell array formula. For example, assume that cell A1 contains a decimal color value. To convert that color value to its RGB components, select a three-cell horizontal range and then enter the following formula. Press **Ctrl+Shift+Enter** to make it an array formula and don't enter the braces.

```
{=DECIMAL2RGB(A1)}
```

If the three-cell range is vertical, you need to transpose the array, as follows:

```
{=TRANSPOSE(DECIMAL2RGB(A1))}
```

Figure 30-2 shows the `DECIMAL2RGB` and `DECIMAL2HSL` functions in use in a worksheet.



On the CD

The companion CD-ROM contains a workbook with the following color conversion functions: `DECIMAL2RGB`, `DECIMAL2HSL`, `HSL2RGB`, `RGB2DECIMAL`, `RGB2HSL`, and `HSL2DECIMAL`. The file is named `color conversion functions.xlsm`.

	A	B	C	D	E	F	G	H	I
1	Decimal		Decimal-To-RGB				Decimal-To-HSL		
2	Color Value		R	G	B		H	S	L
3	0		0	0	0		0	0	0
4	167,772		92	143	2		58	248	72
5	335,544		184	30	5		6	242	94
6	503,316		20	174	7		82	235	90
7	671,088		112	61	10		21	213	61
8	838,860		204	204	12		42	227	108
9	1,006,632		40	92	15		71	184	54
10	1,174,404		132	235	17		63	221	126
11	1,342,176		224	122	20		21	213	122
12	1,509,948		60	10	23		244	182	35
13	1,677,720		152	153	25		43	183	89
14	1,845,492		244	40	28		2	231	136
15	2,013,264		80	184	30		71	184	107
16	2,181,036		172	71	33		12	173	102
17	2,348,808		8	215	35		91	237	112
18	2,516,580		100	102	38		44	117	70
19	2,684,352		192	245	40		53	232	142
20	2,852,124		28	133	43		91	166	80
21	3,019,896		120	20	46		244	182	70
22	3,187,668		212	163	48		30	167	130
23	3,355,440		48	51	51		128	8	50
24	3,523,212		140	194	53		59	146	124
25	3,690,984		232	81	56		6	202	144
26	3,858,756		68	225	58		82	188	142

Figure 30-2: A worksheet that uses the DECIMAL2RGB and DECIMAL2HSL functions



More about decimal color values

You may be curious about how the 16,777,216 decimal color values are arranged. Color 0 is black, and color 16,777,216 is white, but what about all those colors in between?

It might help to think of the decimal color values as being generated by nested For-Next loops, as shown in the following code:

```
Sub GenerateColorValues()
    Dim Red As Long, Blue As Long, Green As Long
    Dim AllColors(0 To 16777215) As Long
    Dim ColorNum As Long
    ColorNum = 0
    For Blue = 0 To 255
        For Green = 0 To 255
            For Red = 0 To 255
                AllColors(ColorNum) = RGB(Red, Blue, Green)
                ColorNum = ColorNum + 1
            Next Red
        Next Green
    Next Blue
End Sub
```

After this procedure runs, the values in the AllColors array correspond exactly to the decimal color values used by Excel.

Understanding Grayscale

When you create worksheets and charts that are intended to be printed, it's important to remember that not everyone has a color printer. And even if your chart is printed on a color printer, it's possible that it may be photocopied, faxed, or viewed by someone who is color-blind (a condition that affects about 8 percent of the male population).

When content is printed on a noncolor device, colors are converted to grayscale. Sometimes you'll be lucky, and your colors will display nicely when converted to grayscale. Other times, you won't be so lucky. For example, the columns in a chart may be indistinguishable when the colors are converted.

Every grayscale color has an equal component of red, green, and blue. Pure black is RGB(0, 0, 0). Pure white is RGB(255, 255, 255). Neutral gray is RGB(128, 128, 128). Using this color system produces 256 shades of gray.

To create a 256-color grayscale in a range of cells, execute the procedure that follows. It colors the background of cells in the range A1:A256, starting with black and ending with white. You might want to zoom out on the worksheet to see the entire range.

```
Sub GenerateGrayScale()  
    Dim r As Long  
    For r = 0 To 255  
        Cells(r + 1, 1).Interior.Color = RGB(r, r, r)  
    Next r  
End Sub
```

Figure 30-3 shows the result, after decreasing the row heights and making column A wider.

Converting colors to gray

One approach to grayscale conversion is to simply average the Red, Green, and Blue components of a color and use that single value for the Red, Green, and Blue components of its grayscale equivalent. That method, however, doesn't take into account the fact that different colors are perceived as varying levels of brightness. For example, green is perceived to be brighter than red, and red is perceived to be brighter than blue.

Perceptual experiments have arrived at the following "recipe" to convert an RGB color value to a grayscale value

- 28.7% of the red component
- 58.9% of the green component
- 11.4% of the blue component



Figure 30-3: Cells displaying 256 shades of gray.

For example, consider color value 16751001, a shade of violet that corresponds to RGB (153, 153, 255). Applying the factors listed previously, the RGB values are

- **Red:** $28.7\% \times 153 = 44$
- **Green:** $58.9\% \times 153 = 90$
- **Blue:** $11.4\% \times 255 = 29$

The sum of these values is 163. Therefore, the corresponding grayscale RGB value for color value 16751001 is RGB (163, 163, 163).

Following is a VBA function that accepts a decimal color value as its argument and returns the corresponding grayscale decimal value:

```
Function Grayscale(color) As Long
    Dim r As Long, g As Long, b As Long
    r = (color \ 256 ^ 0 And 255) * 0.287
    g = (color \ 256 ^ 1 And 255) * 0.589
    b = (color \ 256 ^ 2 And 255) * 0.114
    Grayscale = RGB(r + g + b, r + g + b, r + g + b)
End Function
```

Viewing charts as grayscale

Unfortunately, Excel's print preview feature doesn't do grayscale conversion. For example, if you have a black and white laser printer, previewing your print job shows colors — not the grayscale that is actually produced by your printers.

The Sheet tab of the Page Setup dialog box (displayed by clicking the dialog box launcher in the Page Layout→Page Setup group), has an option labeled Black And White. When checked, your charts are printed in true black and white, not grayscale. Colors are converted to patterns that consist of black and white. Note that this setting applies only to charts and other graphic objects. When printing in Black And White mode, cells colors are ignored.

Here's a technique that lets you see how an embedded chart looks converted to grayscale:

1. Select the chart.
2. Press Ctrl+C to copy the chart to the Clipboard.
3. Click a cell and choose Home→Clipboard→Paste→Picture.
4. Select the pasted picture and choose Picture Tools→Format→Adjust→Color and then choose the Grayscale color mode from the Recolor section of the drop-down gallery (see Figure 30-4).

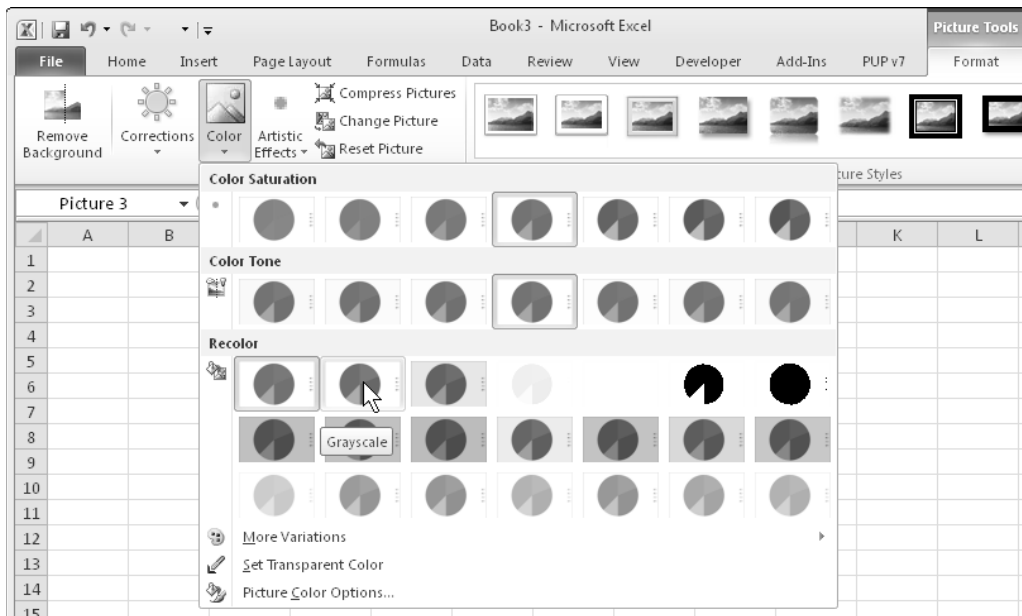


Figure 30-4: Converting a picture of a chart to grayscale.

These steps are automated in the macro that follows. The `ShowChartAsGrayScale` procedure copies the active chart as a picture and converts the picture to grayscale. After you've determined whether the colors are satisfactory for grayscale printing, you can delete the picture.

```
Sub ShowChartAsGrayScale()  
' Copies the active chart as a grayscale picture  
' Embedded charts only  
If ActiveChart Is Nothing Then  
    MsgBox "Select a chart."  
    Exit Sub  
End If  
ActiveChart.Parent.CopyPicture  
ActiveChart.Parent.TopLeftCell.Select  
ActiveSheet.Pictures.Paste  
ActiveSheet.Pictures(ActiveSheet.Pictures.Count). _  
    ShapeRange.PictureFormat.ColorType = msoPictureGrayscale  
End Sub
```



On the CD

A workbook with this example is available on the companion CD-ROM. The filename is `chart to grayscale picture.xlsm`.



Tip

Don't overlook the built-in grayscale chart styles. The grayscales used in these styles seem to be optimized for showing variations in chart elements.

Experimenting with Colors

Figure 30-5 shows a workbook that I created that deals with colors. If you're at all confused about how the RGB color model works, spending some time with this color demo workbook will probably make it all very clear.



On the CD

This workbook, named `RGB color demo.xlsm`, is available on the companion CD-ROM.

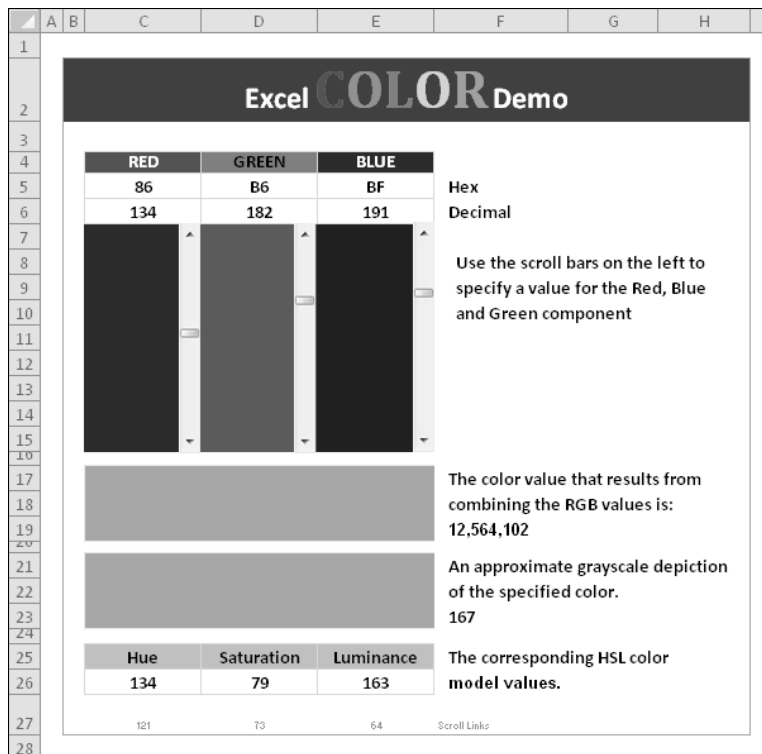


Figure 30-5: This workbook demonstrates how red, green, and blue colors combine.

This workbook contains three vertical scroll bars, each of which controls the background color of a range. Use these scroll bars to specify the red, green, and blue components for a color to values between 0 and 255. Moving the scroll bars changes several areas of the worksheet:

- The cells above the scroll bars display the color components in hexadecimal (00–FF) and in decimal (0–255). Hexadecimal RGB color values are often used in specifying colors for HTML documents.
- The ranges next to each scroll bar change intensity, corresponding to the scroll bar's position (that is, the value of the color component).
- A range below the scroll bars depicts the combined color, determined by the RGB values you specify.
- A cell displays the decimal color value.
- Another range depicts the color's approximate appearance when it's converted to grayscale.
- A range of cells shows the corresponding HSL color values.

Understanding Document Themes

A significant new feature introduced in Excel 2007 was document themes. With a single mouse click, the user can change the entire look of a document. A document theme consists of three components: colors, fonts, and effects (for graphic objects). The rationale for using themes is that they may help users produce better-looking and more consistent documents. A theme applies to the entire workbook, not just the active worksheet.

About document themes

Microsoft Office 2010 ships with about 40 document themes, and you can also download or create additional themes. The Ribbon includes several style galleries (for example, the Chart Styles gallery). The styles available in these galleries vary depending on which theme is assigned to the document. If you apply a different theme to the document, the document changes to reflect the new theme's colors, fonts, and effects.



On the CD

If you haven't explored document themes, open the workbook named `document theme demo.xlsx` found on the companion CD-ROM. This workbook contains a range that shows each theme color, two shapes, text (using the headings and body fonts), and a chart. Choose Page Layout→Themes→Themes Gallery to see how the worksheet changes with each theme.

Users can also mix and match theme elements. For example, you can use the colors from one theme, the fonts from another theme, and the effects from yet a different theme. In addition, the user can create a new color set or a new font set. You can save these customized themes and then apply them to other workbooks.



Note

The concept of document themes is based on the notion that users will apply little, if any, nontheme formatting to the document. If the user applies colors or fonts that aren't part of the current theme, this formatting will not be modified if a new theme is applied to the document. Therefore, it's still very easy to create an ugly document with mismatched colors and too many different fonts.

Understanding document theme colors

When a user applies a color to a cell or object, the color is selected from a control like the one shown in Figure 30-6. The control displays the 60 theme colors (10 columns by 6 rows) plus 10 additional standard colors. Clicking the More Colors option displays the Color dialog box, in which the user can specify any of the 16,777,216 available colors.

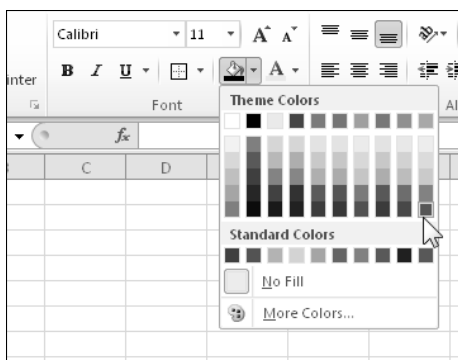


Figure 30-6: A color-selection control.

The 60 theme colors are identified by pop-up ToolTips. For example, the color in the second row of the sixth column is known as “Accent 2, Lighter 80%.”

The first row in each column of colors contains the “pure” color. Below each pure color are six “tint and shade” variations. Table 30-2 shows the color descriptions for the color picker controls.

Keep in mind that these color names remain the same, even if a different document theme is applied. The document theme colors actually consist of the ten colors displayed in the top row (four text/background colors and six accent colors), and each of these ten colors has five tint/shade variations.



Note

If you select **Page Layout**→**Themes**→**Colors**→**Create New Theme Colors**, you see that a theme has two additional colors: **Hyperlink** and **Followed Hyperlink**. These are the colors applied when a hyperlink is created, and they are not shown in the color selector control.

You may find it enlightening to record a macro while you change the fill color and text color of a range. Following is a macro that I recorded when a range was selected. For the fill color, I chose “Accent 2, Darker 25%,” and for the text color, I chose “Text 2, Lighter 80%.”

```
Sub ChangeColors()
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent2
        .TintAndShade = -0.249977111117893
        .PatternTintAndShade = 0
    End With
    With Selection.Font
        .ThemeColor = xlThemeColorLight2
        .TintAndShade = 0.799981688894314
    End With
End Sub
```


Table 30-2: Theme Color Names

[illegible]

First of all, you can safely ignore the three pattern-related properties (`Pattern`, `PatternColorIndex`, and `PatternTintAndShade`). These properties refer to the ugly, old-fashioned (but still supported) cell patterns, which you can specify in the Fill tab of the Format Cells dialog box. These statements are included to maintain any existing pattern that may exist in the range.

The recorded macro, after I deleted the three pattern-related properties (and added comments), is

```
Sub ChangeColors()
    With Selection.Interior
        '(Accent 2, Darker 25%)
        .ThemeColor = xlThemeColorAccent2
        .TintAndShade = -0.249977111117893
    End With
    With Selection.Font
        '(Text 2, Lighter 80%)
        .ThemeColor = xlThemeColorLight2
        .TintAndShade = 0.799981688894314
    End With
End Sub
```

As you can see, each color is specified in terms of a `ThemeColor` property and a `TintAndShade` property. The `ThemeColor` property is easy enough to decipher. Property values are assigned using built-in constants, and these values correspond to the column number of the 10 x 6 theme color table. For example, `xlThemeColorAccent2` has a value of 6. But what about the `TintAndShade` property?

The `TintAndShade` property can have a value between -1 and +1. A value of -1 results in black, and a value of +1 results in white. A `TintAndShade` property value of 0 gives the *pure* color. In other words, as the `TintAndShade` value goes negative, the color gets increasingly darker until it's pure black. As the `TintAndShade` value goes positive, the color gets increasingly lighter until it's pure white. The `TintAndShade` value corresponds to the color name displayed in the color selection controls.

If the color variation is expressed “Darker,” the `TintAndShade` property value is negative. If the color variation is expressed “Lighter,” the `TintAndShade` property value is positive.



Note

I don't know why the `TintAndShade` values have such a high level of precision in recorded macros. It's certainly not necessary. For example, a `TintAndShade` property value of -0.249977111117893 produces the same visual result as a `TintAndShade` property value of -0.25.



On the CD

For a demonstration of how the `TintAndShade` property changes a color, open the `tintandshade demo.xlsm` workbook on the companion CD-ROM (see Figure 30-7). Specify a starting color, and the macro displays that color with 50 levels of the `TintAndShade` property values, ranging from -1 to +1. It also displays the decimal color value and the red, green, and blue components of the color (which are displayed in a chart).

