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EXCEL FORMULAS & FUNCTIONS 2023

Essential Excel Formulas and Functions Master Guide for Beginners and Experts

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GOLDEN MCPHERSON

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TABLE OF CONTENTS

INTRODUCTION

What do Excel formulas mean?

An expression called FORMULAS IN EXCEL operates on values from a variety of cell addresses and operators. Consider the formula =A1+A2+A3, which calculates the sum of the values in cells A1 through A3. An illustration of a formula with discrete values might be =6*3.

=A2 * D2 / 2

"=" tells Excel that this is a formula, and it should evaluate it.

"A2" * D2" makes reference to cell addresses A2 and D2 then multiplies the values found in these cell addresses.

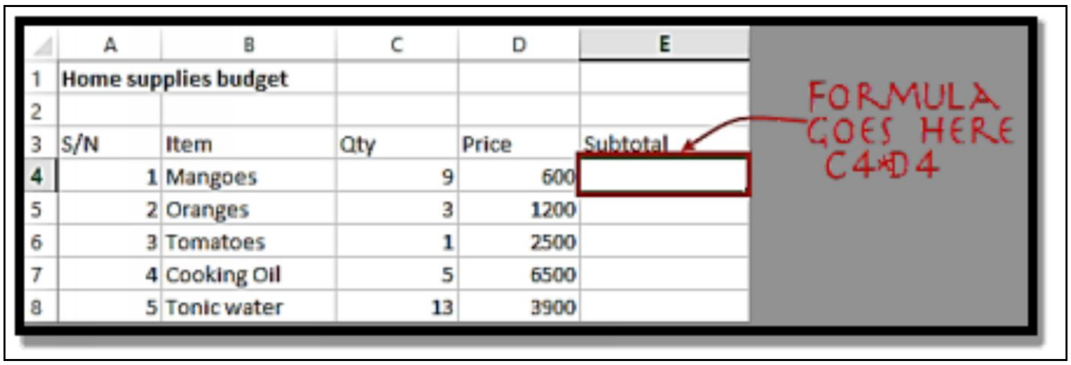
"/" is the division arithmetic operator

"2" is a discrete value

Exercise using formulas

To determine the subtotal, we will use the sample data from the household budget.

- Make a new Excel workbook.
- Enter the information from the budget for household goods above.
- The following should appear on your worksheet.



- The formula for determining the subtotal will now be written.
- Set cell E4 as the focus.

Enter the formula below.

=C4*D4

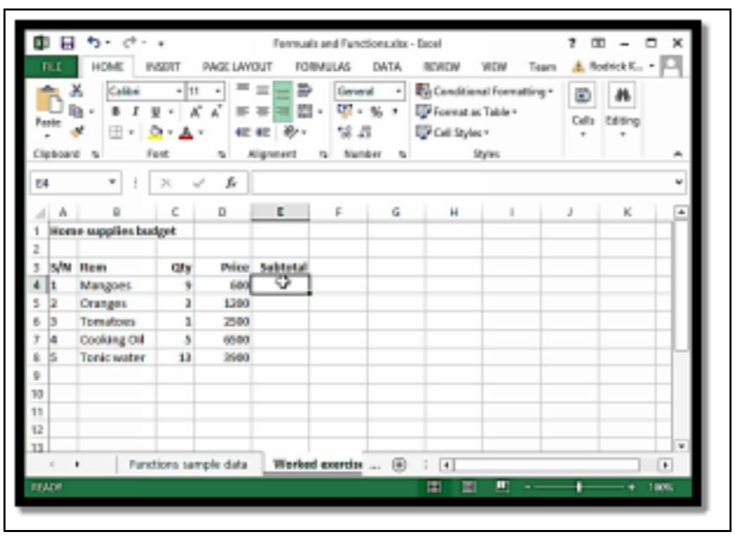
HERE,

The value of the cell addresses C4 and D4 are multiplied using the arithmetic operator multiplication (*) in the formula "C4*D4".

- Hit the Enter key.

The outcome will be as follows.

You can see how to automatically select a cell address and apply the same formula to additional rows in the animated image below.



When using Excel's formulae, watch out for these mistakes.

1.The Division, Multiplication, Addition, and Subtraction Brackets rules should be kept in mind (BODMAS). Since they are enclosed in brackets, expressions are now evaluated first. Division is evaluated first for arithmetic operators, followed by multiplication, addition, and finally subtraction. The formula above can be rewritten as =(A2 * D2) / 2 by applying this rule. By doing this, it will be made sure that D2 and A2 are split by 2 after evaluation.

2.Data validation allows you to specify the type of data that should be allowed by a cell, such as only numbers, as spreadsheet formulas in Excel typically work with numeric data. You can hit F2 on the keyboard to confirm that you are using the right cell references listed in the formulas. The cell addresses used in the calculation will be highlighted, and you may cross-check them to make sure they are the correct cell addresses.

3.When working with a large number of rows, you can assign serial numbers to each row and keep track of the total count at the bottom of the sheet. To make sure that your calculations took into account all the rows, compare the serial number count with the number of records.

What in Excel is a function?

Using specified values in a given order, the predefined formula FUNCTION IN EXCEL is applied. Using a function, you may quickly determine the sum, count, average, maximum value, and minimum value for a set of cells. The SUM function, for instance, calculates the sum of the values in the range A1:A2 in cell A3 below.

SUM for adding up a number range

Use AVERAGE to determine the average of a specified range of integers.

Count to determine how many objects fall within a certain range.

How important functions are

When using Excel, functions boost user productivity. Let's imagine you want to know the overall cost of the home supply budget mentioned above. You can calculate the sum using a formula to make it easier. You would have to make each reference to the cells E4 through E8 individually in a formula. You would need to apply the subsequent formula.

= E4 + E5 + E6 + E7 + E8

With a function, you would write the above formula as

=SUM (E4:E8)

As you can see from the function used above to calculate the sum of a set of cells, employing a function to calculate the sum is far more effective than using a formula, which would require referencing a lot of cells.

The most significant Excel formulas and functions are shown here.

SUM function = =SUM(E4:E8)

MIN function = =MIN(E4:E8)

MAX function = =MAX(E4:E8)

AVERAGE function = =AVERAGE(E4:E8)

COUNT function = =COUNT(E4:E8)

DAYS function = =DAYS(D4,C4)

VLOOKUP function = =VLOOKUP (C12, A4:B8, 2, FALSE)

DATE function = =DATE(2020,2,4)

CHAPTER 1

FORMULAS AND FUNCTIONS

The formulae in spreadsheet programs are what make them so helpful. Without formulas, a spreadsheet would just be a highly developed Word document with outstanding tabular data management.

In Excel spreadsheets, formulas are used to compute outcomes from data in the worksheet. When the data is modified, the equations automatically update the outcomes, saving you time. In this section, formulas and functions are laid out for you to become acquainted with.

The Basic Elements of Formulas

A cell can contain a formula, which is a small piece of code. It performs a calculation of some kind and outputs the outcome in the cell. Formulas can interact with data and text using a wide range of operators and worksheet functions. Spreadsheets can be dynamic since other cells may contain formula values and text, making data modifications simple. For instance, by modifying the data on a spreadsheet and allowing your equations do the job, you can quickly explore a variety of choices.

A formula containing an equal sign can contain any of the components listed below:

• Addition and subtraction operations in mathematics, such as + and * (for multiplication)

• Cell references (such as named cells and ranges)

• Words or values

• Worksheet attributes (like SUM and AVERAGE)

When you enter a formula, the result is displayed in the cell. However, the formula appears in the Formula bar when you choose the cell.

It's important to note that every formula begins with the equal sign (=). The first equal sign allows Excel to distinguish between a formula and plain text.

=150*.05	Multiplies 150 times 0.05. This formula uses only values, and it always returns the same result. You could just enter the value 7.5 into the cell, but using a formula provides information on how the value was calculated.
=A3	Displays the value in cell A3. No calculation is performed on A3.
=A1+A2	Adds the values in cells A1 and A2.
=Income-Expenses	Subtracts the value in the cell named Expenses from the value in the cell named Income.

=SUM(A1:A12)	Adds the values in the range A1:A12, using the SUM function.
=A1=C12	Compares cell A1 with cell C12. If the cells are the same, the formula returns TRUE ; otherwise, it returns FALSE .

formulae that use operators

Excel formulas can handle a variety of operators. Operators are symbols that instruct a formula as to what logical or mathematical operation to perform. Additionally, Excel has a large number of built-in functions that let you perform additional calculations.

As many operators as you require could be used to finish the calculation.

Here are some formulas that make use of various operators:

Operator	Name
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponentiation
&	Concatenation
=	Logical comparison (equal to)
>	Logical comparison (greater than)
<	Logical comparison (less than)
>=	Logical comparison (greater than or equal to)
<=	Logical comparison (less than or equal to)
<>	Logical comparison (not equal to)

Examining the relationship between the operators in formulas

When computing the value of a formula, Excel uses a set of rules to determine how the various formula components are computed. You must comprehend these ideas to guarantee the accuracy of the results produced by your formulas.

Exponentiation has the highest priority in this table and is completed first, whereas logical comparisons have the lowest priority (performed last).

The Excel default precedence order can be changed by using parentheses. When surrounded by parentheses, expressions are always evaluated first. For instance, the following formula employs parenthesis to regulate how the computations are performed in order.

In this case, cell B3 is subtracted from cell B2 and the result is multiplied by cell B4: =(B2-B3) *B4.

The result varies if you enter the calculation in Excel without the parenthesis. Cell B3 is multiplied by cell B4 since multiplication happens first. This unexpected result is then deducted from Cell B2, which was not the desired consequence.

The formula is as follows when the parenthesis is removed:

=B2-B3*B4

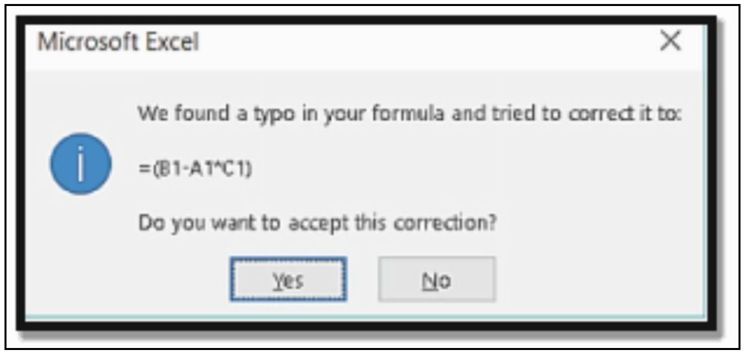
Though technically not necessary, using parentheses is nonetheless a good habit to get into. This makes it clearer what the formula is meant to do. For instance, the formula below makes it apparent that cell B3 should be multiplied by cell B4 and the result should be subtracted from cell B2. If you didn't utilize the parentheses, you'd have to know Excel's order of precedence.

=B2-(B3*B4)

Additionally, parentheses may be nested within formulas, that is, placed inside of other parenthesis. If you do this, Excel starts with the expressions that are the deepest nested and works its way out.

