

MOS 2013 Study Guide

Mark Dodge



EXAMS

77-427 & 77-428

**Microsoft
Excel Expert**

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Introduction

The Microsoft Office Specialist (MOS) certification program has been designed to validate your knowledge of and ability to use programs in the Microsoft Office 2013 suite of programs, Microsoft Office 365, and Microsoft SharePoint. This book has been designed to guide you in studying the types of tasks you are likely to be required to demonstrate in Exam 77-427: Microsoft Excel 2013 Expert Part One, and Exam 77-428: Microsoft Excel 2013 Expert Part Two.

See Also For information about the tasks you are likely to be required to demonstrate in Exam 77-420: Microsoft Excel 2013, see *MOS 2013 Study Guide for Microsoft Excel* by Joan Lambert (Microsoft Press, 2013).

Who this book is for

MOS 2013 Study Guide for Microsoft Excel Expert is designed for experienced Excel users seeking Microsoft Office Specialist Expert certification in Excel 2013. This certification requires that the candidate pass two exams. This book covers the objectives of both exams.

MOS exams for individual programs are practical rather than theoretical. You must demonstrate that you can complete certain tasks or projects rather than simply answering questions about program features. The successful MOS certification candidate will have at least six months of experience using all aspects of the application on a regular basis; for example, using Excel at work or school to manage and share workbooks, apply and share custom formatting, present data in PivotTables and Pivot Charts, create models and scenarios, and create advanced formulas by using functions.

As a certification candidate, you probably have a lot of experience with the program you want to become certified in. Many of the procedures described in this book will be familiar to you; others might not be. Read through each study section and ensure that you are familiar with not only the procedures included in the section, but also the concepts and tools discussed in the review information. In some cases, graphics depict the tools you will use to perform procedures related to the skill set. Study the graphics and ensure that you are familiar with all the options available for each tool.

How this book is organized

The exam coverage is divided into chapters representing broad skill sets that correlate to the functional groups covered by the exams, and each chapter is divided into sections addressing groups of related skills that correlate to the exam objectives. Each section includes review information, generic procedures, and practice tasks you can complete on your own while studying. When necessary, we provide practice files you can use to work through the practice tasks. You can practice the procedures in this book by using the practice files supplied or by using your own files.

Throughout this book, you will find Strategy tips that present information about the scope of study that is necessary to ensure that you achieve mastery of a skill set and are successful in your certification effort.

The exam objectives are divided into four functional groups. The mapping of the exam objectives to the certification exams is shown in the following table.

Functional group	Objectives covered by Exam 77-427	Objectives covered by Exam 77-428
1 Manage and Share Workbooks	1.3 Manage Workbook Changes	1.1 Manage Multiple Workbooks 1.2 Prepare a Workbook Review
2 Apply Custom Formats and Layouts	2.2 Apply Advanced Conditional Formatting and Filtering 2.4 Prepare a Workbook for Internationalization and Accessibility	2.1 Apply Custom Data Formats 2.3 Apply Custom Styles and Templates
3 Create Advanced Formulas	3.2 Look Up Data with Functions 3.3 Apply Advanced Date and Time Functions	3.1 Apply Functions in Formulas 3.4 Create Scenarios
4 Create Advanced Charts and Tables	4.1 Create Advanced Chart Elements 4.2 Create and Manage PivotTables	4.3 Create and Manage Pivot Charts

Candidates must pass both exams to earn the Microsoft Office Specialist Expert certification in Excel 2013.

Download the practice files

Before you can complete the practice tasks in this book, you need to download the book's practice files to your computer. These practice files can be downloaded from the following page: <http://aka.ms/mosExcelExp2013/files>

Important The Excel 2013 program is not available from this website. You should purchase and install that program before using this book.

If you would like to be able to refer to the completed versions of practice files at a later time, you can save the practice files that you modify while working through the exercises in this book. If you save your changes and later want to repeat the exercise, you can download the original practice files again.

The following table lists the practice files for this book.

Folder and functional group	Files
MOSExcel2013Expert\Objective1 1 Manage and share workbooks	<i>ExcelExpert_1-1a.xltx</i> <i>ExcelExpert_1-1b.accdb</i> <i>ExcelExpert_1-1c.xlsx</i> <i>ExcelExpert_1-1d.xlsx</i> <i>ExcelExpert_1-2.xlsx</i> <i>ExcelExpert_1-3a.xlsx</i> <i>ExcelExpert_1-3b.xlsx</i> <i>ExcelExpert_1-3c.xlsx</i> <i>ExcelExpert_1-3d.xlsx</i> <i>ExcelExpert_1-3e.xlsx</i>
MOSExcel2013Expert\Objective2 2 Apply custom formats and layouts	<i>ExcelExpert_2-1.xlsx</i> <i>ExcelExpert_2-2.xlsx</i> <i>ExcelExpert_2-3.xlsx</i> <i>ExcelExpert_2-4.xlsx</i>
MOSExcel2013Expert\Objective3 3 Create advanced formulas	<i>ExcelExpert_3-1a.xlsx</i> <i>ExcelExpert_3-1b.xlsx</i> <i>ExcelExpert_3-2.xlsx</i> <i>ExcelExpert_3-3.xlsx</i> <i>ExcelExpert_3-4a.xlsx</i> <i>ExcelExpert_3-4b.xlsx</i> <i>ExcelExpert_3-4c.xlsx</i> <i>ExcelExpert_3-4d.xlsx</i>
MOSExcel2013Expert\Objective4 4 Create advanced charts and tables	<i>ExcelExpert_4-1.xlsx</i> <i>ExcelExpert_4-2a.xlsx</i> <i>ExcelExpert_4-2b.xlsx</i> <i>ExcelExpert_4-3.xlsx</i>

Adapting exercise steps

The screen images shown in this book were captured at a screen resolution of 1024 × 768, at 100 percent magnification. If your settings are different, the ribbon on your screen might not look the same as the one shown in this book. For example, you might have more or fewer buttons in each of the groups, the buttons you have might be represented by larger or smaller icons than those shown, or the group might be represented by a button that you click to display the group's commands. As a result, exercise instructions that involve the ribbon might require a little adaptation. Our instructions use this format:

→ On the **Insert** tab, in the **Illustrations** group, click the **Chart** button.

If the command is in a list or on a menu, our instructions use this format:

→ On the **Home** tab, in the **Editing** group, click the **Find** arrow and then, on the **Find** menu, click **Advanced Find**.

Tip On subsequent instances of instructions located on the same tab or in the same group, the instructions are simplified to reflect that we've already established the working location.

If differences between your display settings and ours cause a button to appear differently on your screen than it does in this book, you can easily adapt the steps to locate the command. First click the specified tab, and then locate the specified group. If a group has been collapsed into a group list or under a group button, click the list or button to display the group's commands. If you can't immediately identify the button you want, point to likely candidates to display their names in ScreenTips.

If you prefer not to have to adapt the steps, set up your screen to match ours while you read and work through the exercises in this book.

In this book, we provide instructions based on the traditional keyboard and mouse input methods. If you're using the program on a touch-enabled device, you might be giving commands by tapping with a stylus or your finger. If so, substitute a tapping action any time we instruct you to click a user interface element. Also note that when we tell you to enter information, you can do so by typing on a keyboard, tapping an on-screen keyboard, or even speaking aloud, depending on your computer setup and your personal preferences.

Get support and give feedback

The following sections provide information about getting help with this book and contacting us to provide feedback or report errors.

Errata

We've made every effort to ensure the accuracy of this book and its companion content. Any errors that have been reported since this book was published are listed on our Microsoft Press site:

<http://aka.ms/mosExcelExp2013/errata>

If you find an error that is not already listed, you can report it to us through the same page.

If you need additional support, send an email message to Microsoft Press Book Support at:

mspinput@microsoft.com

Please note that product support for Microsoft software is not offered through the preceding addresses.

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At Microsoft Press, your satisfaction is our top priority, and your feedback our most valuable asset. Please tell us what you think of this book at:

<http://www.microsoft.com/learning/booksurvey>

The survey is short, and we read every one of your comments and ideas. Thanks in advance for your input!

Stay in touch

Let's keep the conversation going! We're on Twitter at:

<http://twitter.com/MicrosoftPress>

Taking a Microsoft Office Specialist exam

Desktop computing proficiency is increasingly important in today's business world. When screening, hiring, and training employees, employers can feel reassured by relying on the objectivity and consistency of technology certification to ensure the competence of their workforce. As an employee or job seeker, you can use technology certification to prove that you already have the skills you need to succeed, saving current and future employers the time and expense of training you.

Microsoft Office Specialist certification

Microsoft Office Specialist certification is designed to assist employees in validating their skills with Office programs. The following certification paths are available:

- A Microsoft Office Specialist (MOS) is an individual who has demonstrated proficiency by passing a certification exam in one or more Office programs, including Microsoft Word, Excel, PowerPoint, Outlook, Access, OneNote, or SharePoint.
- A Microsoft Office Specialist Expert (MOS Expert) is an individual who has taken his or her knowledge of Office to the next level and has demonstrated by passing the required certification exams that he or she has mastered the more advanced features of Word or Excel.