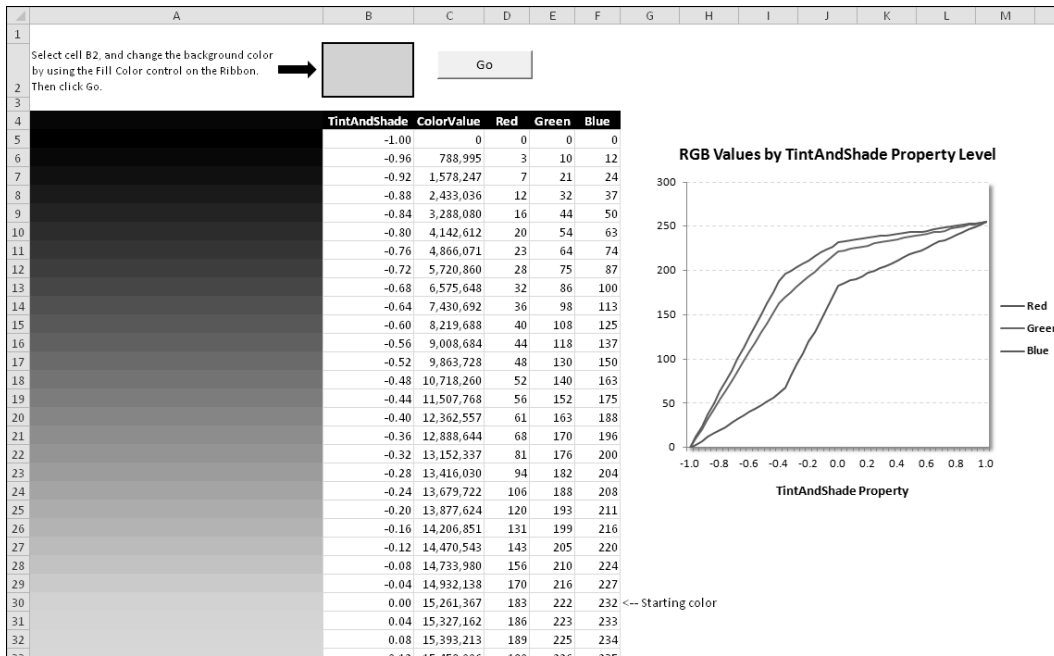


Figure 30-7: This workbook demonstrates how the TintAndShade property affects a color.

Displaying all theme colors

I wrote a macro that displays all 60 theme color variations in a range of cells. These 60 colors are those that appear in the color selection controls.

```
Sub ShowThemeColors()
    Dim r As Long, c As Long
    For r = 1 To 6
        For c = 1 To 10
            With Cells(r, c).Interior
                .ThemeColor = c
            End With
            Select Case c
                Case 1 'Text/Background 1
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = -0.05
                        Case 3: .TintAndShade = -0.15
                        Case 4: .TintAndShade = -0.25
                        Case 5: .TintAndShade = -0.35
                        Case 6: .TintAndShade = -0.5
                    End Select
                Case 2 'Text/Background 2
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 3 'Text/Background 3
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 4 'Text/Background 4
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 5 'Text/Background 5
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 6 'Text/Background 6
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 7 'Text/Background 7
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 8 'Text/Background 8
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 9 'Text/Background 9
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
                Case 10 'Text/Background 10
                    Select Case r
                        Case 1: .TintAndShade = 0
                        Case 2: .TintAndShade = 0.5
                    End Select
            End Select
        Next c
    Next r
End Sub
```

```

        Case 3: .TintAndShade = 0.35
        Case 4: .TintAndShade = 0.25
        Case 5: .TintAndShade = 0.15
        Case 6: .TintAndShade = 0.05
    End Select
Case 3 'Text/Background 3
    Select Case r
        Case 1: .TintAndShade = 0
        Case 2: .TintAndShade = -0.1
        Case 3: .TintAndShade = -0.25
        Case 4: .TintAndShade = -0.5
        Case 5: .TintAndShade = -0.75
        Case 6: .TintAndShade = -0.9
    End Select
Case Else 'Text/Background 4, and Accent 1-6
    Select Case r
        Case 1: .TintAndShade = 0
        Case 2: .TintAndShade = 0.8
        Case 3: .TintAndShade = 0.6
        Case 4: .TintAndShade = 0.4
        Case 5: .TintAndShade = -0.25
        Case 6: .TintAndShade = -0.5
    End Select
    End Select
Cells(r, c) = .TintAndShade
End With
Next c
Next r
End Sub

```

Figure 30-8 shows the result of executing the `ShowThemeColors` procedure. (It looks better in color.) If you switch to a different document theme, the colors will be updated to reflect those in the new theme.



On the CD

This example, named `generate theme colors.xlsm`, is available on the companion CD-ROM.

Earlier in this chapter, I described how to change the fill color of a range by setting the `Color` property of the `Interior` object. As I noted, using the VBA `RGB` function makes this easier. These two statements demonstrate how to change the fill color of a range (they both have the same result):

```

Range("A1:F24").Interior.Color = 5913728
Range("A1:F24").Interior.Color = RGB(128, 60, 90)

```

	A	B	C	D	E	F	G	H	I	J	K
1	0		0	0	0	0	0	0	0	0	
2	-0.04999	0.499985	-0.09998	0.799982	0.799982	0.799982	0.799982	0.799982	0.799982	0.799982	
3	-0.15	0.349986	-0.24998	0.599994	0.599994	0.599994	0.599994	0.599994	0.599994	0.599994	
4	-0.24998	0.249977	-0.49998	0.399976	0.399976	0.399976	0.399976	0.399976	0.399976	0.399976	
5	-0.34999	0.149998	-0.74999	-0.24998	-0.24998	-0.24998	-0.24998	-0.24998	-0.24998	-0.24998	
6	-0.49998	0.049998	-0.39998	-0.49998	-0.49998	-0.49998	-0.49998	-0.49998	-0.49998	-0.49998	
7											

Figure 30-8: A VBA macro generated these theme colors.

It's important to understand that assigning a color in this way doesn't make it a theme color. In other words, if the user switches to a new document theme, range A1:F24 won't change colors. To change cell colors in a way that is consistent with themes, you must use the `ThemeColor` and (optionally) the `TintAndShade` property.

Working with Shape Objects

So far, this chapter has focused exclusively on modifying the color of a range. This section provides examples of changing colors in `Shape` objects. In Excel, use the **Insert**→**Illustrations**→**Shapes** group to add a shape to a worksheet.

Figure 30-9 shows a shape inserted in a worksheet. This object's default name is `Right Arrow 1`. The number in the name varies, depending on how many shapes you have inserted. For example, if you had previously inserted two other shapes (of any style), the name would be `Right Arrow 3`.

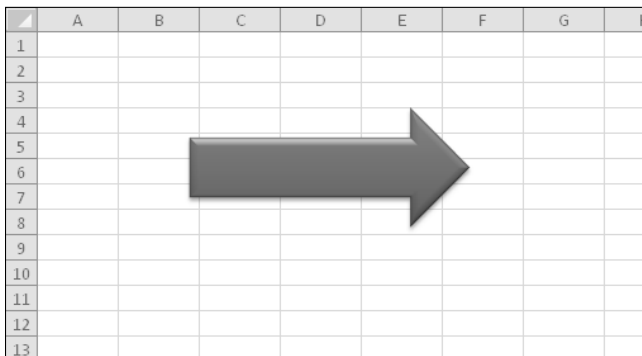


Figure 30-9: A `Shape` object on a worksheet.

A shape's background color

The background color of a `Shape` object is determined by the `RGB` property. So, to get the decimal color value of this shape, use a statement like this:

```
MsgBox ActiveSheet.Shapes("Right Arrow 1").Fill.ForeColor.RGB
```

This statement may be a bit confusing, so I'll break it down. The `Fill` property of the `Shape` object returns a `FillFormat` object. The `ForeColor` property of the `FillFormat` object returns a `ColorFormat` object. So the `RGB` property actually applies to the `ColorFormat` object, and this property contains the decimal color value.



Note

If you're confused about the use of the `ForeColor` property in this example, you're not alone. Most people, myself included, would expect to use the `BackColor` property of the `FillFormat` object to change the background color of an object. As it turns out, the `BackColor` property is used for the second color if the object is shaded or filled with a pattern. For an unfilled `Shape` with no pattern, the `ForeColor` property controls the background color.

When working with `Shape` objects, you almost always want your code to perform multiple actions. Therefore, it's efficient to create an object variable. The code that follows creates an object variable named `Shp`:

```
Dim Shp As Shape  
Set Shp = ActiveSheet.Shapes("Right Arrow 1")  
MsgBox Shp.Fill.ForeColor.RGB
```



Tip

An additional advantage to creating an object variable is that you can take advantage of the VBE's Auto List Members feature, which displays the possible properties and objects as you type (see Figure 30-10). This is particularly helpful in the case of `Shape` objects because some actions you take with Shapes are recorded by Excel's macro recorder.

If you'll be working only with the shape's colors, you can create an object variable for the shape's `ColorFormat` object, like this:

```
Dim ShpCF As ColorFormat  
Set ShpCF = ActiveSheet.Shapes("Right Arrow 1").Fill.ForeColor  
MsgBox ShpCF.RGB
```

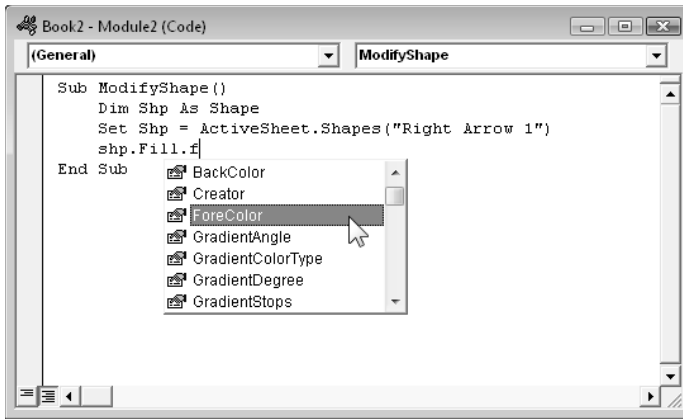


Figure 30-10: Typing a statement with the assistance of the Auto List Members feature.

The RGB property of the `ColorFormat` object controls the color of the shape. Following are some additional properties. If you're not familiar with document theme colors, see "Understanding document theme colors," earlier in this chapter.

- `ObjectThemeColor`: A number between 1 and 10 that represents the theme color (that is, a color in the first row of the 10-x-6 theme color grid).
- `SchemeColor`: A number that ranges from 0 to 80 that represents the color as an index in the current color scheme. These are colors from the old 56-color palette, and I don't see any need to ever use the `SchemeColor` property.
- `TintAndShade`: A number between -1 and +1 that represents the darkness or lightness of the theme color.
- `Type`: A number that represents the `ColorFormat` object type. As far as I can tell, this read-only property is always 1, which represents the RGB color system.

Changing the background color of a shape doesn't affect the shape's outline color. To modify the color of a shape's outline, access the `ColorFormat` object of the shape's `LineFormat` object. The following statements set a Shape's background color and outline to red:

```
Dim Shp As Shape
Set Shp = ActiveSheet.Shapes("Right Arrow 1")
Shp.Fill.ForeColor.RGB = RGB(255, 0, 0)
Shp.Line.ForeColor.RGB = RGB(255, 0, 0)
```

Here's an alternative way to accomplish the same effect, using object variables:

```
Dim Shp As Shape
Dim FillCF As ColorFormat
Dim LineCF As ColorFormat
```

```
Set Shp = ActiveSheet.Shapes("Right Arrow 1")
Set FillCF = Shp.Fill.ForeColor
Set LineCF = Shp.Line.ForeColor
FillCF.RGB = RGB(255, 0, 0)
LineCF.RGB = RGB(255, 0, 0)
```

Keep in mind that the preceding code does *not* produce colors that are compatible with document themes. To specify theme-compatible colors, you must use the `SchemeColor` property and (optionally) the `TintAndShade` property.

Shapes and theme colors

To apply theme colors to a shape, you use the `ObjectThemeColor` and the `TintAndShade` properties of the shape's `ForeColor` object. The following code sets the shape's color to "Accent 4, Lighter 40%."

```
With ActiveSheet.Shapes(1).Fill.ForeColor
    .ObjectThemeColor = msoThemeColorAccent4
    .TintAndShade = 0.4
End With
```

In practice, that code doesn't produce the same color that's produced when you use the Fill Color control in the Ribbon.

Unfortunately, Microsoft's implementation of document themes isn't perfect. For example, I discovered that range theme colors don't match up with shape theme colors. Figure 30-11 shows range B2:D8 with a fill color of "Accent 2, Lighter 80%." The worksheet also contains a triangle shape, which has the default fill color.

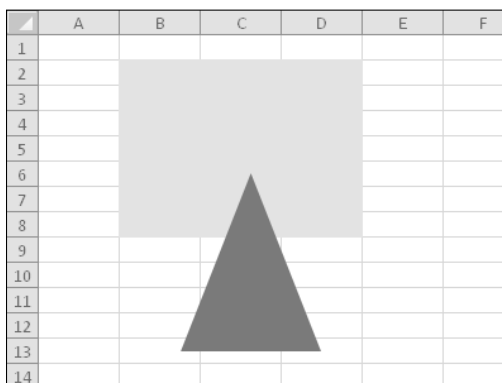


Figure 30-11: The goal is to write code that makes the triangle the same color as the range.

The task sounds simple enough: Make the shape's fill color the same as the range's fill color. This simple procedure should do the job:


```
Sub ColorShape()
    With ActiveSheet.Shapes(1).Fill.ForeColor
        .ObjectThemeColor = Range("B2:D8").Interior.ThemeColor
        .TintAndShade = Range("B2:D8").Interior.TintAndShade
    End With
End Sub
```

Figure 30-12 shows the result of running the `ColorShape` procedure. Although the shape's color is similar to the range, it's definitely not identical. Interestingly, if you apply the "Accent 2, Lighter 80%" color to the shape by using the Fill Color control on the Ribbon, the color is exactly the same as the range.

By the way, matching colors in the opposite direction doesn't work either. It's not possible to color a range by using the properties of a shape's `Interior` object.

Note that it *is* possible to transfer the exact color from the shape to the range by using the "old" color object model. The following statement makes the shape exactly the same color as the range. This color, however, doesn't change when the document theme changes.

```
ActiveSheet.Shapes(1).Fill.ForeColor.RGB = _
    Range("B1:D8").Interior.Color
```

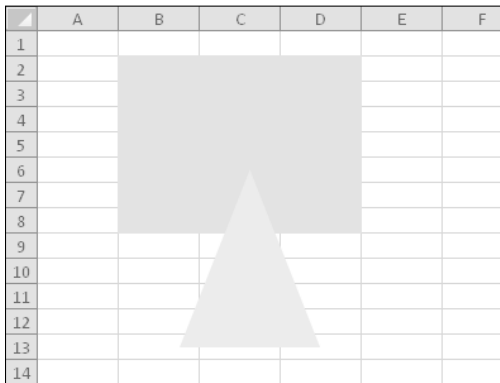


Figure 30-12: The code that should work, doesn't work. The triangle isn't the same color as the range.

I spent quite a bit of time experimenting with shape colors and range colors and reached the following conclusions:

- Excel provides 15 possible theme values for a shape, but only 12 for a range.
- The `ThemeColor` value of a range usually (but not always) corresponds to the `ObjectThemeColor` value of a shape.
- The `TintAndShade` property of the `FillFormat` object for a shape is always 0, unless you set it via code.

So it appears that colors used in shapes (and charts) are different than colors used in cells. It's more a curiosity than a problem. In actual practice, it's rarely critical that color matches between cells and objects be exact.

Shape examples

Shapes can also display other types of fills, such as gradients, pictures, and textures. Figure 30-13 shows a few examples of shapes generated by using VBA.



On the CD

The workbook that contains the code that generates these shapes is available on the companion CD-ROM. The filename is `shape object colors.xlsm`.

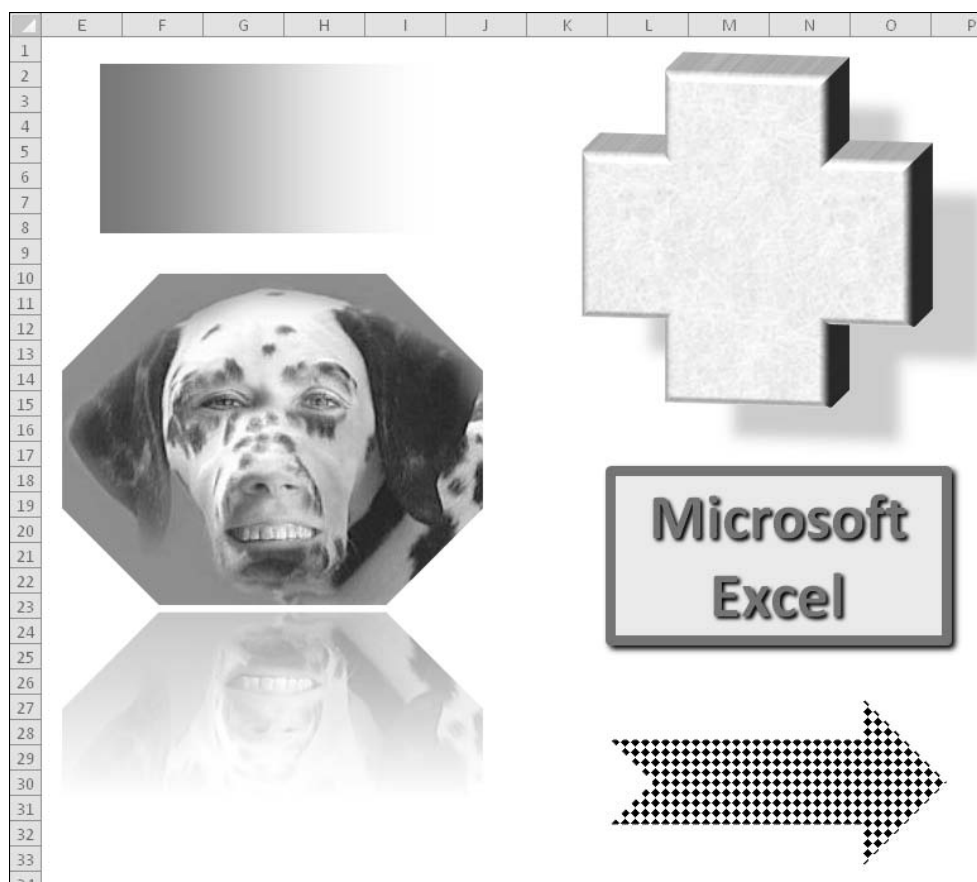


Figure 30-13: Shapes generated with VBA.

Modifying Chart Colors

This section describes how to change colors in a chart. The most important point is to identify the specific chart element that you want to modify. In other words, you need to identify the object and then set the appropriate properties.

