Microsoft

Microsoft Excel

(Office 2021 and Microsoft 365)

Step by Step

Joan Lambert
Curtis Frye

PRACTICE FILES

FREE SAMPLE CHAPTER

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Microsoft

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About the author

Joan Lambert has worked closely with Microsoft technologies since 1986, and in the training and certification industry since 1997, guiding the translation of technical information and requirements into useful, relevant, and measurable resources for people seeking certification of their computer skills or who simply want to get things done efficiently. She has written more than 50 books about Windows, Office, and SharePoint technologies, including dozens of *Step by Step* books and five generations of *Microsoft Office Specialist* certification study guides. Students who use the GO! with Microsoft Office textbook products may overhear her cheerfully demonstrating Office features in the videos that accompany the series.

A native of the Pacific Northwest, Joan has had the good fortune to live in many parts of the world. She currently resides with her family—one daughter, two dogs, two cats, and seven chickens—in the Beehive State, where she enjoys the majestic mountain views every day…from her office chair.

Introduction

Welcome! This *Step by Step* book has been designed so you can read it from the beginning to learn about Excel for Microsoft 365 (or Microsoft Excel 2021) and then build your skills as you learn to perform increasingly specialized procedures. Or, if you prefer, you can jump in wherever you need guidance for performing tasks. The how-to steps are delivered crisply and concisely—just the facts. You'll also find informative graphics that support the instructional content.

Who this book is for

Microsoft Excel Step by Step (Office 2021 and Microsoft 365) is designed for use as a learning and reference resource by people who want to use Excel to manage data, perform calculations, create useful analyses and visualizations, generate forecasts, and discover insights into their operations. The book content is designed to be useful for people who are upgrading from earlier versions of Excel and for people who are discovering Excel for the first time.

The *Step by Step* approach

The book's coverage is divided into parts representing general Excel skill sets. Each part is divided into chapters representing skill set areas, and each chapter is divided into topics that group related skills. Each topic includes expository information followed by generic procedures. At the end of the chapter, you'll find a series of practice tasks you can complete on your own by using the skills taught in the chapter. You can use the practice files available from this book's website to work through the practice tasks, or you can use your own files.

Features and conventions

This book has been designed to lead you step by step through tasks you're likely to want to perform in Excel. The topics are all self-contained, so you can start at the beginning and work your way through all the procedures or reference them independently. If you have worked with a previous version of Excel, or if you complete all the exercises and later need help remembering how to perform a procedure, the following features of this book will help you locate specific information:

- **Detailed table of contents** Browse the listing of the topics, sections, and sidebars within each chapter.
- **Chapter thumb tabs and running heads** Identify the pages of each chapter by the thumb tabs on the book's open fore edge. Find a specific chapter by number or title by looking at the running heads at the top of even-numbered (verso) pages.
- **Topic-specific running heads** Within a chapter, quickly locate the topic you want by looking at the running heads at the top of odd-numbered (recto) pages.
- **Practice tasks page tabs** Easily locate the practice tasks at the end of each chapter by looking for the full-page stripe on the book's fore edge.
- **Detailed index** Look up coverage of specific tasks and features in the index at the back of the book.

You can save time when reading this book by understanding how the *Step by Step* series provides procedural instructions and auxiliary information and identifies on-screen and physical elements that you interact with. The following table lists content formatting conventions used in this book.

Convention	Meaning
TIP	This reader aid provides a helpful hint or shortcut to simplify a task.
IMPORTANT	This reader aid alerts you to a common problem or provides information necessary to successfully complete a procedure.
SEE ALSO	This reader aid directs you to more information about a topic in this book or elsewhere.
1. Numbered steps	Numbered steps guide you through generic procedures in each topic and hands-on practice tasks at the end of each chapter.

Convention	Meaning
■ Bulleted lists	Bulleted lists indicate single-step procedures and sets of multiple alternative procedures.
Interface objects	In procedures and practice tasks, semibold black text indicates on-screen elements that you should select (click or tap).
User input	Light semibold formatting identifies specific information that you should enter when completing procedures or practice tasks.
Ctrl+P	A plus sign between two keys indicates that you must select those keys at the same time. For example, "press **Ctrl+P**" directs you to hold down the Ctrl key while you press the P key.
Emphasis and *URLs*	In expository text, italic formatting identifies web addresses and words or phrases we want to emphasize.

Download the practice files

Before you can complete the practice tasks in this book, you must download the book's practice files to your computer from *MicrosoftPressStore.com/Excel365stepbystep/downloads*. Follow the instructions on the webpage.

⚠ **IMPORTANT** Excel 2021 and other Microsoft 365 apps are not available from the book's website. You should install Excel before working through the procedures and practice tasks in this book.

You can open the files that are supplied for the practice tasks and save the finished versions of each file. If you want to repeat practice tasks later, you can download the original practice files again.

SEE ALSO For information about opening and saving files, see "Create workbooks" in Chapter 1, "Set up a workbook."

The following table lists the files available for use while working through the practice tasks in this book.

Chapter	Folder	File
Part 1: Create and format workbooks		
1: Set up a workbook	Excel365SBS\Ch01	CreateWorkbooks.xlsx CustomizeRibbonTabs.xlsx MergeCells.xlsx ModifyWorkbooks.xlsx ModifyWorksheets.xlsx
2: Work with data and Excel tables	Excel365SBS\Ch02	CompleteFlashFill.xlsx CreateExcelTables.xlsx EnterData.xlsx FindValues.xlsx MoveData.xlsx ResearchItems.xlsx
3: Perform calculations on data	Excel365SBS\Ch03	AuditFormulas.xlsx BuildFormulas.xlsx CreateArrayFormulas.xlsx CreateConditonalFormulas.xlsx NameRanges.xlsx SetIterativeOptions.xlsx
4: Change workbook appearance	Excel365SBS\Ch04	AddImages.xlsx CreateConditionalFormats.xlsx DefineStyles.xlsx FormatCells.xlsx FormatNumbers.xlsx ModifyTableStyles.xlsx ModifyThemes.xlsx phone.jpg

Chapter	Folder	File
Part 2: Analyze and present data		
5: Manage worksheet data	Excel365SBS\Ch05	FilterData.xlsx SummarizeValues.xlsx ValidateData.xlsx
6: Reorder and summarize data	Excel365SBS\Ch06	CustomSortData.xlsx OutlineData.xlsx SortData.xlsx
7: Combine data from multiple sources	Excel365SBS\Ch07	ConsolidateData.xlsx CreateDataLinks.xlsx FleetOperatingCosts.xlsx LookupData.xlsx
8: Analyze alternative data sets	Excel365SBS\Ch08	CreateScenarios.xlsx DefineDataTables.xlsx PerformGoalSeekAnalysis.xlsx
9: Create charts and graphics	Excel365SBS\Ch09	CreateCharts.xlsx CreateComboCharts.xlsx CreateSparklines.xlsx CreateSpecialCharts.xlsx CustomizeCharts.xlsx IdentifyTrends.xlsx InsertShapes.xlsx InsertSmartArt.xlsx
10: Create PivotTables and PivotCharts	Excel365SBS\Ch10	CreatePivotCharts.xlsx CreatePivotTables.xlsx EditPivotTables.xlsx FilterPivotTables.xlsx FormatPivotTables.xlsx

Chapter	Folder	File
Part 3: Collaborate and share in Excel		
11: Print worksheets and charts	Excel365SBS\Ch11	AddHeaders.xlsx ConsolidatedMessenger.png PrepareWorksheets.xlsx PrintCharts.xlsx PrintParts.xlsx PrintWorksheets.xlsx
12: Automate tasks and input	Excel365SBS\Ch12	AssignMacros.xlsm ExamineMacros.xlsm InsertFormControls.xlsm RecordMacros.xlsm
13: Work with other Microsoft 365 apps	Excel365SBS\Ch13	CreateHyperlinks.xlsx EmbedWorkbook.xlsx LevelDescriptions.xlsx LinkCharts.xlsx LinkFiles.xlsx LinkWorkbooks.pptx ReceiveLinks.pptx
14: Collaborate with colleagues	Excel365SBS\Ch14	CreateTemplate.xlsx DistributeFiles.xlsx FinalizeWorkbooks.xlsx ManageComments.xlsx ProtectWorkbooks.xlsx

Chapter	Folder	File
Part 4: Perform advanced analysis		
15: Perform business intelligence analysis	Excel365SBS\Ch15	AnalyzePowerPivotData.xlsx CreateQuery.xlsx DefineModel.xlsx DefineRelationships.xlsx DisplayTimelines.xlsx ManagePowerQueryData.xlsx
16. Create forecasts and visualizations	Excel365SBS\Ch16	CreateForecastSheets.xlsx CreateKPIs.xlsx CreateMaps.xlsx DefineMeasures.xlsx

Adapt exercise steps

This book contains many images of the Excel user interface elements (such as the ribbon and the app window) that you'll work with while performing tasks in Excel on a Windows computer. Unless we're demonstrating an alternative view of content, the screenshots shown in this book were captured on a horizontally oriented display at a screen resolution of 1920 × 1080 and a magnification of 100 percent. If your settings are different, the ribbon on your screen might not look the same as the one shown in this book. As a result, exercise instructions that involve the ribbon might require a little adaptation.