Selecting a certification path

When deciding which certifications you would like to pursue, you should assess the following:

- The program and program version or versions with which you are familiar
- The length of time you have used the program and how frequently you use it
- Whether you have had formal or informal training in the use of that program
- Whether you use most or all of the available program features
- Whether you are considered a go-to resource by business associates, friends, and family members who have difficulty with the program

Candidates for MOS-level certification are expected to successfully complete a wide range of standard business tasks, such as formatting a document or worksheet and its content; creating and formatting visual content; or working with SharePoint lists, libraries, Web Parts, and dashboards. Successful candidates generally have six or more months of experience with the specific Office program, including either formal, instructor-led training or self-study using MOS-approved books, guides, or interactive computer-based materials.

Candidates for MOS Expert-level certification are expected to successfully complete more complex tasks that involve using the advanced functionality of the program. Successful candidates generally have at least six months, and may have several years, of experience with the programs, including formal, instructor-led training or self-study using MOS-approved materials.

Test-taking tips

Every MOS certification exam is developed from a set of exam skill standards (referred to as the objective domain) that are derived from studies of how the Office programs are used in the workplace. Because these skill standards dictate the scope of each exam, they provide critical information about how to prepare for certification. This book follows the structure of the full objective domain for Excel Expert certification; see “How this book is organized” in the Introduction for more information.

The MOS certification exams are performance based and require you to complete business-related tasks or projects in the program for which you are seeking certification. For example, you might be presented with a file and told to do something specific with it, or presented with a sample document and told to create it by using resources provided for that purpose. Your score on the exam reflects how well you perform the requested tasks or complete the project within the allotted time.

Here is some helpful information about taking the exam:

- Keep track of the time. Your exam time does not officially begin until after you finish reading the instructions provided at the beginning of the exam. During the exam, the amount of time remaining is shown at the bottom of the exam interface. You can't pause the exam after you start it.

- Pace yourself. At the beginning of the exam, you will receive information about the questions or projects that are included in the exam. Some questions will require that you complete more than one task. Each project will require that you complete multiple tasks. During the exam, the amount of time remaining to complete the questions or project, and the number of completed and remaining questions if applicable, is shown at the bottom of the exam interface.
- Read the exam instructions carefully before beginning. Follow all the instructions provided completely and accurately.
- Enter requested information as it appears in the instructions, but without duplicating the formatting unless you are specifically instructed to do so. For example, the text and values you are asked to enter might appear in the instructions in bold and underlined text, but you should enter the information without applying these formats.
- Close all dialog boxes before proceeding to the next exam question unless you are specifically instructed not to do so.
- Don't close task panes before proceeding to the next exam question unless you are specifically instructed to do so.
- If you are asked to print a document, worksheet, chart, report, or slide, perform the task, but be aware that nothing will actually be printed.
- When performing tasks to complete a project-based exam, save your work frequently.
- Don't worry about extra keystrokes or mouse clicks. Your work is scored based on its result, not on the method you use to achieve that result (unless a specific method is indicated in the instructions).
- If a computer problem occurs during the exam (for example, if the exam does not respond or the mouse no longer functions) or if a power outage occurs, contact a testing center administrator immediately. The administrator will restart the computer and return the exam to the point where the interruption occurred, with your score intact.

Strategy This book includes special tips for effectively studying for the Microsoft Office Specialist exams in Strategy paragraphs such as this one.

Certification benefits

At the conclusion of the exam, you will receive a score report, indicating whether you passed the exam. If your score meets or exceeds the passing standard (the minimum required score), you will be contacted by email by the Microsoft Certification Program team. The email message you receive will include your Microsoft Certification ID and links to online resources, including the Microsoft Certified Professional site. On this site, you can download or order a printed certificate, create a virtual business card, order an ID card, view and share your certification transcript, access the Logo Builder, and access other useful and interesting resources, including special offers from Microsoft and affiliated companies.

Depending on the level of certification you achieve, you will qualify to display one of three logos on your business card and other personal promotional materials. These logos attest to the fact that you are proficient in the applications or cross-application skills necessary to achieve the certification.

Microsoft Office Specialist **Microsoft** Office Specialist Expert **Microsoft** Office Specialist Master

Using the Logo Builder, you can create a personalized certification logo that includes the MOS logo and the specific programs in which you have achieved certification. If you achieve MOS certification in multiple programs, you can include multiple certifications in one logo.

For more information

To learn more about the Microsoft Office Specialist exams and related courseware, visit:

<http://www.microsoft.com/learning/en/us/mos-certification.aspx>

3 Create advanced formulas

The skills tested in this section of the Microsoft Office Specialist Expert exams for Microsoft Excel 2013 relate to the creation of sophisticated formulas. Specifically, the following objectives are associated with this set of skills:

- 3.1 Apply functions in formulas
 - 3.2 Look up data by using functions
 - 3.3 Apply advanced date and time functions
 - 3.4 Create scenarios
-

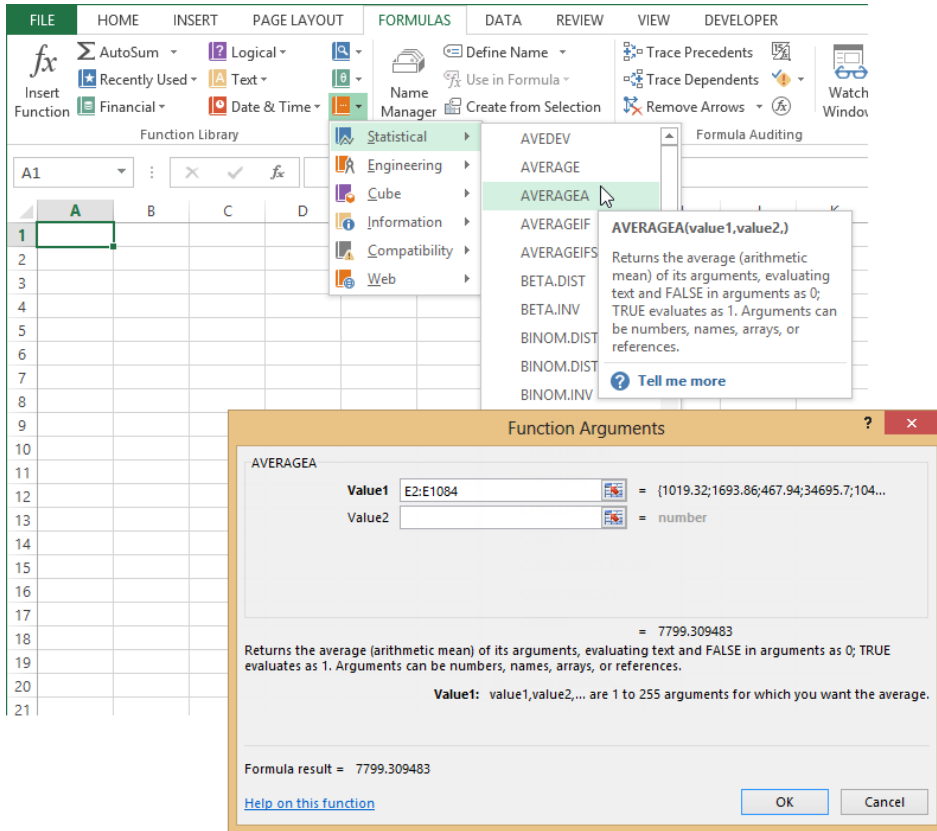
Most users of Excel have created formulas that include one or more of the most commonly used Excel functions, such as SUM, AVERAGE, COUNT, MAX, and MIN. However, Excel provides functions for other very specific operations.

This chapter guides you in studying methods for these other operations, such as calculating dates and times, performing statistical or financial analysis, working with text strings, and looking up values.

Practice Files To complete the practice tasks in this chapter, you need the practice files contained in the MOSExcel2013Expert\Objective3 practice file folder. For more information, see “Download the practice files” in this book’s Introduction.

3.1 Apply functions in formulas

Menus in the Function Library group on the Formulas tab offer functions grouped by type, including a More Functions menu. Depending on your screen size and resolution, some of the menus might include text labels, but if not, point to the menu to display a ScreenTip that has a thumbnail explanation, which might be all the information you need to proceed.



When you select a function from one of the menus, the Function Arguments dialog box opens, which you use to enter the information (called *arguments*) that the function needs to perform its calculations. The Function Arguments dialog box provides a description of the function and a description of each of the function's arguments. When you fill in the arguments, the result of the formula is displayed above the function description in the dialog box.

Tip You can insert functions in Excel two additional ways. The Insert Function button (*fx*) appears both on the Formulas tab and in the formula bar. Select a category and scroll through the list of functions for a description of each one, or enter keywords in the Search For A Function box.