Here's an example of nested parentheses in a formula:

=((B2*C2) +(B3*C3) +(B4*C4)) *B6



This formula contains four sets of brackets, three of which are nested inside the fourth. Excel evaluates each stacked pair of parentheses before combining the three results. The outcome is then multiplied by the value in cell B6.

Even though there are four sets of parenthesis in the formula above, only the outer set is necessary. It should be clear that you can rewrite this formula as follows if you understand operator precedence:

B6 = (B2*C2 + B3*C3 + B4*C4)

Most people would agree that the computation is significantly clearer with the added parenthesis.

It's important to note that operators with the same amount of precedence, like division and multiplication, are evaluated in the same order.

Of course, there must be a right parenthesis for every left parenthesis. When there are several layers, it could be difficult to keep track of nested parentheses. If the parenthesis do not line up, Excel displays an error message and won't let you enter the computation.

In some cases, Excel will also advise a change to your computation if your parenthesis are not aligned correctly.

Symbol	Operator	Precedence
^	Exponentiation	1
*	Multiplication	2
/	Division	2
+	Addition	3
-	Subtraction	3
&	Concatenation	4
=	Equal to	5
<	Less than	5

Formulas that use functions

A large number of equations make use of worksheet functions. By using these functions, you can greatly strengthen your formulas and carry out computations that would be challenging (or possibly impossible) to perform if you only employed the operators previously discussed. For instance, the TAN function can be used to determine the tangent of an angle. Mathematical operators alone are unable to complete this challenging computation.

Examples of function-based formulas

A formula is substantially streamlined by a spreadsheet function. Here is one example. Without using a function, you would need to write a formula like this to calculate the average of the values in the ten cells (A1:A10):

=(A1+A2+A3+A4+A5+A6+A7+A8+A9+A10)/10

It's a little unappealing, isn't it? Even worse, you would need to modify this formula if you added a new cell to the range. Fortunately, you can use Excel's built-in worksheet function AVERAGE to replace this calculation.

=AVERAGE(A1:A10)

The formula that follows demonstrates how to use a function to perform calculations that would be otherwise impossible. Consider the situation where you must determine the highest integer in a range. A formula cannot provide you with the answer without the assistance of a function. This formula uses the MAX function to return the highest value from the range A1:D100:

=MAX (A1:D100) (A1:D100)

Additionally, functions assist in obviating the requirement for manual editing. In cells A1 to A1000 of a spreadsheet, there are 1,000 names that are all written in capital letters. Your boss looks over the list and informs you that the recipients' names will be merged into a form letter and distributed. It is now necessary to write JOHN F. SMITH as John F. Smith instead of using all capital letters as before. You could either re-enter the list for the next few hours (ugh),

Alternatively, you might use a formula similar to the one below, which uses the Correct function to convert the text in cell A1 to the appropriate case:

=PROPER(A1)

The first cell B1 should contain this formula, which should then be copied down to the next 999 rows. Select the range B1:B1000, then choose Home > Clipboard > Copy to copy it. In order to convert the formulas to values while keeping B1:B1000 selected, click Home > Clipboard > Paste Values (V). By eliminating the original column, you have just finished several hours of work in under a minute.

Note: The Excel Flash Fill tool can also be used to do this kind of change without the use of formulas.

You should be convinced of the use of functions by one more example. Take into account a spreadsheet that determines sales commissions.

If the salesperson sold $100,000 or more in goods, the commission rate is 7.5 percent; otherwise, it is 5.0 percent. If you didn't use a function, you would have to create two new formulas and make sure you used the correct formula for each sales amount. The IF function can be used to create a formula that ensures the correct commission is calculated regardless of the volume of sales:

If (A1100000, A1*5%, and A1*7.5) is true, then

Using this formula, simple decisions can be made. The formula looks up the sales amount in Cell A1, which is checked. If the amount is less than 100,000, the algorithm returns the value in cell A1 multiplied by 5%.

If not, it returns the data from cell A1 multiplied by 7.5%. In this example, there are three parameters that are separated by commas. This is covered in the "Function Parameters" section that follows.

Function arguments

You may have noticed that all of the functions in the earlier examples utilized parentheses. The list of parameters is contained inside the parenthesis.

The way functions utilize parameters varies. A function may use one of the following methods, depending on the task at hand:

- No arguments at all
- There is a limit to the number of arguments that may be used.
- A single argument
- There are an undetermined number of arguments
- Arguments with choices

The **NOW function**, which returns the current date and time, is an example of a function that doesn't take an argument.

Even if a function doesn't take an argument, you must give a set of empty parentheses, as seen below:

=NOW ()

If a function has more than one parameter, use a comma to separate them. Cell references were used as arguments in the examples at the start of the chapter. However, when it comes to function parameters, Excel is fairly accommodating. A cell reference, literal values, literal text strings, expressions, and even other functions may all be used as arguments.

Here are a few functions that utilize different sorts of arguments:

- =SUM is a cell reference (A1:A24)
- =SQRT is the literal value (121)

- =PROPER ("john f. smith") is a literal text string.
- Formula: =SQRT (183+12)
- Other functions: =SQRT (SUM (A1:A24)); =SQRT (SUM (A1:A24)); =SQRT (SUM (A1:

For the US version of Excel, the list separator character is a comma. A semicolon may be used in certain other language variants. The list separator is a Windows preference that may be changed in the Control Panel.

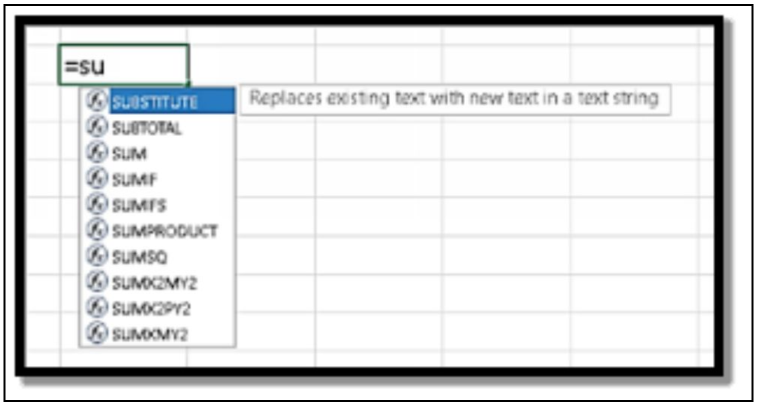
More information about functions

Over 450 built-in functions are available in all in Excel. In addition, if you desire, you can create your own unique functions (using VBA) or get additional specialized functions from independent suppliers if that isn't enough.

You'll probably only use a dozen or so of the available features on a regular basis, despite the fact that some users may find the sheer quantity of options overwhelming. Moreover, even if you don't use functions frequently, finding and inserting them is simple thanks to the Excel Insert Function dialog box, which is discussed in more detail later in this chapter.

Enter Formulas for Your Worksheets

For Excel to recognize that a formula rather than text is present in the cell, every formula must start with an equal sign. Excel gives you the choice of manually inserting a formula into a cell or using cell references. Each tactic is fully explained in the sections that follow.



Excel provides you with a drop-down list of function names and range names while you are constructing formulas. Which items are on the list depend on what you've already written. If you type the letters SU while inputting a formula, the drop-down list will appear.

The list gets narrowed down to the functions that match if you send another letter. Select an item in the list using the arrow keys, then click Tab to have Excel autocomplete it. A brief description of the function appears when you select a function from the list.

Formula AutoComplete Use

Thanks to the Formula AutoComplete feature, entering formulas has never been easier. Enter your formula as you normally would, and Excel will guide you by presenting a list of possible options and parameters. In this illustration, Excel is displaying the SUBTOTAL function options.

Formula AutoComplete includes the following items (and each category is denoted by an icon):

• The features that come with Excel.

• Modular functionality (functions explained by the person via VBA or other methods).

• Defined names, which are names that are allocated to cells or ranges using the Formulas > Defined Names > Define Name command.

• In enumerated arguments, values are utilized to indicate options. Only a few functions, like SUBTOTAL, demand such parameters.

• Table structures are mentioned (used to identify portions of a table).

Manual entry of formulas

It is necessary to manually enter a formula while doing so. You enter the formula in a particular cell after the equal symbol (=). As you type, the characters show up in both the formula bar and the cell. Naturally, all of the regular editing keys are available when entering a formula.

Formulae entered by pointing

Even if you can type the entire formula into Excel, there is another method that is often easier, quicker, and less prone to errors. However, you can just direct to the cell references rather than manually entering the values, even if this method still requires some manual input.

For instance, use the following steps to enter the formula =A1+A2 into cell A3:

1. Select cell A3.

2. Use the equal sign (=) to start the formula. You may see Enter in the status bar of Excel.

3. Press the up arrow twice. When you press this key, Excel displays a dashed border around cell A1, and cell reference appears in cell A3 and the Formula bar. Additionally, Excel's status bar displays Point.

4. Finish your phrase with a plus sign (+). Enter is back in the status bar, and A1's dashed border has been changed to a solid color border.

5. Press the up arrow a last time. The dashed border surrounds Cell A2, adding that cell address to the formula.

6. Press Enter to complete the formula.

As you type the formula by pointing, you can also use your mouse to point at the data cells.

Pasted formulas with range names

You have two choices if your formula requires named cells or ranges: enter the name rather than the address, or choose a name from a list, and Excel will insert it for you.

There are three approaches to formula naming:

The drop-down menu allows for the selection of a name.

You must at least be familiar with the initial letter of the name in order to employ this technique. When entering the formula, type the first character and then choose the name from the drop-down option.

• Depress F3 to start. A dialog box for pasting names displays.

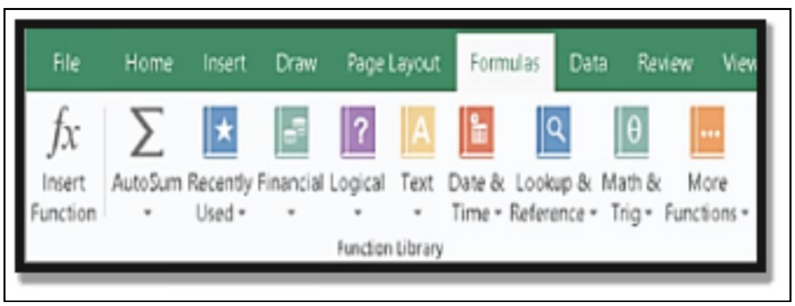
Click OK after selecting a name from the list (or just double-click the name). Excel automatically includes the name in your formula.

F3 has no impact if no names are given.

• On the Formulas tab, choose Use in Formula from the drop-down menu (Defined Names group). When in edit mode, you can use this command to select a probable range name from a list.

Adding functions to formulas

Formula The simplest way to add a function to a formula is via AutoComplete. Another choice is to introduce a function using the tools in the Function Library group on the Formulas tab of the Ribbon.



Another choice for adding a function to a calculation is the Insert Function dialog box.