Simple procedural instructions use this format:

- On the **Insert** tab, in the **Illustrations** group, select the **Chart** button.

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

1. On the **Home** tab, in the **Editing** group, select the **Find** arrow and then, in the **Find** list, select **Go To**.

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 select the specified tab, and then locate the specified group. If a group has been collapsed into a group list or under a group button, select 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.

Multistep procedural instructions use this format:

1. To select the paragraph that you want to format in columns, triple-click the paragraph.
2. On the **Layout** tab, in the **Page Setup** group, select the **Columns** button to display a menu of column layout options.
3. On the **Columns** menu, select **Three**.

On subsequent instances of instructions that require you to follow the same process, the instructions might be simplified in this format because the working location has already been established:

1. Select the paragraph that you want to format in columns.
2. On the **Columns** menu, select **Three**.

The instructions in this book assume that you're selecting on-screen content and user interface elements on your computer by clicking (with a mouse, touchpad, or other hardware device) or tapping a touchpad or the screen (with your finger or a stylus). Instructions refer to Excel user interface elements that you click or tap on the screen as *buttons*, and to physical buttons that you press on a keyboard as *keys*, to conform to the standard terminology used in documentation for these products.

When the instructions tell you to enter information, you can do so by typing on a connected external keyboard, tapping an on-screen keyboard, or even speaking aloud, depending on your computer setup and your personal preferences.

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3

Perform calculations on data

Excel workbooks provide an easy interface for storing and organizing data, but Excel can do so much more than that. Using the built-in functions, you can easily perform a variety of calculations—from simple tasks such as calculating totals to complex financial calculations. Excel can report information such as the current date and time, the maximum value or number of blank cells in a data set, and the cells that meet specific conditions, and it can use this information when performing calculations. To simplify the process of referencing cells or data ranges in your calculations, you can name them. Excel provides guidance for creating formulas to perform calculations and for identifying and fixing any errors in the calculations.

This chapter guides you through procedures related to naming data ranges, creating formulas to calculate values, summarizing data in one or more cells, copying and moving formulas, creating array formulas, troubleshooting issues with formula calculations, and configuring automatic and iterative calculation options.

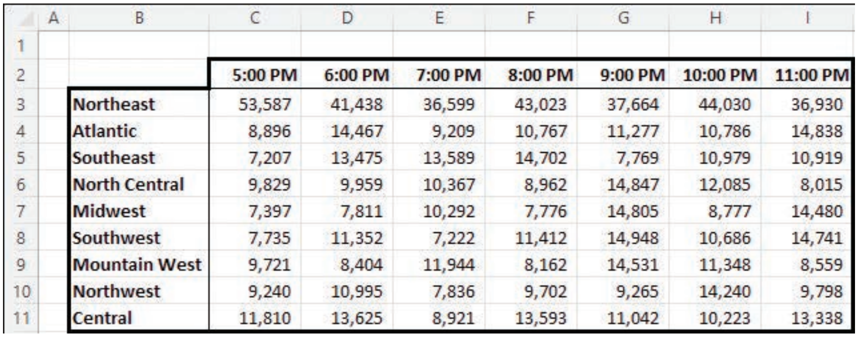
In this chapter

- Name data ranges
- Create formulas to calculate values
- Summarize data that meets specific conditions
- Copy and move formulas
- Create array formulas
- Find and correct errors in calculations
- Configure automatic and iterative calculation options

Name data ranges

When you work with large amounts of data, it's often useful to identify groups of cells that contain related data. For example, you might have a worksheet for a delivery service in which:

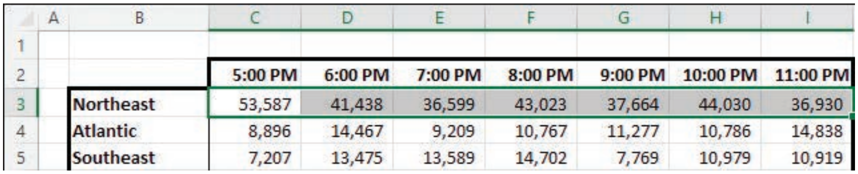
- Each column of data summarizes the number of packages handled during one hour of the day.
- Each row of data represents a region that handled packages.



	A	B	C	D	E	F	G	H	I
1									
2			5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
3		Northeast	53,587	41,438	36,599	43,023	37,664	44,030	36,930
4		Atlantic	8,896	14,467	9,209	10,767	11,277	10,786	14,838
5		Southeast	7,207	13,475	13,589	14,702	7,769	10,979	10,919
6		North Central	9,829	9,959	10,367	8,962	14,847	12,085	8,015
7		Midwest	7,397	7,811	10,292	7,776	14,805	8,777	14,480
8		Southwest	7,735	11,352	7,222	11,412	14,948	10,686	14,741
9		Mountain West	9,721	8,404	11,944	8,162	14,531	11,348	8,559
10		Northwest	9,240	10,995	7,836	9,702	9,265	14,240	9,798
11		Central	11,810	13,625	8,921	13,593	11,042	10,223	13,338

Worksheets often contain logical groups of data

Instead of specifying a cell or range of cells individually every time you want to reference the data they contain, you can name the cell or cells—in other words, create a *named range*. For example, you could group the packages handled in the Northeast region during all time periods into a range named *Northeast*. Whenever you want to use the contents of that range in a calculation, you can reference Northeast instead of $C$3:$I$3. That way, you don't need to remember the cell range or even the worksheet it's on.



	A	B	C	D	E	F	G	H	I
1									
2			5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
3		Northeast	53,587	41,438	36,599	43,023	37,664	44,030	36,930
4		Atlantic	8,896	14,467	9,209	10,767	11,277	10,786	14,838
5		Southeast	7,207	13,475	13,589	14,702	7,769	10,979	10,919

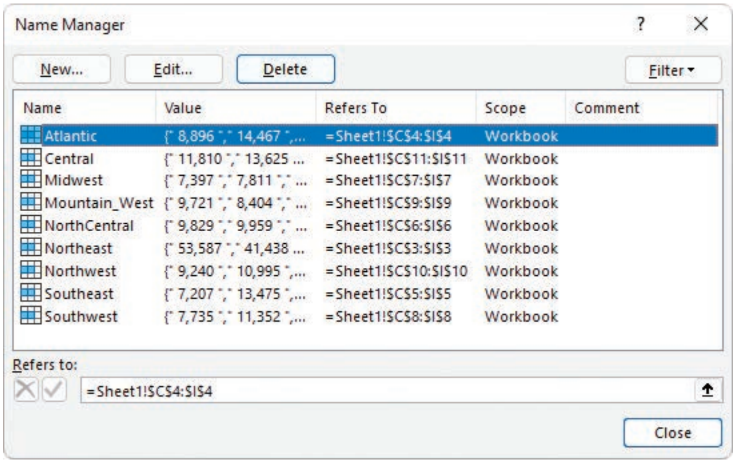
Select a group of cells to create a named range

TIP Range names can be simple or complex. In a workbook that contains different kinds of data, a more descriptive name such as *NortheastVolume* can help you remember the data the range includes.

If you have a range of data with consistent row or column headings, you can create a series of ranges at one time instead of having to create each individually.

By default, when you create a named range, its scope is the entire workbook. This means that you can reference the name in a formula on any worksheet in the workbook. If a workbook contains a series of worksheets with the same content—for example, sales data worksheets for each month of a year—you might want to set the scope of ranges on those worksheets to the worksheet instead of to the workbook.