After a function is inserted in a cell, double-click the cell (or click in the formula bar) to edit the formula, which activates a number of helpful tools. When you click anywhere in the function in a cell or in the formula bar, a ScreenTip appears, showing you the correct syntax and displaying the currently selected argument in bold. If you click the function's

name in the ScreenTip, the Help window opens, displaying a topic that describes the function. Also, the formula's dependent cells are surrounded by colored borders on the sheet; drag the borders or resize them to change the cells used as arguments.

		AVERAGEA		: X ✓ fx		=AVERAGEA(E2:E1084)	
		A	B	C	D	E	F
		Product	Date	Team	Division	Sales	Units
						Unit Price	
2	ASH-1001	1/1/2013	4	United States	1,019.32	34	29.98
3	ASH-1002	1/1/2013	4	United States	1,693.86	37	45.78
4	ASH-1031	1/1/2013	4	Asia	467.94	33	14.18
5	ASH-1032	1/1/2013	4	Canada	34,695.70	130	266.89

Using nested functions

Functions are said to be *nested* when the parenthetical expression following the function name contains another function. A nested function performs a subordinate calculation to provide an argument for another function. For example, in the simple nested formula `=INT((SUM(B2:B5))`, the SUM function calculates the total first, and then the INT function rounds the result to the nearest integer.

In the formula `=INT((SLN(SUM(B2:B5),0,5))`, the SUM function provides an argument (cost) for the SLN function (five-year straight-line depreciation), which becomes the argument for the INT (integer) function. You can create up to 64 levels of nested functions.

Using the IF, AND, and OR functions

IF, AND, and OR are classified as logical functions in Excel. Logical operations seek a result of either TRUE or FALSE (1 or 0), and are used to test for conditions by employing the logical operators `=`, `<`, `>`, `>=`, `<=` or `<>` to create conditional tests. For example, "if A is less than B, then C; but if not, then D" describes how the IF function works. The statement "A is less than B" is a logical test, which can employ any one of the logical operators. For example, the formula `=IF(B5<500, 12, 24)` returns the value 12 only if cell B5 is less than 500 (TRUE); otherwise it returns the value 24. The following shows the syntax of these functions; non-italic text indicates required values.

`=IF(logical_test, value_if_true, value_if_false)`

`=AND(logical1,logical2, ...)`

`=OR(logical1,logical2, ...)`

The OR function returns TRUE if any of its arguments are true. The AND function returns TRUE only if all of its arguments are true. These two functions can be used alone, but are frequently nested within an IF function, which can also contain additional IF functions. If

either of the optional arguments *value_if_true* or *value_if_false* are left blank, the IF function returns a logical value: TRUE or FALSE.

Strategy The objective domain for Microsoft Office Specialist Exam 77-428 “MOS Excel Expert 2013, Part 2” includes “Utilizing the IF function in conjunction with other functions,” and “Utilizing AND/OR functions” as separate topics under Objective 3.1. Both topics are covered in this section.

Using the SUMIFS, AVERAGEIFS, and COUNTIFS functions

The SUM, AVERAGE, and COUNT functions have useful “IF variants” that you can use to apply a criterion (one “if”) before tallying the results: SUMIF, AVERAGEIF, and COUNTIF. Similarly, you can use the “IFS variants” to apply multiple criteria (more “ifs”): SUMIFS, AVERAGEIFS, and COUNTIFS. The following shows the syntax of these functions; non-italic arguments are required.

`=SUMIF(range, criteria, sum_range)`

`=AVERAGEIF(range, criteria, average_range)`

`=COUNTIF(range, criteria)`

`=SUMIFS(sum_range, criteria_range, criteria, criteria_range2, criteria,...)`

`=AVERAGEIFS(sum_range, criteria_range, criteria, criteria_range2, criteria,...)`

`=COUNTIFS(sum_range, criteria_range, criteria, criteria_range2, criteria,...)`

The SUMIF function adds values in the specified *sum_range* that match the criteria found in the range. For example (using named ranges instead of cell references for readability), the formula `=SUMIF(Team,4,Sales)` adds only those totals in the Sales column where 4 appears in the Team column.

Tip If the logical operator you need is an equal sign, you can simply enter the value alone as the logical test (4). However, when using a logical operator or text (other than a defined name) in a logical test, you must always enclose the expression in double quotation marks (“>4”).

Team	Division	Sales	Units	Unit Price	US/Asia Only	US/Asia/\$25-50		
4	United States	1,019.32	34	29.98	\$ 1,019.32	\$ 1,019.32		
4	United States	1,693.86	37	45.78	\$ 1,693.86	\$ 1,693.86	Team 4	865,516.33
4	Asia	467.94	33	14.18	\$ 467.94	\$ -	Team 4 Asia	241,522.91
4	Canada	34,695.70	130	266.89	\$ -	\$ -		
4	Asia	1,049.30	35	29.98	\$ 1,049.30	\$ 1,049.30		
8	United States	47.00	10	4.70	\$ -	\$ -		

The SUMIFS function adds values in the specified *sum_range* that match the criteria applied to the range. You can add up to 127 sets of criteria.

Important The *sum_range* argument is the first argument in the SUMIFS function and the last argument in the SUMIF function.

For example, the formula `=SUMIFS(Sales,Team,4,Division,"Asia")` adds only those totals in the Sales column where 4 appears in the Team column, and where Asia appears in the Division column.

The rest of the –IF and –IFS functions operate similarly.

- **COUNTIF** Counts the number of cells that match a single criterion
- **COUNTIFS** Counts the number of cells that match multiple criteria
- **AVERAGEIF** Averages the values in cells that match a single criterion
- **AVERAGEIFS** Averages the values in cells that match multiple criteria

Tip When using a SUMIFS, COUNTIFS, or AVERAGEIFS function, all range arguments—the *sum_range* and each *criteria_range*—must have the same number of rows and columns.

► To insert a function

1. On the **Formulas** tab, in the **Function Library** group, click the **Insert Function** button or any function category button, and then select the function you need.
2. In the **Function Arguments** dialog box, enter the arguments for the function.

► To find a function

1. On the **Formulas** tab, in the **Function Library** group, click the **Insert Function** button.
2. In the **Insert Function** dialog box, in the **Search for a function** box, enter a description of the operation you want to perform.
3. To filter the list of functions, choose a category from the **Or select a category** list.

Using financial functions

Most financial calculations are performed by using the basics: addition, subtraction, multiplication, and division. Complex financial algorithms that involve multiple steps are packaged as functions. The functions that Excel provides in its financial toolbox fall into three major subcategories: investments, depreciation, and securities.

You can find a wealth of information in the Help system about functions and how to use them; far more material than this book can cover. This section provides an overview of each subcategory and selects a few functions to examine in more detail.

See Also For information about working with international currencies, see section 2.4, "Prepare workbooks for internationalization and accessibility."

Calculating investments

Investing is all about cash flow: how much, how often, for how long, and at what rate? These functions all perform similar calculations and share some of the same underlying algorithms. The investment functions in Excel include the value functions FV, PV, and NPV; the payment functions PMT, PPMT, IPMT; the rate functions RATE, IRR, and MIRR; and the periods function, NPER. The following shows the syntax of these investment functions; non-italic arguments are required.

- **Present value** =*PV*(rate, nper, pmt, *fv*, *type*)
- **Future value** =*FV*(rate, nper, pmt, *fv*, *type*)
- **Net present value** =*NPV*(rate, value1, *value2*,...)
- **Payment** =*PMT*(rate, nper, pv, *fv*, *type*)
- **Principal payment** =*PPMT*(rate, per, nper, pv, *fv*)
- **Interest payment** =*IPMT*(rate, per, nper, pv, *fv*)
- **Rate of return** =*RATE*(nper, pmt, pv, *fv*, *type*, *guess*)

- **Internal rate of return** =*IRR(values, guess)*
- **Modified internal rate of return** =*MIRR(values, finance_rate, reinvest_rate)*
- **Number of periods** =*NPER(rate, pmt, pv, fv, type)*

Arguments common to the investment functions include those in the following table.

Argument	Description
<i>Fv</i>	(Future value) The value of an investment at the end of the term (0 if omitted)
<i>Value1, value2, ...</i>	A series of payments when the amounts differ
<i>Nper</i>	Short for <i>number of periods</i> ; the term of the investment
<i>Pmt</i>	Short for <i>payment</i> ; a series of payments when the amounts are the same.
<i>Type</i>	Payment at the end of each period (0 or omitted), or the beginning (1)
<i>Per</i>	The period number of an individual period
<i>Pv</i>	Short for <i>present value</i> ; the value of an investment today
<i>Rate</i>	Discount or interest
<i>Guess</i>	A starting rate (10 percent if omitted)
<i>Finance Rate</i>	The interest rate paid on borrowed money
<i>Reinvest rate</i>	The interest rate received on invested money

The payment on a loan covers both the principal (the amount of the original loan) and the interest (the cost of borrowing money). In a fixed-rate loan, the payment stays the same over the loan term, but the principal portion increases each month, whereas the interest portion decreases. The functions you can use to dissect loans are PMT, which calculates a loan payment; PPMT, which returns only the principal portion of a payment for a particular period; and IPMT, which returns the interest portion.