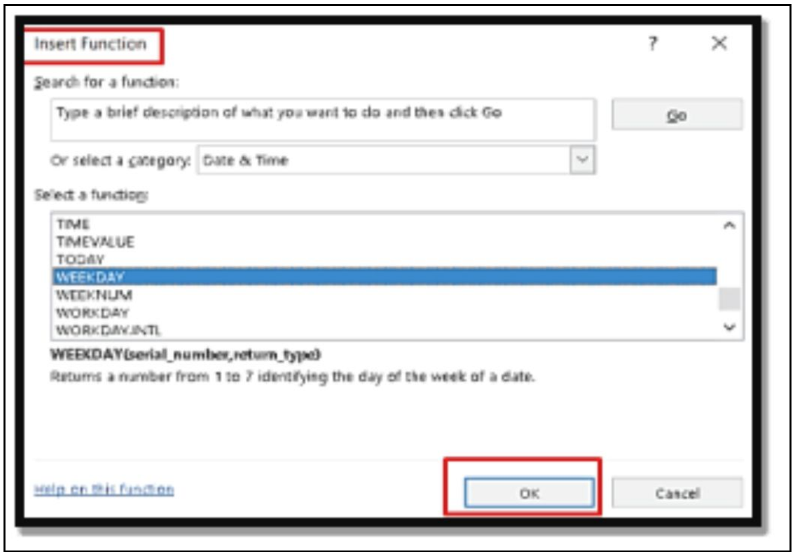
There are several ways to access this dialog box:

• From the Formulas menu, choose Insert Function > Formulas > Function Library.

• Use the Insert Function command, which can be found at the bottom of each drop-down list in the Formulas > Function Library group.

• Toggle the Formula bar to the left, then select the Insert Function button. When you press this button, fx is shown.

Shift and F3 should both be pressed simultaneously.



Use the Search for a Function area at the top of the dialog box to hunt for the function you require if you are unsure of the one you require.

1. Enter your search terms and press Enter. A list of helpful functions will be provided to you. When you select a function from the Select a Function list, Excel displays the function (and the names of its parameters) in the dialog box along with a brief description of what the function does.

2. After finding the function you wish to use, click OK after selecting it.

3. Specify the parameters for the function. The Function Parameters dialog box has a text field for each of the function's arguments, depending on the function you're creating. You have two options for entering the address: manually or by clicking inside the argument box and selecting a cell or range from the sheet as an argument.

4. After you've entered each function argument, click OK.

The Name field typically displays a number of the most recent functions you've used when you enter or modify a formula.

Function entry guidance

When utilizing the Insert Function dialog box to enter functions, keep the following in mind:

• To add a function to an existing formula, utilize the Insert Function dialog box. Simply alter the formula and move the insertion point to the desired location to insert the function. Open the Insert Function dialog box and select the function using one of the methods previously described.

• The arguments for a function in an existing formula can also be changed using the Function Parameters dialog box. After choosing the function in the Formula bar, click the Insert Function button.

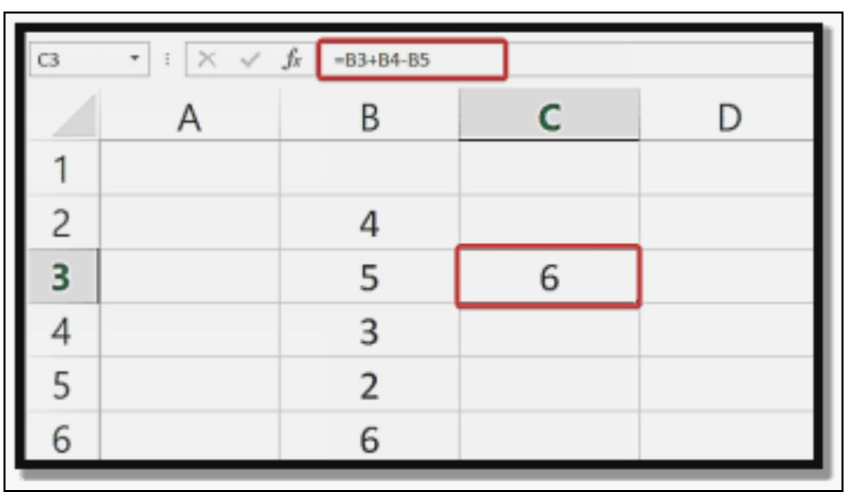
• If a variable number of parameters are required for the function.

For each optional argument you offer, Excel adds a new box. Optional arguments are not bolded, but required arguments are.

• Some functions have multiple iterations, such as INDEX. After selecting one of these options, Excel displays a new dialog box where you may choose the form you want to use.

Editing Formulas

You can alter a formula after you've entered it. If you implement adjustments to your worksheet and then need to update the formula to suit the changes, you may need to edit a formula. Alternatively,, the formula might return an incorrect value, in which case you'll need to change it to fix the problem.



When you input or amend a formula in Excel, you'll see that the range addresses and ranges are color-coded.

NB: This makes it easier to identify the cells that are utilized in a formula.

Here are a few options for entering cell edit mode:

- Double-click the cell to alter the contents of the cell directly in the cell.
- **Press F2** to alter the contents of the cell immediately inside the cell.
- Click on the **Formula bar** after selecting the cell you wish to alter. This allows you to change the contents of the cells in the Formula bar.
- Excel will show a little triangle in the upper-left corner of the cell if the cell includes a formula that returns an error. When you activate the cell, an error signal appears. You may repair the problem by clicking the error indication and selecting one of the choices.

In the Formulas section of the **Excel Options dialog box**, you can choose whether or not to show these formula error indications. Choose **File > Options** to bring up this dialog box. Excel no longer shows these problem flags if you uncheck the **Enable Background Error Checking box**.

Note: You can select several characters when altering a formula by dragging the mouse pointer over them or hitting Shift while using the navigation keys.

If you have a formula that you can't seem to get right, you may convert it to text and come back to it later. Simply delete the first equal sign (=) to convert a formula to text. To convert the contents of the cell back to a formula, enter the original equal sign when you're ready to attempt again.

Using Cell References in Formulas

The majority of formulae you write include references to cells or ranges. These references allow your calculations to interact with the data in specific cells or ranges in real-time. If your formula refers to cell A1 and the value in A1 is changed, the formula result will alter to reflect the new value.

If you didn't utilize references in your formulae, you'd have to update the values in the formulas themselves if you wanted to change them.

Referencing with mixed, relative, and absolute terms

In a formula, you can refer to a cell (or range) using one of three types of references:

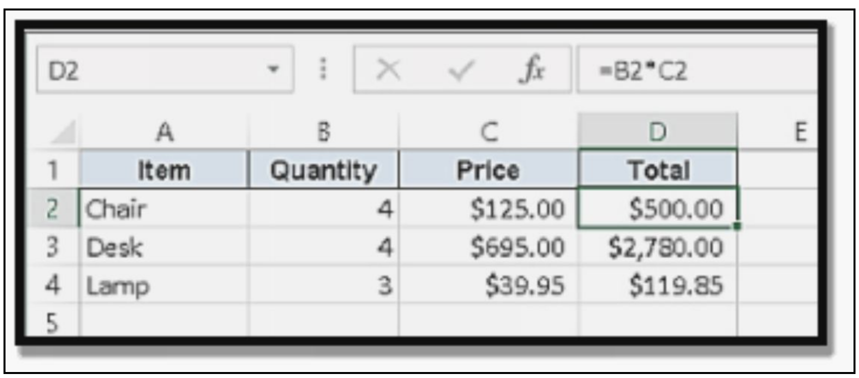
• Relative: Since the references are offsets from the current row and column, the row and column references may change if you copy the formula to a different cell. In equations, Excel automatically generates relative cell references.

Row and column references remain the same when you duplicate the formula since the reference is absolute and points to a genuine cell location. The address of an absolute reference includes two-dollar signs: one for the column letter and the other for the row number (for instance, $A$5 in the example above).

• Mixed: One reference is relative and one is absolute to the row or column.

There is only one absolute address component (like $A4 or A$4).

The type of cell reference is only necessary if you want to copy the formula into more cells. The examples that follow show how this works.

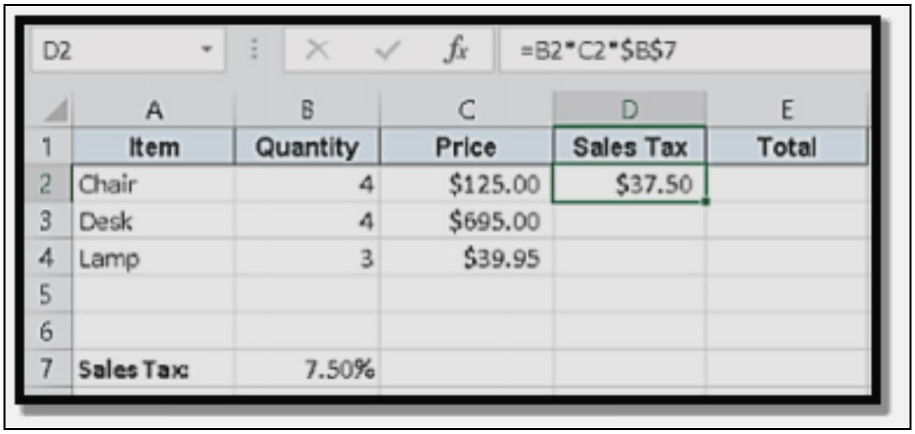


	A	B	C	D	E
1	Item	Quantity	Price	Total	
2	Chair	4	$125.00	$500.00	
3	Desk	4	$695.00	$2,780.00	
4	Lamp	3	$39.95	$119.85	
5					

Relative cell references are used in this calculation. As a result, the references adapt in a relative way when the formula is copied to the cells below it. For instance, in cell D3, the formula is:

=B3*C3

But what if, like this, the cell references in D2 were absolute references?



=$B$2*$C$2

Copying the formula to the cells below would generate inaccurate results in this scenario. Cell D3's formula would be the same as cell D2's formula.

We'll now update the example to include the calculation of sales tax, which will be recorded in cell B7. The formula in cell D2 in this case is:

=(B2*C2) *$B$7

After multiplying the amount by the price, the result is multiplied by the sales tax rate contained in cell B7. It's worth noting that the reference to B7 is an absolute one. Cell D3 will have the following formula when the formula in D2 is transferred to the cells below it:

=(B3*C3) *$B$7

The references to cells B2 and C2 were changed, but not the reference to cell B7, which is precisely what you want since the address of the sales tax cell never changes.

The C3:F7 set of formulae calculates the area of different lengths and widths. The formula for cell C3 is as follows:

=$B3*C$2

Both cell references are intermingled. The column ($B) is referenced by an absolute reference in cell B3, while the row ($2) is referenced by an absolute reference in cell C2. As a consequence,, this formula may be duplicated down and across with no errors in the computations. For instance, in cell F7, the formula is

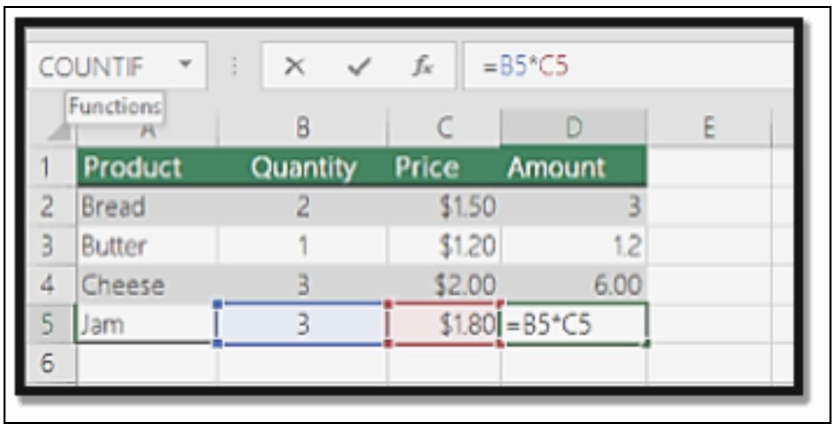
=$B7*F$2

Copying the formula would generate inaccurate results whether C3 employed absolute or relative references.