After you create a named range, you can edit the name, the cells the range includes, or the scope in which the range exists, or delete a range you no longer need, in the Name Manager.



Name	Value	Refers To	Scope	Comment
Atlantic	{" 8,896 "," 14,467 ",...	=Sheet1!$C$4:$I$4	Workbook	
Central	{" 11,810 "," 13,625 ...	=Sheet1!$C$11:$I$11	Workbook	
Midwest	{" 7,397 "," 7,811 "," ...	=Sheet1!$C$7:$I$7	Workbook	
Mountain_West	{" 9,721 "," 8,404 "," ...	=Sheet1!$C$9:$I$9	Workbook	
NorthCentral	{" 9,829 "," 9,959 "," ...	=Sheet1!$C$6:$I$6	Workbook	
Northeast	{" 53,587 "," 41,438 ...	=Sheet1!$C$3:$I$3	Workbook	
Northwest	{" 9,240 "," 10,995 ",...	=Sheet1!$C$10:$I$10	Workbook	
Southeast	{" 7,207 "," 13,475 ",...	=Sheet1!$C$5:$I$5	Workbook	
Southwest	{" 7,735 "," 11,352 ",...	=Sheet1!$C$8:$I$8	Workbook	

Refers to: =Sheet1!$C$4:$I$4

Manage named ranges in the Name Manager

TIP If your workbook contains a lot of named ranges, tables, or other objects, you can filter the Name Manager list to locate objects more easily.

To create a named range

1. Select the cells you want to include in the named range.
2. In the **Name Box**, next to the formula bar, enter a name for your named range.

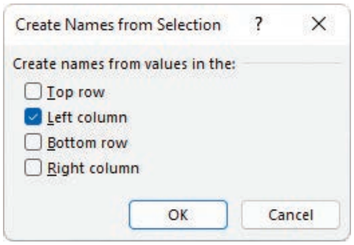
Or

1. Select the cells you want to include in the named range.
2. On the **Formulas** tab, in the **Defined Names** group, select **Define Name**.

3. In the **New Name** dialog, do the following:
    a. In the **Name** box, enter a name for the range. The name must begin with a letter or underscore and may not contain spaces.
    b. If you want to restrict the range to use on a specific worksheet, select that worksheet in the **Scope** list.
    c. If you want to provide additional information to help workbook users identify the range, enter a description of up to 255 characters in the **Comment** box.
    d. Verify that the **Refers to** box includes the cells you want to include in the range.
    e. Select **OK**.

To create a series of named ranges from data with headings

1. Select the cells that contain the headings and data you want to include in the named ranges.
2. On the **Formulas** tab, in the **Defined Names** group, select **Create from Selection**.
3. In the **Create Names from Selection** dialog, select the checkbox next to the location of the heading text from which you want to create the range names.



Create Names from Selection

Create names from values in the:

☐ Top row
☑ Left column
☐ Bottom row
☐ Right column

Name ranges by any outer row or column in the selection

4. Select **OK**.

To open the Name Manager

- On the **Formulas** tab, in the **Defined Names** group, select **Name Manager**.

To change the name of a named range

1. Open the **Name Manager**.
2. Select the range you want to rename, and then select **Edit**.
3. In the **Edit Name** dialog, in the **Name** box, change the range name, and then select **OK**.

To change the cells in a named range

1. Open the **Name Manager**.
2. Select the range you want to edit, and then do either of the following:
   - In the **Refers to** box, change the cell range.
   - Select **Edit**. In the **Edit Name** dialog, in the **Refers to** box, change the cell range, and then select **OK**.

To change the scope of a named range

1. Select the range you want to change the scope of and note the range name shown in the **Name Box**.
2. On the **Formulas** tab, in the **Defined Names** group, select **Define Name**.
3. In the **New Name** dialog, do the following:
   a. In the **Name** box, enter the existing range name that you noted in step 1.
   b. In the **Scope** list, select the new scope.
   c. If you want to provide additional information to help workbook users identify the range, enter a description of up to 255 characters in the **Comment** box.
   d. Verify that the **Refers to** box includes the cells you want to include in the range.
   e. Select **OK**.

To delete a named range

1. Open the **Name Manager**.
2. Select the range you want to delete, and then select **Delete**.
3. In the Microsoft Excel dialog prompting you to confirm the deletion, select **OK**.

Create formulas to calculate values

After you enter data on a worksheet and, optionally, define ranges to simplify data references, you can create formulas to performs calculations on your data. For example, you can calculate the total cost of a customer's shipments, figure the average number of packages for all Wednesdays in the month of January, or find the highest and lowest daily package volumes for a week, month, or year.

You can enter a formula directly into a cell or into the formula bar located between the ribbon and the worksheet area.

Every formula begins with an equal sign (=), which tells Excel to interpret the expression after the equal sign as a calculation instead of as text. The formula that you enter after the equal sign can include simple references and mathematical operators, or it can begin with an Excel function. For example, you can find the sum of the numbers in cells C2 and C3 by using the formula =C2+C3. You can edit formulas by selecting the cell and then editing the formula in the cell or in the formula bar.

Operators and precedence

When you create an Excel formula, you use the built-in functions and arithmetic operators that define operations such as addition and multiplication. The following table displays the order in which Excel evaluates mathematical operations.

Precedence	Operator	Description
1	-	Negation
2	%	Percentage
3	^	Exponentiation
4	* and /	Multiplication and division
5	+ and –	Addition and subtraction
6	&	Concatenation

If two operators at the same level, such as + and –, occur in the same equation, Excel evaluates them from left to right.

For example, Excel evaluates the operations in the formula = *4 + 8 * 3 – 6* in this order:

1. 8 * 3 = 24
2. 4 + 24, with a result of 28
3. 28 – 6, with a final result of 22

You can control the order in which Excel evaluates operations by using parentheses. Excel always evaluates operations in parentheses first.

For example, if the previous equation were rewritten as = *(4 + 8) * 3 – 6*, Excel would evaluate the operations in this order:

1. (4 + 8), with a result of 12
2. 12 * 3, with a result of 36
3. 36 – 6, with a final result of 30

In a formula that has multiple levels of parentheses, Excel evaluates the expressions within the innermost set of parentheses first and works its way out. As with operations on the same level, expressions at the same parenthetical level are evaluated from left to right.

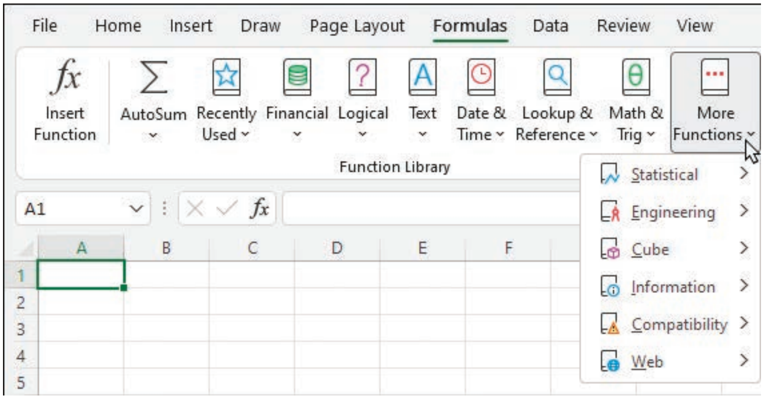
For example, Excel evaluates the formula = *4 + (3 + 8 * (2 + 5)) – 7* in this order:

1. (2 + 5), with a result of 7
2. 7 * 8, with a result of 56
3. 56 + 3, with a result of 59
4. 4 + 59, with a result of 63
5. 63 – 7, with a final result of 56

You can perform mathematical operations on numbers by using the mathematical operators for addition (+), subtraction (–), multiplication (*), division (/), negation (-), and exponentiation (^). You can perform other operations on a range of numbers by using the following Excel functions:

- **SUM** Returns the sum of the numbers.
- **AVERAGE** Returns the average of the numbers.
- **COUNT** Returns the number of entries in the cell range.
- **MAX** Returns the largest number.
- **MIN** Returns the smallest number.