Tip When expressing periods, you must use the same units. For example, interest is usually expressed as an annual rate, but payments are usually made on a monthly basis. For example, if the units are months and you're trying to figure out the annual interest rate, you would divide by 12 so that the units (months) match.

If you add an additional amount each month to scheduled payments, it is applied directly to the principal loan amount. This serves to reduce the number of periods necessary to repay the loan. You can see exactly what effect this will have on your payment schedule by using the NPER function, which returns the number of periods required to pay off a loan.

	A	B	C	D	E	F	G	H	I
1	Monthly Interest	0.4167%		(\$1,073.64)	Calculated Payment				
2	Months	360		(\$1,500.00)	Adjusted Payment				
3	Amount	\$200,000		195	Adjusted Loan Term				
4	Payment Number	180							
5									
6									

Tip Payments are considered cash outflows, so the result of a payment function is always negative. If you don't need the negative number for other calculations, you can display a positive payment amount by entering a minus sign between the equal sign and the function name in the formula, as in `=-PMT(.4167,360,200000)`.

Calculating depreciation

Depreciation is a crucial tax calculation that allows businesses to spread tax deductions for major asset purchases over time, rather than having to expense them all in a single year. The United States Internal Revenue Service provides guidelines for the depreciable life of different classes of assets, and these are subject to change (see *IRS.gov* for details.) For example, cars are considered 5-year assets for tax purposes, whereas fruit trees are considered 10-year assets.

The depreciation functions in Excel include the declining-balance depreciation functions DB, DDB (double-declining), and VDB (variable-declining); the straight-line depreciation function SLN; and the sum-of-the-year's-digits depreciation function SYD. The following shows the syntax of the depreciation functions; non-italic arguments are required.

`=SLN(cost, salvage, life)`

`=SYD(cost, salvage, life, per)`

`=DB(cost, salvage, life, period, month)`

`=DDB(cost, salvage, life, period, factor)`

`=VDB(cost, salvage, life, start_period, end_period, factor, no_switch)`

Arguments common to the depreciation functions include those in the following table.

Argument	Description
<i>Cost</i>	The initial cost of the asset.
<i>Life</i>	The depreciable life of the asset.
<i>Period</i>	The period to be computed.

Argument	Description
<i>Salvage</i>	The residual value of the asset after depreciation.
<i>No_switch</i>	Used in the VDB function only. If omitted, the calculation switches to straight-line depreciation if the amount is greater than the declining balance calculation. If TRUE, does not switch.

Straight-line depreciation is calculated by chopping the total cost into equal pieces after subtracting the salvage value (the estimated market value of the asset at the end of its depreciable life).

		=SLN(Asset_Cost,Salvage_Value,Asset_Life)						
	A	B	C	D	E	F	G	H
1	Asset Cost	\$ 10,000		\$1,640.00	Straight Line			
2	Asset Life	5		\$1,037.94	Declining Balance			
3	Salvage Value	\$ 1,800		\$360.00	Double Declining Balance			
4	Depreciation Period	4		\$1,093.33	Sum of the Year's Digits			
5								
6								

When you calculate straight-line depreciation, however, the function returns the depreciation you can take for each period, which is the same for each period. The three declining balance methods (DB, DDB, and VDB) and the Sum-of-the-year's-digits method (SYD) calculate depreciation at accelerated rates. These depreciation functions require you to specify a period number because the amount of depreciation differs in each period.

Analyzing securities

Securities analysis is complex, and understanding the theories behind it is equally complex. T-bills mature in one year or less, and do not pay periodic interest, only interest at maturity. T-notes mature in 2 to 10 years, pay a semiannual coupon amount, and come in denominations of \$1,000. There are TIPS and STRIPS and zero-coupon bonds, US Savings bonds, corporate bonds, and other types of securities that use similar mechanisms. Excel provides functions to massage them all.

The securities-analysis functions in Excel are located on the Financial menu in the Function Library group on the Formulas tab, and perform the following types of calculations:

- **DOLLARDE and DOLLARFR** Convert the typical fractional pricing of securities between fractional and decimal values
- **ACCRINT and ACCRINTM** Calculate the accrued interest for securities that accrue on either a periodic basis or at maturity

- **INTRATE and RECEIVED** Calculate either the interest rate or the total value at maturity for fully invested securities
- **PRICE, PRICEMAT, and PRICEDISC** Calculate the price for securities per \$100 of face value, for securities that pay periodic interest, interest at maturity, or are discounted instead of paying periodic interest
- **YIELD, YIELDDISC, and YIELDMAT** Calculate the annual yield for securities that pay periodic interest, interest at maturity, or are discounted instead of paying periodic interest
- **DISC** Calculates the discount rate for a security
- **TBILLEQ, TBILLPRICE, and TBILLYIELD** Calculate yield, price, and bond-equivalent yield for US Treasury bills
- **COUPDAYBS, COUPDAYS, COUPDAYSNC, COUPNCD, COUPNUM, and COUPPCD** Calculate the number of coupons payable, and various associated dates and durations
- **DURATION and MDURATION** Calculate how bond prices responds to changes in yield

Arguments common to the securities analysis functions include those listed in the following table.

Argument	Description
<i>Basis</i>	The number of days in a year, as calculated. Default is 0=US (NASD) 30/360; 1=actual/actual; 2=actual/360; 3=actual/365; 4=European 30/360.
<i>Coupon</i>	The annual coupon rate of the security.
<i>Frequency</i>	The number of coupon payments per year: 1=annual; 2=semiannual; 3=quarterly.
<i>Investment</i>	The amount invested in the security.
<i>Issue</i>	The security's issue date.
<i>Maturity</i>	The date that the security matures.
<i>Par</i>	The face value of the security.
<i>Price</i>	The price of the security.
<i>Rate</i>	The interest rate of the security; must be greater than or equal to zero.
<i>Redemption</i>	The value of the security at redemption.
<i>Settlement</i>	The settlement date (date of payment) for the security.
<i>Yield</i>	The annual yield of the security.

Tip A coupon, in bond terms, is an interest payment. Historically, bonds were physical certificates with tear-off coupons that you presented in exchange for a scheduled payment. This is where the term “coupon-clipper” originated.

These are very specialized functions that both require and extract specific details about the security you’re investigating. For example, you can use the ACCRINT function to learn the amount of interest that has accrued by a security such as a US Treasury bond as of a certain date.

	A	B	C	D	E	F	G	H
1	Issue	3/1/2014		1.416667				
2	First Interest	9/1/2014						
3	Settlement	4/1/2014						
4	Rate	0.017						
5	Par	1000						
6	Frequency	2						
7	Basis	0						
8								

► To insert a financial function

1. On the **Formulas** tab, in the **Function Library** group, click **Financial**, and then select the function you need.
2. In the **Function Arguments** dialog box, enter the arguments for the function.

Practice tasks

The practice files for these tasks are located in the MOSExcel2013Expert\Objective3 practice file folder. Save the results of the tasks in the same folder.

- Open the *ExcelExpert_3-1a* workbook and try performing the following tasks:
 - On Sheet1, insert a new column between columns G and H, and create a column of IF formulas that specify a different team and division.
 - On Sheet2, copy the shaded area and paste a copy below it. Edit the six formulas (and the labels) to include only team numbers above 4.
- Open the *ExcelExpert_3-1b* workbook and try performing the following tasks:
 - On the Periods worksheet, create a new formula to calculate the interest portion of payment number 175.
 - On the Securities worksheet, create a new ACCRINTM formula by using a basis of 1.

3.2 Look up data by using functions

Lookup functions are data-mining minions. You use them to address tables of data, searching for a particular value to display or use in a formula. The Lookup and Reference menu on the Formulas tab includes 19 functions, but this section focuses on the top contenders: LOOKUP, VLOOKUP, and HLOOKUP. The section also examines the TRANSPOSE function, which you use to flip vertically oriented data horizontal, and vice-versa.

Using the VLOOKUP and HLOOKUP functions

How to choose between the VLOOKUP and HLOOKUP functions depends upon how your table is organized. If your data is arranged in columns (labels on the left), use VLOOKUP. If your data is arranged in rows (labels at the top), use HLOOKUP. The following shows the syntax of these functions; non-italic arguments are required.

```
=VLOOKUP(lookup_value, table_array, col_index_num, range_lookup)
```

```
=HLOOKUP(lookup_value, table_array, row_index_num, range_lookup)
```

The *table_array* argument can be a range address or a name that defines the entire lookup table. The *col_index_num* and *row_index_num* arguments literally specify the column or row number in the table, counted from the top or left (including labels), from which to select the result. The *lookup_value* is the value that you want to match (approximately) in your table's row or column of comparison values.