Figure 30-14 shows a simple column chart named Chart 1. This chart has two data series, a legend, and a chart title.

Following is a VBA statement that changes the color of the first data series to red:

```
ActiveSheet.ChartObjects("Chart 1").Chart. _
    SeriesCollection(1).Format.Fill.ForeColor.RGB = vbRed
```

To the uninitiated, this statement is probably confusing because so many objects are involved. The object hierarchy is as follows.

The active sheet contains a `ChartObjects` collection. One object in that collection is the `ChartObject` named Chart 1. The `Chart` property of the `ChartObject` object returns a `Chart` object. The `Chart` object has a `SeriesCollection` collection, and one `Series` object in the collection has an index number of 1. The `Format` property of the `Series` object returns a `ChartFormat` object. The `Fill` property of the `ChartFormat` object returns a `FillFormat` object. The `ForeColor` property of the `FillFormat` object returns a `ColorFormat` object. The `RGB` property of the `ColorFormat` object is set to red.

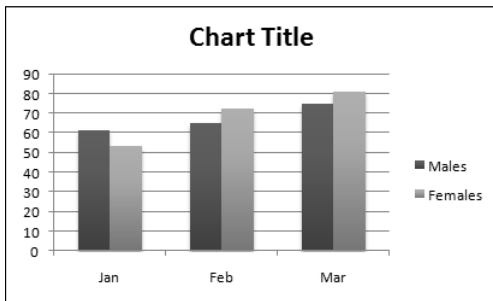


Figure 30-14: A simple column chart.



Cross-Ref

Refer to Chapter 18 for more information about using VBA to work with charts.

Another way of writing the preceding statement, using object variables to identify the individual objects (and, perhaps, clarify the objects' relationships), is

```
Sub ChangeSeries1Color
    Dim MyChartObject As ChartObject
    Dim MyChart As Chart
```

```

Dim MySeries As Series
Dim MyChartFormat As ChartFormat
Dim MyFillFormat As FillFormat
Dim MyColorFormat As ColorFormat
' Create the objects
Set MyChartObject = ActiveSheet.ChartObjects("Chart 1")
Set MyChart = MyChartObject.Chart
Set MySeries = MyChart.SeriesCollection(1)
Set MyChartFormat = MySeries.Format
Set MyFillFormat = MyChartFormat.Fill
Set MyColorFormat = MyFillFormat.ForeColor
' Change the color
MyColorFormat.RGB = vbRed
End Sub

```

The RGB property accepts a decimal color value, which I specified using a built-in VBA constant. Other color-related properties of the `ColorFormat` object are

- `ObjectThemeColor`: An integer between 0 and 16 that represents the theme color. VBA provides constants for these values. For example, `msoThemeColorAccent3` contains the value 7.
- `TintAndShade`: A number between -1 and +1 that represents the tint or shade of the theme color.

In the previous section, I noted some problems in color matching between ranges and shapes. Those same problems apply to colors used in charts.



On the CD

The examples in this section are available on the companion CD-ROM. The filename is `chart colors.xlsm`.

You can also specify color gradients. Here's an example that applies a preset gradient to the second data series in a chart. Notice that the gradient is set using the `FillFormat` object:

```

Sub AddPresetGradient()
Dim MyChart As Chart
Set MyChart = ActiveSheet.ChartObjects("Chart 1").Chart
With MyChart.SeriesCollection(1).Format.Fill
    .PresetGradient _
        Style:=msoGradientHorizontal, _
        Variant:=1, _
        PresetGradientType:=msoGradientFire
End With
End Sub

```

Working with other chart elements is similar. The procedure that follows changes the colors of the chart's chart area and plot area, using colors from the current document theme:

```
Sub RecolorChartAndPlotArea()
    Dim MyChart As Chart
    Set MyChart = ActiveSheet.ChartObjects("Chart 1").Chart
    With MyChart
        .ChartArea.Format.Fill.ForeColor.ObjectThemeColor = _
            msoThemeColorAccent6
        .ChartArea.Format.Fill.ForeColor.TintAndShade = 0.9
        .PlotArea.Format.Fill.ForeColor.ObjectThemeColor = _
            msoThemeColorAccent6
        .PlotArea.Format.Fill.ForeColor.TintAndShade = 0.5
    End With
End Sub
```

The final example in this section applies a random color to each chart element. Using this macro virtually guarantees an ugly chart. However, this code demonstrates how to change the color for other chart elements. The `UseRandomColors` procedure uses a simple function, `RandomColor`, to determine the color used.

```
Sub UseRandomColors()
    Dim MyChart As Chart
    Set MyChart = ActiveSheet.ChartObjects("Chart 4").Chart
    With MyChart
        .ChartArea.Format.Fill.ForeColor.RGB = RandomColor
        .PlotArea.Format.Fill.ForeColor.RGB = RandomColor
        .SeriesCollection(1).Format.Fill.ForeColor.RGB = RandomColor
        .SeriesCollection(2).Format.Fill.ForeColor.RGB = RandomColor
        .Legend.Font.Color = RandomColor
        .ChartTitle.Font.Color = RandomColor
        .Axes(xlValue).MajorGridlines.Border.Color = RandomColor
        .Axes(xlValue).TickLabels.Font.Color = RandomColor
        .Axes(xlValue).Border.Color = RandomColor
        .Axes(xlCategory).TickLabels.Font.Color = RandomColor
        .Axes(xlCategory).Border.Color = RandomColor
    End With
End Sub

Function RandomColor()
    RandomColor = Application.RandBetween(0, RGB(255, 255, 255))
End Function
```


Frequently Asked Questions about Excel Programming

In This Chapter

- Understanding Excel quirks
- Exploring FAQs about Excel programming
- Getting VBE help

Getting the Scoop on FAQs

If you like to cruise the Internet, you're undoubtedly familiar with *FAQs* — lists of *frequently asked questions* (and their answers) about a particular topic. FAQs are prevalent in the discussion groups and are posted in an attempt to reduce the number of messages that ask the same questions over and over again. They rarely serve their intended purpose, however, because the same questions keep appearing despite the FAQs.

I've found that people tend to ask the same questions about Excel programming, so I put together a list of FAQs that cover the following programming topics for Excel:

- Excel quirks that you can and can't work around
- Frequently asked questions about Excel programming
- Some help getting around in the Visual Basic Editor

Although this FAQ list certainly won't answer all your questions, it covers many common questions and might set you straight about a thing or two.

I organized this list of questions by assigning each question to one of these categories:

- General Excel questions
- The Visual Basic Editor (VBE)

- Sub procedures
- Function procedures
- Objects, properties, methods, and events
- UserForms
- Add-ins
- Excel user interface modification

In some cases, my classifications are rather arbitrary; a question could justifiably be assigned to other categories. Moreover, questions within each category are listed in no particular order.

By the way, most of the information in this chapter is discussed in greater detail in other chapters in this book.

General Excel Questions

How do I record a macro? Click the little square icon in the left side of the status bar, at the bottom of Excel's window.

How do I run a macro? Choose View→Macros→Macros (or its shortcut key, Alt+F8). Or, choose Developer→Code→Macros.

What do I do if I don't have a Developer tab? Right-click anywhere in the Ribbon and choose Customize the Ribbon. In the Customize Ribbon tab of the Excel Options dialog box, place a check mark next to Developer (which is in the list labeled Main tabs).

I recorded a macro and saved my workbook. When I reopened it, the macros were gone! Where did they go? By default, Excel proposes that you destroy your macros when you first save a new workbook. When you save the file, read Excel's warning very carefully and don't accept the default Yes button. If your workbook contains macros, you must save it as an XLSM file, not an XLSX file.



What if my question isn't answered here?

If this chapter doesn't provide an answer to your question, start by checking this book's index. This book includes lots of information that doesn't qualify as a frequently asked question. If you still come up empty-handed, check out the resources listed in Appendix A.

How do I hide the Ribbon so that it doesn't take up so much space? Excel 2010 has a new Minimize the Ribbon icon, next to the Help icon in the title bar. You can click that icon to toggle the Ribbon display. Or, use the Ctrl+F1 shortcut key to toggle the display of the Ribbon. If you'd like to toggle the Ribbon display using VBA, you must resort to using the `Sendkeys` method:

```
Sub ToggleRibbon()  
    Application.SendKeys "^{F1}"  
End Sub
```

By using an XLM macro, you can remove the Ribbon completely:

```
ExecuteExcel4Macro "SHOW.TOOLBAR(""Ribbon"",False)"
```

When this statement is executed, the user can't make the Ribbon visible. The only way to get the Ribbon to display again is to re-run the XLM code, with the last argument set to True.

Where are my old custom toolbars? Click the Add-Ins tab, and you'll see them in the Custom Toolbars group.

Can I make my old custom toolbars float? No, you can't. The old custom toolbars are fixed in place in the Add-Ins→Custom Toolbars group.

How can I hide the status bar in Excel 2010? You must use VBA to hide the status bar. The following statement will do the job:

```
Application.DisplayStatusBar = False
```

Is there a utility that will convert my Excel application into a stand-alone .exe file? No.

Why doesn't Ctrl+A select all the cells in my worksheet? That's probably because the cell pointer is inside a table. When the active cell is in a table, you must press Ctrl+A three times to select all worksheet cells. The first time selects the data cells, the second time selects the data cells and header row, and the third time selects all cells in the worksheet.

Why is the Custom Views command disabled? That's probably because your workbook contains a table. Convert the table to a range, and then you can use Views→Workbook Views→Custom Views. Nobody (except Microsoft) knows why that command is disabled when the workbook contains a table.

How can I add a drop-down list to a cell so the user can choose a value from the list? This technique doesn't require any macros. Type the list of valid entries in a single column. You can hide this column from the user if you wish. Select the cell or cells that will display the list of entries, choose Data→Data Tools→Data Validation, and then click the Settings tab in the Data Validation dialog box. From the Allow drop-down list, select List. In the Source box, enter a range address or a reference to the single-column list on your sheet. Make sure the In-Cell Dropdown check box is selected. If the list is short, you can simply type the items, each separated by a comma.

Can I use this drop-down list method if my list is stored on a different worksheet in the workbook? Yes. In previous versions of Excel you needed to create a name for the list (for example, `ListEntries`). Excel 2010 allows you to use a range in any worksheet, and the worksheet can even be in a different workbook.

I use `Application.Calculation` to set the calculation mode to manual. However, this seems to affect all workbooks and not just the active workbook. The `Calculation` property is a member of the `Application` object. Therefore, the calculation mode affects all workbooks. You can't set the calculation mode for only one workbook. Excel 2000 and later versions provide a new `Worksheet` object property: `EnableCalculation`. When this property is `False`, the worksheet will not be calculated, even if the user requests a calculation. Setting the property to `True` will cause the sheet to be calculated.

Why doesn't the F4 function key repeat all my operations? I don't know. Unfortunately, the very useful F4 key became much less useful beginning with Excel 2007. For example, if you click the Insert Worksheet icon (in the row of sheet tabs) and then press F4, Excel does *not* repeat the Insert Worksheet command. However, if you insert the worksheet by using Shift+F11, then F4 *does* repeat the command.

Another example: If you apply a style to a chart (using Chart Tools→Design→Chart Styles), pressing F4 doesn't repeat the style. Rather it duplicates all of the series in the chart!

What happened to the ability to “speak” the cell contents? To use those commands, you must customize your Quick Access toolbar or customize the Ribbon. Perform these tasks in the Excel Options dialog box. The speech commands are listed in the Commands Not in the Ribbon category (they all begin with the word “Speak”).

I opened a workbook, and it has only 65,546 rows. What happened? Excel 2010 worksheets contain 1,048,576 rows and 16,384 columns. If you're not seeing this many rows and columns, then the workbook is in compatibility mode. When Excel opens a workbook that was saved in a previous version's file format, it doesn't automatically convert it to an Excel 2010 workbook. You need to do it manually: Save the workbook in an Excel 2010 file format, close it, and then re-open it. You'll then see the additional rows and columns.

How do I get my old workbook to use the new fonts? Beginning with Excel 2007, the default font is much easier to read, and not as cramped-looking as in previous versions. To force an old workbook to use these new fonts, press Ctrl+N to create a blank workbook. Activate your old workbook and choose the Home tab. Click the very bottom of the vertical scroll bar in the Styles gallery and choose Merge Styles. In the Merge Styles dialog box, double-click the new workbook you created with Ctrl+N, and the old styles will be replaced with the new styles. But this works only with cells that haven't been formatted with other font attributes. For example, bold cells retain their old fonts. For these cells, you must update the styles manually.

How do I get a print preview? In Excel 2010, print preview occurs automatically when you choose File→Print. Another option is to use the Page Layout view (the icon on the right side of the status bar).

To get the old-style print preview, you need to use VBA. The following statement displays a print preview for the active sheet:

```
ActiveSheet.PrintPreview
```

When I switch to a new document template, my worksheet no longer fits on a single page.

That's probably because the new theme uses different fonts. After applying the theme, use the Page Layout→Themes→Fonts control to select your original fonts to use with the new theme. Or, modify the font size for the Normal style. If page fitting is critical, you should choose the theme before you do much work on the document.

How do I get rid of the annoying dotted-line page break display in Normal view mode? Open the Excel Options dialog box, click the Advanced tab, scroll down to the Display Options for This Worksheet section, and remove the check mark from Show Page Breaks.

Can I add that Show Page Breaks option to my Quick Access toolbar or to the Ribbon? No. For some reason, this very useful command can't be added to the Quick Access toolbar or Ribbon. You can turn off the page break display by using this VBA statement:

```
ActiveSheet.DisplayPageBreaks = False
```

I'm trying to apply a table style to a table, but it has no visible effect. What can I do? That's probably because the table cells were formatted manually. Select the cells and set the fill color to No Fill and the font color to Automatic. Then, applying a table style will work.

Can I change the color of the sheet tabs? Right-click the sheet tab and select Tab Color. Tab colors will change if you apply a different document theme.

Can I write VBA macros that play sounds? Yes, you can play WAV and MIDI files, but it requires Windows Application Programming Interface (API) functions (see Chapter 11). You might prefer to take advantage of the Speech object. The following statement, when executed, greets the user by name:

```
Application.Speech.Speak ("Hello" & Application.UserName)
```

When I open a workbook, Excel asks whether I want to update the links. I've searched all my formulas and can't find any links in this workbook. Is this a bug? Probably not. Try using the Edit Links dialog box (choose File→Info→Edit Links to Files). In the Edit Links dialog box, click Break Link. Keep in mind that links can occur in places other than formulas. If you have a chart in your workbook, click each data series in the chart and examine the SERIES formula in the formula bar. If the formula refers to another workbook, you've identified the link. To eliminate it, move the chart's data into the current workbook and re-create your chart.

If your workbook contains any Excel 5/95 dialog sheets, select each object in each dialog box and examine the formula bar. If any object contains a reference to another workbook, edit or delete that reference.

Choose Formulas→Defined Names→Name Manager. Scroll down the list in the Name Manager dialog box and examine the Refers To column. Delete names that refer to another workbook or that contain an erroneous reference (such as #REF!). This is the most common cause of "phantom links."

Why does Excel crash every time I start it? When Excel starts, it opens several files, including an *.xlb file, which contains menu and toolbar customizations. If this file is damaged, it might cause Excel to crash when it's started. Also, this file might (for some reason) be very large. In such a case, this could also cause Excel to crash. Typically, your *.xlb file should be 100K or smaller.

If Excel crashes when it's started, try deleting your *.xlb file. To do so, close Excel and search your hard drive for *.xlb. (The filename and location will vary.) Create a backup copy of this file, delete the original file, and then try restarting Excel. It's likely that Excel will now start up normally, and create a new *.xlb file.

Deleting your *.xlb file will also delete any toolbar or menu customizations that appear in the Add-Ins tab.

Where can I find examples of VBA code? The Internet has thousands of VBA examples. A good starting point is my Web site:

```
http://spreadsheetpage.com
```

Or, do a search at

```
http://google.com
```

The Visual Basic Editor

Can I use the VBA macro recorder to record all my macros? No. Recording is useful for very simple macros only. Macros that use variables, looping, or any other type of program-flow changes can't be recorded. In addition, you can't record Function procedures. You can, however, often take advantage of the macro recorder to write some parts of your code or to discover the relevant properties or methods.

I have some macros that are general in nature. I would like to have these available all the time.

What's the best way to do this? Consider storing those general-purpose macros in your Personal Macro Workbook. This is a (normally) hidden workbook that is loaded automatically by Excel. When you record a macro, you have the option of recording it to your Personal Macro Workbook. The file, `Personal.xlsb`, is stored in your `\XLStart` directory.

I can't find my Personal Macro Workbook. Where is it? The `Personal.xlsb` file doesn't exist until you record a macro to it and then close Excel.

I locked my VBA project with a password, and I forget what it was. Is there any way to unlock it? Several third-party password-cracking products exist. Use a Web search engine to search for *Excel password*. The existence of these products should tell you that Excel passwords aren't very secure.

How can I write a macro to change the password of my project? You can't. The protection elements of a VBA project aren't exposed in the object model. Most likely, this was done to make it more difficult for password-cracking software.

When I insert a new module, it always starts with an Option Explicit line. What does this mean?

If `Option Explicit` is included at the top of a module, it means that you must declare every variable before you use it in a procedure (which is a good idea). If you don't want this line to appear in new modules, activate the VB Editor, choose **Tools**→**Options**, click the **Editor** tab, and clear the **Require Variable Declaration** check box. Then you can either declare your variables or let VBA handle the data typing automatically.

Why does my VBA code appear in different colors? Can I change these colors? VBA uses color to differentiate various types of text: comments, keywords, identifiers, statements with a syntax error, and so on. You can adjust these colors and the font used by choosing the **Tools**→**Options** command (**Editor Format** tab) in the VBE.

Can I delete a VBA module by using VBA code? Yes. The following code deletes `Module1` from the active workbook:

```
With ActiveWorkbook.VBProject
    .VBComponents.Remove .VBComponents("Module1")
End With
```

This might not work, though. See the next question.

I wrote a macro that adds VBA code to the VB project. When my colleague tries to run it, he gets an error message. What's wrong? Excel 2002 introduced a new setting: **Trust Access to Visual Basic Project**. By default, this setting is turned off. To change it, choose **File**→**Options**→**Trust Center**. Click the **Trust Center Settings** button to display the **Trust Center** dialog box. Click the **Macro Settings** tab and place a check mark next to **Trust Access to the VBA Project Object Model**.

How can I write a macro to change the user's macro security setting? I want to avoid the security message when my application is opened.

The ability to change the security level using VBA would pretty much render the entire macro security system worthless. Think about it.