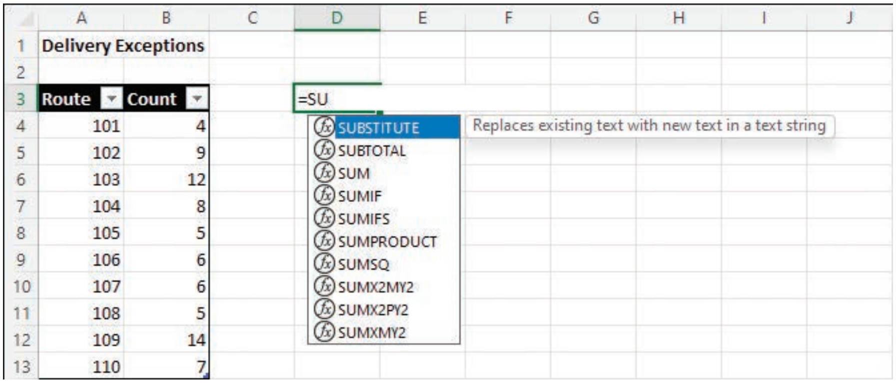
These functions are available from the AutoSum list, which is in the Editing group on the Home tab of the ribbon and in the Function Library group on the Formulas tab. The Function Library is also where you'll find the rest of the Excel functions, organized into categories.


File
Home
Insert
Draw
Page Layout
Formulas
Data
Review
View
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Statistical
Engineering
Cube
Information
Compatibility
Web
A1
A
B
C
D
E
F
1
2
3
4
5

Excel includes a wide variety of functions

The Formula AutoComplete feature simplifies the process of referencing functions, named ranges, and tables in formulas. It provides a template for you to follow and suggests entries for each function argument. Here's how it works:

1. As you begin to enter a function name after the equal sign, Excel displays a list of functions matching the characters you've entered. You can select a function from the list and then press Tab to enter the function name and the opening parenthesis in the cell or formula bar.



Delivery Exceptions

Route	Count
101	4
102	9
103	12
104	8
105	5
106	6
107	6
108	5
109	14
110	7

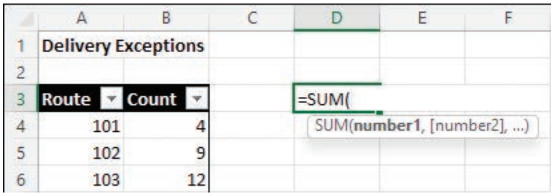
=SU

Replaces existing text with new text in a text string

A
B
C
D
E
F
G
H
I
J
1
2
3
4
5
6
7
8
9
10
11
12
13
SUBSTITUTE
SUBTOTAL
SUM
SUMIF
SUMIFS
SUMPRODUCT
SUMSQ
SUMX2MY2
SUMX2PY2
SUMXMY2

Select a function from the list

2. After the opening parenthesis, Excel displays the arguments that the selected function accepts. Bold indicates required arguments and square brackets enclose optional arguments. You can simply follow the prompts to enter or select the necessary information, and then enter a closing parenthesis to finish the formula.



Delivery Exceptions

Route	Count
101	4
102	9
103	12

=SUM(

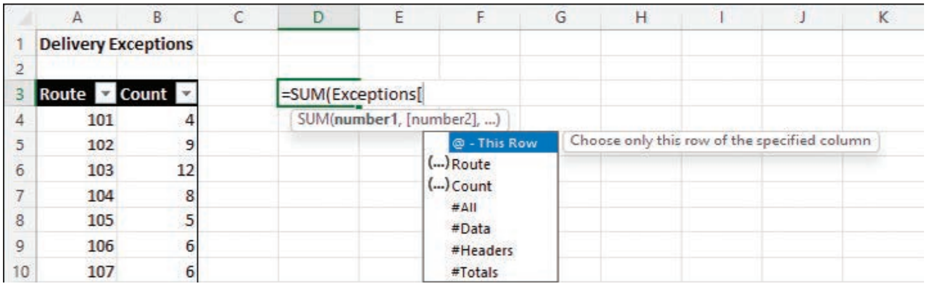
SUM(**number1**, [number2], ...)

A
B
C
D
E
F
1
2
3
4
5
6

Excel prompts you for required and optional information

3. To reference a named range, table, or table element, start entering the name (or an opening square bracket to indicate a table element) and Excel displays a list of options to choose from.

TIP You can reference a series of contiguous cells in a formula by entering the cell range or by dragging through the cells. If the cells aren't contiguous, hold down the Ctrl key and select each cell.



	A	B	C	D
1	**Delivery Exceptions**			
2				
3	Route	Count		=SUM(Exceptions[
4	101	4		
5	102	9		
6	103	12		
7	104	8		
8	105	5		
9	106	6		
10	107	6		

SUM(**number1**, [number2], ...)

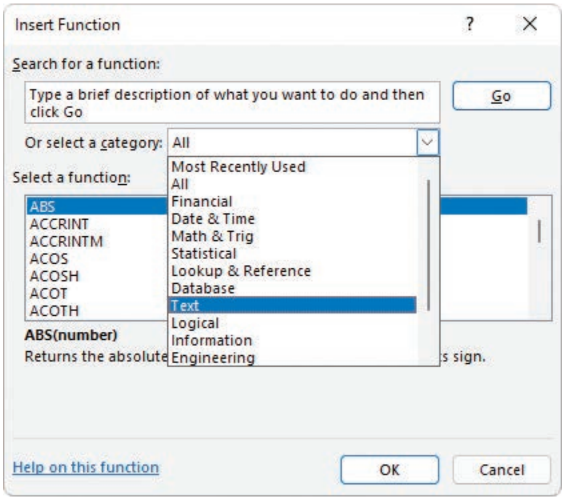
Choose only this row of the specified column

A
B
C
D
E
F
G
H
I
J
K
@ - This Row
(...) Route
(...) Count
#All
#Data
#Headers
#Totals

Excel displays the available table elements

SEE ALSO For information about using keyboard shortcuts to select cell ranges, see the appendix, "Keyboard shortcuts."

If you're creating a more complex formula and want extra guidance, you can assemble the formula in the Insert Function dialog. All the Excel functions are available from within the dialog.



Search for a function: Type a brief description of what you want to do and then click Go

Or select a category: All

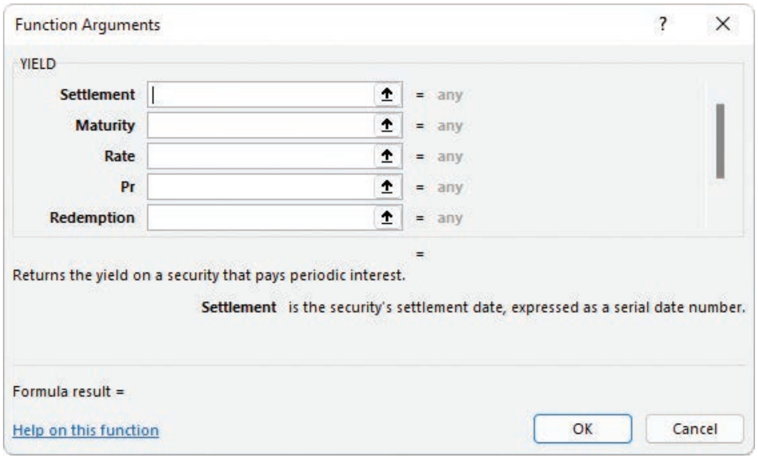
ABS(number)

Returns the absolute ... s sign.

Insert Function
?
X
Go
Select a function:
ABS
ACCRINT
ACCRINTM
ACOS
ACOSH
ACOT
ACOTH
Most Recently Used
All
Financial
Date & Time
Math & Trig
Statistical
Lookup & Reference
Database
Text
Logical
Information
Engineering
Help on this function
OK
Cancel

Create formulas in the Insert Function dialog

If you're uncertain which function to use, you can search for one by entering a simple description of what you'd like to accomplish. Selecting any function displays the function's arguments and description.



YIELD

Settlement = any
Maturity = any
Rate = any
Pr = any
Redemption = any

=

Returns the yield on a security that pays periodic interest.

Settlement is the security's settlement date, expressed as a serial date number.

Formula result =

Activate any field to display a description of the argument

After you select a function, Excel displays an interface in which you can enter all the function arguments. The complexity of the interface depends on the function.

Whether you enter a formula directly or assemble it in the Insert Function dialog, you can reference data in cells (A3) or cell ranges (A3:J12), in named ranges (Northeast), or in table columns (TableName[ColumnName]). For example, if the Northeast range refers to cells C3:I3, you can calculate the average of cells C3:I3 by using the formula =AVERAGE(Northeast).