Important LOOKUP, VLOOKUP, and HLOOKUP normally look for the *greatest value that is less than or equal to the lookup value*, not necessarily an exact match. For this reason, the table must be sorted in ascending order, on the row or column that contains your comparison values. For example, if your *lookup_value* is 1,000 and the largest comparison value is 500, then the function returns 500. If, instead, you need to find an exact match, set the optional *range_lookup* argument to FALSE (0).

For example, the formula `=VLOOKUP(410,B3:D7,3)` looks in the first column of a 3 × 5 table in the range B3:D7, finds the greatest value that is less than or equal to 410 (400), and returns Epsilon, the value found in the third column of the table.

D1		=VLOOKUP(410,B3:D7,3)					
	A	B	C	D	E	F	G
1				Epsilon			
2							
3		100	123.45	Alpha			
4		200	23.45	Beta			
5		300	67.89	Delta			
6		400	234.56	Epsilon			
7		500	78.90	Gamma			
8							

If you edit the formula to include a value of 0 (FALSE) as the optional *range_lookup* argument, as in `=VLOOKUP(410,B3:D7,3,0)`, the result of the formula would be #N/A because there is not an exact match for 410 in the first column.

Similarly, the formula `=HLOOKUP("Beta",A3:D8,3)` looks in the first row of a 4 × 6 table in the range A3:D8, finds the greatest value that is less than or equal to Beta, and then returns the value found in the third row of the table.

D1		=HLOOKUP("Beta",A3:D8,3)					
	A	B	C	D	E	F	G
1				101			
2							
3	Alpha	Beta	Delta	Epsilon			
4	5	100	99	1			
5	10	101	98	2			
6	25	105	95	3			
7	30	110	94	2			
8	35	125	90	1			
9							

The text *Beta* happens to be an exact match. But if a text lookup value is not an exact match, the same rules apply. For example, if you misspell *Beta* in the previous formula to read `=HLOOKUP("Bata",A3:D8,3)`, the result of the function is 10 instead of 101 because, alphabetically, Alpha is the greatest value that is less than or equal to the lookup value Bata.

Tip Uppercase and lowercase text are equivalent in lookup functions.

Using the LOOKUP function

You use the LOOKUP function primarily for one-dimensional lookup tasks—single rows or columns of data. You can also use LOOKUP with two-dimensional tables, but it always looks at the first row or column for the comparison value and selects the result from the same position in the last row or column. (You can specify any row or column by using VLOOKUP and HLOOKUP.)

The LOOKUP function has two forms. Use the *vector* form to return a value from a single row or column of data, or use the *array* form with either horizontally or vertically oriented tables. The following shows the syntax of the two forms.

`=LOOKUP(lookup_value, lookup_vector, result_vector)`

`=LOOKUP(lookup_value, array)`

As with the other lookup functions, you must sort your table in ascending order on the row or column that contains the comparison value. For example, the formula `=LOOKUP("Delta",B3:B7,E3:E7)` specifies a *lookup_vector* and an optional *result_vector* (both must be the same size). If a *result_vector* is not specified, the result is pulled from the *lookup_vector*.

	A	B	C	D	E	F	G
1					300		
2							
3		Alpha			100		
4		Beta			200		
5		Delta			300		
6		Epsilon			400		
7		Gamma			500		
8							

	A	B	C	D	E	F	G	H
1	Alpha							
2	Beta							
3	Delta							
4	Epsilon							
5	Gamma							
6			100	200	300	400	500	
7	300							
8								

The array form of the LOOKUP function automatically determines the orientation of the two-dimensional table specified by the *array* argument. If the table is wider than it is tall, LOOKUP searches the first row for a comparison value; if the table is taller than it is wide, (or square) it searches the first column. For most uses, it is best to use VLOOKUP or HLOOKUP, which allow more control and are easier to audit because the table orientation is indicated by the function name. LOOKUP is provided primarily for compatibility with other spreadsheet programs.

Using the TRANSPOSE function

The TRANSPOSE function does a seemingly simple thing (until you try to do it yourself): it flips the horizontal/vertical orientation of a selected range.

The tricks with this function are as follows:

- The formula must be entered as an array.
- Prior to entering the function, you must select a range to accept the transposed data that is exactly the same size as the source range, transposed.

When you lock in an array formula, the formula is duplicated in all selected cells, and brackets appear around the formula in the formula bar. You cannot edit any individual cell in an array; you must edit all cells in an array together. If you try editing a cell, Excel displays an error message. To edit an array, double-click any formula, edit it, and then press **Ctrl+Shift+Enter** again. This changes all the formulas in the array at once.

Tip You can also transpose by clicking the **Transpose** button on the **Paste Special** button of the **Home** tab. After you copy the range you want to transpose and select the cell where you want the transposed range to start, click the **Transpose** button. Excel determines the orientation of the selected cells, and pastes them in the opposite orientation.

➤ **To insert a TRANSPOSE function**

1. On the **Formulas** tab, in the **Function Library** group, click **Lookup & Reference** and then click **TRANSPOSE**.
2. In the **Function Arguments** dialog box, specify the cell range you want to transpose.

➤ **To transpose a selected cell range**

1. Copy the range you want to transpose, and then click the cell where you want the result to start.
2. On the **Home** tab, in the **Clipboard** group, click the **Paste Special** button, and then click the **Transpose** icon in the **Paste** category.

Or

1. Select a destination range that has exactly the same dimensions as the source range (transposed).
2. Enter a formula by using the **TRANSPOSE** function, specifying the source range.
3. Lock in the formula as an array by pressing **Ctrl+Shift+Enter**.

► **To insert a LOOKUP function**

1. On the **Formulas** tab, in the **Function Library** group, click **Lookup & Reference**, and then click the function you want.
2. In the **Function Arguments** dialog box, enter the function's arguments.

► **To enter an array formula**

→ Enter the formula, and then press **Ctrl+Shift+Enter**.

► **To edit an array formula**

→ Edit any formula in the array, and then press **Ctrl+Shift+Enter**.

Practice tasks

The practice file for these tasks is located in the `MOSExcel2013Expert\Objective3` practice file folder. Save the results of the tasks in the same folder.

Open the `Excel_3_2` workbook and try performing the following tasks:

- Edit the formula on the `Vlookup` worksheet so that the result is Beta.
- Edit the formula on the `Hlookup` worksheet so that the result is 98.
- On the `Transpose` worksheet, transpose the values in `B10:F10`.

3.3 Apply advanced date and time functions

Date and time arithmetic has its own rules and syntax. In Excel (and in most modern computers), date and time counting begins at 12:00 AM on January 1, 1900, starting at 1. January 2, 1900 is 2, and January 1, 2014 is 41640. Time is expressed as a decimal value expressing how much of the day has passed by. For example, the serial date 41640.50 is another way of saying "noon on New Year's Day 2014."

Tip You can change the date or time value displayed in a cell to a serial date value by applying the **General** format. Click **General** in the **Number Format** list in the **Number** group on the **Home** tab. Click **Short Date** or **Long Date** to change it back again.

Fortunately, you don't have to enter dates that way, nor do you generally need to apply date or time formats. If you enter dates and times by using standard formats, Excel recognizes them and formats them automatically. For example, if you enter `1/11/14` into a

Using functions to serialize dates and times

When using date and time functions, Excel always calculates by using the precise underlying serial values. But when constructing formulas, you might need only the month or a specific time of day. Or you might need to convert imported dates that have been stored as text into dates that Excel recognizes. Excel includes a suite of functions you can use to address these tasks, and more.

Using the YEAR, MONTH, DAY, HOUR, MINUTE, and SECOND functions

The YEAR, MONTH, DAY, HOUR, MINUTE, and SECOND functions each extract only the corresponding component of a date or time. They all accept just a single argument, which can be a reference to a cell that contains a date or time value, another date or time function, or a text date enclosed in quotation marks, as in `=YEAR("1/1/2014")`.

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E
1	Sunday, June 16, 2013 12:30 PM	Year	2013		
2		Month	6		
3		Day	16		
4		Hour	12		
5		Minute	30		
6		Second	41		
7					
8					

The formula bar at the top shows the formula `=YEAR(A1)` in cell C1.

Using the DATEVALUE and TIMEVALUE functions

The DATEVALUE and TIMEVALUE functions convert text dates and times into serial values, which is generally not necessary because Excel recognizes dates in most configurations. But sometimes they can come in handy when building formulas that use other formulas, or if you need to work with imported, unformatted text. Again, these functions take but a single argument, a reference to a cell that contains a date value, a date in text surrounded by quotes, or another date or time function. For example, the formula `=DATEVALUE("December 13, 2014")` returns the serial date value 41986. You can also use these functions to construct dates. For example, the formula `=(DATEVALUE(C2&"-"&C3&"-"&C1))` returns a serial date value based on the values contained in the referenced cells (assuming they contain valid date values). A text-style date is constructed within the function by using cell references separated by dashes. In effect, the function first interprets the text, and then converts the date.