The cell references in a formula aren't altered when you cut and paste it (transfer it to another spot). This is, in most cases, what you want to happen. When you relocate a formula, you usually want it to keep referring to the same cells as before.

Altering the references you use

You can manually input non-relative references by manually inserting dollar signs in the appropriate places of the cell address (absolute or mixed). The F4 key can also be used as a shortcut. After you've entered a cell reference (by typing it in or pointing to it), you can continually press F4 to have Excel cycle through all four reference kinds.



For instance, pressing F4 changes the cell reference in a formula that begins with =A1 to =AA1. F4 again transforms it into =A$1. When you press it once more, =$A1 appears. It returns to the initial =A1 after the third press. Press F4 again until Excel displays the reference type you desire.

Excel uses an absolute reference (by default) when referring to the name of a column or range. For instance, the Refers To box in the New Name dialog box displays the reference as $B$1: $B$12 when you give B1:B12 the name Sales Forecast. This is typically what you want. The duplicated formula has a reference when you copy a cell whose formula contains a named reference.

Using cells outside the worksheet as references

The worksheets that the formula refers to need not be in the same workbook. It also refers to cells in other worksheets. Excel has a distinct syntax for dealing with these kinds of references.

Referencing cells from different workbooks

Use the format shown below to refer to a cell on another worksheet inside the same workbook:

Name of Sheet = Cell Number

Or, to put it another way, the cell address should come before the exclamation point and come after the worksheet name. Here is an example of a cell-based formula from the Sheet2 worksheet:

=A1*Sheet2! A1

Multiplying the value in cell A1 of Sheet2 by the value in cell A1 of the current worksheet produces the answer.

NB: You must enclose the worksheet name in single quote marks if it has one or more spaces in it.

If you generate the computation using the point-and-click method, Excel might perhaps do it for you.) Consider the following formula, which refers to a cell on a sheet labeled "All Depts" as an example: "All Depts" equals A1

Referencing cells in other workbooks

Use this format to refer to a cell in a separate workbook:

=[WorkbookName]SheetName!

Cell Address

An example of a formula using a cell reference is shown below and is found in the Sheet1 worksheet of the Budget workbook:

Budget. xlsx sheet one!

You must surround the workbook name in single quotation marks if it contains one or more spaces in the reference (together with the sheet name and square brackets). For illustration, the following formula refers to a cell on Sheet 1 of the workbook titled Budget for 2019:

2019 Budget =A1*' .xlsx] A1 Sheet 1

When a calculation makes reference to cells in another worksheet, the second workbook does not need to be open. In order for Excel to find the workbook if it is closed, you must specify the entire path in the reference. Here is an example:

My Documents =A1*'A1*'A1*'A1*'A

[Budget for the 2019 Calendar Year]

xlsx] Sheet1'!A1

There's a chance that a connected file could be on a different machine on your company's network. Excel automatically inserts absolute cell references when you build a calculation and reference a different worksheet or file. Make sure to change the cell references to a relative one before copying if you wish to duplicate the formula to multiple cells.

Making Use of Formulas in Tables

A table is a collection of cells with well-defined column titles. How formulas and tables work together is described in this section.

Data in a table being compiled

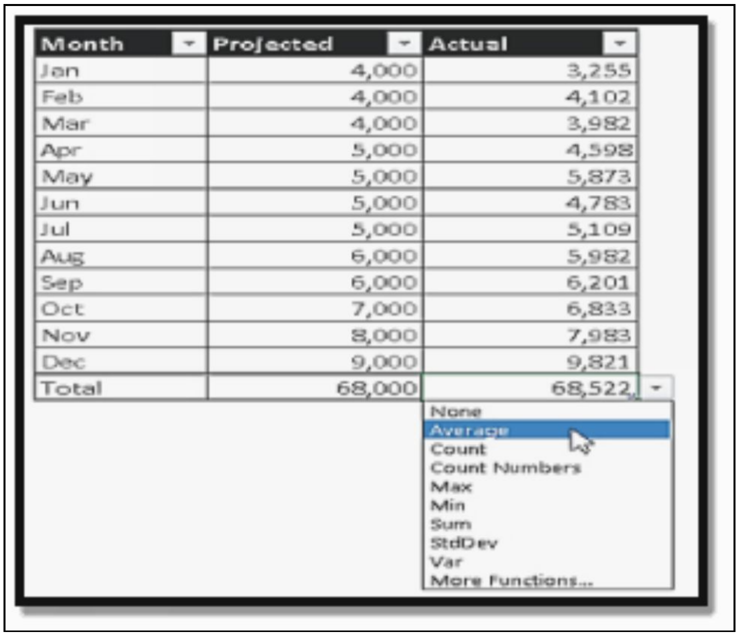
After entering the data, we created a table by using Insert > Tables > Table. Despite the fact that we didn't give the table a name, it has the default name of Table1.

Month	Projected	Actual
Jan	4,000	3,255
Feb	4,000	4,102
Mar	4,000	3,982
Apr	5,000	4,598
May	5,000	5,873
Jun	5,000	4,783
Jul	5,000	5,109
Aug	6,000	5,982
Sep	6,000	6,201
Oct	7,000	6,833
Nov	8,000	7,983
Dec	9,000	9,821

To add a row of summary formulae to the table, just click a button:

1. Select any cell in the table and activate it.
2. Select **Table Tools Design > Table Style Options > Total Row** and verify it. In Excel, a total row is added to the table, and the sum of each numeric column is shown.
3. To alter the kind of summary formula, select a cell in the total row and change the type of summary formula from the drop-down box.

NB*:* Table Tools Design > Table Style Options > Total Row allows you to adjust the total row display. When you switch it back on after turning it off, the summary choices you chose will be presented again.



Month	Projected	Actual
Jan	4,000	3,255
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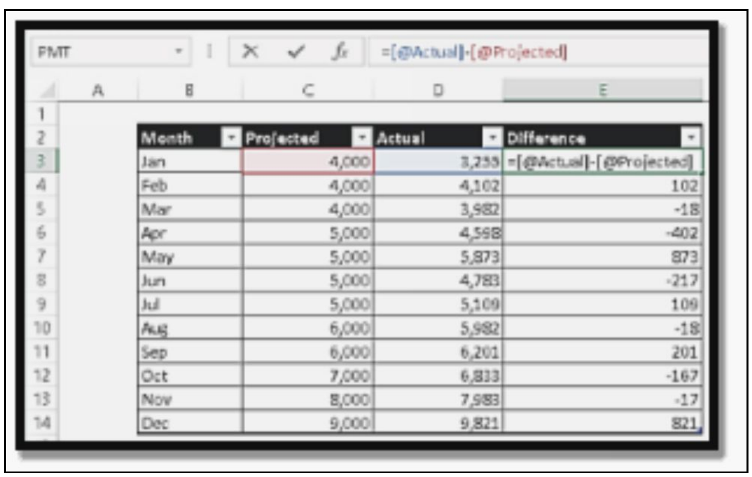
Mar	4,000	3,982
Apr	5,000	4,598
May	5,000	5,873
Jun	5,000	4,783
Jul	5,000	5,109
Aug	6,000	5,982
Sep	6,000	6,201
Oct	7,000	6,833
Nov	8,000	7,983
Dec	9,000	9,821
Total	68,000	68,522

Using formulas within a table

You will want to employ formulae inside a table to do calculations that involve other columns in the database in many circumstances.



Month	Projected	Actual	Difference
Jan	4,000	3,255	=[@Actual]-[@Projected]
Feb	4,000	4,102	102
Mar	4,000	3,982	-18
Apr	5,000	4,598	-402
May	5,000	5,873	873
Jun	5,000	4,783	-217
Jul	5,000	5,109	109
Aug	6,000	5,982	-18
Sep	6,000	6,201	201
Oct	7,000	6,833	-167
Nov	8,000	7,983	-17
Dec	9,000	9,821	821

To add this formula, take these actions:

1. Open cell E2 and enter Difference as the column header. As soon as you press Enter, Excel expands the table to include the new column.

2. To begin a formula, enter an equal sign in cell E3 by itself.

3. Depress the left arrow key. Excel displays [@Actual], the column heading, in the Formula bar.

4. After inputting a minus sign, press the left arrow key twice. Excel displays [@Projected] in your calculation.

5. Hit Enter to finish the formula. Excel applies the method to every row in the table.

The formula for all cells in the Difference column of the table is as follows:

=[@Actual]-[@Projected]

The formula was in the first row of the table, although it wasn't necessary. A formula automatically fills all of the cells in a column when it is entered into an empty table column. Excel will duplicate any formula modifications you make to the other cells in the column if you need to.

The at sign (@) that comes before the column heading denotes "this row." Therefore, [@Actual] denotes "the value in the Actual column of this row."

In these steps, the formula is constructed using the pointing approach. Instead of using column headings, you may have manually entered the calculation by using standard cell references.

For instance, you might have entered the following formula in cell E3: =D3-C3.

One thing to keep in mind about equations that use column headings instead of cell references is that they are much easier to understand.

Using a table's data as a reference

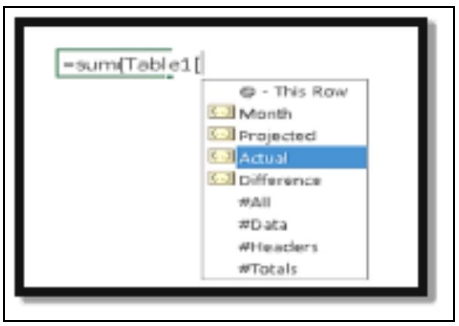
Two other ways to refer to the data in an Excel table are the table name and the column titles.

You don't have to give your tables or columns names, it's crucial to keep in mind. The column headers, which are not range names, can be used to refer to data inside the database. The data in the table has a range name that is automatically generated when the table (for example, Table1) is constructed.

You can refer to data in a table by using conventional cell references, but using the table name and column headings has a key advantage: the names adjust automatically when the table size changes as a result of the addition or deletion of rows. Additionally, if you change a table's name or a column's name, formulas that use those names will automatically adapt.

This table is called Table1. To calculate the total of all the values in the table, enter the following formula into a cell outside the table:

=SUM(AnnualData)



The majority of the time, a formula will relate to a particular table column.

The total of the data in the Actual column is returned using the formula below:

=SUM

Even better, when you build a formula that relates to data in a table, Excel offers some aid. Excel specifies various table components that you may reference in addition to the column headings in the table.

Correcting Common Formula Errors

Excel occasionally shows a value that starts with a hash (#) when you enter a formula. This indicates that an incorrect value was returned by the formula. You must modify the formula (or a cell that the formula refers to) to get rid of the error message (or a cell that the formula refers to).