To create a formula manually

1. Select the cell in which you want to create the formula.
2. In the cell or in the formula bar, enter an equal sign (=).
3. If the formula will call a function, enter the function name and an opening parenthesis to begin the formula and display the required and optional arguments.
4. Enter the remainder of the formula:
    - Reference cells by entering the cell reference or selecting the cell.
    - Reference cell ranges by entering the cell range or dragging across the range.
    - Reference named ranges and tables by entering the range or table name.
    - Reference table elements by entering [after the table name, selecting the element from the list, and then entering].

5. If the formula includes a function, enter the closing parenthesis to end it.
6. Press **Enter** to enter the formula in the cell and return the results.

To open the Insert Function dialog

- On the formula bar, to the left of the text entry box, select the **Insert Function** button (*fx*).
- On the **Formulas** tab, in the **Function Library** group, select **Insert Function**.
- Press **Shift+F3**.

To locate a function in the Insert Function dialog

- In the **Search for a function** box, enter a brief description of the operation you want to perform, and then select **Go**.

Or

1. In the **Or select a category** list, select the function category.
2. Scroll down the **Select a function** list to the function.

To create a formula in the Insert Function dialog

1. Open the **Insert Function** dialog.
2. Select the function you want to use in the formula, and then select **OK**.
3. In the **Function Arguments** dialog, enter the function's arguments, and then select **OK**.

To reference a named range in a formula

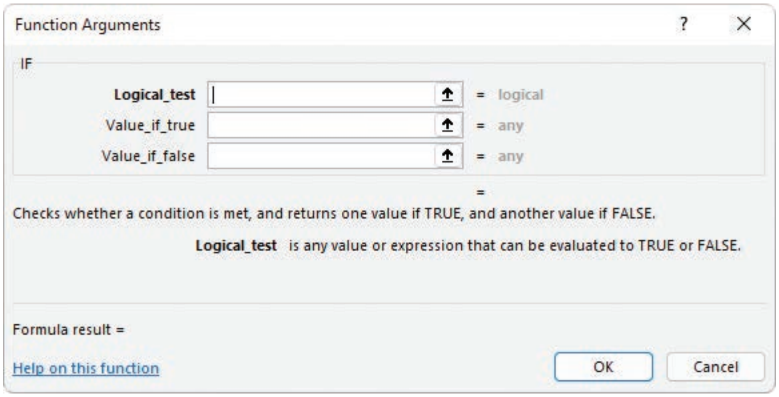
- Enter the range name in place of the cell range.

To reference an Excel table column in a formula

- Enter the table name followed by an opening bracket (**[**), the column name, and a closing bracket (**]**).

Summarize data that meets specific conditions

Another use for formulas is to display messages when certain conditions are met. This kind of formula is called a *conditional formula*. One way to create a conditional formula in Excel is to use the IF function. Selecting the Insert Function button next to the formula bar and then choosing the IF function displays the Function Arguments dialog with the fields required to create an IF formula.



Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.

Logical_test is any value or expression that can be evaluated to TRUE or FALSE.

Formula result =

The Function Arguments dialog for an IF formula

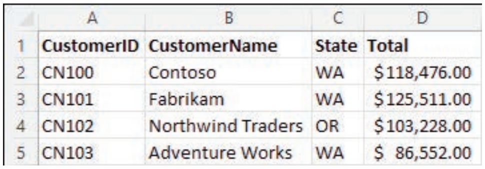
When you work with an IF function, the Function Arguments dialog displays three input boxes:

- **Logical_test** The condition you want to check.
- **Value_if_true** The value to display if the condition is met. This could be a cell reference, or a number or text enclosed in quotes.
- **Value_if_false** The value to display if the condition is not met.

The following table displays other conditional functions you can use to summarize data.

Function	Description
AVERAGEIF	Finds the average of values within a cell range that meet a specified criterion
AVERAGEIFS	Finds the average of values within a cell range that meet multiple criteria
COUNT	Counts the cells in a range that contain numerical values
COUNTA	Counts the cells in a range that are not empty
COUNTBLANK	Counts the cells in a range that are empty
COUNTIF	Counts the cells in a range that meet a specified criterion
COUNTIFS	Counts the cells in a range that meet multiple criteria
IFERROR	Displays one value if a formula results in an error and another if it doesn't
SUMIF	Adds the values in a range that meet a single criterion
SUMIFS	Adds the values in a range that meet multiple criteria

To create a formula that uses the AVERAGEIF function, you define the range to be examined for the criterion, the criterion, and, if required, the range from which to draw the values. As an example, consider a worksheet that lists each customer's ID number, name, state, and total monthly shipping bill. If you want to find the average order of customers from the state of Washington (abbreviated in the worksheet as WA), you can create the formula =AVERAGEIF(C3:C6, "WA", D3:D6).



	A	B	C	D
1	**CustomerID**	**CustomerName**	**State**	**Total**
2	CN100	Contoso	WA	$118,476.00
3	CN101	Fabrikam	WA	$125,511.00
4	CN102	Northwind Traders	OR	$103,228.00
5	CN103	Adventure Works	WA	$ 86,552.00

Sample data that illustrates the preceding example

The AVERAGEIFS, SUMIFS, and COUNTIFS functions extend the capabilities of the AVERAGEIF, SUMIF, and COUNTIF functions to allow for multiple criteria. For example, if you want to find the sum of all orders of at least $100,000 placed by companies in Washington, you can create the formula =SUMIFS(D2:D5, C2:C5, "=WA", D2:D5, ">=100000").

The AVERAGEIFS and SUMIFS functions start with a data range that contains values that the formula summarizes. You then list the data ranges and the criteria to apply to that range. In generic terms, the syntax is =AVERAGEIFS(data_range, criteria_range1, criteria1[,criteria_range2, criteria2…]). The part of the syntax in brackets (which aren't used when you create the formula) is optional, so an AVERAGEIFS or SUMIFS formula that contains a single criterion will work. The COUNTIFS function, which doesn't perform any calculations, doesn't need a data range; you just provide the criteria ranges and criteria. For example, you could find the number of customers from Washington who were billed at least $100,000 by using the formula =COUNTIFS(C2:C5, "=WA", D2:D5, ">=100000").

You can use the IFERROR function to display a custom error message instead of relying on the default Excel error messages to explain what happened. For example, you could create this type of formula to employ the VLOOKUP function to look up a customer's name in the second column of a table named Customers based on the customer identification number entered into cell G8. That formula might look like this: =IFERROR(VLOOKUP(G8,Customers,2,FALSE),"Customer not found"). If the function finds a match for the customer ID in cell G8, it displays the customer's name; if not, it displays the text "Customer not found."

TIP The last two arguments in the VLOOKUP function tell the formula to look in the Customers table's second column and to require an exact match. For more information about the VLOOKUP function, see "Look up data from other locations" in Chapter 7, "Combine data from multiple sources."

To summarize data by using the IF function

- Use the syntax **=IF(*logical_test, value_if_true, value_if_false*)** where:
    - ***logical_test*** is the logical test to be performed.
    - ***value_if_true*** is the value the formula returns if the test is true.
    - ***value_if_false*** is the value the formula returns if the test is false.

To count cells that contain numbers in a range

- Use the syntax **=COUNT(*range*)**, where *range* is the cell range in which you want to count cells.

To count cells that are non-blank

- Use the syntax **=COUNTA(*range*)**, where *range* is the cell range in which you want to count cells.

To count cells that contain a blank value

- Use the syntax **=COUNTBLANK(*range*)**, where *range* is the cell range in which you want to count cells.

To count cells that meet one condition

- Use the syntax **=COUNTIF(*range*, *criteria*)** where:
  - *range* is the cell range that might contain the criteria value.
  - *criteria* is the logical test used to determine whether to count the cell.

To count cells that meet multiple conditions

- Use the syntax **=COUNTIFS(*criteria_range1*, *criteria1*, *criteria_range2*, *criteria2*,...)** where for each *criteria_range* and *criteria* pair:
  - *criteria_range* is the cell range that might contain the criteria value.
  - *criteria* is the logical test used to determine whether to count the cell.

To find the sum of data that meets one condition

- Use the syntax **=SUMIF(*range*, *criteria*, *sum_range*)** where:
  - *range* is the cell range that might contain the criteria value.
  - *criteria* is the logical test used to determine whether to include the cell.
  - *sum_range* is the range that contains the values to be included if the range cell in the same row meets the criterion.