How does the `UserInterfaceOnly` option work when protecting a worksheet? When protecting a worksheet using VBA code, you can use a statement such as

```
ActiveSheet.Protect UserInterfaceOnly:=True
```

This causes the sheet to be protected, but your macros can still make changes to the sheet. It's important to understand that this setting isn't saved with the workbook. When the workbook is re-opened, you'll need to re-execute the statement in order to reapply the `UserInterfaceOnly` protection.

How can I tell whether a workbook has a macro virus? In the VB Editor, activate the project that corresponds to the workbook. Examine all the code modules (including the `ThisWorkbook` code module) and look for VBA code that isn't familiar to you. Usually, virus code won't be formatted well and will contain many unusual variable names. Another option is to use a commercial virus-scanning program.

I'm having trouble with the concatenation operator (&) in VBA. When I try to concatenate two strings, I get an error message. VBA is probably interpreting the ampersand as a type-declaration character. Make sure that you insert a space before and after the concatenation operator.

I can't seem to get the VBA line continuation character (underscore) to work. The line continuation sequence is actually two characters: a space followed by an underscore.

I distributed an Excel application to many users. On some machines, my VBA error-handling procedures don't work. Why not? The error-handling procedures won't work if the user has the Break on All Errors option set. This option is available in the General tab of the Options dialog box in the VB Editor (choose Tools→Options). You can't change this setting with VBA.

Procedures

What's the difference between a VBA procedure and a macro? Nothing, really. The term *macro* is a carry-over from the old days of spreadsheets. These terms are now used interchangeably.

What's a procedure? A procedure is a grouping of VBA instructions that can be called by name. If these instructions are to give an explicit result (such as a value) back to the instruction that called them, they most likely belong to a `Function` procedure. Otherwise, they probably belong to a `Sub` procedure.

What is a variant data type? Variables that aren't specifically declared are assigned the `Variant` type by default, and VBA automatically converts the data to the proper type when it's used. This is particularly useful for retrieving values from a worksheet cell when you don't know in advance what the cell contains. Generally, it's a good idea to specifically declare your variables with the `Dim`, `Public`, or `Private` statement because using variants is a bit slower and isn't the most efficient use of memory.

What's the difference between a variant array and an array of variants? A variant is a unit of memory with a special data type that can contain any kind of data: a single value or an array of values (that is, a variant array). The following code creates a variant that contains a three-element array:

```
Dim X As Variant
X = Array(30, 40, 50)
```

A normal array can contain items of a specified data type, including nontyped variants. The following statement creates an array that consists of three variants:

```
Dim X (0 To 2) As Variant
```

Although a variant containing an array is conceptually different from an array whose elements are of type `Variant`, the array elements are accessed in the same way.

What's a type-definition character? VBA lets you append a character to a variable's name to indicate the data type. For example, you can declare the `MyVar` variable as an integer by tacking `%` onto the name, as follows:

```
Dim MyVar%
```

VBA supports these type-declaration characters:

- Integer: `%`
- Long: `&`
- Single: `!`
- Double: `#`
- Currency: `@`
- String: `$`

Type-definition characters are included primarily for compatibility. Declaring variables by using words is the standard approach.

I would like to create a procedure that automatically changes the formatting of a cell based on the data that I enter. For example, if I enter a value greater than 0, the cell's background color should be red. Is this possible? It's certainly possible, and you don't need any programming. Use Excel's Conditional Formatting feature, accessed with the `Home`→`Styles`→`Conditional Formatting` command.

The Conditional Formatting feature is useful, but I'd like to perform other types of operations when data is entered into a cell. In that case, you can take advantage of the `Change` event for a worksheet object. Whenever a cell is changed, the `Change` event is triggered. If the code module for the `Sheet` object contains a procedure named `Worksheet_Change`, this procedure will be executed automatically.

What other types of events can be monitored? Lots! Search the Help system for events to get a complete listing.

I tried entering an event procedure (Sub `Workbook_Open`), but the procedure isn't executed when the workbook is opened. What's wrong? You probably put the procedure in the wrong place. Workbook event procedures must be in the code module for the `ThisWorkbook` object. Worksheet event procedures must be in the code module for the appropriate `Sheet` object, as shown in the VB Editor Project window.

Another possibility is that macros are disabled. Check your settings in the Trust Center dialog box (accessible from the Excel Options dialog box).

I can write an event procedure for a particular workbook, but can I write an event procedure that will work for any workbook that's open? Yes, but you need to use a class module. Details are in Chapter 19.

I'm very familiar with creating formulas in Excel. Does VBA use the same mathematical and logical operators? Yes. And it includes some additional operators that aren't valid in worksheet formulas. These additional VBA operators are listed in the following table:

Operator	Function
\	Division with an integer result
Eqv	Returns <code>True</code> if both expressions are true or both are false
Imp	A bitwise logical implication on two expressions (rarely used)
Is	Compares two object variables
Like	Compares two strings by using wildcard characters
Xor	Returns <code>True</code> if only one expression is true

How can I execute a procedure that's in a different workbook? Use the `Run` method of the `Application` object. The following instruction executes a procedure named `Macro1` located in the `Personal.xlsb` workbook:

```
Run "Personal.xlsb!Macro1"
```

Another option is to add a reference to the workbook. Do this by choosing the **Tools→References** command in the VBE. After you've added a reference, you can then run the procedures in the referenced workbook without including the name of the workbook.

I've used VBA to create several custom functions. I like to use these functions in my worksheet formulas, but I find it inconvenient to precede the function name with the workbook name. Is there any way around this? Yes. Convert the workbook that holds the function definitions to an XLAM add-in. When the add-in is open, you can use the functions in any other worksheet without referencing the function's filename.

In addition, if you set up a reference to the workbook that contains the custom functions, you can use the function without preceding it with the workbook name. To create a reference, choose the **Tools→References** command in the VB Editor.

I would like a particular workbook to be loaded every time I start Excel. I would also like a macro in this workbook to execute automatically. Am I asking too much? Not at all. To open the workbook automatically, just store it in your `\XLStart` directory. To have the macro execute automatically, create a `Workbook_Open` macro in the code module for the workbook's `ThisWorkbook` object.

I have a workbook that uses a `Workbook_Open` procedure. Is there a way to prevent this from executing when I open the workbook? Yes. Hold down `Shift` when you issue the **File→Open** command. To prevent a `Workbook_BeforeClose` procedure from executing, press `Shift` when you close the workbook. Using the `Shift` key won't prevent these procedures from executing when you're opening an add-in.

Can a VBA procedure access a cell's value in a workbook that isn't open? VBA can't do it, but Excel's old XLM language can. Fortunately, you can execute XLM from VBA. Here's a simple example that retrieves the value from cell A1 on Sheet1 in a workbook named `myfile.xlsx` in the `c:\files` directory:

```
MsgBox ExecuteExcel4Macro("'c:\files\[myfile.xlsx]Sheet1'!R1C1")
```

Note that the cell address must be in R1C1 notation.

How can I prevent the “save file” prompt from being displayed when I close a workbook from VBA? You can use this statement:

```
ActiveWorkbook.Close SaveChanges:=False
```

Or, you can set the workbook's `Saved` property to `True` by using a statement like this:

```
ActiveWorkbook.Saved = True
```

This statement, when executed, doesn't actually save the file, so any unsaved changes will be lost when the workbook is closed.

A more general solution to avoid Excel prompts is to insert the following instruction:

```
Application.DisplayAlerts = False
```

Normally, you'll want to set the `DisplayAlerts` property back to `True` after the file is closed.

How can I set things up so that my macro runs once every hour? You need to use the `OnTime` method of the `Application` object. This enables you to specify a procedure to execute at a particular time of day. When the procedure ends, use the `OnTime` method again to schedule another event in one hour.

How do I prevent a macro from showing in the macro list? To prevent the macro from being listed in the Macro dialog box (displayed by using `View→Macros→Macro`), declare the procedure by using the `Private` keyword:

```
Private Sub MyMacro()
```

Or you can add a dummy optional argument, declared as a specific data type:

```
Sub MyMacro (Optional FakeArg as Long)
```

Can I save a chart as a .gif file? Yes. The following code saves the first embedded chart on Sheet1 as a .gif file named Mychart.gif:

```
Set CurrentChart = Sheets("Sheet1").ChartObjects(1).Chart
Fname = ThisWorkbook.Path & "\Mychart.gif"
CurrentChart.Export Filename:=Fname, FilterName:="GIF"
```

Are variables in a VBA procedure available to other VBA procedures? What if the procedure is in a different module? Or in a different workbook? You're referring to a variable's scope. The scope of a variable can be any of three levels: local, module, and public. Local variables have the narrowest scope and are declared within a procedure. A local variable is visible only to the procedure in which it was declared. Module-level variables are declared at the top of a module, prior to the first procedure. Module-level variables are visible to all procedures in the module. Public variables have the broadest scope, and they're declared by using the `Public` keyword.

Functions

I created a VBA function for use in worksheet formulas. However, it always returns #NAME?. What went wrong? You probably put the function in the code module for a Sheet (for example, Sheet1) or in the `ThisWorkbook` module. Custom worksheet functions must reside in standard VBA modules.

I wrote a VBA function that works perfectly when I call it from another procedure, but it doesn't work when I use it in a worksheet formula. What's wrong? VBA functions called from a worksheet formula have some limitations. In general, they must be strictly passive. That is, they can't change the active cell, apply formatting, open workbooks, or change the active sheet. If the function attempts to do any of these things, the formula will return an error.

When I access a custom worksheet function with the Insert Function dialog box, it reads "No help available." How can I get the Insert Function dialog box to display a description of my function? To add a description for your custom function, activate the workbook that contains the Function procedure. Then choose `View→Macros→Macros` to display the Macro dialog box. Your function won't be listed, so you must type it into the Macro Name box. After typing the function's name, click `Options` to display the Macro Options dialog box. Enter the descriptive text in the Description box.

Can I also display help for the arguments for my custom function in the Insert Function dialog box? Yes. Excel 2010 added a new argument to the `MacroOptions` method. You can write a macro to assign descriptions to your function arguments. See Chapter 10 for details.

My custom worksheet function appears in the User Defined category in the Insert Function dialog box. How can I make my function appear in a different function category? You need to use VBA to do this. The following instruction assigns the function named `MyFunc` to `Category 1` (Financial):

```
Application.MacroOptions Macro:="MyFunc", Category:=1
```

The following table lists the valid function category numbers:

Number	Category
0	No category (appears only in All)
1	Financial
2	Date & Time
3	Math & Trig
4	Statistical
5	Lookup & Reference
6	Database
7	Text
8	Logical
9	Information
10	Commands (normally hidden)
11	Customizing (normally hidden)
12	Macro Control (normally hidden)
13	DDE/External (normally hidden)
14	User Defined (default)
15	Engineering

How can I create a new function category? Specify a text string for the `Category` argument in the `MacroOptions` method. Here's an example:

```
Application.MacroOptions Macro:="MyFunc", Category:="XYZ Corp Functions"
```

I have a custom function that will be used in a worksheet formula. If the user enters arguments that are not appropriate, how can I make the function return a true error value (#VALUE!)? If your function is named `MyFunction`, you can use the following instruction to return an error value to the cell that contains the function:

```
MyFunction = CVErr(xlErrValue)
```

In this example, `xlErrValue` is a predefined constant. Constants for the other error values are listed in the Help system.

I use a Windows API function in my code, and it works perfectly. I gave the workbook to a colleague, and he gets a compile error. What's the problem? Most likely, your colleague uses the 64-bit version of Excel 2010. API declarations must be designated as `"PtrSafe"` in order to work with 64-bit Excel. For example, the following declaration works with 32-bit Excel versions, but causes a compile error with 64-bit Excel 2010:

```
Declare Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

In many cases, making the declaration compatible with 64-bit Excel is as simple as adding the word `PtrSafe` after the `Declare` keyword. Adding the `PtrSafe` keyword works for most commonly used API functions, but some function might require that you change the data types for the arguments.

The following declaration is compatible with both 32-bit Excel 2010 and 64-bit Excel 2010:

```
Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

However, the code will fail in Excel 2007 (and earlier versions) because the `PtrSafe` keyword isn't recognized. Here's an example of how to use compiler directives to declare an API function that's compatible with 32-bit Excel (including versions prior to Excel 2010) and 64-bit Excel:

```
#If VBA7 And Win64 Then  
    Declare PtrSafe Function GetWindowsDirectoryA Lib "kernel32" _  
        (ByVal lpBuffer As String, ByVal nSize As Long) As Long  
#Else  
    Declare Function GetWindowsDirectoryA Lib "kernel32" _  
        (ByVal lpBuffer As String, ByVal nSize As Long) As Long  
#End If
```

The first `Declare` statement is used when `VBA7` and `Win64` are both `True` — which is the case only for 16-Bit Excel 2010. In all other versions, the second `Declare` statement is used.

How can I force a recalculation of formulas that use my custom worksheet function? To force a single formula to be recalculated, select the cell, press `F2`, and then press `Enter`. To force all formulas and functions to be recalculated, press `Ctrl+Alt+F9`.

Can I use Excel's built-in worksheet functions in my VBA code? In most cases, yes. You access Excel's worksheet functions via the `WorksheetFunction` method of the `Application` object. For example, you could access the `SUM` worksheet function with a statement such as the following:

```
Ans = Application.WorksheetFunction.Sum(Range("A1:A3"))
```

This example assigns the sum of the values in `A1:A3` (on the active sheet) to the `Ans` variable.

Generally, if VBA includes an equivalent function, you can't use Excel's worksheet version. For example, because VBA has a function to compute square roots (`Sqr`), you can't use the `SQRT` worksheet function in your VBA code.

Is there any way to force a line break in the text of a message box? Use a carriage return or a linefeed character to force a new line. The following statement displays the message box text on two lines (`vbNewLine` is a built-in constant that represents a carriage return):

```
MsgBox "Hello" & vbNewLine & Application.UserName
```

Objects, Properties, Methods, and Events

Is there a listing of the Excel objects I can use? Yes. The Help system has that information.

I'm overwhelmed with all the properties and methods available. How can I find out which methods and properties are available for a particular object? There are several ways. You can use the Object Browser available in the VBE. Press F2 to access the Object Browser and then choose Excel from the Libraries/Workbooks drop-down list. The Classes list (on the left) shows all the Excel objects. When you select an object, its corresponding properties and methods appear in the Member Of list on the right.

You can also get a list of properties and methods as you type. For example, enter the following:

```
Range ("A1" ) .
```

When you type the dot, you'll see a list of all properties and methods for a `Range` object. If the list doesn't appear, choose Tools→Options (in the VBE), click the Editor tab, and place a check mark next to Auto List Members. Unfortunately, Auto List Members doesn't work for all objects. For example, you won't see a list of properties and methods when you type this statement:

```
ActiveSheet.Shapes (1) .
```

And, of course, the Help system for VBA is very extensive; it lists the properties and methods available for most objects of importance. The easiest way to access these lists is to type the object name into the Immediate window at the bottom of the VBE and move the cursor anywhere within the object name. Then press F1, and you'll get the help topic appropriate for the object.

What's the story with collections? Is a collection an object? What are collections? A collection, which is an object that contains a group of related objects, is designated by a plural noun. For example, the `Worksheets` collection is an object that contains all the `Worksheet` objects in a workbook. You can think of this as an array: `Worksheets (1)` refers to the first `Worksheet` object in the `Workbook`. Rather than use index numbers, you can also use the actual worksheet name, such as `Worksheets ("Sheet1")`. The concept of a collection makes it easy to work with all related objects at once and to loop through all objects in a collection by using the `For Each-Next` construct.

When I refer to a worksheet in my VBA code, I get a “subscript out of range” error. I’m not using any subscripts. What gives? This error occurs when you attempt to access an element in a collection that doesn’t exist. For example, the following instruction generates the error if the active workbook doesn’t contain a worksheet named `MySheet`:

```
Set X = ActiveWorkbook.Worksheets("MySheet")
```

How can I prevent the user from scrolling around the worksheet? You can either hide the unused rows and columns or use a VBA instruction to set the scroll area for the worksheet. The following instruction, for example, sets the scroll area on `Sheet1` so that the user can’t activate any cells outside of `B2:D50`:

```
Worksheets("Sheet1").ScrollArea = "B2:D50"
```

To set scrolling back to normal, use a statement like this:

```
Worksheets("Sheet1").ScrollArea = ""
```

Keep in mind that the `ScrollArea` setting is not saved with the workbook. Therefore, you need to execute the `ScrollArea` assignment instruction whenever the workbook is opened. This instruction can go in the `Workbook_Open` event-handler procedure.

What’s the difference between using `Select` and `Application.Goto`? The `Select` method of the `Range` object selects a range on the active worksheet only. Use `Application.Goto` to select a range on any worksheet in a workbook. `Application.Goto` might or might not make another sheet the active sheet. The `Goto` method also lets you scroll the sheet so that the range is in the upper-left corner.

What’s the difference between activating a range and selecting a range? In some cases, the `Activate` method and the `Select` method have exactly the same effect. But in other cases, they produce quite different results. Assume that range `A1:C3` is selected. The following statement activates cell `C3`. The original range remains selected, but `C3` becomes the active cell — that is, the cell that contains the cell pointer.

```
Range("C3").Activate
```

Again, assuming that range `A1:C3` is selected, the following statement selects a single cell, which also becomes the active cell:

```
Range("C3").Select
```

Is there a quick way to delete all values from a worksheet yet keep the formulas intact? Yes. The following code works on the active sheet and deletes all nonformula cells. (The cell formatting isn't affected.)

```
On Error Resume Next  
Cells.SpecialCells(xlCellTypeConstants, 23).ClearContents
```

The second argument, 23, is the sum of the values of the following built-in constants: `xlErrors` (16), `xlLogical` (4), `xlNumbers` (1), and `xlTextValues` (2).

Using `On Error Resume Next` prevents the error message that occurs if no cells qualify.