The column is too tiny to display the value if a cell contains only hash-mark characters. Either make the column wider or alter the way the cell's numbers are formatted.

Error Value	Explanation
#DIV/0!	The formula is trying to divide by zero. Because Excel applies a value of 0 to empty cells, this error also occurs when the formula attempts to divide by a cell that is blank or has a value of 0.
#NAME?	The formula uses a name that Excel doesn't recognize. This can happen if you delete a name that's used in the formula, if you misspell a name and then hit Enter, or if you have unmatched quotes when using text.
#N/A	The formula is referring (directly or indirectly) to a cell that uses the NA function to signal that data is not available. For instance, the following formula returns an #N/A error if the A1 is empty: =IF(A1="", NA(), A1) Some lookup functions (for example, VLOOKUP and MATCH) can also return #N/A when they do not find a match.
#NULL!	The formula uses an intersection of two ranges that don't intersect. (This concept is described later in the chapter.)
#NUM!	A problem with a value exists; for example, you specified a negative number as an argument where a positive number

Excel won't allow you to insert an incorrect formula in certain instances.

The following formula, for example, is lacking the concluding parenthesis:

=A1*(B1+C2

If you try to input this formula, Excel warns you that your parenthesis is mismatched and suggests a solution. The recommended fix is usually right, but you can't rely on it.

If a cell to which a formula refers contains an erroneous value, the formula may return an error value. The ripple effect describes how a single erroneous value may spread to many more cells containing formulae that rely on that one cell.

Circular references management

When the circular reference notice appears after inputting a formula, Excel gives you two options:

- Choose OK to input the formula exactly as it is.
- To access a help screen with circular references, select Help.

No matter which option you select, Excel alerts you to the existence of a circular reference by displaying a message on the left side of the status bar.

A circular reference may be used on purpose in a few circumstances. In certain cases, the parameter Enable Iterative Calculation must be enabled. In order to avoid being warned about circular references, it is advised to turn off this option. An issue that has to be resolved is typically indicated by a circular reference.

indicating the time when formulas are calculated

You've probably seen that Excel immediately performs the formula calculations on your worksheet. Excel displays the updated formula result when you change any of the formula's input cells.

Obey these guidelines:

Excel performs calculations that are dependent on new or updated data immediately after you make a change, such as entering or editing data or formulae. If Excel is performing a lengthy calculation, it will temporarily pause it while you perform other worksheet tasks; it will resume calculating after you have finished your other worksheet tasks. Formulas are evaluated in a logical order.

In other words, Excel calculates cell D24 before cell D12 if the result of the calculation in cell D12 is reliant on the formula's result in cell D24.

However, you might like to have some control over how Excel performs formula calculations. For instance, if you create a spreadsheet with hundreds of complex calculations, you could notice that processing bogs down while Excel works its magic. In this case, change Excel's calculation mode to Manual by selecting Formulas > Calculation > Calculation Options > Manual.

If your worksheet includes any large data tables, use the Automatic Except for Data Tables option. Large data tables are notorious for being computationally expensive.

The table created by choosing Insert > Tables > Table is different from a data table.

Use the following shortcut keys to recalculate the formulae:

• F9: Calculates the formulas in all open spreadsheets.

Shift+F9 only calculates the formulae in the active worksheet. Other spreadsheets in the same workbook are not computed.

• Ctrl+Alt+F9: Recalculates all formulae by default.

• Ctrl+Alt+Shift+F9: Rebuilds the calculation dependency tree to perform a thorough recalculation.

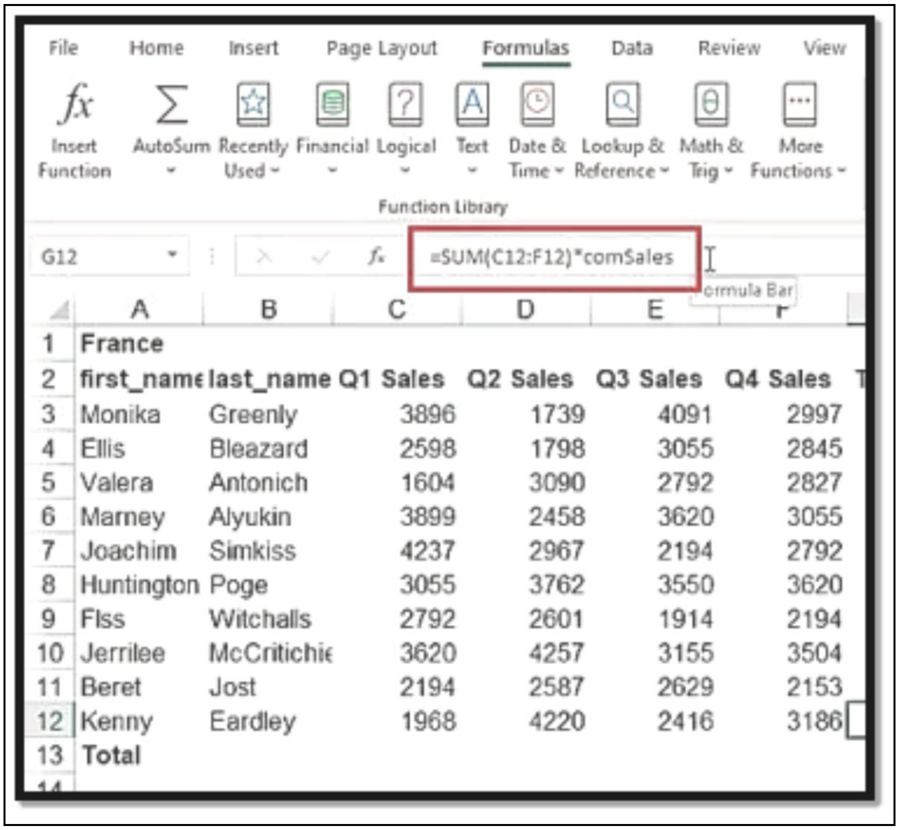
Utilizing Advanced Naming Methods

Your computations may be easier to understand, modify, and avoid errors if you include range names in them. Working with a meaningful phrase like AnnualSales is much easier than working with a reference range like AB12:AB68.

Excel includes a ton of extra tools that improve the effectiveness of using names. We'll go through these tactics in further detail in the sections that follow. This information is for those who are interested in learning about some Excel capabilities that aren't widely known.

Constant names are used

Many Excel users are not aware that a name could be assigned to an object that doesn't actually exist in a cell. For instance, you would probably enter the value of the sales tax rate in a cell and use it as a reference in your formulas if your worksheet's computations need it. You may label this cell Sales Tax or something similar to make things easier.



Here's how to give a value that doesn't show in a cell name:

1. Select **Formulas > Defined Names > Define Name** from the drop-down menu. The dialog window for a new name appears.
2. In the Name box, type the name (in this instance, SalesTax).
3. Choose a scope for the name to be valid in (Might be some workbooks or just a few).
4. Delete the existing contents of the Refers To text box and replace them with a value (such as .075).
5. Add a note about the name in the Comment box.

You've just made a name for a constant rather than a cell or range. If you enter =SalesTax into a cell inside the scope of the name, you'll get the value

0.075, which is the constant you specified. This constant may also be used in a formula, such as =A1*SalesTax.

The Name box and the **Go To dialog box** do not display named constants. This makes it reasonable since these constants have no physical location. They do show up in the drop-down menu that appears when you type in a formula. This is useful since these names are used in formulae.

Using names for formulas

You can build named formulae in addition to named constants. A named formula, like a named constant, is not stored in a cell.

The **New Name dialog box** is used to generate named formulae in the same manner as it is used to create named constants. Create a named formula that calculates the monthly interest rate from a yearly rate, for example.

The monthly rate refers to the following formula in this case:

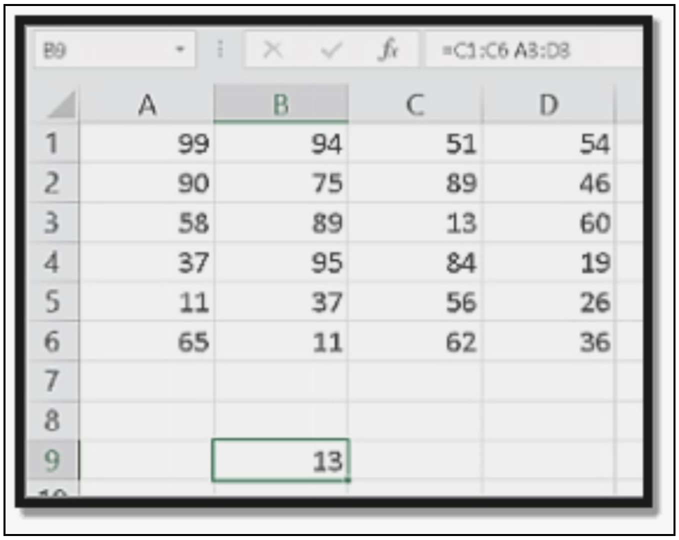
=Sheet3!$B$1/12

When you use relative references instead of absolute references, naming formulae becomes more interesting. Excel always utilizes absolute cell references when you use the pointing approach to construct a formula in the Refers to field of the New Name dialog box, unlike when you write a formula in a cell.

For example, for the following formula, activate cell B1 on Sheet1 and name it Cubed:

=Sheet1!A1^3

Using range intersections



B9 | =C1:C6 A3:D3

	A	B	C	D
1	99	94	51	54
2	90	75	89	46
3	58	89	13	60
4	37	95	84	19
5	11	37	56	26
6	65	11	62	36
7				
8				
9		13		

To find the overlapping references in two ranges, Excel employs the intersection operator.

In cell B9, the formula is:

A3:D3 =C1:C6

The value in cell C3—that is, the value at the intersection of the two ranges—is returned by this formula. The intersection operator is one of three range-related reference operators.

When you utilize names, the true usefulness of understanding range intersections becomes obvious. We picked the full table and then used Formulas Defined Names Create from Selection to generate names for the top row and left column automatically.

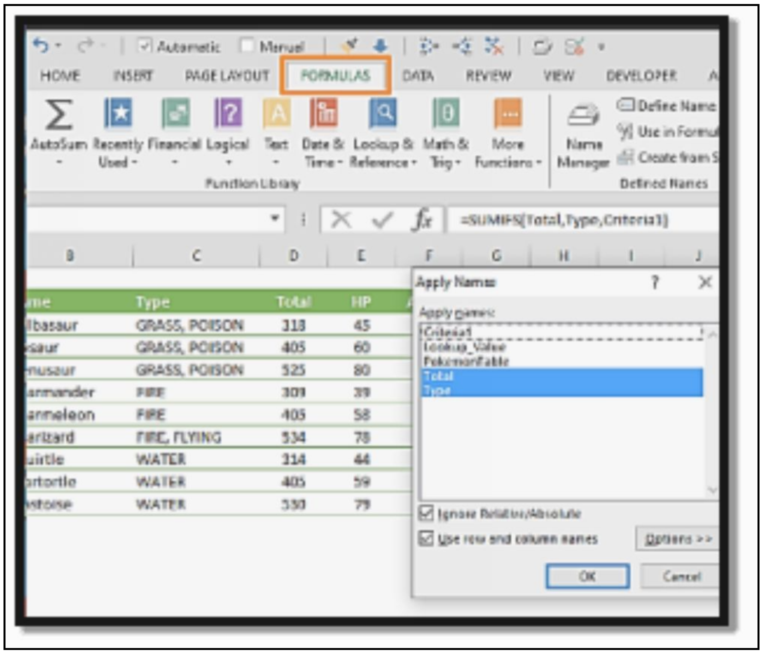
Operator	What It Does
: (colon)	Specifies a range.
, (comma)	Specifies the union of two ranges. This operator combines multiple range references into a single reference.
Space	Specifies the intersection of two ranges. This operator produces cells that are common to two ranges.