To find the sum of data that meets multiple conditions

- Use the syntax **=SUMIFS(*sum_range*, *criteria_range1*, *criteria1*, *criteria_range2*, *criteria2*,...)** where:
  - *sum_range* is the range that contains the values to be included if all *criteria_range* cells in the same row meet all criteria.
  - *criteria_range* is the cell range that might contain the criteria value.
  - *criteria* is the logical test used to determine whether to include the cell.

To find the average of data that meets one condition

- Use the syntax **=AVERAGEIF(*range*, *criteria*, *average_range*)** where:
  - *range* is the cell range that might contain the *criteria* value.
  - *criteria* is the logical test used to determine whether to include the cell.
  - *average_range* is the range that contains the values to be included if the *range* cell in the same row meets the criterion.

To find the average of data that meets multiple conditions

- Use the syntax **=AVERAGEIFS(*average_range*, *criteria_range1*, *criteria1*, *criteria_range2*, *criteria2*,…)** where:
  - *average_range* is the range that contains the values to be included if all *criteria_range* cells in the same row meet all criteria.
  - *criteria_range* is the cell range that might contain the *criteria* value.
  - *criteria* is the logical test used to determine whether to include the cell.

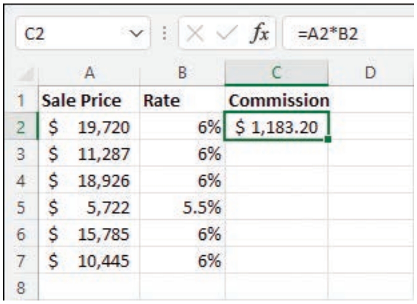
To display a custom message if a cell contains an error

- Use the syntax **=IFERROR(*value*, *value_if_error*)** where:
  - *value* is a cell reference or formula.
  - *value_if_error* is the value to be displayed if the *value* argument returns an error.

Copy and move formulas

After you create a formula, you can copy it and paste it into another cell. When you do, Excel changes the formula to work in the new cells. For instance, suppose you have a worksheet in which cell C7 contains the formula =SUM(C2:C6). If you copy cell C7 and paste the copied formula into cell D7, Excel enters =SUM(D2:D6). Excel knows to change the cells used in the formula because the formula uses a *relative reference*—a reference that can change if the formula is copied to another cell. Relative references are written with just the cell row and column—for example, C14.

Relative references are useful when you summarize rows of data and want to use the same formula for each row. As an example, suppose you have a worksheet with two columns of data, labeled Sale Price and Rate, and you want to calculate a sales representative's commission by multiplying the two values in a row. To calculate the commission for the first sale, you would enter the formula =A2*B2 in cell C2.



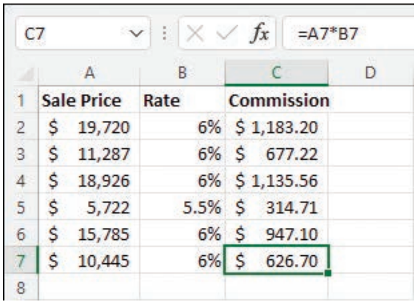
C2

=A2*B2

	A	B	C	D
1	**Sale Price**	**Rate**	**Commission**	
2	$ 19,720	6%	$ 1,183.20	
3	$ 11,287	6%		
4	$ 18,926	6%		
5	$ 5,722	5.5%		
6	$ 15,785	6%		
7	$ 10,445	6%		
8				

Use formulas to calculate values such as commissions

Selecting cell C2 and dragging the fill handle down through cell C7 copies the formula from cell C2 into each of the other cells. Because you created the formula by using relative references, Excel updates each cell's formula to reflect its position relative to the starting cell (in this case, cell C2). The formula in cell C7, for example, is =A7*B7.



C7

=A7*B7

	A	B	C	D
1	**Sale Price**	**Rate**	**Commission**	
2	$ 19,720	6%	$ 1,183.20	
3	$ 11,287	6%	$ 677.22	
4	$ 18,926	6%	$ 1,135.56	
5	$ 5,722	5.5%	$ 314.71	
6	$ 15,785	6%	$ 947.10	
7	$ 10,445	6%	$ 626.70	
8				

Copying formulas to other cells to summarize additional data

When you enter a formula in a cell of an Excel table column, Excel automatically copies the formula to the rest of the column and updates any relative references in the formula.

If you want a cell reference to remain constant when you copy a formula to another cell, use an *absolute reference* by inserting a dollar sign ($) before the column letter and row number or a *mixed reference* by inserting a dollar sign before either the column letter or row number.

TIP In addition to using an absolute reference, another way to ensure that your cell references don't change when you copy a formula to another cell is to select the cell that contains the formula, copy the formula's text in the formula bar, press the Esc key to exit cut-and-copy mode, select the cell where you want to paste the formula, and press Ctrl+V. Excel doesn't change the cell references when you copy your formula to another cell in this manner.

One quick way to change a cell reference from relative to absolute is to select the cell reference in the formula bar and then press F4. Pressing F4 cycles a cell reference through the four possible types of references:

- Relative columns and rows (for example, C4)
- Absolute columns and rows (for example, $C$4)
- Relative columns and absolute rows (for example, C$4)
- Absolute columns and relative rows (for example, $C4)

To copy a formula without changing its cell references

1. Select the cell that contains the formula you want to copy.
2. In the formula bar, select the formula text.
3. Press **Ctrl+C**.
4. Select the cell in which you want to paste the formula.
5. Press **Ctrl+V**.
6. Press **Enter**.

To move a formula without changing its cell references

1. Select the cell that contains the formula you want to copy.
2. Point to the edge of the selected cell until the pointer changes to a black four-headed arrow.
3. Drag the outline to the cell where you want to move the formula.

To copy a formula and change its cell references

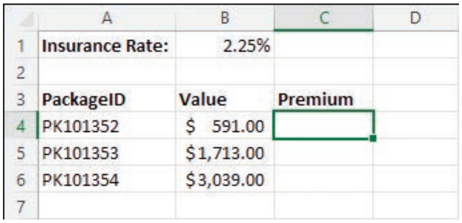
1. Select the cell that contains the formula you want to copy.
2. Press **Ctrl+C**.
3. Select the cell in which you want to paste the formula.
4. Press **Ctrl+V**.

To create relative and absolute cell references

1. Enter a cell reference into a formula.
2. Do either of the following:
    - Enter a **$** in front of a row or column reference you want to make absolute.
    - Select within the cell reference, and then press **F4** to advance through the four possible combinations of relative and absolute row and column references.

Create array formulas

Most Excel formulas calculate values to be displayed in a single cell. For example, you could add the formulas =B1*B4, =B1*B5, and =B1*B6 to consecutive worksheet cells to calculate shipping insurance costs based on the value of a package's contents.

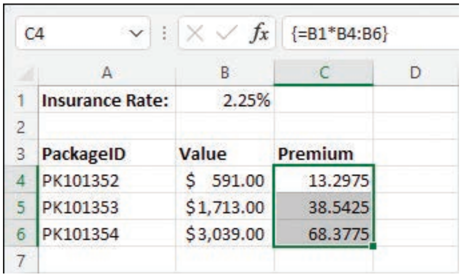


	A	B	C	D
1	Insurance Rate:	2.25%		
2				
3	PackageID	Value	Premium	
4	PK101352	$ 591.00		
5	PK101353	$1,713.00		
6	PK101354	$3,039.00		
7				

A worksheet with data to be summarized by an array formula

Instead of entering the same formula in multiple cells one cell at a time, you can enter a formula in every cell in the target range at the same time by creating an *array formula*. To calculate package insurance rates by multiplying the values in the cell range B4:B6 by the insurance rate in cell B1, you select the target cells (C4:C6) and enter the formula =B1*B4:B6. Note that you must select a range of the same shape as the values you're using in the calculation. (For example, if the value range is three columns wide by one row high, the target range must also be three columns wide by one row high.) If you enter the array formula into a range of the wrong shape, Excel displays duplicate results, incomplete results, or error messages, depending on how the target range differs from the value range.

When you press Ctrl+Shift+Enter, Excel creates an array formula in the selected cells. The formula appears within a pair of braces to indicate that it is an array formula.



C4

{=B1*B4:B6}

	A	B	C	D
1	Insurance Rate:	2.25%		
2				
3	PackageID	Value	Premium	
4	PK101352	$ 591.00	13.2975	
5	PK101353	$1,713.00	38.5425	
6	PK101354	$3,039.00	68.3775	
7				

An array formula calculates multiple results

> **IMPORTANT** You can't add braces to a formula to make it an array formula. You must press Ctrl+Shift+Enter to create it.