I know how to write a VBA instruction to select a range by using a cell address, but how can I write one to select a range if I know only its row and column numbers? Use the `Cells` method. The following instruction, for example, selects the cell in the 5th row and the 12th column (that is, cell L5):

```
Cells(5, 12).Select
```

When I try to record the File→Exit command, Excel closes down before I can see what code it generates. Is there a VBA command to quit Excel? Use the following instruction to end Excel:

```
Application.Quit
```

How can I turn off screen updating while a macro is running? The following instruction turns off screen updating and speeds up macros that modify the display:

```
Application.ScreenUpdating = False
```

When your procedure ends, the `ScreenUpdating` property is set back to `True`. However, you can resume screen updating at any time by executing this statement:

```
Application.ScreenUpdating = False
```

What's the easiest way to create a range name in VBA? If you turn on the macro recorder while you name a range, you get code something like this:

```
Range("D14:G20").Select  
ActiveWorkbook.Names.Add Name:="InputArea", _  
    RefersToR1C1:="=Sheet1!R14C4:R20C7"
```

A much simpler method is to use a statement like this:

```
Sheets("Sheet1").Range("D14:G20").Name = "InputArea"
```

How can I determine whether a particular cell or range has a name? You need to check the `Name` property of the `Name` object contained in the `Range` object. The following function accepts a range as an argument and returns the name of the range (if it has one). If the range has no name, the function returns `False`.

```
Function RangeName(rng) As Variant
    On Error Resume Next
    RangeName = rng.Name.Name
    If Err <> 0 Then RangeName = False
End Function
```

Excel 2010 doesn't seem to have a print preview window. I can see a preview in the Backstage View (when I choose File→Print), but I'd like the old-style preview window. The only way to display the old print preview window is to use a VBA statement.

```
ActiveSheet.PrintPreview
```

I have a lengthy macro, and it would be nice to display its progress in the status bar. Can I display messages in the status bar while a macro is running? Yes. Assign the text to the `StatusBar` property of the `Application` object. Here's an example:

```
Application.StatusBar = "Now processing File " & FileNum
```

Before your routine finishes, return the status bar back to normal with either of the following instructions:

```
Application.StatusBar = False
Application.StatusBar = ""
```

I recorded a VBA macro that copies a range and pastes it to another area. The macro uses the `Select` method. Is there a more efficient way to copy and paste? Yes. Although the macro recorder generally selects cells before doing anything with them, selecting is not necessary and can actually slow down your macro. Recording a very simple copy-and-paste operation generates four lines of VBA code, two of which use the `Select` method. Here's an example:

```
Range("A1").Select
Selection.Copy
Range("B1").Select
ActiveSheet.Paste
```


These four lines can be replaced with a single instruction, such as the following:

```
Range("A1").Copy Range("B1")
```

Notice that this instruction doesn't use the `Select` method.

I have not been able to find a method to sort a VBA array. Does this mean that I have to copy the values to a worksheet and then use the `Range.Sort` method? There is no built-in way to sort an array in VBA. Copying the array to a worksheet is one method, but you can also write your own sorting procedure. Many sorting algorithms are available, and some are quite easy to code in VBA. This book contains VBA code for several sorting techniques.

My macro works with the selected cells, but it fails if something else (like a chart) is selected. How can I make sure that a range is selected? You can use VBA's `TypeName` function to check the `Selection` object. Here's an example:

```
If TypeName(Selection) <> "Range" Then
    MsgBox "Select a range!"
    Exit Sub
End If
```

Another approach is to use the `RangeSelection` property, which returns a `Range` object that represents the selected cells on the worksheet in the specified window, even if a graphic object is active or selected. This property applies to a `Window` object — not a `Workbook` object. The following instruction, for example, displays the address of the selected range:

```
MsgBox ActiveWindow.RangeSelection.Address
```

How can I determine if a chart is activated? Use a block of code like this:

```
If ActiveChart Is Nothing Then
    MsgBox "Select a chart"
    Exit Sub
End If
```

The message box will be displayed only if a chart isn't activated. (This includes embedded charts and charts on a chart sheet.)

My VBA macro needs to count the number of rows selected by the user. Using `Selection.Rows.Count` doesn't work when nonadjacent rows are selected. Is this a bug? Actually, this is the way it's supposed to work. The `Count` method returns the number of elements in only the first area of the selection (a noncontiguous selection has multiple areas). To get an accurate row count, your VBA code must first determine the number of areas in the selection and then count the number of rows in each area. Use `Selection.Areas.Count` to count the number of areas. Here's an example that stores the total number of selected rows in the `NumRows` variable:

```
NumRows = 0
For Each area In Selection.Areas
    NumRows = NumRows + area.Rows.Count
Next area
```

By the way, this process is also relevant to counting selected columns and cells.

I use Excel to create invoices. Can I generate a unique invoice number? One way to do this is to use the Windows Registry. The following code demonstrates:

```
Counter = GetSetting("XYZ Corp", "InvoiceNum", "Count", 0)
Counter = Counter + 1
SaveSetting "XYZ Corp", "InvoiceNum", "Count", Counter
```

When these statements are executed, the current value is retrieved from the Registry, incremented by one, and assigned to the `Counter` variable. Then this updated value is stored back to the Registry. You can use the value of `Counter` as your unique invoice number.

You can adapt this technique for other purposes. For example, you can keep track of the number of times a workbook has been opened by including similar code in a `Workbook_Open` procedure.

Is there a workbook property that forces an Excel workbook to always remain visible so it won't be hidden by another application's window? No.

Is there a VBA instruction to select the last entry in a column or row? Normally, I can use Ctrl+Shift+↓ or Ctrl+Shift+→ to do this, but how can I do it with a macro? The VBA equivalent for Ctrl+Shift+↓ is the following:

```
Selection.End(xlDown).Select
```

The constants used for the other directions are `xlToLeft`, `xlToRight`, and `xlUp`.

How can I determine the last non-empty cell in a particular column? The following instruction displays the address of the last non-empty cell in column A:

```
MsgBox ActiveSheet.Cells(Rows.Count, 1).End(xlUp).Address
```

But that instruction won't work if the last cell in the column is not empty. To handle that unlikely occurrence, use this code:

```
With ActiveSheet.Cells(Rows.Count, 1)
    If IsEmpty(.Value) Then
        MsgBox .End(xlUp).Address
    Else
        MsgBox .Address
    End If
End With
```

VBA references can be very lengthy, especially when I need to fully qualify an object by referencing its sheet and workbook. Can I reduce the length of these references? Yes. use the `Set` statement to create an object variable. Here's an example:

```
Dim MyRange as Range
Set MyRange = ThisWorkbook.Worksheets("Sheet1").Range("A1")
```

After the `Set` statement is executed, you can refer to this single-cell `Range` object simply as `MyRange`. For example, you can assign a value to the cell with the following:

```
MyRange.Value = 10
```

Besides making it easier to refer to objects, using object variables can also help your code execute more quickly.

Can I declare an array if I don't know how many elements it will have? Yes. You can declare a dynamic array with the `Dim` statement by using empty parentheses; then allocate storage for that array later with the `ReDim` statement when you know how many elements the array should have. Use `ReDim Preserve` if you don't want to lose the current array's contents when reallocating it.

Can I let the user undo my macro? In some cases, yes — but undoing a macro can't be done automatically. To enable the user to undo the effects of your macro, your VBA code module must keep track of what was changed by the macro and then be capable of restoring the original state if the user chooses `Undo`.

To enable the `Undo` command, use the `OnUndo` method as the last action in your macro. This method enables you to specify text that will appear on the `Undo` menu item and also to specify a procedure to run if the user chooses `Undo`. Here's an example:

```
Application.OnUndo "The Last Macro", "MyUndoMacro"
```

Can I pause a macro so the user can enter data into a certain cell? You can use Excel's `InputBox` statement to get a value from a user and place it in a particular cell. The first instruction that follows, for example, displays an input box. When the user enters a value, that value is placed in cell `A1`.

```
UserVal = Application.InputBox(prompt:="Value?", Type:=1)
If TypeName(UserVal) <> "Boolean" Then Range("A1") = UserVal
```

VBA has an `InputBox` function, but there's also an `InputBox` method for the `Application` object. Are these the same? No. Excel's `InputBox` method is more versatile because it allows a user to select a range. In addition, Excel's `InputBox` method allows validation of the user's entry. The preceding example uses `1` (which represents a numeric value) for the `Type` argument of the `InputBox` method. This ensures that the user enters a value into the input box.

I'm trying to write a VBA instruction that creates a formula. To do so, I need to insert a quote character (") within quoted text. How can I do that? Assume that you want to enter the following formula into cell B1 with VBA:

```
=IF (A1="Yes" , TRUE, FALSE)
```

The following instruction generates a syntax error because of the embedded quote characters:

```
Range("B1").Formula = "=IF (A1="Yes" , TRUE, FALSE) " 'erroneous
```

The solution is to use two double quotes side by side. When two quotes are embedded within another set of quotes, Excel interprets the double quote characters as a single quote. The following instruction produces the desired result:

```
Range("B1").Formula = "=IF (A1=""Yes"" , TRUE, FALSE) "
```

Another approach is to use VBA's Chr function with an argument of 34, which returns a quotation mark. The following example demonstrates:

```
Range("B1").Formula = _  
    "=IF (A1=" & Chr(34) & "Yes" & Chr(34) & " , TRUE, FALSE) "
```

Yet another technique is to compose your formula using apostrophes in place of the quote marks. Then use VBA's Replace function to replace the apostrophes with quote characters:

```
MyFormula = "=IF (A1='Yes' , TRUE, FALSE) "  
Range("B1").Formula = Replace(MyFormula, "'", Chr(34))
```

I created an array, but the first element in that array is being treated as the second element.

What's wrong? Unless you tell it otherwise, VBA uses 0 as the first index number for an array. If you want all your arrays to always start with 1, insert the following statement at the top of your VBA module:

```
Option Base 1
```

Or you can specify the upper and lower bounds of an array when you declare it. Here's an example:

```
Dim Months(1 To 12) As String
```

I heard that programming some aspects of Excel can be done only if you use the old XLM macro language. Is that true? It was true. One of the design goals of Excel 2010 was to remove this limitation and make the features available in VBA.

For example, previous versions required an XLM macro to specify descriptions for arguments in a custom worksheet function. Excel 2010 added the `ArgumentDescriptions` argument for the `MacroOptions` method. Another example is the new `AddIns2` collection, which is comprised of all open add-ins (not just those that are installed). In earlier versions, accessing open (but uninstalled) add-ins required an XLM macro.

I would like my VBA code to run as quickly as possible. Any suggestions? Here are a few general tips:

- Make sure that you declare all your variables. Use `Option Explicit` at the top of your modules to force yourself to do this.
- If you reference an Excel object more than once, create an object variable for it.
- Use the `With-End With` construct whenever possible.
- If your macro writes information to a worksheet, turn off screen updating by using `Application.ScreenUpdating = False`.
- If your application enters data into cells that are referenced by one or more formulas, set the calculation mode to manual to avoid unnecessary calculations.

UserForms

My macro needs to get just a few pieces of information from the user, and a UserForm seems like overkill. Are there any alternatives? Yes, check out VBA's `MsgBox` function and its `InputBox` function. Alternatively, you might want to use Excel's `InputBox` method.

I have 12 CommandButtons on a UserForm. How can I assign a single macro to be executed when any of the buttons is clicked? There is no easy way to do this because each `CommandButton` has its own `Click` event procedure. One solution is to call another procedure from each of the `CommandButton_Click` procedures. Another solution is to use a class module to create a new class. This technique is described in Chapter 15.

How can I display a chart in a UserForm? There is no direct way to do this. One solution is to write a macro that saves the chart to a GIF file and then loads the GIF file into an `Image` control on the UserForm. You'll find an example in Chapter 15.

How can I remove the "X" from the title bar of my UserForm? I don't want the user to click that button to close the form. Removing the close button on a UserForm's title bar requires some complex API functions. A simpler approach is to intercept all attempts to close the UserForm by using a `UserForm_QueryClose` event procedure in the code module for the UserForm. The following example doesn't allow the user to close the form by clicking the close button:

```
Private Sub UserForm_QueryClose _
    (Cancel As Integer, CloseMode As Integer)
    If CloseMode = vbFormControlMenu Then
        MsgBox "You can't close the form like that."
        Cancel = True
    End If
End Sub
```

I created a UserForm with controls that are linked to cells on the worksheet with the ControlSource property. Is this the best way to do this?

In some cases, using links to worksheet cells can slow your application because the worksheet is recalculated every time a control changes the cell. In addition, if your UserForm has a Cancel button, the cells might have already been changed when the user clicks Cancel.

Can I create a control array for a UserForm? It's possible with Visual Basic, but I can't figure out how to do it with Excel VBA. You can't create a control array, but you can create an array of Control objects. The following code creates an array consisting of all CommandButton controls:

```
Private Sub UserForm_Initialize()
    Dim Buttons() As CommandButton
    Cnt = 0
    For Each Ctl In UserForm1.Controls
        If TypeName(Ctl) = "CommandButton" Then
            Cnt = Cnt + 1
            ReDim Preserve Buttons(1 To Cnt)
            Set Buttons(Cnt) = Ctl
        End If
    Next Ctl
End Sub
```

Is there any difference between hiding a UserForm and unloading a UserForm? Yes, the Hide method keeps the UserForm in memory but makes it invisible. The Unload statement unloads the UserForm, beginning the “termination” process (invoking the Terminate event for the UserForm) and removing the UserForm from memory.

How can I make my UserForm stay open while I do other things? By default, each UserForm is modal, which means that it must be dismissed before you can do anything else. However, you can make a UserForm modeless by using vbModeless as the argument for the Show method. Here's an example:

```
UserForm1.Show vbModeless
```

I need to display a progress indicator like those you see when you're installing software while a lengthy process is being executed. How can I do this? You can do this with a UserForm. Chapter 15 describes several different techniques, including one in which the code gradually stretches a shape inside a frame while the lengthy macro is running.

How can I use Excel's shapes on my UserForm? You can't use the shapes directly with a UserForm, but you can do so indirectly. Start by adding a shape to a worksheet. Then select the shape and choose Home→Clipboard→Copy. Activate your UserForm and insert an Image object. Press F4 to display the Properties window. Select the Picture property and press Ctrl+V to paste the Clipboard contents to the Image control. You might also need to set the AutoSize property to True.

How can I generate a list of files and directories into my UserForm so the user can select a file from the list? There's no need to do that. Use VBA's GetOpenFilename method. This method displays an Open dialog box in which the user can select a drive, directory, and file. This method doesn't open the selected file, so you need to write additional code.

I need to concatenate strings and display them in a ListBox control. But when I do so, they aren't aligned properly. How can I get them to display equal spacing between strings? You can use a monospaced font such as Courier New for the ListBox. A better approach, however, is to set up your ListBox to use two or more columns. (See Chapter 14 for details.)

Is there an easy way to fill a ListBox or ComboBox control with items? Yes, you can use an array. The statement that follows adds three items to ListBox1:

```
ListBox1.List = Array("Jan", "Feb", "Mar")
```

Can I display a built-in Excel dialog box from VBA? Many of Excel's dialog boxes can be displayed by using the Application.Dialogs method. For example, the following instruction displays the dialog box that enables you to format numbers in cells:

```
Application.Dialogs(xlDialogFormatNumber).Show
```

However, this method isn't reliable, and not all of Excel's dialog boxes are available.

A better option is to execute Ribbon commands (including those that display a dialog box) by using the ExecuteMso method along with the control name. The statement that follows, for example, displays the dialog box that enables you to format numbers in a cell:

```
Application.CommandBars.ExecuteMso("NumberFormatsDialog")
```

See Chapter 22 for more information.

I tried the technique described in the preceding question and received an error message. Why is that? The ExecuteMso method will fail if the context isn't appropriate. For example, the following statement displays the Insert Cells dialog box. But if you execute this statement when a chart is selected or the worksheet is protected, you'll get an error message.

```
Application.CommandBars.ExecuteMso ("CellsInsertDialog")
```

Every time I create a UserForm, I go through the steps of adding an OK button and a Cancel button. Is there a way to get these controls to appear automatically? Yes. Set up a UserForm with the controls that you use most often. Then choose File→Export File to save the UserForm. When you want to add a new form to another project, choose File→Import File.

Can I create a UserForm without a title bar? Yes, but it requires some complex API functions.

When I click a button on my UserForm, nothing happens. What am I doing wrong? Controls added to a UserForm do nothing unless you write event-handler procedures for them. These procedures must be located in the code module for the UserForm, and they must have the correct name.

Can I create a UserForm whose size is always the same, regardless of the video display resolution? You can, but it's probably not worth the effort. You can write code to determine the video resolution and then use the `Zoom` property of a UserForm to change its size. The normal way to deal with this matter is simply to design your UserForm for the lowest resolution that will be used — probably a 1024 × 768 display.

Can I create a UserForm box that lets the user select a range in a worksheet by pointing? Yes. Use the `RefEdit` control for this. See Chapter 14 for an example.

Can I change the startup position of a UserForm? Yes, you can set the UserForm's `Left` and `Top` properties. But for these to be effective, you need to set the UserForm's `StartPosition` property to 0.

I use a system with two monitors, and UserForms don't display in the center of Excel's window. Is there a way to force the UserForm to be centered? Yes. Use the following code to display your UserForm:

```
With UserForm1
    .StartPosition = 0
    .Left = Application.Left + (0.5 * Application.Width) - (0.5 * .Width)
    .Top = Application.Top + (0.5 * Application.Height) - (0.5 * .Height)
    .Show 0
End With
```

Can I make a UserForm that's resizable by the user? Yes. See Chapter 15 for an example.

Add-Ins

Where can I get Excel add-ins? You can get Excel add-ins from a number of places:

- Excel includes several add-ins that you can use whenever you need them. Use the Add-Ins dialog box to install them.
- You can download more add-ins from the Microsoft Office Update Web site.
- Third-party developers distribute and sell add-ins for special purposes.

- Many developers create free add-ins and distribute them via their Internet sites.
- You can create your own add-ins.

How do I install an add-in? The most common way to install an add-in is by using the Add-Ins dialog box. Choose File→Options. In the Excel Options dialog box, select the Add-Ins tab. Then, select Excel Add-ins from the Manage drop-down control and click Go. A quicker method to display the Add-Ins dialog box is to press Alt+Tl. Or, if the Developer tab is displayed, choose Developer→Add-Ins→Add-Ins.

You can also open an add-in by using the File→Open command, but using the Add-Ins dialog box is the preferred method. An add-in opened with File→Open can't be closed without using VBA.

When I install my add-in from Excel's Add-Ins dialog box, it shows up without a name or description. How can I give my add-in a description? Before creating the add-in, use the File→Info→Properties→Advanced Properties command to display the Properties dialog box. Click the Summary tab. In the Title field, enter the text that you want to appear in the Add-Ins dialog box. In the Comments field, enter the description for the add-in. Then create the add-in as usual.

I have several add-ins that I no longer use, but I can't figure out how to remove them from the Add-Ins Available list in the Add-Ins dialog box. What's the story? Oddly, there is no way to remove unwanted add-ins from the list directly from Excel. One way to remove an add-in from the list is to move or delete the add-in file. Then, when you attempt to open the add-in from the Add-Ins dialog box, Excel will ask whether you want to remove the add-in from the list. Answer yes.

How do I create an add-in? Activate any worksheet and then choose File→Save As. Then select Excel Add-in (*.xlam) from the Save as Type drop-down list. The add-in is created, and the original workbook remains open.