Applying names to existing references

Excel does not automatically utilize the name you give a cell or a range instead of existing references in your formulae when you name it. For example, assume cell F10 has the following formula:

=A1–A2

Excel will not automatically modify your formula to =Income–Expenses if you subsequently create a name for A1 and Expenses for A2. It is, however, rather simple to replace cell or range references with their respective names.



After formulas have been created, you can add names to cell references by first selecting the range that needs to be modified. Next, select Formulas. Specific Names Identify Names From the drop-down option, select Apply Names. Apply Names dialog box appears. You can select the names you want to apply by clicking on them, after which you can click OK. In Excel, the names in the selected cells take the place of the range references.

Utilizing Formulas

In this part, we offer a few more formula-related advice and suggestions.

not using hard-coded values

When writing a formula, think again before including a particular value.

You might be tempted to apply the following formula if your formula calculates sales tax, which is now 6.5 percent: =A1*.065

It is preferable to enter the sales tax rate in a cell and then use the cell reference.

This makes managing and changing your worksheet simple. Every calculation that relied on the prior figure would need to be revised, for instance, if the sales tax rate increased to 6.75 percent. However, if you save the tax rate in a cell, any changes you make to that cell update all of Excel's calculations.

Calculating with the Formula bar

To quickly calculate something, you can use the Formula bar as a calculator. Enter the following formula, for instance, instead of pressing Enter:

= (145*1.05)/12

When you press Enter in Excel, the formula is entered into the cell. You might wish to keep the result rather than the formula itself because this formula always produces the same outcome. To do this, hit F9, and then check the Formula bar to see the outcome. Enter the value to save it in the currently selected cell. This method also works whether the formula contains cell references or worksheet functions.

precise replication of a formula

When you put a formula somewhere else after copying it, Excel automatically updates the cell references. On sometimes, you might want to create an exact duplicate of the formula. One method to accomplish this is to convert cell references to absolute values, albeit this isn't always preferred. It is advisable to select the formula in Edit mode and then copy it as text to the Clipboard. There are several ways to go about doing this.

To duplicate the formula in A1 and paste it in A2, follow these steps:

1.Double-click A1 to access Edit mode (or press F2).

2. Use the mouse to drag to select the entire formula. Drag from left to right or from right to left. End, Shift+Home, End, Shift+Home, End, End.

3. From the drop-down menu, select Home > Clipboard > Copy (or press Ctrl+C). This moves the selected text to the Clipboard (which will become the copied formula).

4. Press Esc to leave Edit mode.

5. Opt for cell A2.

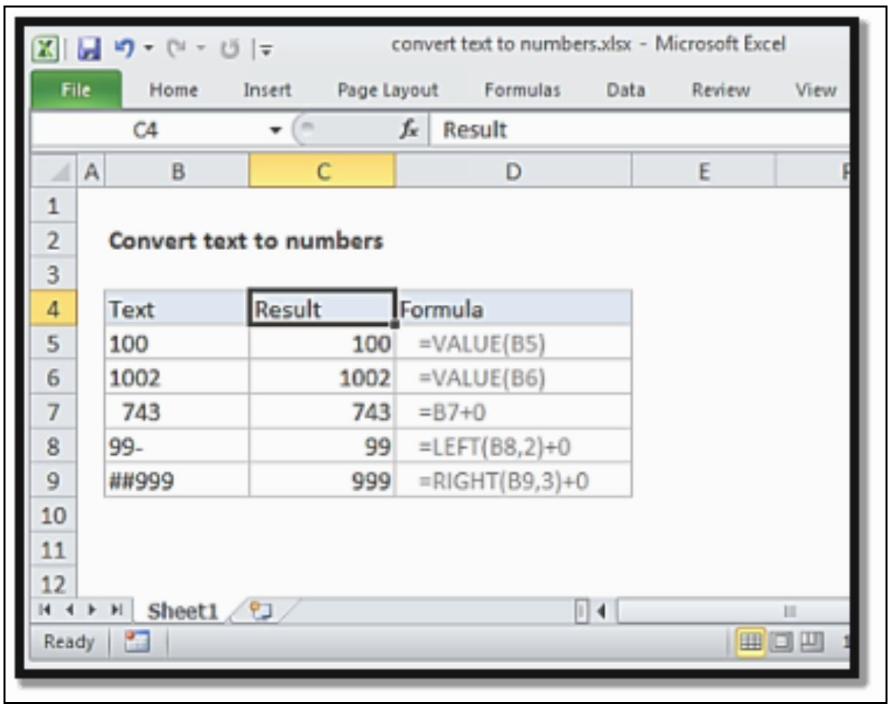
6. From the drop-down menu, select Home > Clipboard. Use Ctrl+V (or press Ctrl+V) to paste the content into column A2.

When formulae (or portions of formulae) are copied in this fashion, their cell references are preserved when pasted into a new cell. This is due to the fact that text copies of the formulae rather than actual formulas are being used.

To convert a formula into text, place an apostrophe (') in front of the equal sign. Copy the cell and paste it in its new location as usual after that. If the apostrophe is deleted, the reproduced formula will be the same as the original. Keep in mind to remove the apostrophe from the initial formula.

Converting formulas to values

In certain cases, you may wish to employ formulae to arrive at a solution and then translate the formulas to real-world numbers.



Simply follow the instructions below:

1. Choose A1:A20.
2. Select **Home > Clipboard > Copy** (or press Ctrl+C) from the Home menu.
3. Select **Home > Clipboard > Paste Values** from the drop-down menu (V).
4. To exit **Copy mode**, hit **Esc**.

CHAPTER 2

APPLICATION OF FORMULAS TO REGULAR MATHEMATICAL ACTIVITIES

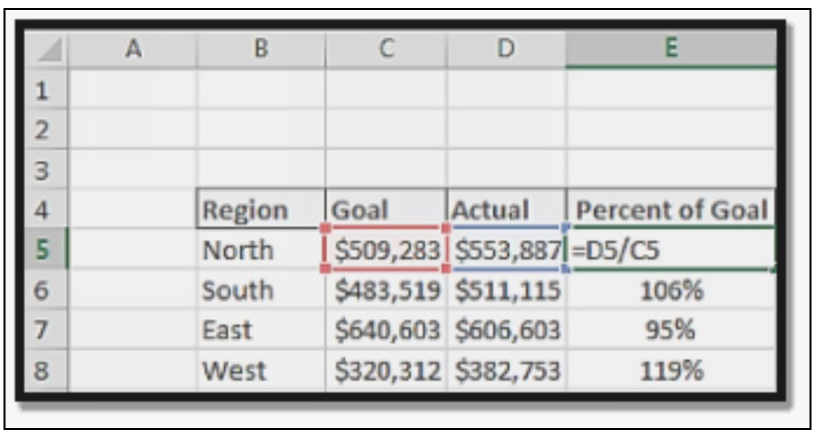
Most Excel analysts working for corporations will be asked to perform mathematical calculations that provide insight into crucial operational data. In this chapter, a few mathematical procedures that are often used in business analytics will be covered.

Percentage Calculations

Running totals, deviation from the budget, and percentages of totals are all crucial considerations in any basic business analysis. This section will teach you about certain equations that can help you with these kinds of analysis.

determining the percentage of the target

Simply comparing your actual performance to a predetermined target is all that is required when someone asks you to compute a percentage of an objective. Dividing the actual by the target is the simple mathematical formula for this calculation. This will provide you with a percentage that represents how close you are to achieving your goal. If your goal is to sell 100 widgets but you only sell 80, you fell short by 80% (80/100).

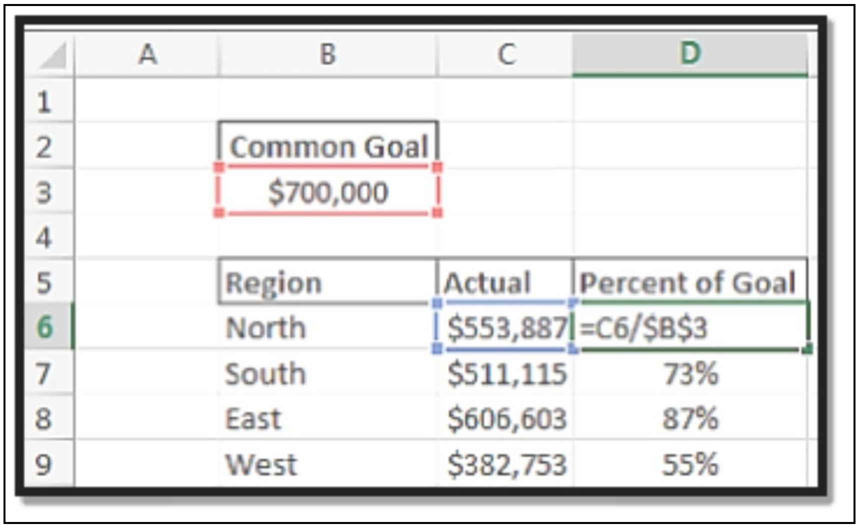


	A	B	C	D	E
1					
2					
3					
4		Region	Goal	Actual	Percent of Goal
5		North	$509,283	$553,887	=D5/C5
6		South	$483,519	$511,115	106%
7		East	$640,603	$606,603	95%
8		West	$320,312	$382,753	119%

It's worth noting that the formula in cell E5 simply divides the Actual column value by the Goal column value.

=D5/C5

This formula isn't complicated. You're merely dividing one number by another by utilizing cell references. You can input the formula once in the first row (in this example, cell E5) and then duplicate it down to each subsequent row in your table.



	A	B	C	D
1				
2		Common Goal		
3		$700,000		
4				
5		Region	Actual	Percent of Goal
6		North	$553,887	=C6/$B$3
7		South	$511,115	73%
8		East	$606,603	87%
9		West	$382,753	55%

If you need to compare actuals to a shared aim, you could use a model like the one below. Each zone does not have its purpose under this approach. Instead, you're comparing the Actual column's values against a single target in cell B3.