To create an array formula

1. Select the cells in which you want to display the formula results.
2. In the formula bar, enter the array formula.
3. Press **Ctrl+Shift+Enter**.

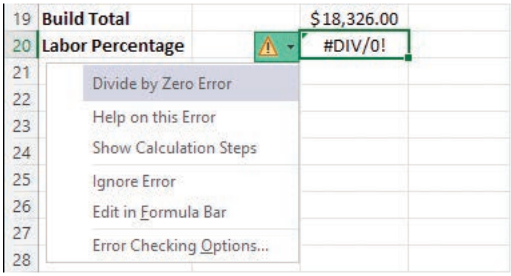
To edit an array formula

1. Select every cell that contains the array formula.
2. In the formula bar, edit the array formula.
3. Press **Ctrl+Shift+Enter** to re-enter the formula as an array formula.

Find and correct errors in calculations

Including calculations in a worksheet gives you valuable answers to questions about your data. As is always true, however, it's possible for errors to creep into your formulas. With Excel, you can find the source of errors in your formulas by identifying the cells used in a specific calculation and describing any errors that have occurred. The process of examining a worksheet for errors is referred to as *auditing*.

Excel identifies errors in several ways. The first way is to display an error code in the cell that contains the formula generating the error.


19 Build Total $18,326.00
20 Labor Percentage #DIV/0!
21
22
23
24
25
26
27
28
Divide by Zero Error
Help on this Error
Show Calculation Steps
Ignore Error
Edit in Formula Bar
Error Checking Options...

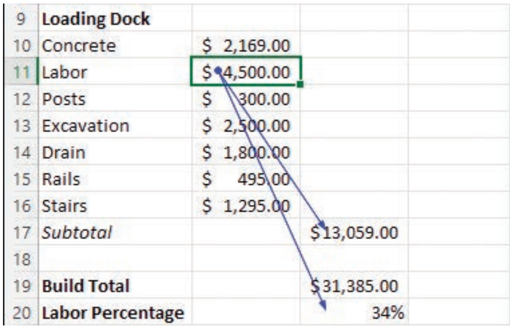
A warning triangle and pound sign indicate an error

When the active cell generates an error, Excel displays an Error button next to it. Pointing to the button displays information about the error, and selecting the button displays a menu of options for handling the error.

The following table explains the most common error codes.

Error code	Description
#####	The column isn't wide enough to display the value.
#VALUE!	The formula has the wrong type of argument, such as text in a cell where a numerical value is required.
#NAME?	The formula contains text that Excel doesn't recognize, such as an unknown named range.
#REF!	The formula refers to a cell that doesn't exist, which can happen whenever cells are deleted.
#DIV/0!	The formula attempts to divide by zero.

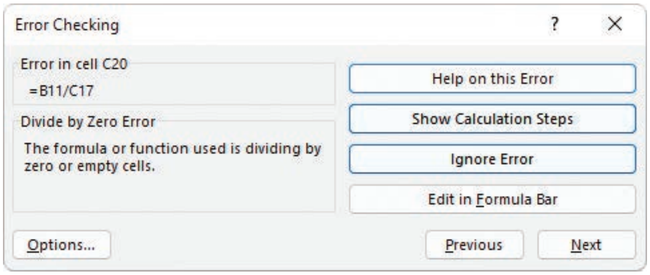
Another technique you can use to find the source of formula errors is to ensure that the appropriate cells are providing values for the formula. You can identify the source of an error by having Excel trace a cell's *precedents*, which are the cells with values used in the active cell's formula. You can also audit your worksheet by identifying cells with formulas that use a value from a particular cell. Cells that use another cell's value in their calculations are known as *dependents*, meaning that they depend on the value in the other cell to derive their own value. They are identified in Excel by tracer arrows. If the cells identified by the tracer arrows aren't the correct cells, you can hide the arrows and correct the formula.



9	**Loading Dock**		
10	Concrete	$ 2,169.00	
11	Labor	$ 4,500.00	
12	Posts	$ 300.00	
13	Excavation	$ 2,500.00	
14	Drain	$ 1,800.00	
15	Rails	$ 495.00	
16	Stairs	$ 1,295.00	
17	*Subtotal*		$ 13,059.00
18			
19	**Build Total**		$ 31,385.00
20	**Labor Percentage**		34%

Tracing a cell's dependents

If you prefer to have the elements of a formula error presented as text in a dialog, you can use the Error Checking tool to locate errors one after the other. You can choose to ignore the selected error or move to the next or the previous error.



Error Checking

Error in cell C20

=B11/C17

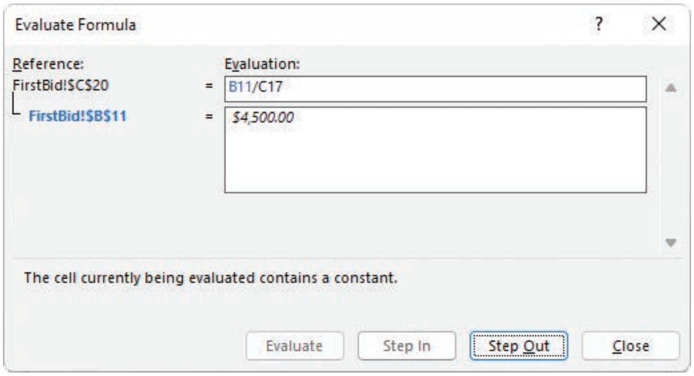
Divide by Zero Error

The formula or function used is dividing by zero or empty cells.

Identify and manage errors from the Error Checking window

TIP You can have the Error Checking tool ignore formulas that don't use every cell in a region (such as a row or column). To do so, on the Formulas tab of the Excel Options dialog, clear the Formulas Which Omit Cells In A Region checkbox. Excel will no longer mark these cells as an error.

When you just want to display the results of each step of a formula and don't need the full power of the Error Checking tool, you can use the Evaluate Formula dialog to move through each element of the formula. The Evaluate Formula dialog is particularly useful for examining formulas that don't produce an error but aren't generating the result you expect.



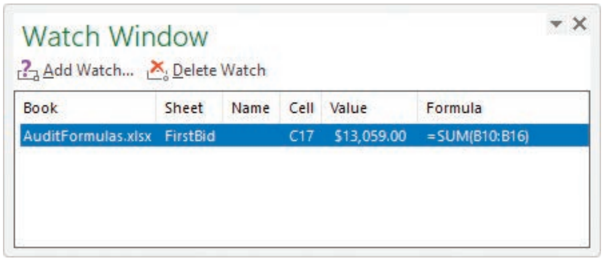
FirstBid!$C$20 = B11/C17

FirstBid!$B$11 = $4,500.00

The cell currently being evaluated contains a constant.

Step through formulas in the Evaluate Formula window

Finally, you can monitor the value in a cell regardless of where you are in your workbook by opening a Watch Window that displays the value in the cell. For example, if one of your formulas uses values from cells in other worksheets or even other workbooks, you can set a watch on the cell that contains the formula, and then change the values in the other cells. As you change the precedent values, the formula result changes in the Watch Window. When you're done watching the formula, you can delete the watch and close the Watch Window.



Book	Sheet	Name	Cell	Value	Formula
AuditFormulas.xlsx	FirstBid		C17	$13,059.00	=SUM(B10:B16)

Monitor formula results in the Watch Window

To display information about a formula error

1. Select the cell that contains the error.
2. Point to the error indicator next to the cell to display information about the error.
3. Select the error indicator to display options for correcting or learning more about the error.

To identify the cells that a formula references

1. Select the cell that contains the formula.
2. On the **Formulas** tab, in the **Formula Auditing** group, select **Trace Precedents**.

To identify formulas that reference a specific cell

1. Select the cell.
2. In the **Formula Auditing** group, select **Trace Dependents**.

To remove tracer arrows

- In the **Formula Auditing** group, do one of the following:
    - To remove all the arrows, select the **Remove Arrows** button (not its arrow).
    - To remove only precedent or dependent arrows, select the **Remove Arrows** arrow, and then select **Remove Precedent Arrows** or **Remove Dependent Arrows**.