I try to create an add-in, but the Save as Type drop-down box doesn't provide Add-in as an option. The most likely reason is that the active sheet isn't a worksheet. An add-in must have at least one worksheet, and a worksheet must be the active sheet when you save the file as an add-in.

Should I convert all my essential workbooks to add-ins? No! Although you can create an add-in from any workbook, not all workbooks are suitable. When a workbook is converted to an add-in, it's essentially invisible. For most workbooks, being invisible isn't a good thing.

Do I need to keep two copies of my workbook: the XLSM version and the XLAM version? No, you can edit an add-in and even convert an add-in back to a normal workbook.

How do I modify an add-in after it has been created? If you need to modify only the VBA code, no special action is required; you can access the code from the VB Editor and then save your changes in the VBE. If you need to modify information on a worksheet, activate the VB Editor (press Alt+F11) and then set the `IsAddIn` property of the `ThisWorkbook` object to `False`. Make your changes to the worksheet, set the `IsAddIn` property to `True`, and resave the file.

What's the difference between an XLSM file and an XLAM file created from an XLSM file? Is the XLAM version compiled? Does it run faster? There isn't a great deal of difference between the files, and you generally won't notice any speed differences. VBA code is always compiled before it's executed. This is true whether it's in an XLSM file or an XLAM file. However, XLAM files still contain the actual VBA code — not some special compiled code. Another difference is that the workbook is never visible in an XLAM file.

How do I protect the code in my add-in from being viewed by others? Activate the VBE and choose Tools→xxxx Properties (where xxxx is the name of your project). Click the Protection tab, select Lock Project for Viewing, and enter a password. Then save the file.

Are my add-ins safe? In other words, if I distribute an XLAM file, can I be assured that no one else will be able to view my code? protect your add-in by locking it with a password. This prevents most users from being able to access your code. Recent versions of Excel have improved the security features, but the password still might be broken by using any of a number of utilities. Bottom line? Don't think of an XLAM as being a secure file.

User Interface

How do I use VBA to add a button to the Ribbon? You can't. You must write special XML code (known as RibbonX code) and insert the XML document into a workbook file by using third-party tools. Or, if you're a glutton for punishment (and know what you're doing), you can do it by unzipping the document and making the edits manually.

What are my options for modifying the user interface to make it easy for a user to run my macros? In Excel 2010, you have these choices:

- Modify the Ribbon by adding RibbonX code (not an easy task).
- Add your macro to the Quick Access toolbar (a manual task that's not possible to perform using VBA).
- Add your macro to the Ribbon (also a manual task that's not possible to perform using VBA).
- Assign a shortcut key to the macro.
- Add a new menu item to a shortcut menu.
- Create an old-style toolbar or menu, which will display in the Add-Ins tab.

How do I add a macro to the Quick Access toolbar? Right-click the Quick Access toolbar and choose Customize Quick Access Toolbar from the shortcut menu. In the Quick Access Toolbar tab of the Excel Options dialog box, choose Macros from the drop-down list on the left. Select your macro and click Add. To change the icon or text displayed, click the Modify button.

How do I add a macro to the Ribbon? Right-click the Ribbon and choose Customize the Ribbon from the shortcut menu. In the Customize Ribbon tab of the Excel Options dialog box, choose Macros from the drop-down list on the left. Select your macro and click Add. Note that you can't add a macro to an existing group. You must first add a new group to a tab by using the New Group button.

How do I use VBA to activate a particular tab on the Ribbon? `SendKeys` is your only choice. Press the Alt key to find out the keystroke(s) required. For example, to switch to the Page Layout tab, use this:

```
Application.SendKeys "%p{F6}"
```

This statement works only when Excel is the active window. For example, you can't execute this statement directly from the VBE.

How can I disable all the right-click shortcut menus? The following procedure will do the job:

```
Sub DisableAllShortcutMenus()  
    Dim cb As CommandBar  
    For Each cb In CommandBars  
        If cb.Type = msoBarTypePopup Then _  
            cb.Enabled = False  
    Next cb  
End Sub
```


Appendixes

APPENDIX A

Excel Resources Online

APPENDIX B

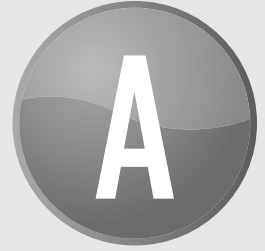
VBA Statements and Functions Reference

APPENDIX C

VBA Error Codes

APPENDIX D

What's on the CD-ROM



Excel Resources Online

If I've done my job, the information provided in this book will be very useful to you. The book, however, can't cover every conceivable topic about Excel. Therefore, I've compiled a list of additional resources that you may find helpful.

I classify these resources into four categories: Excel's Help system, Microsoft technical support, Internet newsgroups, and Internet Web sites.

The Excel Help System

Many users forget about an excellent source of information: the Excel Help system. This Help information is available by clicking the question mark icon in the upper-right corner of Excel's window or just by pressing F1. Either of these methods displays Excel Help in a new window. You can then type your search query and click Search.

If you're working in the Visual Basic Editor, you can get help by using either of these methods:

- Type a search query in the box to the right of the menu bar and press Enter.
- Move the blinking cursor within any keyword, object, property, or method, and press F1.

The Excel Help system isn't perfect — it often provides only superficial help and ignores some topics altogether. But if you're stuck, a quick search of the Help system may be worth a try.

Microsoft Technical Support

Technical support is the common term for assistance provided by a software vendor. In this case, I'm talking about assistance that comes directly from Microsoft. Microsoft's technical support is available in several different forms.

Support options

Microsoft's support options are constantly changing. To find out what options are available (both free and fee-based), go to

```
http://support.microsoft.com
```

Microsoft Knowledge Base

Perhaps your best bet for solving a problem may be the Microsoft Knowledge Base, which is the primary Microsoft product information source. It's an extensive, searchable database that consists of tens of thousands of detailed articles containing technical information, bug lists, fix lists, and more.

You have free and unlimited access to the Knowledge Base via the Internet. To access the Knowledge Base, go to the following URL, enter some search terms, and click Search:

```
http://support.microsoft.com/search
```

Microsoft Excel home page

The official home page of Excel is at

```
www.microsoft.com/office/excel
```

This site contains a variety of material, such as tips, templates, answers to questions, training materials, and links to companion products.

Microsoft Office home page

For information about Office 2010 (including Excel), try this site:

```
http://office.microsoft.com
```

You'll find product updates, add-ins, examples, and lots of other useful information.



Note

As you know, the Internet is a dynamic entity that changes rapidly. Web sites are often reorganized, so a particular URL listed in this appendix may not be available when you try to access it.

Internet Newsgroups

Usenet is an Internet service that provides access to several thousand special interest groups and enables you to communicate with people who share common interests. A newsgroup works like a public bulletin board. You can post a message or questions, and (usually) others reply to your message.

Thousands of newsgroups cover virtually every topic you can think of (and many that you haven't thought of). Typically, questions posed on a newsgroup are answered within 24 hours — assuming, of course, that you ask the questions in a manner that makes others want to reply.

Accessing newsgroups by using a newsreader

You can use newsreader software to access the Usenet newsgroups. Many such programs are available, but you probably already have one installed. Depending on your version of Windows, it's called Outlook Express, Windows Mail, or Windows Live Mail (a separate download).

Microsoft maintains an extensive list of newsgroups, including quite a few devoted to Excel. If your Internet service provider doesn't carry the Microsoft newsgroups, you can access them directly from Microsoft's news server. (In fact, that's the preferred method.) You need to configure your newsreader software (not your Web browser) to access Microsoft's news server at this address:

```
msnews.microsoft.com
```

Accessing newsgroups by using a Web browser

As an alternative to using newsreader software, you can read and post to the Microsoft newsgroups directly from your Web browser. This option is often significantly slower than using standard newsgroup software and is best suited for situations in which newsgroup access is prohibited by network policies.

- Access thousands of newsgroups at Google Groups:

```
http://groups.google.com
```

- Access the Microsoft newsgroups (including Excel newsgroups) from this URL:

```
www.microsoft.com/communities/newsgroups/default.aspx
```

Table A-1 lists the most popular English-language Excel newsgroups found on Microsoft's news server (and also available at Google Groups).

Table A-1: The Microsoft.Com Excel-Related Newsgroups

Newsgroup	Topic
microsoft.public.excel	General Excel topics
microsoft.public.excel.charting	Building charts with Excel
microsoft.public.excel.interopoledde	OLE, DDE, and other cross-application issues
microsoft.public.excel.macintosh	Excel issues on the Macintosh operating system
microsoft.public.excel.misc	General topics that don't fit one of the other categories
microsoft.public.excel.newusers	Help for newcomers to Excel
microsoft.public.excel.printing	Printing with Excel
microsoft.public.excel.programming	Programming Excel with VBA macros
microsoft.public.excel.templates	Spreadsheet Solutions templates and other Xlt files
microsoft.public.excel.worksheet.functions	Worksheet functions

Searching newsgroups

The fastest way to find a quick answer to a question is to search past newsgroup postings. Often, searching past newsgroup postings is an excellent alternative to posting a question to the newsgroup because you can get the answer immediately. Unless your question is very obscure, there's an excellent chance that your question has already been asked and answered. The best source for searching newsgroup postings is Google Groups:

<http://groups.google.com>

How does searching work? Suppose that you have a problem identifying unique values in a range of cells. You can perform a search using the following keywords: **Excel**, **Range**, and **Unique**. The Google search engine probably will find dozens of newsgroup postings that deal with these topics.

If the number of results is too large, refine your search by adding search terms. Sifting through the messages may take a while, but you have an excellent chance of finding an answer to your question. In fact, I estimate that at least 90 percent of the questions posted in the Excel newsgroups can be answered by searching Google.



Tips for posting to a newsgroup

If you're new to online newsgroups, here are some pointers:

1. Conduct a search first to make sure that your question has not already been answered.
2. Make the subject line descriptive.
Postings with a subject line like "Help me!" and "Another Question" are less likely to be answered than postings with a more specific subject, such as "Sizing a Chart's Plot Area."
3. Specify the Excel version that you use.
In many cases, the answer to your question depends on your version of Excel.
4. For best results, ask only one question per message.
5. Make your question as specific as possible.
6. Keep your question brief and to the point but provide enough information so that someone can answer it adequately.
7. Indicate what you've done to try to answer your own question.
8. Post in the appropriate newsgroup and don't cross-post to other groups unless the question applies to multiple groups.
9. Don't type in all uppercase or all lowercase; check your grammar and spelling.
10. Don't include a file attachment.
11. Avoid posting in HTML format. Plain text is the preferred format.
12. If you request an e-mail reply in addition to a newsgroup reply, don't use an anti-spam e-mail address that requires the responder to modify your address.

Why cause extra work for someone doing you a favor?

Internet Web sites

The World Wide Web has dozens of excellent sites devoted to Excel. I list a few of my favorites here.

The Spreadsheet Page

<http://spreadsheetpage.com>

This is my own Web site, which contains files to download, developer tips, instructions for accessing Excel Easter eggs, spreadsheet jokes, an extensive list of links to other Excel sites, and information about my books.

Daily Dose of Excel

<http://DailyDoseOfExcel.com>

This is a frequently updated Web log created by Dick Kusleika, with about a dozen contributors. It covers a variety of topics, and readers can leave comments.

Jon Peltier's Excel Page

<http://peltiertech.com/Excel>

Those who frequent the `microsoft.public.excel.charting` newsgroup are familiar with Jon Peltier. Jon has an uncanny ability to solve practically any chart-related problem. His Web site contains many Excel tips and an extensive collection of charting examples.

Pearson Software Consulting

<http://peltiertech.com/Excel>

This site, maintained by Chip Pearson, contains dozens of useful examples of VBA and clever formula techniques.

Contextures

<http://contextures.com/>

This site is maintained by Deborah Dalgliesh and covers Excel and Access.

Pointy Haired Dilbert

<http://chandoo.org/wp/>

This is an interesting Excel blog by Chandoo.

David McRitchie's Excel Pages

www.mvps.org/dmcritchie/excel/excel.htm

David's site is jam-packed with useful Excel information and is updated frequently.

Mr. Excel

www.MrExcel.com

Mr. Excel, also known as Bill Jelen, maintains an extensive site devoted to Excel. The site also features a message board.



VBA Statements and Functions Reference

This appendix contains a complete listing of all Visual Basic for Applications (VBA) statements and built-in functions. For details, consult Excel's online help.



There are no new VBA statements in Excel 2010.

Note

Table B-1: Summary of VBA Statements

Statement	Action
AppActivate	Activates an application window
Beep	Sounds a tone via the computer's speaker
Call	Transfers control to another procedure
ChDir	Changes the current directory
ChDrive	Changes the current drive
Close	Closes a text file
Const	Declares a constant value
Date	Sets the current system date
Declare	Declares a reference to an external procedure in a Dynamic Link Library (DLL)
DefBool	Sets the default data type to <code>Boolean</code> for variables that begin with specified letters
DefByte	Sets the default data type to <code>Byte</code> for variables that begin with specified letters
DefCur	Sets the default data type to <code>Currency</code> for variables that begin with specified letters
DefDate	Sets the default data type to <code>Date</code> for variables that begin with specified letters
DefDec	Sets the default data type to <code>Decimal</code> for variables that begin with specified letters

continued

Table B-1: Summary of VBA Statements (*continued*)

Statement	Action
DefDbl	Sets the default data type to <code>Double</code> for variables that begin with specified letters
DefInt	Sets the default data type to <code>Integer</code> for variables that begin with specified letters
DefLng	Sets the default data type to <code>Long</code> for variables that begin with specified letters
DefObj	Sets the default data type to <code>Object</code> for variables that begin with specified letters
DefSng	Sets the default data type to <code>Single</code> for variables that begin with specified letters
DefStr	Sets the default data type to <code>String</code> for variables that begin with specified letters
DefVar	Sets the default data type to <code>Variant</code> for variables that begin with specified letters
DeleteSetting	Deletes a section or key setting from an application's entry in the Windows Registry
Dim	Declares variables and (optionally) their data types
Do-Loop	Loops through a set of instructions
End	Used by itself, exits the program; also used to end a block of statements that begin with <code>If</code> , <code>With</code> , <code>Sub</code> , <code>Function</code> , <code>Property</code> , <code>Type</code> , or <code>Select</code>
Enum	Declares a type for enumeration
Erase	Re-initializes an array
Error	Simulates a specific error condition
Event	Declares a user-defined event
Exit Do	Exits a block of <code>Do-Loop</code> code
Exit For	Exits a block of <code>For-Next</code> code
Exit Function	Exits a <code>Function</code> procedure
Exit Property	Exits a property procedure
Exit Sub	Exits a subroutine procedure
FileCopy	Copies a file
For Each-Next	Loops through a set of instructions for each member of a series
For-Next	Loops through a set of instructions a specific number of times
Function	Declares the name and arguments for a <code>Function</code> procedure
Get	Reads data from a text file
GoSub...Return	Branches to and returns from a procedure
GoTo	Branches to a specified statement within a procedure
If-Then-Else	Processes statements conditionally
Implements	Specifies an interface or class that will be implemented in a class module
Input #	Reads data from a sequential text file
Kill	Deletes a file from a disk
Let	Assigns the value of an expression to a variable or property
Line Input #	Reads a line of data from a sequential text file
Load	Loads an object but doesn't show it

Statement	Action
Lock...Unlock	Controls access to a text file
Lset	Left-aligns a string within a string variable
Mid	Replaces characters in a string with other characters
MkDir	Creates a new directory
Name	Renames a file or directory
On Error	Gives specific instructions for what to do in the case of an error
On...GoSub	Branches, based on a condition
On...GoTo	Branches, based on a condition
Open	Opens a text file
Option Base	Changes the default lower limit for arrays
Option Compare	Declares the default comparison mode when comparing strings
Option Explicit	Forces declaration of all variables in a module
Option Private	Indicates that an entire module is Private
Print #	Writes data to a sequential file
Private	Declares a local array or variable
Property Get	Declares the name and arguments of a Property Get procedure
Property Let	Declares the name and arguments of a Property Let procedure
Property Set	Declares the name and arguments of a Property Set procedure
Public	Declares a public array or variable
Put	Writes a variable to a text file
RaiseEvent	Fires a user-defined event
Randomize	Initializes the random number generator
ReDim	Changes the dimensions of an array
Rem	Specifies a line of comments (same as an apostrophe ['])
Reset	Closes all open text files
Resume	Resumes execution when an error-handling routine finishes
Rmdir	Removes an empty directory
RSet	Right-aligns a string within a string variable
SaveSetting	Saves or creates an application entry in the Windows Registry
Seek	Sets the position for the next access in a text file
Select Case	Processes statements conditionally
SendKeys	Sends keystrokes to the active window
Set	Assigns an object reference to a variable or property
SetAttr	Changes attribute information for a file
Static	Declares variables at the procedure level so that the variables retain their values as long as the code is running

continued

Table B-1: Summary of VBA Statements (*continued*)

Statement	Action
Stop	Pauses the program
Sub	Declares the name and arguments of a Sub procedure
Time	Sets the system time
Type	Defines a custom data type
Unload	Removes an object from memory
While...Wend	Loops through a set of instructions as long as a certain condition remains true
Width #	Sets the output line width of a text file
With	Sets a series of properties for an object
Write #	Writes data to a sequential text file

Invoking Excel functions in VBA instructions

If a VBA function that's equivalent to one you use in Excel isn't available, you can use Excel's worksheet functions directly in your VBA code. Just precede the function with a reference to the `WorksheetFunction` object. For example, VBA doesn't have a function to convert radians to degrees. Because Excel has a worksheet function for this procedure, you can use a VBA instruction such as the following:

```
Deg = Application.WorksheetFunction.Degrees(3.14)
```

The `WorksheetFunction` object was introduced in Excel 97. For compatibility with earlier versions of Excel, you can omit the reference to the `WorksheetFunction` object and write an instruction such as the following:

```
Deg = Application.Degrees(3.14)
```



Note

There are no new VBA functions in Excel 2010.