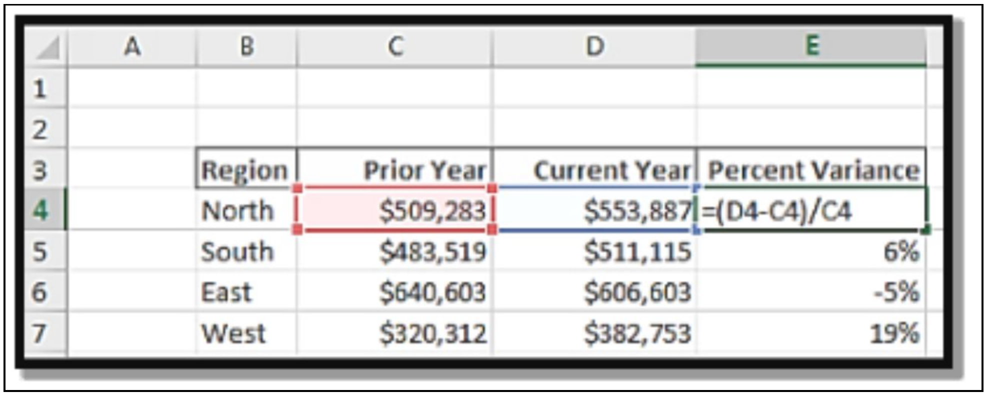
=C6/$B$3

The cell reference to the common objective ($B$3) has been inserted as an absolute reference. The dollar symbols fix the goal reference, guaranteeing that the cell reference relating to the common objective does not change as you duplicate the formula down.

Percentage variance calculation

The difference between two numbers is quantified by the term "variance." Think about the consequences if you sold 120 widgets one day and 150 the next. You sold 30 more widgets on the second day, which is a definite difference in terms of sales. By taking 150 widgets away from 120 widgets, a unit variance of +30 is produced.

How much of a difference is a percent, then? This is all about the % difference between the new value and the benchmark value (120). (150). To determine the percent variance, subtract the benchmark number from the new one and then divide the result by the benchmark number. 25% is equal to (150-120)/120 in this instance. Your sales were 25% more than the previous day, according to the percent variance.



	A	B	C	D	E
1					
2					
3		Region	Prior Year	Current Year	Percent Variance
4		North	$509,283	$553,887	=(D4-C4)/C4
5		South	$483,519	$511,115	6%
6		East	$640,603	$606,603	-5%
7		West	$320,312	$382,753	19%

The percent deviation between current and prior year sales is calculated using the method in E4.

=(D4-C4)/C4

The usage of parenthesis is one thing to observe about this formula. By default, the sequence of operations in Excel requires division before subtraction. However, if we allow this to happen, we will end up with an incorrect outcome. Excel applies subtraction before division when the initial portion of the calculation is wrapped in parentheses.

Simply input the formula once in the first row (in this example, cell E4), and then duplicate it down to each subsequent row in your table.

Another method for estimating percent variation is to divide current year sales by prior year sales and then remove one. You don't need to use parenthesis with this alternate formula since Excel does division operations before subtracting.

=D4/C4-1

% Variance calculation with negative values

But the formula fails if the benchmark value is zero or lower. Think about the following situation: you're starting a business and expect to lose money the first year. You therefore allocate yourself a negative $10,000 budget. Let's say you were able to turn a profit of $12,000 after the first year.

Your real revenue is -220 percent lower than what you anticipated. To test it, use a calculator. – 12,000 less -10,000 divided by -10,000 equals 220 percent.

How can you claim a variance of -220 percent when you made money? The problem is that the math inverts the results when your benchmark value is negative, rendering the numbers absurd. In the business world, where budgets are frequently negative, this is a severe problem.

The remedy is to neutralize the negative benchmark value using the ABS function.

=(C4-B4)/ABS(B4)

Excel's ABS function returns the absolute value of any given integer. If =ABS were input, Cell A1 would return 100. (-100). Any integer can be changed into a non-negative number with the ABS function. The correct % variance is obtained by using ABS in this computation, which eliminates the negative benchmark (in our example, a negative $10,000 budget).

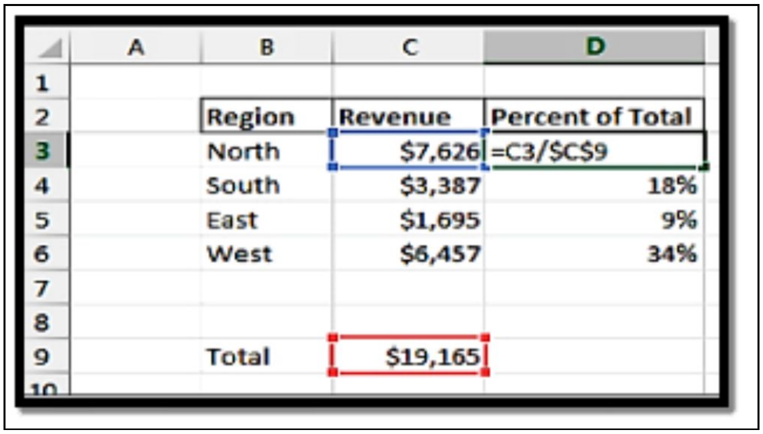
	A	B	C	D	E
1					
2					
3		Budget	Actual	Standard Percent Variance	Improved Percent Variance
4		-10,000	12,000	-220%	220%

Since it works with any pairing of positive and negative values, you can use this formula for all of your percent variance requirements.

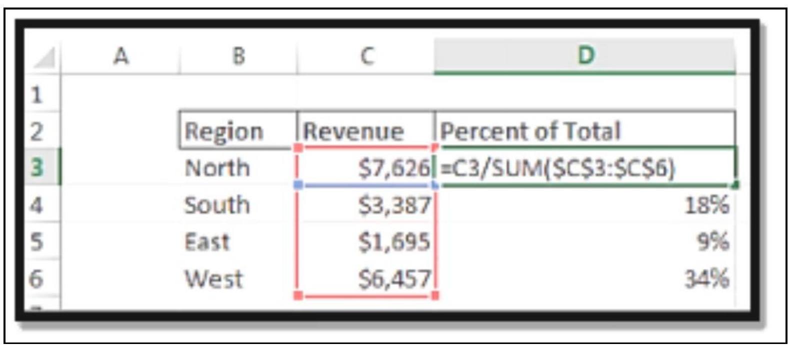
How to compute a percent distribution

The percent distribution of a statistic, such as total income, indicates how evenly it is distributed across the component parts that make up the total. You divide the total by the sum of each component part. In this example, we have a field that includes all of the revenue (cell C9). We divide the income of each region by the total to get a percent distribution for each area.

It's easy to understand this formula. Using cell references, you are merely dividing the value of each component by the sum. The total cell reference ($C$9) is entered as an absolute reference, which is something to bear in mind. By locking in the reference when you employ the dollar signs, you can ensure that as you replicate the formula down, the cell reference for the total amount won't change.



There is no need to enter a specific total amount in a different cell. You can rapidly determine the total using the% distribution formula. The SUM function adds up each and every integer you supply.



Pay attention to the absolute references used by the SUM function once more. The SUM range will stay locked as you continue to multiply the formula downward.

=C3/SUM($C$3:$C$6)

Running total calculation

When examining changes in a measure over time, some companies opt to utilize a running total as a tool. From cell D3, the formula for every month is copied down.

=SUM($C$3:C3)

	A	B	C	D
1				
2			Units Sold	Running Total
3		January	78	=SUM($C$3:C3)
4		February	63	141
5		March	38	179
6		April	17	196
7		May	84	280
8		June	63	343
9		July	32	375
10		August	20	395
11		September	98	493
12		October	63	556
13		November	75	631
14		December	75	706

The **SUM function** is used in this formula to add all of the units from cell C3 to the current row. The **absolute reference ($C$3)** is the key to this formula. The initial value of the year is locked down by using an absolute reference in the reference. This guarantee that the SUM function will always collect and add the units from the initial value to the value on the current row as the formula is copied down.

Adding or subtracting items by a percentage

For an Excel analyst, applying a percentage increase or decrease to a given value is a routine task. For instance, when adding a price increase to a product, you typically raise the starting price by a specific %. By giving a customer a discount, you lower their rate by a certain amount.

We're raising the cost of Product A by 10% in cell E5. In cell E9, customer A gets a 20% discount.

To increase a number by a percentage, multiply the original value by 1 plus the percent increase. In this case, Product A is getting a 10% bump. We start by adding 1 to the 10% as a consequence. Our final result is 110 percent. Then, a 110 percent increase is applied to the original price of 100. This results in a new cost of 110.

	A	B	C	D	E
1					
2					
3					
4			Unit Cost	Price Increase	Final Price
5		Product A	100	10%	=C5*(1+D5)
6					
7					
7					
8			Cost per Service	Percent Discount	Discounted Cost
9		Customer A	1000	20%	=C9*(1-D9)

Also, multiply the original value by 1, which is the percent discount, to reduce a figure by a percentage amount. Customer A is receiving a 20% discount in this scenario. So, we start by subtracting 20% from 1. This gives us a score of 80%. The initial 1000 cost per service is then multiplied by 80%. This adds up to a new rate of 800.

The usage of parenthesis in the formulations should be noted. Multiplication must be done before addition or subtraction, according to Excel's default sequence of operations. However, if we allow this to happen, we will end up with an incorrect outcome. By enclosing the second portion of the calculation in parenthesis, Excel guarantees that the multiplication is done last.

Dealing with divide-by-zero errors

Division by zero is impossible in mathematics. Consider what occurs when you divide one number by another to see why it's impossible.

The division is just a sophisticated version of subtraction. For example, dividing 10 by 2 is equivalent to beginning with 10 and subtracting 2 as many times as necessary until you reach zero. In this situation, you'd have to remove 2 five times in a row.

- 10 plus two equals eight
- 6 + 8 Equals 8
- 6 + 2 equals 4
- 2 + 4 Equals 2

As a result, 10/2 Equals 5.

If you attempted to do this with 10 divided by 0 instead, you'd never get far since 10 0 is always 10. You'd be sat there till your calculator died, subtracting 0's.

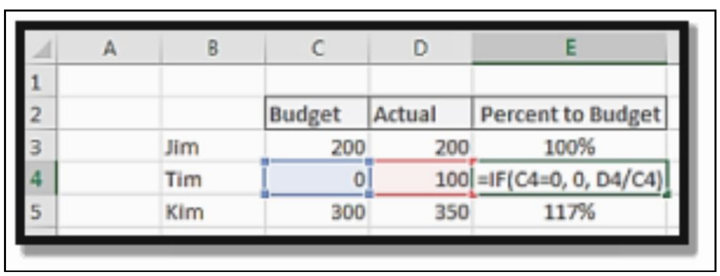
- 10 - 0 = 10
- 10 - 0 = 10
- 10 - 0 = 10

And so on.

When you divide any integer by zero, the result is called undefined by mathematicians. When you attempt to divide by zero in software like Excel, you get an error. When you divide a number by zero in Excel, you'll receive the #DIV/0! error.

If your denominator is a zero, you can prevent this by instructing Excel to skip the computation.

=IF(C4=0, 0, D4/C4)



	A	B	C	D	E
1					
2			Budget	Actual	Percent to Budget
3		Jim	200	200	100%
4		Tim	0	100	=IF(C4=0, 0, D4/C4)
5		Kim	300	350	117%

The condition, what to do if the condition is true, and what to do if the condition is false are the three inputs to the **IF function**.

In this case, the condition argument is that the budget in C4 is zero (C4=0). Condition parameters must be designed to return **TRUE or FALSE**, which typically implies a comparison operation or the other worksheet function that returns **TRUE or FALSE** (like ISERR or ISBLANK).