To evaluate a formula one calculation at a time

1. Select the cell that contains the formula you want to evaluate.
2. In the **Formula Auditing** group, select **Evaluate Formula**.
3. In the **Evaluate Formula** dialog, select **Evaluate**. Excel replaces the underlined calculation with its result.
4. Do either of the following:
    - Select **Step In** to move forward by one calculation.
    - Select **Step Out** to move backward by one calculation.
5. When you finish, select **Close**.

To change error display options

1. Display the **Formulas** page of the **Excel Options** dialog.
2. In the **Error Checking** section, select or clear the **Enable background error checking** checkbox.
3. Select the **Indicate errors using this color** button and select a color.
4. Select **Reset Ignored Errors** to return Excel to its default error indicators.
5. In the **Error checking rules** section, select or clear the checkboxes next to errors you want to indicate or ignore, respectively.

To watch the values in a cell range

1. Select the cell range you want to watch.
2. In the **Formula Auditing** group, select the **Watch Window** button.
3. In the **Watch Window** dialog, select **Add Watch**.
4. In the **Add Watch** dialog, confirm the cell range, and then select **Add**.

To delete a watch

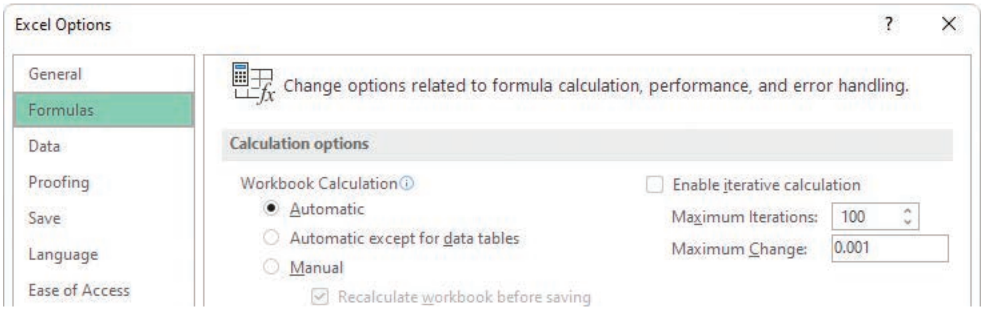
1. Select the **Watch Window** button.
2. In the **Watch Window** dialog, select the watch you want to delete.
3. Select **Delete Watch**.

Configure automatic and iterative calculation options

Excel formulas use values in other cells to calculate their results. If you create a formula that refers to the cell that contains the formula, the result is a circular reference.

Under most circumstances, Excel treats a circular reference as a mistake for two reasons. First, most Excel formulas don’t refer to their own cell, so a circular reference is unusual enough to be identified as an error. The second, more serious consideration is that a formula with a circular reference can slow down your workbook. Because Excel repeats, or iterates, the calculation, you must set limits on how many times the app repeats the operation.

You can control how often Excel recalculates formulas. Three calculation options are available from the Formulas tab and from the Formulas page of the Excel Options dialog.



Change options related to formula calculation, performance, and error handling.

Calculation options

Workbook Calculation
● Automatic
○ Automatic except for data tables
○ Manual
☑ Recalculate workbook before saving

☐ Enable iterative calculation
Maximum Iterations: 100
Maximum Change: 0.001

You can modify the iterative calculation options Excel uses

The calculation options work as follows:

- **Automatic** recalculates a worksheet whenever a value that affects a formula changes. This is the default setting.
- **Automatic Except for Data Tables** recalculates a worksheet whenever a value changes but doesn't recalculate data tables.
- **Manual** recalculates formulas only when you tell Excel to do so.

You can also use options in the Calculation Options section to allow or disallow iterative calculations (repeating calculations of formulas that contain circular references). The default values (a maximum of 100 iterations and a maximum change per iteration of 0.001) are appropriate for all but the most unusual circumstances.

To manually recalculate the active workbook

- On the **Formulas** tab, in the **Calculation** group, select **Calculate Now**.
- Press **F9**.

To manually recalculate the active worksheet

- In the **Calculation** group, select the **Calculate Sheet** button.

To set worksheet calculation options

- Display the worksheet whose calculation options you want to set.
- On the **Formulas** tab, in the **Calculation** group, select **Calculation Options**, and then select **Automatic**, **Automatic Except for Data Tables**, or **Manual**.

To enable iterative calculations

1. Open the **Excel Options** dialog and display the **Formulas** page.
2. In the **Calculation options** section, select the **Enable iterative calculation** checkbox.
3. In the **Maximum Iterations** box, enter the maximum iterations allowed for a calculation.
4. In the **Maximum Change** box, enter the maximum change allowed for each iteration.
5. Select **OK**.

Skills review

In this chapter, you learned how to:

- Name data ranges
- Create formulas to calculate values
- Summarize data that meets specific conditions
- Copy and move formulas
- Create array formulas
- Find and correct errors in calculations
- Configure automatic and iterative calculation options

Practice tasks

Before you can complete these tasks, you must copy the book's practice files to your computer. The practice files for these tasks are in the **Excel365SBS\Ch03** folder. You can save the results of the tasks in the same folder.

Name data ranges

Open the **NameRanges** workbook in Excel, and then perform the following tasks:

1. Create a named range named **Monday** for the V_101 through V_109 values (found in cells **C4:C12**) for that weekday.
2. Edit the **Monday** named range to include the V_110 value for that column.
3. Select cells **B4:H13** and create a batch of named ranges for V_101 through V_110, using the row headings as the range names.
4. Delete the **Monday** named range.

Create formulas to calculate values

Open the **BuildFormulas** workbook in Excel, and then perform the following tasks:

1. On the **Summary** worksheet, in cell **F9**, create a formula that displays the value from cell **C4**.
2. Edit the formula in cell **F9** so it uses the SUM function to find the total of values in cells **C3:C8**.
3. In cell **F10**, create a formula that finds the total expenses for desktop software and server software.
4. Edit the formula in **F10** so the cell references are absolute references.
5. On the **JuneLabor** worksheet, in cell **F13**, create a SUM formula that finds the total of values in the **JuneSummary** table's **Labor Expense** column.

Summarize data that meets specific conditions

Open the **CreateConditionalFormulas** workbook in Excel, and then perform the following tasks:

1. In cell **G3**, create an IF formula that tests whether the value in **F3** is greater than or equal to 35,000. If it is, display **Request discount**; if not, display **No discount available**.
2. Copy the formula from cell **G3** to the range **G4:G14**.
3. In cell **I3**, create a formula that finds the average cost of all expenses in cells **F3:F14** where the **Type** column contains the value *Box*.
4. In cell **I6**, create a formula that finds the sum of all expenses in cells **F3:F14** where the **Type** column contains the value *Envelope*, and the **Destination** column contains the value *International*.

Create array formulas

Open the **CreateArrayFormulas** workbook in Excel, and then perform the following tasks:

1. On the **Fuel** worksheet, in cells **C11:F11**, enter the array formula **=C3*C9:F9**.
2. Edit the array formula you just created to read **=C3*C10:F10**.
3. On the **Volume** worksheet, in cells **D4:D7**, create the array formula **=B4:B7*C4:C7**.

Find and correct errors in calculations

Open the **AuditFormulas** workbook in Excel, and then perform the following tasks:

1. Set a watch on the value in cell **C19**.
2. Display the precedents for the formula in cell **C7**.
3. Hide the tracer arrows.
4. Use the **Error Checking** dialog to identify the error in cell **C20**.
5. Show the tracer arrows for the error.
6. Hide the arrows, and then change the formula in cell **C20** to **=C12/D20**.

7. Use the **Evaluate Formula** dialog to step through the formula in cell **C20**.
8. Delete the watch you created in step 1.

Configure automatic and iterative calculation options

Open the **SetIterativeOptions** workbook in Excel, and then perform the following tasks:

1. On the **Formulas** tab, in the **Calculation** group, select the **Calculation Options** button, and then select **Manual**.
2. In cell **B6**, enter the formula **=B7*B9**, and then press **Enter**.
3. Note that this result is incorrect because the Gross Savings value minus the Savings Incentive value should equal the Net Savings value, which it does not.
4. Press **F9** to recalculate the workbook and read the message box indicating that you have created a circular reference.
5. Select **OK**.
6. Use options in the **Excel Options** dialog to enable iterative calculation.
7. Close the **Excel Options** dialog and recalculate the worksheet.
8. Change the workbook's calculation options back to **Automatic**.

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