Table B-2: Summary of VBA Functions

Function	Action
Abs	Returns the absolute value of a number
Array	Returns a variant containing an array
Asc	Converts the first character of a string to its ASCII value
Atn	Returns the arctangent of a number

Function	Action
CallByName	Executes a method, or sets or returns a property of an object
CBool	Converts an expression to a Boolean data type
CByte	Converts an expression to a Byte data type
CCur	Converts an expression to a Currency data type
CDate	Converts an expression to a Date data type
CDBl	Converts an expression to a Double data type
CDec	Converts an expression to a Decimal data type
Choose	Selects and returns a value from a list of arguments
Chr	Converts a character code to a string
CInt	Converts an expression to an Integer data type
CLng	Converts an expression to a Long data type
Cos	Returns the cosine of a number
CreateObject	Creates an Object Linking and Embedding (OLE) Automation object
CSng	Converts an expression to a Single data type
CStr	Converts an expression to a String data type
CurDir	Returns the current path
CVar	Converts an expression to a variant data type
CVDate	Converts an expression to a Date data type (for compatibility, not recommended)
CVErr	Returns a user-defined error value that corresponds to an error number
Date	Returns the current system date
DateAdd	Adds a time interval to a date
DateDiff	Returns the time interval between two dates
DatePart	Returns a specified part of a date
DateSerial	Converts a date to a serial number
DateValue	Converts a string to a date
Day	Returns the day of the month of a date
DDB	Returns the depreciation of an asset
Dir	Returns the name of a file or directory that matches a pattern
DoEvents	Yields execution so the operating system can process other events
Environ	Returns an operating environment string
EOF	Returns True if the end of a text file has been reached
Error	Returns the error message that corresponds to an error number
Exp	Returns the base of natural logarithms (e) raised to a power
FileAttr	Returns the file mode for a text file
FileDateTime	Returns the date and time when a file was last modified

continued

Table B-2: Summary of VBA Functions (*continued*)

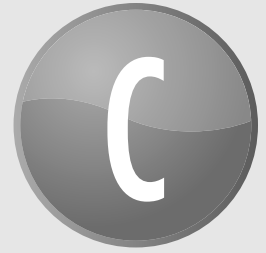
Function	Action
FileLen	Returns the number of bytes in a file
Filter	Returns a subset of a string array, filtered
Fix	Returns the integer portion of a number
Format	Displays an expression in a particular format
FormatCurrency	Returns an expression formatted with the system currency symbol
FormatDateTime	Returns an expression formatted as a date or time
FormatNumber	Returns an expression formatted as a number
FormatPercent	Returns an expression formatted as a percentage
FreeFile	Returns the next available file number when working with text files
FV	Returns the future value of an annuity
GetAllSettings	Returns a list of settings and values from the Windows Registry
GetAttr	Returns a code representing a file attribute
GetObject	Retrieves an OLE Automation object from a file
GetSetting	Returns a specific setting from the application's entry in the Windows Registry
Hex	Converts from decimal to hexadecimal
Hour	Returns the hour of a time
IIf	Evaluates an expression and returns one of two parts
Input	Returns characters from a sequential text file
InputBox	Displays a box to prompt a user for input
InStr	Returns the position of a string within another string
InStrRev	Returns the position of a string within another string from the end of the string
Int	Returns the integer portion of a number
IPmt	Returns the interest payment for a given period of an annuity
IRR	Returns the internal rate of return for a series of cash flows
IsArray	Returns <code>True</code> if a variable is an array
IsDate	Returns <code>True</code> if a variable is a date
IsEmpty	Returns <code>True</code> if a variable has not been initialized
IsError	Returns <code>True</code> if an expression is an error value
IsMissing	Returns <code>True</code> if an optional argument was not passed to a procedure
IsNull	Returns <code>True</code> if an expression contains a <code>Null</code> value
IsNumeric	Returns <code>True</code> if an expression can be evaluated as a number
IsObject	Returns <code>True</code> if an expression references an OLE Automation object
Join	Combines strings contained in an array
LBound	Returns the smallest subscript for a dimension of an array

Function	Action
LCase	Returns a string converted to lowercase
Left	Returns a specified number of characters from the left of a string
Len	Returns the number of characters in a string
Loc	Returns the current read or write position of a text file
LOF	Returns the number of bytes in an open text file
Log	Returns the natural logarithm of a number
LTrim	Returns a copy of a string with no leading spaces
Mid	Returns a specified number of characters from a string
Minute	Returns the minute of a time
MIRR	Returns the modified internal rate of return for a series of periodic cash flows
Month	Returns the month of a date as a number
MonthName	Returns the month of a date as a string
MsgBox	Displays a modal message box
Now	Returns the current system date and time
NPer	Returns the number of periods for an annuity
NPV	Returns the net present value of an investment
Oct	Converts from decimal to octal
Partition	Returns a string representing a range in which a value falls
Pmt	Returns a payment amount for an annuity
Ppmt	Returns the principal payment amount for an annuity
PV	Returns the present value of an annuity
QBColor	Returns a red/green/blue (RGB) color code
Rate	Returns the interest rate per period for an annuity
Replace	Returns a string in which a substring is replaced with another string
RGB	Returns a number representing an RGB color value
Right	Returns a specified number of characters from the right of a string
Rnd	Returns a random number between 0 and 1
Round	Returns a rounded number
RTrim	Returns a copy of a string with no trailing spaces
Second	Returns the seconds portion of a specified time
Seek	Returns the current position in a text file
Sgn	Returns an integer that indicates the sign of a number
Shell	Runs an executable program
Sin	Returns the sine of a number
SLN	Returns the straight-line depreciation for an asset for a period

continued

Table B-2: Summary of VBA Functions (*continued*)

Function	Action
Space	Returns a string with a specified number of spaces
Spc	Positions output when printing to a file
Split	Returns a one-dimensional array containing a number of substrings
Sqr	Returns the square root of a number
Str	Returns a string representation of a number
StrComp	Returns a value indicating the result of a string comparison
StrConv	Returns a converted string
String	Returns a repeating character or string
StrReverse	Returns a string, reversed
Switch	Evaluates a list of Boolean expressions and returns a value associated with the first True expression
SYD	Returns the sum-of-years' digits depreciation of an asset for a period
Tab	Positions output when printing to a file
Tan	Returns the tangent of a number
Time	Returns the current system time
Timer	Returns the number of seconds since midnight
TimeSerial	Returns the time for a specified hour, minute, and second
TimeValue	Converts a string to a time serial number
Trim	Returns a string without leading spaces and/or trailing spaces
TypeName	Returns a string that describes the data type of a variable
UBound	Returns the largest available subscript for a dimension of an array
UCase	Converts a string to uppercase
Val	Returns the number formed from any initial numeric characters of a string
VarType	Returns a value indicating the subtype of a variable
Weekday	Returns a number indicating a day of the week
WeekdayName	Returns a string indicating a day of the week
Year	Returns the year of a date



VBA Error Codes

This appendix contains a complete listing of the error codes for all trappable errors in Visual Basic for Applications (VBA). This information is useful for error trapping. For complete details, consult Excel's Help system.

Error Code	Message
3	Return without <code>GoSub</code> .
5	Invalid procedure call or argument.
6	Overflow (for example, value too large for an integer).
7	Out of memory. This error rarely refers to the amount of physical memory installed on your system. Rather, it usually refers to a fixed-size area of memory used by Excel or Windows (for example, the area used for graphics or custom formats).
9	Subscript out of range. You will also get this error message if a named item is not found in a collection of objects. For example, if your code refers to <code>Sheets("Sheet2")</code> , and <code>Sheet2</code> does not exist.
10	This array is fixed or temporarily locked.
11	Division by zero.
13	Type mismatch.
14	Out of string space.
16	Expression too complex.
17	Can't perform requested operation.
18	User interrupt occurred. This error occurs if the user interrupts a macro by pressing the Cancel key.
20	Resume without error. This error probably indicates that you forgot the <code>Exit Sub</code> statement before your error handler code.
28	Out of stack space.
35	Sub or Function not defined.
47	Too many Dynamic Link Library (DLL) application clients.
48	Error in loading DLL.

continued

Error Code	Message (<i>continued</i>)
49	Bad DLL calling convention.
51	Internal error.
52	Bad filename or number.
53	File not found.
54	Bad file mode.
55	File already open.
57	Device Input/Output (I/O) error.
58	File already exists.
59	Bad record length.
61	Disk full.
62	Input past end of file.
63	Bad record number.
67	Too many files.
68	Device unavailable.
70	Permission denied.
71	Disk not ready.
74	Can't rename with different drive.
75	Path/File access error.
76	Path not found.
91	Object variable or With block variable not set. This error occurs if you don't use <code>Set</code> at the beginning of a statement that creates an object variable. Or, it occurs if you refer to a worksheet object (such as <code>ActiveCell</code>) when a chart sheet is active.
92	For loop not initialized.
93	Invalid pattern string.
94	Invalid use of <code>Null</code> .
96	Unable to sink events of object because the object is already firing events to the maximum number of event receivers that it supports.
97	Cannot call friend function on object that is not an instance of defining class.
98	A property or method call can't include a reference to a private object, either as an argument or as a return value.
321	Invalid file format.
322	Can't create necessary temporary file.
325	Invalid format in resource file.
380	Invalid property value.
381	Invalid property array index.
382	<code>Set</code> not supported at runtime.

Error Code	Message
383	Set not supported (read-only property).
385	Need property array index.
387	Set not permitted.
393	Get not supported at runtime.
394	Get not supported (write-only property).
422	Property not found.
423	Property or method not found.
424	Object required. This error occurs if text preceding a dot is not recognized as an object.
429	ActiveX component can't create object (might be a registration problem with a library that you've referenced).
430	Class doesn't support Automation or doesn't support expected interface.
432	Filename or class name not found during Automation operation.
438	Object doesn't support this property or method.
440	Automation error.
442	Connection to type library or object library for remote process has been lost.
443	Automation object doesn't have a default value.
445	Object doesn't support this action.
446	Object doesn't support named arguments.
447	Object doesn't support current locale setting.
448	Named argument not found.
449	Argument not optional.
450	Wrong number of arguments or invalid property assignment.
451	Property Let procedure not defined, and Property Get procedure did not return an object.
452	Invalid ordinal.
453	Specified DLL function not found.
454	Code resource not found.
455	Code resource lock error.
457	Key is already associated with an element of this collection.
458	Variable uses an Automation type not supported in Visual Basic.
459	Object or class doesn't support the set of events.
460	Invalid Clipboard format.
461	Method or data member not found.
462	Remote server machine doesn't exist or is unavailable.
463	Class not registered on local machine.

continued

Error Code	Message (<i>continued</i>)
481	Invalid picture.
482	Printer error.
735	Can't save file to TEMP.
744	Search text not found.
746	Replacements too long.
1004	Application-defined or object-defined error. This is a very common catch-all error message. This error occurs when an error doesn't correspond to an error defined by VBA. In other words, the error is defined by Excel (or some other object) and is propagated back to VBA.



What's on the CD-ROM

This appendix describes the contents of the CD-ROM that accompanies this book. For any last-minute changes, please refer to the ReadMe file located at the root of the CD.

This appendix provides information on the following topics:

- System requirements
- Using the CD
- Files and software on the CD
- Troubleshooting

System Requirements

Make sure that your computer meets the minimum system requirements listed in this section. If your computer doesn't match up to most of these requirements, you may have a problem using the contents of the CD.

- A Windows PC with Microsoft Excel 2010
- A CD-ROM drive

Using the CD

To install the items from the CD to your hard drive, follow these steps:

1. Insert the CD into your computer's CD-ROM drive.



Note

The interface won't launch if you have autorun disabled. In that case, choose **Start→Run**. In the dialog box that appears, type **D:\start.exe**. (Replace *D* with the proper letter if your CD drive uses a different letter. If you don't know the letter, see how your CD drive is listed under My Computer [or Computer].) Click OK.

2. The CD-ROM interface appears.

The interface provides a simple point-and-click way to explore the contents of the CD.

Files and Software on the CD

The following sections provide more details about the software and other materials available on the CD.

Applications

Adobe Reader is a freeware application for viewing files in the Adobe Portable Document format.

Shareware programs are fully functional, trial versions of copyrighted programs. If you like particular programs, register with their authors for a nominal fee and receive licenses, enhanced versions, and technical support.

Freeware programs are copyrighted games, applications, and utilities that are free for personal use. Unlike shareware, these programs do not require a fee or provide technical support.

GNU software is governed by its own license, which is included inside the folder of the GNU product. See the GNU license for more details.

Trial, demo, or evaluation versions are usually limited either by time or functionality (such as being unable to save projects). Some trial versions are very sensitive to system date changes. If you alter your computer's date, the programs will "time out" and no longer be functional.

eBook version of *Excel 2010 Power Programming with VBA*

The complete text of the book you hold in your hands is provided on the CD in Adobe's Portable Document Format (PDF). You can read and quickly search the content of this PDF file by using Adobe's Acrobat Reader, also included on the CD. Or, you can load the file onto an ebook reader, such as Kindle.

Sample files for *Excel 2010 Power Programming with VBA*

The CD contains more than 300 files used as examples in the book. The files are organized by chapter. With a few exceptions, the files are all Excel 2010 files that have one of the following extensions:

- `.xlsx`: An Excel workbook file.
- `.xlsm`: An Excel workbook file that contains VBA macros.
- `.xlam`: An Excel add-in file that contains VBA macros.

When you open an XLSM file, Excel may display a security warning that tells you that macros have been disabled. To enable macros, click the Options button in the security warning panel and then select Enable This Content.

Because the files on this CD are from a trusted source, you may want to copy the files to your hard drive and then designate the folder as a trusted location. To do so, follow these steps:

1. Open an Explorer window and double-click the CD-ROM drive that contains the companion CD-ROM.
2. Right-click the folder that corresponds to the root folder for the sample files and choose Copy from the shortcut menu.
3. Activate the folder on your hard drive where you'd like to copy the files, right-click the directory, and choose Paste from the shortcut menu.

The CD-ROM files will be copied to a subfolder in the folder you specified in Step 3.

To designate this new folder as a trusted location:

1. Start Excel and choose File→Options to display the Excel Options dialog box.
2. In the Excel Options dialog box, click the Trust Center tab.
3. Click the Trust Center Settings button.
4. In the Trust Center dialog box, click the Trusted Locations tab.
5. Click the Add New Location button to display the Microsoft Office Trusted Location dialog box.
6. In the Microsoft Office Trusted Location dialog box, click the Browse button and locate the folder that contains the files copied from the CD-ROM.
7. Make sure you select the option labeled Subfolders of This Location Are Also Trusted.

After performing these steps, when you open XLSM files from this location, the macros are enabled and you don't see the security warning.

Following is a list of the sample files, along with a brief description. Examples that use multiple files are contained in a separate subdirectory.



Note

Some chapters don't use any sample files.

Chapter 3

- `array formula examples.xlsx`: A workbook that contains various examples of array formulas.
- `counting and summing examples.xlsx`: A workbook that contains examples of counting and summing formulas.

- `megaformula.xlsm`: A workbook that demonstrates intermediate formulas, a megaformula, and a VBA function.
- `named_formulas.xlsx`: A workbook that contains several examples of named formulas.
- `yearly_calendar.xlsx`: A workbook that contains a yearly calendar, generated using array formulas.

Chapter 4

- `sample.xlsm`: A sample file used to demonstrate the file structure of an Excel workbook.

Chapter 6

- `worksheet_controls.xlsx`: A workbook that demonstrates the use of ActiveX controls on a worksheet (with no macros).

Chapter 7

- `comment_object.xlsm`: A workbook that demonstrates some ways to manipulate Comment objects using VBA.

Chapter 8

- `timing_test.xlsm`: A workbook that demonstrates the speed advantage of declaring variables as a specific data type.

Chapter 9

- `sheet_sorter.xlsm`: A macro that sorts worksheets in a workbook.

Chapter 10

- `array_argument.xlsm`: A workbook that contains an example of a function that uses an array argument.
- `commission_functions.xlsm`: A workbook that contains an example of a function that uses an argument.
- `draw.xlsm`: A workbook that contains a function that selects a cell randomly.
- `extended_date_functions.xlsm`: A workbook that demonstrates functions to work with pre-1900 dates.
- `extended_date_functions_help.docx`: A Word document that describes the extended data functions.

- `key_press.xlsm`: A workbook that uses an API function to determine if the Ctrl, Shift, or Alt key is pressed.
- `month_names.xlsm`: A workbook that demonstrates returning an array from a function.
- `mysum_function.xlsm`: A workbook that contains a function that simulates Excel's SUM function.
- `no_argument.xlsm`: A workbook that contains functions that don't use an argument.
- `remove_vowels.xlsm`: A workbook that contains a function that removes the vowels from its argument.
- `upper_case.xlsm`: A workbook that contains a function that converts text to uppercase.
- `win32api.txt`: A text file that contains Windows API declarations and constants.
- `windows_directory.xlsm`: A workbook that uses an API function to determine the Windows directory.

Chapter 11

- `about_range_selection.xlsm`: A workbook that contains a macro that describes the current range selection.
- `\batch_processing`: A directory that contains files used by the batch processing example.
- `celltype_function.xlsm`: A workbook that contains a function that describes the data type of its single-cell argument.
- `copy_multiple_selection.xlsm`: A workbook that contains a macro that copies a noncontiguous range selection.
- `date_and_time.xlsm`: A workbook that contains a macro that displays the current date and time.
- `delete_empty_rows.xlsm`: A workbook that contains a macro that deletes all empty rows in a workbook.
- `drive_information.xlsm`: A workbook that uses API functions to list information about all disk drives.
- `duplicate_rows.xlsm`: A workbook that contains a macro that duplicates rows, based on the contents of a cell.
- `efficient_looping.xlsm`: A workbook that demonstrates an efficient way to loop through a range.
- `file_association.xlsm`: A workbook that contains an API function that returns the application associated with a particular file.
- `hide_rows_and_columns.xlsm`: A workbook that contains a macro that hides all rows and columns that are outside of the current range selection.

- `inputbox_demo.xlsm`: A workbook that contains a macro that demonstrates how to prompt for a value.
- `inrange_function.xlsm`: A workbook that contains a function that determines whether a range is contained in another range.
- `list_fonts.xlsm`: A workbook that contains a macro that lists all installed fonts.
- `loop_vs_array_fill_range.xlsm`: A workbook that contains macros that demonstrate ways to fill a range of cells.
- `next_empty_cell.xlsm`: A workbook that contains a macro that determines the next empty cell in a column.
- `page_count.xlsm`: A workbook that contains a macro that counts the number of printed pages in a workbook.
- `printer_info.xlsm`: A workbook that contains an API function that returns information about the active printer.
- `prompt_for_a_range.xlsm`: A workbook that contains a macro that demonstrates how to prompt for a user-selected range.
- `range_selections.xlsm`: A workbook that contains macros that perform various types of range selections.
- `select_by_value.xlsm`: A workbook that contains a macro that demonstrates how to select cells based on their values.
- `sorting_demo.xlsm`: A workbook that contains macros that demonstrate four ways to sort an array.
- `\sound.xlsm`: A directory that contains files to demonstrate generating sound in Excel.
- `synchronize_sheets.xlsm`: A workbook that contains a macro that synchronizes worksheets.
- `\value_from_closed_workbook`: A directory that includes files to demonstrate how to use a function to retrieve a value from a closed workbook.
- `variant_transfer.xlsm`: A workbook that contains a macro that transfers a range to a variant array.
- `vba_utility_functions.xlsm`: A workbook that contains several useful functions for use in your VBA code.
- `video_mode.xlsm`: A workbook that contains an API function that determines the current video mode.
- `windows_registry.xlsm`: A workbook that contains macros that read from and write to the Windows Registry.
- `worksheet_functions.xlsm`: A workbook that contains some useful worksheet functions created using VBA.