	A	B	C	D	E	F
1	Sunday, June 16, 2013 12:57 PM	Year	2013		41986	
2		Month	6		41441	
3		Day	16			
4		Hour	12			
5		Minute	57			
6		Second	55			
7						
8						

Concatenating text in formulas

Concatenation is the linking of characters or strings in a specific order to form a single string. The concatenation operator is the ampersand (&). You can use concatenation to construct arguments within a function, or to merge the contents of cells. The process is simple: when you want to add a string of text, enclose it in ampersands. For example, the formula `=DATEVALUE(11&"/"&12&"/"&13)` uses ampersands to construct the text string 11/12/13. Each number is connected by a `&"/"&` statement. The ampersand instructs Excel that what follows is to be inserted as text: if a cell reference, the cell value is inserted; if text, it must be enclosed in quotation marks. The concatenation operator can be used in formulas without functions as well. For example, if cell A1 contains the text *Jelly* and cell A2 contains the text *Donut*, the formula `=A1&A2` returns the text string *JellyDonut*. To add a space, the formula `=A1&" "&A2` does the trick. The space character must be enclosed in quotation marks, which is in turn enclosed in ampersands. You can also use the `CONCATENATE` function, which takes the form `=CONCATENATE (Text1, Text2, ...)`.

Using the WEEKDAY, WORKDAY, and NETWORKDAYS functions

The `WEEKDAY`, `WORKDAY`, and `NETWORKDAYS` functions are helpful when calculating work or payroll schedules, planning projects, or even planning a vacation. The `WEEKDAY` function can be used to determine the day of the week for a specific date, and returns a value from 1 through 7. The function takes the form `=WEEKDAY(serial_number, return_type)`, where *serial_number* is a date value or reference to a cell containing a date. *Return_type* is an optional argument indicating the way the days are counted. The default *return_type* is zero, indicating that 1=Sunday and 7=Saturday; a value of 1 indicates that 1=Monday and 7=Sunday; and a value of 3 specifies a number from 0 through 6, where 0=Monday and 6=Sunday.

Tip You can add or subtract days from a date by using + and – signs. For example, if cell B1 contains 1/1/2013, the formula =B1+1 returns 1/2/2013.

The WORKDAY function takes the form =WORKDAY(start_date, days, holidays) and returns a date that is a specified number of days before or after a given start_date, excluding weekends and (optionally) holidays. The NETWORKDAYS function counts the number of workdays between two dates, and takes them from =NETWORKDAYS(start_date, end_date, holidays). For both functions, holidays is an optional argument specifying a list of dates that you want to exclude.

The WORKDAY.INTL and NETWORKDAYS.INTL functions each take an additional argument—weekend—that specifies alternate days of the week to use as nonwork days. A list of options appears when you select the weekend argument while editing the NETWORKDAYS.INTL function. Just click one of the 17 different combinations of weekend days (days off) to insert the corresponding number (for example, if you click the 7 - Friday, Saturday option, the number 7 is inserted into the function).

	A	B	C	J	K	L
1	Start date	1/1/2013	10/23/2017	Workday	1 - Saturday, Sunday	Saturday and Sunday are weekend days
2	Number of Days	1,234	863	Networkdays	2 - Sunday, Monday	
3	End Date	5/19/2016	9/25/2017	Workday.intl	3 - Monday, Tuesday	
4			ITL(B1,B3,)	Networkdays.intl	4 - Tuesday, Wednesday	
5	Holidays				5 - Wednesday, Thursday	
6	1/1/2014				6 - Thursday, Friday	
7	1/20/2014				7 - Friday, Saturday	
8	2/17/2014				11 - Sunday only	
9	5/26/2014				12 - Monday only	
10	7/4/2014				13 - Tuesday only	
11	9/1/2014				14 - Wednesday only	
12	10/13/2014				15 - Thursday only	
13	11/11/2014					
14	11/27/2014					
15	12/25/2014					
16	1/1/2015					
17	1/19/2015					

Tip Your list of holidays would be best located on its own worksheet in the workbook.

► To insert a NOW or TODAY function

- On the Formulas tab, in the Function Library group, click the Date & Time button, click NOW or TIME, and then click OK.

► **To insert a DATEVALUE or TIMEVALUE function**

1. On the **Formulas** tab, in the **Function Library** group, click the **Date & Time** button, and then click **DATEVALUE** or **TIMEVALUE**.
2. In the **Function Arguments** dialog box, enter the text or reference you want to convert.

Practice tasks

The practice file for these tasks is located in the MOSExcel2013Expert\Objective3 practice file folder. Save the results of the tasks in the same folder.

Open the *Excel_3_3* workbook and try performing the following tasks:

- On the *Work* worksheet, create a new NETWORKDAYS.INTL formula where Sunday and Monday are considered weekends.
- On the *Concat* worksheet, create a new CONCATENATE formula that assembles the words in column B into a sentence.

3.4 Create scenarios

In Excel, a *scenario* is a selection of cells that contain specific values you can save and reapply at any time. To create one, use the Scenario Manager, which is described later in this section. In a broader context, a scenario is a possible world; a collection of assumptions about the future; a guideline you can use to prepare for the worst case, the best case, or anything in between. Each line item in an annual budget could have multiple scenarios, for example, depending on the planners' perception of what the future holds.

This section first provides values with which to populate scenarios by using what-if analysis tools. Then it describes how to consolidate data from multiple worksheets into one.

Strategy The objective domain for Microsoft Office Specialist Expert Exam 77-428, "MOS Excel 2013 Expert, Part 2" includes "Using financial functions" as a topic under Objective 3.4. This topic appears in section 3.1, "Apply functions in formulas."

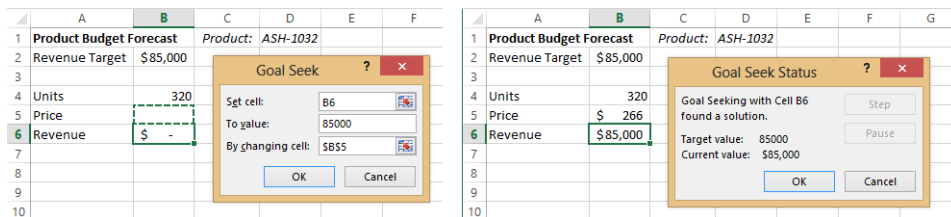
Using what-if analysis tools

By using built-in tools that appear on the What-If Analysis menu in the Data Tools group on the Data tab, you can calculate a value for a variable that helps you meet a goal, define and run scenarios, and test a range of values for one or two variables by using a data table. Also on the Data tab, the Solver add-in can be used to tackle larger models with multiple variables.

Simply stated, what-if analysis is changing one or more variables in a data model to test a range of possible results. Suppose you want to predict an inevitable rise in the cost of materials by using a range of percentages, such as -2%, +5% or +15%, which can represent “best case, likely case, worst case.” Use what-if analysis to try different options, and use the Scenario Manager to keep track of the results.

Using Goal Seek

The Goal Seek feature, which you access from the What-If Analysis menu in the Data Tools group on the Data tab, helps you obtain a specific result, using a single variable. In the Goal Seek dialog box, you point to a cell that contains a formula (called the *set cell*), enter the value you are seeking, and then specify the changing cell—the cell whose value Excel changes to meet the goal you define.



Tip If you work with what-if analysis tools, you'll find it helpful to name cells and cell ranges rather than use cell references (for example, Revenue instead of \$D\$12). To name a cell or cell range, select it and then enter a name in the name box to the left of the formula bar. Names cannot include spaces and must be unique within a workbook.

The Step and Pause buttons in the Goal Seek Status dialog box are enabled when Excel needs many calculation iterations to find the goal. Use the Pause button to pause the calculation, and click Step to proceed through each iteration one at a time.

Enabling iterative calculations

If you pose a particularly challenging goal-seeking problem, Excel might be unable to arrive at a precise solution, particularly if there are any circular references involved. Circular references are formulas that loop back on themselves through other formulas, which is usually not desirable, but is not uncommon in complex what-if models. Enabling iterative calculation can help. To do so, click Options in the Backstage view, and click Formulas. In the Calculation Options section of the Excel Options dialog box, select the Enable Iterative Calculation check box. The default but adjustable settings are 100 iterations with a maximum change value of .001. If, within the given number of iterations, Excel comes within the maximum change value of your goal, calculation stops and the result is displayed.

► To identify a goal by using Goal Seek

1. Select the cell that contains the formula you want to solve for.
2. On the **Data** tab, in the **Data Tools** group, click **What-If Analysis**, and then click **Goal Seek**.
3. Enter your goal in the **To value** box.
4. In the **By changing cell** box, specify the cell where you want the result to appear.

Using Solver

Solver is designed to find an optimal value by manipulating multiple variables and combinations of variables. You can additionally specify multiple conditions that must be met in order to achieve a solution.

In a Solver model, you need to define three basic elements:

- An objective or target, which is the value you want to optimize
- Changing cells, which are the values you can adjust to reach the objective
- Constraints, which are conditions that must be met in evaluating the model

For example, in a model projecting sales and cost of goods sold for a group of products who share a common production budget, one goal could be to find a balance between cost and sales volume that optimizes the production budget costs. If it were that simple, however, you could just sell a zillion units of your most profitable product; an unrealistic solution that an unconstrained optimization would likely produce.

So, you can use the Solver to keep everything within parameters, such as the following:

- The grand total of the product group’s cost of goods cannot exceed \$150,000.
- The minimum projected sales per product is 50 units.
- No single product can consume more than 20 percent of the grand total.
- The cost of products 4 and 5 together cannot exceed \$35,000.
- Projected sales must be expressed in integers.

Tip Before using the Solver, name the cells and cell ranges you’ll be working with, to make them easier to read and to work with.

	A	B	C	D	E	F	G	H
1	Constraints				Total supply budget - Alpha		\$150,000	
2					Total budget for Product 4 + 5		\$35,000	
3					Maximum % of budget spent on any product		20.00%	
4					Minimum sales per product		50	
5	Product Group	Cost of Goods	Profit margin	Projected Sales	Total Profit	Total Cost	Percent of total	
6	Alpha							
7	Product 1	\$55.87	11.50%	250	\$1,606	\$13,968	9%	
8	Product 2	\$103.00	8.40%	250	\$2,163	\$25,750	16%	
9	Product 3	\$8.45	8.20%	250	\$173	\$2,113	1%	
10	Product 4	\$183.66	11.20%	250	\$5,142	\$45,915	28%	
11	Product 5	\$288.00	13.90%	250	\$10,008	\$72,000	44%	
12	Product 6	\$16.99	16.30%	250	\$692	\$4,248	3%	
13	Total Cost of Goods					\$163,993		
14	Product 4 + 5 only					\$117,915		

Solver Parameters

Set Objective:

To: Max Min Value Of:

By Changing Variable Cells:

Subject to the Constraints:

- GrandTotal <= \$G\$1
- Projected_Sales >= \$G\$4
- Products4and5only <= \$G\$2
- Percent_of_total <= \$G\$3
- Projected_Sales = integer

Make Unconstrained Variables Non-Negative

Select a Solving Method: Options

Solving Method
Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Buttons: Help, Solve, Close

Add Constraint

Cell Reference: <=

Buttons: OK, Add, Cancel

When you set up constraints, you can specify that a cell or cell range must be a whole number by choosing *Int* (integer) from the list of operators. You can specify *Bin* (binary) as the constraint type to set up yes/no decisions, or *Dif* to specify a constraint to indicate that all the values in the constrained cell or cells are different. In the Add Constraint dialog box, you can also enter values directly into the Constraint box.

Solver provides three options in the Select A Solving Method list in the Solver Parameters dialog box:

- **GRG Nonlinear** This is the default method, which applies to nonlinear problems whose points sit on a line that is curved.
- **Simplex LP** Use this method for straight-line problems.
- **Evolutionary** This method applies to problems whose elements do not fit on either a straight or curved line (that is, the elements are more random or discontinuous).

In the Solver Options dialog box, you can set options for solving limits (maximum time and number of iterations), that let you step through each iteration of Solver's calculations (Show Iteration Results), and provides an option that controls the precision of values that are under constraints. The default value for precision is 0.000001. Changing the precision to a lower amount (closer to 1) might result in additional time needed to solve a problem.

Important When the Solver Results dialog box appears on the screen, it might be in front of your data. The results are on the worksheet already, so take a look before you commit to keeping the results. You can drag the dialog box out of the way. If you click OK to keep the solution Solver arrived at, the results remain on the worksheet, and cannot be undone.

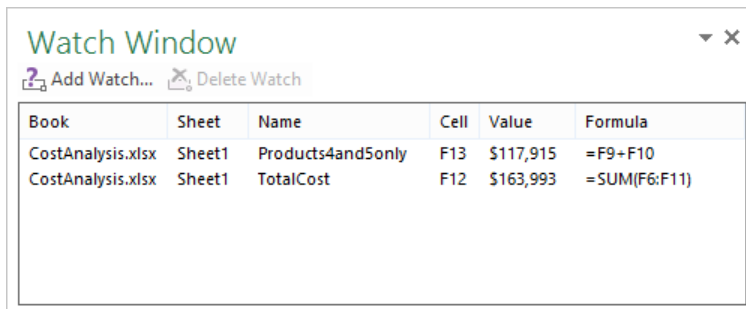
When you save a workbook in which you have defined a problem for Solver, Excel saves the Solver information with the workbook. You can store one set of Solver parameters with each worksheet in a workbook; however, you can store and retrieve additional sets by clicking the Load/Save button in the Solver Parameters dialog box.

Tip This section is a brief introduction to Solver. To learn more about the details of how to work with Solver and the type of problems it can analyze, see the chapters about Solver in *Microsoft Excel 2010 Data Analysis and Business Modeling* by Wayne Winston (Microsoft Press, 2010). You can also find information at www.solver.com.

Using the watch window

In the watch window, you can keep an eye on critical formulas as you edit the worksheet. Rather than having to jump back and forth between locations on a worksheet or between workbooks, you can keep the formulas you need to see in view.

Click the Watch Window command in the Formula Auditing group on the Formulas tab. Then select the cell or cells you want to keep an eye on. When you click Add Watch, Excel adds an entry to the watch window that lists the workbook, worksheet, cell reference, value, and any formula that's defined in that cell. As you edit, the effects of your edits are reflected in real time in the watch window. You can also dock the watch window by dragging it to the top, bottom, or sides of the worksheet window.



Book	Sheet	Name	Cell	Value	Formula
CostAnalysis.xlsx	Sheet1	Products4and5only	F13	\$117,915	=F9+F10
CostAnalysis.xlsx	Sheet1	TotalCost	F12	\$163,993	=SUM(F6:F11)

Formulas that you add to the watch window are saved with the workbook, and continue to be available until you select them and click **Delete Watch**.

► To load the Solver add-in

1. In the **Backstage** view, click **Options**.
2. In the **Excel Options** dialog box, click **Add-Ins**.
3. In the **Manage** list, click **Excel Add-ins**, and then click **Go**.
4. In the **Add-Ins** dialog box, select the **Solver Add-in** check box, and then click **OK**.

► To set up Solver parameters

1. On the **Data** tab, in the **Analysis** group, click **Solver**.
2. In the **Solver Parameters** dialog box, specify the **Set Objective** cell.
3. In the **To** area, select **Max**, **Min**, or **Value Of**. If you choose **Value Of**, enter a value.

4. In the **By Changing Variable Cells** box, specify the cells whose values Solver can change when analyzing the data.
5. In the **Subject to the Constraints** area, click **Add**, and then define the constraint in the **Add Constraint** dialog box. Click **Add** in the **Add Constraint** dialog box to define another constraint. Click **OK** when you finish defining constraints.
6. Click **Solve**.

Using the Scenario Manager

To manage your what-if models so that you recall them instantly, use the Scenario Manager. You can create multiple scenarios by using the same model, for example, Best, Most Likely, or Worst Case. Each scenario can store values for up to 32 changing cells. For example, after making changes to a Solver model, you could save the result as a scenario named *Solved*.

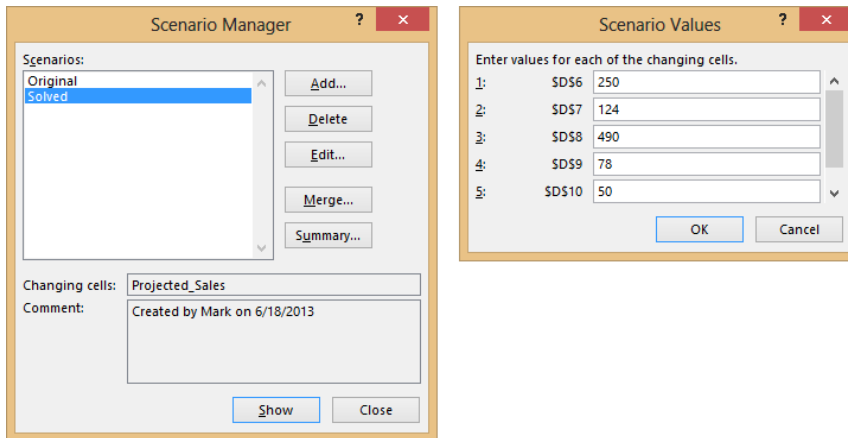
Product Group	Cost of Goods	Profit margin	Projected Sales	Total Profit	Total Cost	Percent of total
Product 1	\$55.87	11.50%	250	\$1,604	\$13,948	19%
Product 2	\$103.00	8.40%	124	\$1,072	\$12,758	18%
Product 3	\$8.45	8.20%	490	\$339	\$4,136	6%
Product 4	\$183.66	11.20%	78	\$1,613	\$14,400	20%
Product 5	\$288.00	13.90%	50	\$2,002	\$14,400	20%
Product 6	\$16.99	16.30%	727	\$2,014	\$12,358	17%
Total Cost of Goods					\$72,000	
Product 4 + 5 only					\$28,800	

You define a scenario by specifying changing cells, whose value you want to record when you're done. Excel displays the Scenario Values dialog box, in which the current value is displayed for each of the changing cells you selected.