Chapter 12

- `data form example.xlsm`: A workbook that contains a macro that displays Excel's built-in data form.
- `get directory.xlsm`: A workbook that contains macros that demonstrate two ways to prompt a user for a directory.
- `inputbox method.xlsm`: A workbook that contains macros that demonstrate the use of Excel's `InputBox` method.
- `prompt for file.xlsm`: A workbook that demonstrates how to prompt for one or more file names.
- `ribbon control names.xlsx`: A workbook that lists all of the Excel 2007 and Excel 2010 Ribbon control names.
- `VBA inputbox.xlsm`: A workbook that contains macros that demonstrate the use of the VBA `InputBox` function.

Chapter 13

- `activex worksheet controls.xlsx`: A workbook that demonstrates the use of ActiveX controls on a worksheet (with no macros).
- `all userform controls.xlsm`: A workbook that contains a UserForm that uses all available controls.
- `get name and sex.xlsm`: A workbook that contains a simple UserForm example.
- `newcontrols.pag`: A file that contains customized controls that can be imported into your UserForm Toolbox as a new page.
- `spinbutton and textbox.xlsm`: A workbook that demonstrates the use of a paired `SpinButton` control and `TextBox` control in a UserForm.
- `spinbutton events.xlsm`: A workbook that demonstrates `SpinButton` events.
- `userform events.xlsm`: A workbook that demonstrates UserForm events.

Chapter 14

- `change userform size.xlsm`: A workbook that demonstrates how to use VBA to change the size of a UserForm.
- `date and time picker.xlsm`: A workbook that demonstrates the use of the `Date` and `Time Picker` control.
- `listbox activate sheet.xlsm`: A workbook that demonstrates how to allow a user to select a sheet by using a `ListBox` control.

- `listbox fill.xlsm`: A workbook that demonstrates how to fill a `ListBox` control in a `UserForm`.
- `listbox item transfer.xlsm`: A workbook that demonstrates how to transfer items between two `ListBox` controls.
- `listbox move items.xlsm`: A workbook that demonstrates how to allow the user to change the order of items in a `ListBox` control.
- `listbox multicolumn1.xlsm`: A workbook that demonstrates a range-based multi-column `ListBox` control.
- `listbox multicolumn2.xlsm`: A workbook that demonstrates an array-based multi-column `ListBox` control.
- `listbox multiple lists.xlsm`: A workbook that demonstrates how to display multiple lists in a single `ListBox` control.
- `listbox select rows.xlsm`: A workbook that demonstrates how to allow a user to select worksheet rows by using a `ListBox` control.
- `listbox selected items.xlsm`: A workbook that demonstrates how to identify the selected item(s) in a `ListBox`.
- `listbox unique items1.xlsm`: A workbook that demonstrates how to fill a `ListBox` control with unduplicated items.
- `listbox unique items2.xlsm`: A variation of the `listbox unique items1.xlsm` example that also sorts the items.
- `\mediaplayer`: A folder that contains `mediaplayer.xlsm` (a workbook that demonstrates the Media Player control), plus several MP3 audio files.
- `multipage control demo.xlsm`: A workbook that demonstrates the `MultiPage` control in a `UserForm`.
- `queryclose demo.xlsm`: A workbook that demonstrates how to prevent a user from closing a `UserForm` by clicking its Close button in the title bar.
- `random number generator.xlsm`: A workbook that demonstrates how to program simple animation in a `UserForm`.
- `range selection demo.xlsm`: A workbook that demonstrates the `RefEdit` control in a `UserForm`.
- `resizable userform api.xlsm`: A workbook that demonstrates how to use a Windows API function to allow the user to change the size of a `UserForm`.
- `splash screen.xlsm`: A workbook that demonstrates how to use a `UserForm` as a splash screen that displays when a workbook is opened.
- `userform menus.xlsm`: A workbook that demonstrates how to use a `UserForm` to display a menu of macros.

- `zoom and scroll sheet.xlsm`: A workbook that demonstrates how to zoom and scroll a worksheet while a UserForm is displayed.
- `zoom userform.xlsm`: A workbook that demonstrates how to allow the user to change the size of a UserForm.

Chapter 15

- `chart in userform.xlsm`: A workbook that demonstrates how to display a chart in a UserForm.
- `\dataform`: This directory contains the Enhanced Data Form add-in created by the author.
- `excel lightbox.xlsm`: A workbook that demonstrates how to darken the Excel window while a UserForm is displayed.
- `getacolor function.xlsm`: A workbook that contains a function that allows the user to select a color by using controls on a UserForm.
- `modeless userform1.xlsm`: A workbook that demonstrates how to display a modeless UserForm to display information about the active cell.
- `modeless userform2.xlsm`: A more sophisticated version of `modeless userform1.xlsm`.
- `move controls.xlsm`: A workbook that demonstrates how to allow the user to move controls on a UserForm.
- `msgbox emulation.xlsm`: A workbook that contains macros that simulate the VBA `MsgBox` function.
- `multiple buttons.xlsm`: A workbook that demonstrates how to use a class module to allow a single procedure to handle events for multiple controls on a UserForm.
- `no title bar.xlsm`: A workbook that uses API functions to display a UserForm without a title bar.
- `progress indicator1.xlsm`: A workbook that displays a progress indicator in a UserForm.
- `progress indicator2.xlsm`: A workbook that uses a `MultiPage` control to display a progress indicator in a UserForm.
- `progress indicator3.xlsm`: A workbook that displays a progress indicator in a UserForm by changing the size of the UserForm.
- `resizable userform.xlsm`: A workbook that demonstrates a UserForm that's resizable by the user.
- `semitransparent userform.xlsm`: A workbook that demonstrates how to display a semitransparent UserForm.

- `simulated_toolbar.xlsm`: A workbook that uses a UserForm to simulate a toolbar.
- `sliding_tile_puzzle.xlsm`: A workbook that contains a UserForm with a sliding tile puzzle.
- `splash_screen2.xlsm`: The `splash_screen.xlsm` example from Chapter 14, with a UserForm that doesn't have a title bar.
- `video_poker.xlsm`: A workbook that displays a video poker game in a UserForm.
- `wizard_demo.xlsm`: A workbook that uses a `MultiPage` control to display a simple wizard UserForm.

Chapter 16

- `simple_undo_demo.xlsm`: A workbook that demonstrates a method to undo the effects of a VBA macro.
- `text_tools.xlam`: An add-in that adds text manipulation features to Excel.
- `text_tools.chm`: The help file for `text_tools.xlam`.
- `\text_tools_help_source`: The source files used to create the `texttools.chm` help file.

Chapter 17

- `budget_pivot_table.xlsm`: A workbook that contains data suitable for a pivot table.
- `normalized_data.xlsx`: A workbook that shows the difference between normalized data and summarized data.
- `reverse_pivot_table.xlsm`: A workbook that contains a macro that converts a summary table into a 3-column data table.
- `simple_pivot_table.xlsm`: A workbook that contains data suitable for a pivot table.
- `survey_data_pivot_tables.xlsm`: A workbook that contains a macro to generate 28 pivot tables from a range of data.

Chapter 18

- `animated_charts.xlsm`: A workbook that demonstrates how to use VBA to animate charts.
- `chart_active_cell.xlsm`: A workbook that contains a macro that displays a chart that uses data based on the active cell position.

- `chart image map.xlsm`: A workbook that uses chart events to create a simple clickable image map.
- `chart in userform.xlsm`: A workbook that displays a chart in a UserForm, using the data based on the active cell position.
- `climate data.xlsx`: An interactive chart application that uses no macros.
- `data labels.xlsm`: A workbook that contains a macro that applies chart data labels that are stored in a range.
- `events - chart sheet.xlsm`: A workbook that demonstrates events for a chart on a chart sheet.
- `events - embedded chart.xlsm`: A workbook that demonstrates events for an embedded chart.
- `export all graphics.xlsm`: A workbook that contains a macro that exports all graphic objects in a workbook.
- `format all charts.xlsm`: A workbook that contains a macro that changes the formatting of all charts on a worksheet.
- `get series ranges.xlsm`: A workbook that contains functions that identify the ranges used in a chart.
- `hide and unhide series.xlsm`: A workbook that contains check boxes that allow a user to indicate which chart series to display.
- `hypocycloid - animated.xlsm`: A workbook that includes macros to display an animated hypocycloid chart.
- `mouseover event - chart sheet.xlsm`: A workbook that demonstrates the `MouseOver` event for a chart sheet.
- `mouseover event - embedded.xlsm`: A workbook that demonstrates the `MouseOver` event for an embedded chart.
- `scrolling chart.xlsm`: A workbook that demonstrates how to create an animated scrolling chart.
- `size and align charts.xlsm`: A workbook that contains a macro that sizes and aligns all charts on a worksheet.
- `sparkline report.xlsm`: A workbook that generates a report that describes Sparkline graphics on a worksheet.
- `unlinked chart.xlsm`: A workbook that contains macros that demonstrate two ways to unlink a chart from its source data.
- `vba clock chart.xlsm`: A workbook that displays a chart that resembles an analog clock.

Chapter 19

- `application event tracker.xlsm`: A workbook that demonstrates how to monitor application-level events.
- `hide columns before printing.xlsm`: A workbook that uses an event both to hide columns before printing and to unhide the columns after printing.
- `log workbook open.xlsm`: A workbook that demonstrates how to keep track of every workbook that is opened by using a class module.
- `make formulas bold.xlsm`: A workbook that demonstrates the `Worksheet Change` event.
- `no shortcut menus.xlsm`: A workbook that uses the `Workbook_Open` event to disable shortcut keys and the `Workbook_BeforeClose` event to re-enable shortcut keys.
- `onkey event demo.xlsm`: A workbook that demonstrates the `OnKey` event.
- `ontime event demo.xlsm`: A workbook that demonstrates the `OnTime` event.
- `shade active row and column.xlsm`: A workbook that uses the `Worksheet SelectionChange` event to apply shading to the row and column of the active cell.
- `validate entry1.xlsm`: A workbook that demonstrates how to validate data entered into a cell by using VBA (uses the `EnableEvents` property).
- `validate entry2.xlsm`: A workbook that demonstrates how to validate data entered into a cell by using VBA (uses a static variable).
- `validate entry3.xlsm`: A workbook that demonstrates how to validate data by using Excel's data validation feature — and ensuring that the data validation conditions do not get erased.
- `workbook_beforeclose workaround.xlsm`: A workbook that demonstrates how to overcome a problem with the `Workbook BeforeClose` event.

Chapter 20

- `\automate excel`: A directory that contains a Word document with macros that automate Excel.
- `control panel dialogs.xlsm`: A workbook that contains macros that display Windows Control Panel dialog boxes.
- `make memos.xlsm`: A workbook that automates Word and creates a customized memo.
- `personalized email - outlook.xlsm`: A workbook that contains a macro to send personalized e-mail via Outlook (using early binding).
- `personalized email - outlook (late binding).xlsm`: A workbook that contains a macro to send personalized e-mail via Outlook (using late binding).

- `personalized_email - sendkeys.xlsm`: A workbook that contains a macro to send personalized e-mail via Windows Mail.
- `send_pdf_via_outlook.xlsm`: A workbook that contains a macro that sends e-mail with a PDF file attachment using Outlook.
- `\shellexecute`: A folder that contains a workbook that demonstrates the `ShellExecute` API function (`shellexecute_examples.xlsm`), plus a few ancillary files.
- `start_calculator.xlsm`: A workbook that contains a macro that launches the Calculator application.

Chapter 21

- `check_addin.xlam`: A workbook that contains code to ensure that an add-in is installed properly.
- `export_charts.xlsm`: The Export Charts Utility workbook, which can be converted to an add-in.
- `export_charts.chm`: The help file for the `export_charts.xlsm` workbook.
- `\export_charts_help_source`: A directory that contains the source files that were used to create the `export_charts.chm` help file.
- `list_add-in_information.xlsm`: A workbook that contains a macro that lists information about all add-ins.

Chapter 22

- `dynamicmenu.xlsm`: A workbook that demonstrates the `dynamicMenu` control.
- `mso_image_browser.xlsm`: A workbook that contains a macro that displays the images associated with Ribbon commands.
- `old-style_toolbar.xlsm`: A workbook that demonstrates how to create a toolbar, used in previous versions of Excel.
- `page_break_display.xlsm`: The workbook file used to create the `page_break_display_add-in.xlam` add-in.
- `page_break_display_add-in.xlam`: An add-in that adds a useful control to Excel's Ribbon.
- `ribbon_control_names.xlsx`: A workbook that contains the names of all Excel 2007 and 2010 Ribbon controls.
- `ribbon_controls_demo.xlsm`: A workbook that demonstrates several types of Ribbon controls.
- `ribbon_modification.xlsm`: A workbook that contains a simple example that modifies Excel's Ribbon.

Chapter 23

- `add to cell shortcut.xlsm`: A workbook that contains a macro that adds a new menu item to a shortcut menu.
- `context-sensitive shortcut menu.xlsm`: A workbook that contains a macro that creates a new shortcut menu that's context-sensitive.
- `make xl 2003 menus.xlsm`: A workbook that contains a macro that adds a toolbar that mimics the Excel 2003 menu.
- `shortcut with submenu.xlsm`: A workbook that contains a macro that adds new menu and submenu items to a shortcut menu.
- `show faceids.xlsm`: A workbook that contains a macro that displays `FaceId` images.
- `show shortcut menu items.xlsm`: A workbook that contains a macro that lists all menu items on all shortcut menus.
- `show shortcut menu names.xlsm`: A workbook that contains a macro that lists the names of all shortcut menus.

Chapter 24

- `\cell comments`: A directory that contains a workbook that demonstrates using cell comments to display help information.
- `\function help`: A workbook that demonstrates how to display help for custom VBA worksheet functions.
- `\html help`: A directory that contains files that demonstrate using compiled HTML help.
- `\mhtml file`: A directory that contains files that demonstrate using an MHTML file to display help information in Internet Explorer.
- `\textbox`: A directory that contains a workbook that demonstrates using a text box to display help information.
- `\userform1`: A directory that contains a workbook that demonstrates using a UserForm with a `SpinButton` control to display help information.
- `\userform2`: A directory that contains a workbook that demonstrates using a UserForm with a scrolling `Label` control to display help information.
- `\userform3`: A directory that contains a workbook that demonstrates using a UserForm with a `ComboBox` control to display help information.
- `\web browser`: A directory that contains files that demonstrate using a UserForm to display help information.
- `\worksheet`: A directory that contains a file that demonstrates using a worksheet to display help information.

Chapter 25

- `loan amortization wizard.xlam`: An add-in used for the loan amortization wizard example.

Chapter 26

- `multilingual wizard.xlsm`: A workbook used for the multilingual wizard example.

Chapter 27

- `create file list.xlsm`: A workbook that contains a macro that creates a list of files contained in a directory.
- `export and import csv.xlsm`: A workbook that contains macros that export and import a CSV file.
- `export to HTML.xlsm`: A workbook that contains a macro that exports worksheet data to an HTML file.
- `export to XML.xlsm`: A workbook that contains a macro that exports worksheet data to an XML file.
- `file functions.xlsm`: A workbook that contains the `FileExists` and `PathExists` functions.
- `file information.xlsm`: A workbook that contains a macro that creates a list of files and extended file information.
- `\filter text file`: A directory that contains files used to import selected information from a text file.
- `recursive file list.xlsm`: A workbook that contains a macro that creates a list of files contained in a directory, including all subdirectories.
- `show drive info.xlsm`: A workbook that contains a macro that displays information about all disk drives.
- `\simple ADO 1`: A directory that contains an example of using ADO to query an Access file.
- `\simple ADO 2`: A directory that contains an example of using ADO to query a CSV text file.
- `unzip a file.xlsm`: A workbook that contains a macro that unzips a file.
- `zip files.xlsm`: A workbook that contains a macro that zips files.

Chapter 28

- `add 100 buttons.xlsm`: A workbook that contains a macro that adds 100 `CommandButton` controls and code to a `UserForm` at design time.

- `add button and code.xlsm`: A workbook that contains both a macro that adds a button to a worksheet and VBA code that is executed when the button is clicked.
- `create userform on the fly.xlsm`: A workbook that contains a macro that creates a UserForm.
- `getoption function.xlsm`: A workbook that contains a function that creates a UserForm (with `OptionButton` controls) on the fly and returns a value that corresponds to the user's choice.
- `list all procedures.xlsm`: A workbook that contains a macro that lists all VBA procedures in a workbook.
- `list VB components.xlsm`: A workbook that contains a macro that lists all VB components in a workbook.
- `\update user workbook`: A directory that contains a workbook that demonstrates a macro that replaces a VBA module with a new module.

Chapter 29

- `csv class.xlsm`: A workbook that makes it easy to import and export a CSV file.
- `keyboard class.xlsm`: A workbook that contains a class module that defines a `NumLock`, a `CapsLock`, and a `ScrollLock` class.

Chapter 30

- `chart colors.xlsm`: A workbook that contains macros that work with chart colors.
- `chart to grayscale picture.xlsm`: A workbook that contains a macro that creates a grayscale image from a chart.
- `color conversion functions.xlsm`: A workbook that contains functions that convert between various color systems.
- `document theme demo.xlsx`: A workbook that contains various elements that demonstrate the effects of applying a different theme.
- `generate theme colors.xlsm`: A workbook that contains a macro that demonstrates theme colors.
- `rgb color demo.xlsm`: A workbook that contains an interactive demonstration of the RGB color system.
- `\shape object colors`: A directory that contains a workbook with macros that work with shapes.
- `tintandshade demo.xlsm`: A workbook that demonstrates how the `TintAndShade` property works.

Troubleshooting

If you have difficulty installing or using any of the materials on the companion CD, try the following solutions:

- **Turn off any antivirus software that you may have running.** Installers sometimes mimic virus activity and can make your computer incorrectly believe that it is being infected by a virus. (Be sure to turn the antivirus software back on later.)
- **Close all running programs.** The more programs you're running, the less memory is available to other programs. Installers also typically update files and programs; if you keep other programs running, installation may not work properly.
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