Tip Consider selecting your changing cells before performing any analysis, and save them as a scenario named something like *Beginning* or *Original*. This makes it easy to start over if you don't like the results.

To edit a scenario, select it in the Scenario Manager and click Edit. Make any changes in the Edit Scenario dialog box and the Scenario Values dialog box, where you can modify the values for each changing cell directly.

Click the Show button in Scenario Manager to insert the values for the selected scenario in the worksheet.



Merging scenarios

You can distribute a workbook, have other people define scenarios in their copies of the workbook, and then merge them all into a single workbook. With the workbooks that contain scenarios open, click the Merge button in the Scenario Manager dialog box. In the Merge Scenario dialog box, select the workbook that contains the scenarios you want to merge.

► To define a scenario and then view the results

1. On the **Data** tab, in the **Data Tools** group, click **What-If Analysis**, and then click **Scenario Manager**.
2. In Scenario Manager, click **Add**.
3. In the **Add Scenario** dialog box, enter a name for the scenario.
4. In the **Changing cells** box, specify each cell you want to alter, and click **OK**.
5. In the **Scenario Values** dialog box, enter the values for each changing cell.
6. Click **Add** to define another scenario, or click **OK** to return to the **Scenario Manager** dialog box.

➤ **To see the results of a scenario**

→ In the **Scenario Manager** dialog box, select a scenario and click **Show**.

➤ **To edit a scenario**

1. In the **Scenario Manager** dialog box, select a scenario, and then click **Edit**.
2. In the **Edit Scenario** dialog box, change the scenario name or alter the list of changing cells. Then click **OK**.
3. In the **Scenario Values** dialog box, modify the values of changing cells.

➤ **To delete a scenario**

→ In **Scenario Manager**, select a scenario, and then click **Delete**.

Consolidating data

You can use the **Consolidate** command in the **Data Tools** group on the **Data** tab to combine values from up to 255 worksheets into one master worksheet. The source worksheets can be from the same workbook or from other workbooks, and the consolidation settings are saved so that you can rerun it at any time. You can consolidate data in two ways:

- **Consolidation by position** Using this command is the easiest way to consolidate, but the cell ranges in all supporting worksheets must be the same size with identical row and column labels in identical locations.
- **Consolidation by category** By using this command, you can collect data from supporting worksheets whose cell ranges are different sizes, but use the identical row and column labels in different locations.

Consolidating by position

Suppose you have three worksheets containing sales data—Jan, Feb, and Mar—and you want to create a quarterly summary. The layout and labels are identical in all three worksheets. With all the supporting worksheets open, the first step is to select cells on the empty summary sheet where you want the consolidated data to go, without selecting the row or column labels.

Product	January	February	March
ASH-1662	1,412	5,471	4,064
ASH-1839	1,437	8,572	9,176
ASH-1762		15,889	34,162
ASH-1670		19,786	3,908
ASH-1706		5,471	14,282
ASH-1713		3,868	1,416
ASH-1716		25,369	3,867
ASH-1849		37,365	22,981

In the Consolidate dialog box, you specify a cell range to consolidate by clicking a worksheet tab (or a tab in another workbook) to activate it, and then dragging to select cells. References are inserted in the dialog box. In a consolidation by position, you shouldn't need to select cells again, just the worksheet tab, because Excel selects the same range of cells specified in the first consolidation reference.

Product	Sales	Units
ASH-1662	5,471	35
ASH-1839	8,572	61
ASH-1762	15,889	78
ASH-1670	19,786	70
ASH-1706	5,471	35
ASH-1713	3,868	50
ASH-1716	25,369	85
ASH-1849	37,365	140

Tip If you select row or column labels, click Use Labels In in the Consolidate dialog box so that the consolidated result includes them.

Repeat this process for each worksheet until all the cell ranges you want to consolidate are represented in the All References box. Consolidation data is saved with the workbook, so that the next time you use the Consolidate command, you can rerun the same consolidation immediately.

Tip You can add sheets to a consolidation from other workbooks, but if they are not open you'll have to type external cell references from memory, including the full path to the folder. If you aren't working with too many sheets, hold down the Ctrl key while dragging a copy of each sheet into one workbook, and then run the consolidation there.

Consolidating by category

Suppose you have three similar worksheets you want to consolidate, but each contains different data in the rows and columns. This time when you consolidate, you'll include the labels from your source worksheets. The first step in this case is to select a single cell on the summary worksheet where you want the consolidated data to start. Make sure there is room; give the summary its own worksheet and you won't have to worry.

	A	B	C
1	First Quarter		
2	Product	Sales	Units
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

	A	B	C	D
1	January			
2	Product	Sales	Units	
3	ASH-1739	9,175.92	39	
4	ASH-1787	22,086.04	74	
5	ASH-1821			
6	ASH-1742			

	A	B	C	D
1	February			
2	Product	Sales	Units	
3	ASH-1662	5,470.85	35	
4	ASH-1839	8,572.33	61	
5	ASH-1762			
6	ASH-1670			
7	ASH-1706			
8	ASH-1713			

	A	B	C	D
1	March			
2	Product	Units	Sales	
3	ASH-1775	26.00	4,064	
4	ASH-1853	39.00	9,176	
5	ASH-1682	128.00	34,162	
6				
7				
8				
9				
10				

This time on the summary worksheet, just select a single cell specifying the upper-left corner of the result range. The consolidation will pull in values and the labels from the source worksheets. The Consolidate command uses the labels from each source sheet to put the results in the right places. If the row or column labels match, Excel adds the values together; if they are different, Excel adds another row or column.

In the Consolidate dialog box, you'll need to select each range manually to ensure that all the data you need makes it into the summary, because all the cell ranges are different sizes. Make sure to include both the row and column labels in all the selections.

1	First Quarter		
2	Product	Sales	Units
3	ASH-1662	5,470.85	35
4	ASH-1839	8,572.33	61
5	ASH-1762	15,888.60	78
6	ASH-1670	19,786.20	70
7	ASH-1706	5,470.85	35
8	ASH-1713	3,867.50	50
9	ASH-1739	9,175.92	39
10	ASH-1787	22,086.04	74
11	ASH-1821	1,948.70	65
12	ASH-1742	7,358.06	79
13	ASH-1775	4,064	26.00
14	ASH-1853	9,176	39.00
15	ASH-1682	34,162	128.00

Tip The consolidations discussed in this section are static; if the source data changes, you'll need to rerun the consolidation. But you can create a dynamic consolidation that updates automatically by clicking **Create Links To Source Data** in the Consolidate dialog box, which inserts reference formulas in your summary worksheet.

► To consolidate data by position

1. Open the workbook or workbooks to consolidate.
2. On the summary worksheet, select the range that will contain the consolidated data. This range and all the source ranges must be the same size, and all must have identical row and/or column labels.
3. On the **Data** tab, in the **Data Tools** group, click the **Consolidate** button.
4. Select the function that you want to apply, and then click in the **Reference** box.
5. Click the first worksheet tab you want to add, select the data you want to consolidate, and then click the **Add** button. Repeat for each worksheet you want to consolidate.
6. Select options for labels and links, if necessary.
7. Click **OK**.

► **To consolidate data by category**

1. Open the workbook or workbooks to consolidate.
2. On the summary worksheet, select the cell in the upper-left corner of the range that will contain the consolidated data.
3. On the **Data** tab, in the **Data Tools** group, click **Consolidate**.
4. Select the function that you want to apply, and then click in the **Reference** box.
5. Click the first worksheet tab you want to add, select the data you want to consolidate, and then click the **Add** button. Repeat for each worksheet you want to consolidate.
6. Select options for labels and links, if necessary.
7. Click **OK**.

Practice tasks

The practice files for these tasks are located in the MOSExcel2013Expert\Objective3 practice file folder. Save the results of the tasks in the same folder.

- Open the *ExcelExpert_3-4a* workbook and on the Goal Seek worksheet, find a price that would yield revenue of \$125,000.
- Open the *ExcelExpert_3-4b* workbook and run the Solver; increase the cost of goods for products 4 and 5 by 10 percent and save the result as a new scenario.
- Open the *ExcelExpert_3-4c* workbook and consolidate values by position from the Jan, Feb, and Mar worksheets on the Summary sheet.
- Open the *ExcelExpert_3-4d* workbook and consolidate values by category from the Jan, Feb, and Mar worksheets on the Summary sheet. Add fake data to any or all of the month worksheets and rerun the consolidation.

Objective review

Before finishing this chapter, ensure that you have mastered the following skills:

- 3.1 Apply functions in formulas
- 3.2 Look up data by using functions
- 3.3 Apply advanced date and time functions
- 3.4 Create scenarios

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