The second parameter of the IF function is returned to the cell if our condition argument returns TRUE. Our second parameter is 0, which simply means that if the budget number in column C4 is zero, we want a zero shown.

The third argument takes effect if the condition argument is not zero. We instruct Excel to conduct the division computation (D4/C4) in our third parameter.

So, if C4 equals 0, this formula states to return a 0; otherwise, return the value of D4/C4.

Rounding Numbers

Your clients would often prefer to look at numbers that are neat and circular. For the sake of accuracy, inundating a user with decimal numbers and extraneous digits might make your reports more difficult to comprehend. As a result, you will need to explore utilizing Excel's rounding tools.

In this part, you'll learn about some of the methods for applying rounding to your computations.

Rounding numbers using formulas

The **ROUND function** in Excel is used to round a value to a certain number of digits. The original value and the number of digits to round to are sent to the **ROUND function**.

By using 0 as the second option, Excel will remove all decimal places from the number and round the integer component to the first decimal place. This formula, for example, rounds to 94:

=ROUND(94.45,0)

The second parameter of 1 instructs Excel to round to one decimal place depending on the value of the second decimal place. This formula, for example, yields 94.5:

=ROUND(94.45,1)

You may also supply a negative integer to the second option, which instructs Excel to round to the nearest decimal point.

For instance, the following formula yields 90:

=ROUND(94.45,-1)

Using the ROUNDUP or ROUNDDOWN functions, you may force rounding in a certain direction.

94.45 is rounded down to 94 using the ROUNDDOWN formula:

=ROUNDDOWN(94.45,0)

94.45 is rounded up to 95 using the ROUNDUP formula:

=ROUNDUP(94.45,0)

Rounding to the nearest penny

It is customary practice in various businesses to round currency amounts to the closest penny. Using the CEILING or FLOOR functions, you may round to the closest penny.

	A	B	C	D
1				
2		Dollar Amount	Round up to Nearest Penny	Round Down to the Nearest Penny
3		$ 34.243	$34.25	$34.24
4				
5			=CEILING(B3,0.01)	=FLOOR(B3,0.01)

When you send a number to the CEILING function, it will round it up to the closest multiple of significance. When you need to alter the normal rounding procedure with your business criteria, this comes in useful. For example, you may use the CEILING function with a significance of 1 to compel Excel to round 123.222 to 124.

=CEILING(123.222,1)

Assigning a significance of.01 instructs the CEILING function to round up to the closest penny.

You might use.05 as the significance if you wish to round up to the nearest nickel. For example, the calculation below yields 123.15:

=CEILING(123.11,.05)

The FLOOR function is similar, except it forces a rounding down to the next significant figure.

The following example function takes 123.19 and rounds it down to the nearest nickel, yielding 123.15:

=FLOOR(123.19,.05)

Rounding up to significant digits

In some financial reports, figures are given in large numbers. The idea behind this is that when dealing with millions of dollars, there's no need to fill up a report with more data just to show accuracy down to the tens, hundreds, and thousands of dollars.

You may round the figure to one significant digit rather than showing it as 883,788, for instance. According to this, the number 900,000 would be displayed. 880,000 is what you get if you round 883,788 to two significant figures.

In other words, you're choosing whether or not to display a particular number's location. Zeroes could make up the number's remaining fraction. This would appear to be a problem, but when dealing with large enough quantities, any number below a certain significance is irrelevant.

Let's examine how this operates:

The **ROUND function** in Excel is used to round a value to a certain number of digits. The original value and the number of digits to round to are sent to the ROUND function.

When the second input is a negative value, Excel rounds the result using significant digits to the left of the decimal point. For example, the following formula yields 9500:

=ROUND(9489,-2)

When the significant digits parameter is set to –3, the result is 9000.

=ROUND(9489,-3)

This is excellent, but what if our numbers are on different scales? What if some of our numbers are in the millions, while others are in the hundreds of thousands? If we wanted to show all of our numbers with one significant digit, we'd have to create a separate ROUND function for each number to account for the varied significant digits arguments that each kind of number would need.

To deal with this, we may use a formula to generate the number that should be used instead of our hard-coded significant digits input.

Assume our phone number is –2330.45. In our ROUND function, we can utilize this formula as the important digits argument:

LEN(INT(ABS(-2330.45)))

*-1+2

This formula first wraps our integer in the ABS function, thereby eliminating any potential negative symbols. The result is then wrapped in the INT function, which strips away any decimals. Finally, it uses the **LEN function** to calculate the number of digits in the number without using decimals or negation symbols.

This component of the formula yields 4 in the example. When you remove the decimals and the negative sign from the number –2330.45, you're left with four digits.

This number is then multiplied by –1 to make it a negative number, which is then added to the desired number of significant digits. 4*-1+2 Equals –2 in this case.

We'll utilize this formula as the second input for our ROUND function once again. If you plug this calculation into Excel, you'll get a result of –2300. (Two significant digits).

=ROUND (-2330.45, LEN (INT (ABS (-2330.45))) *-1+2)

The formula can be replaced by cell references to the source number and a cell with the required number of significant digits.

=ROUND (B5, LEN(INT(ABS(B5))) *-1+$E$3)

A Range of Values Can Be Counted

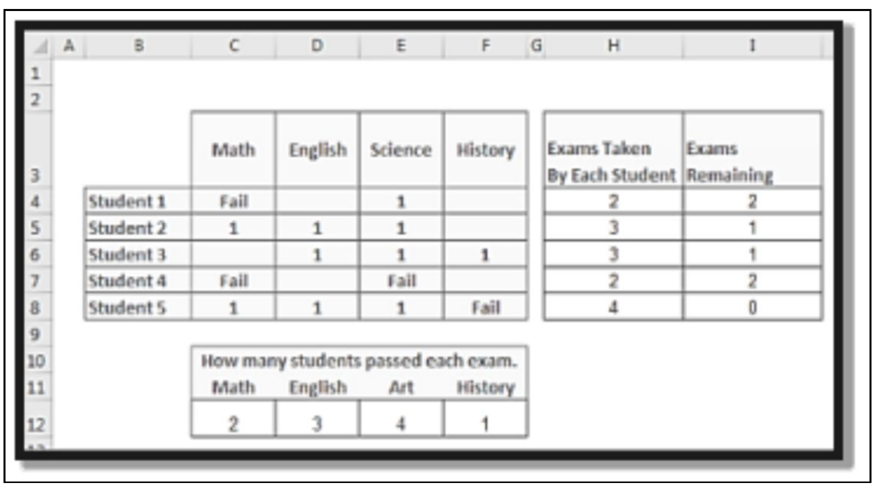
Some of the Excel functions that can be used to count the numbers in a range include COUNT, COUNTA, and COUNTBLANK. Each of these routines use a unique method of counting depending on whether the values are numbers, numbers and text, or blank.

In row 12, we utilize the COUNT function to only count the exams that students have passed. We are counting all of a student's tests using the COUNTA function in column H. In column I, we are exclusively using the COUNTBLANK function to count untaken exams.

When utilizing the COUNT function, only numerical values within a particular range will be counted. A range of cells serving as a single parameter is all that is required.

This formula, for example, will only count cells in the range C4:C8 that have a numeric value:

=COUNT (C4:C8)



	Math	English	Science	History	Exams Taken By Each Student	Exams Remaining
Student 1	Fail		1		2	2
Student 2	1	1	1		3	1
Student 3		1	1	1	3	1
Student 4	Fail		Fail		2	2
Student 5	1	1	1	Fail	4	0

How many students passed each exam.			
Math	English	Art	History
2	3	4	1

The COUNTA function will count every cell that isn't empty. This function can be applied to cells that contain any combination of numbers and text to count them. A range of cells serving as a single parameter is all that is required. For instance, this formula counts every non-blank cell in the range C4:F4: =COUNTA (C4:F4)

The COUNTBLANK function only counts the empty cells in a range. A range of cells serving as a single parameter is all that is required.

This formula, for example, will count all of the blank cells in the range C4:F4:

=COUNTBLANK(C4:F4)

Using the conversion functions in Excel

You might work for a company that requires you to understand how many cups it takes to fill an Imperial gallon or how many cubic yards a gallon of material can cover.

You can make a conversion table in Excel using the CONVERT function that has all the conversions you might possibly need for a group of measurements.

Using this table, you may easily see how one unit of measure converts to another. As you can see, a cup contains 48 teaspoons, an English pint contains 2.4 cups, and so on.

	C	D	E	F	G	H	I
1							
2				Teaspoon	Tablespoon	Fluid ounce	Cup
3				tsp	tbs	oz	cup
4		Teaspoon	tsp	=CONVERT(1,$E4,F$3)	0.33	0.17	0.02
5		Tablespoon	tbs	3.00	1.00	0.50	0.06
6		Fluid ounce	oz	6.00	2.00	1.00	0.13
7		Cup	cup	48.00	16.00	8.00	1.00
8		U.S. pint	us_pt	96.00	32.00	16.00	2.00
9		U.K. pint	uk_pt	115.29	38.43	19.22	2.40
10		Quart	qt	192.00	64.00	32.00	4.00
11		Imperial quart	uk_qt	230.58	76.86	38.43	4.80
12		Gallon gal	gal	768.00	256.00	128.00	16.00

The CONVERT function requires three parameters: a numeric value, the unit you're converting from, and the unit you're converting to.

Using this method, you might, for instance, convert 100 miles to kilometers and get the value 160.93:

TRANSFORM = (100,"mi", "km")

Utilize the following formula to change 100 gallons into liters. You will receive 378.54 as a result of this.

TRANSFORM = (100,"gal", "l")

You'll see that there is a conversion code for each unit of measurement. These codes are special, and they must be entered exactly how Excel expects. You will receive an error if you substitute gallon or GAL for the gal in a CONVERT computation. Thankfully, Excel provides you with a tooltip when you type the CONVERT function, allowing you to select the right unit codes from a list.

Look up the CONVERT function in the Excel help files to get a list of acceptable units of measure conversion codes.

When you have the desired codes, you may add them to a matrix-style table. Your matrix's top-left cell should contain a formula that makes a reference to the correct conversion code for the row and column of the matrix.

Keep in mind that you must provide the absolute references necessary to protect the conversion code references. A matrix row's row of codes should be locked to that column's reference. Lock the matrix column's row reference for the codes.

(1, $E4, F$3) =CONVERT

At this point, just duplicate your formula throughout the entire matrix.

CHAPTER 3

MANIPULATING TEXT WITH FORMULAS

Working with Excel typically involves modifying and organizing data to fit your data models, rather than just adding and subtracting numbers. A significant portion of many of these operations involves text string manipulation. In addition to giving, you an overview of several of Excel's text-based features, this section will highlight some of the text transformation tasks that an Excel analyst performs most frequently.

Excel instantly detects when you enter data into a column whether you are entering a formula, a number, or anything else when you are working with text. Text is considered to be "anything else."

The phrase string could be heard rather than read. These two terms are interchangeable. Even better, they might show up together, like in a text string.

Up to 32,000 characters can fit into a single cell, which is more than the entire number of characters in this chapter.

Contrarily, Excel is not a word processor, hence there is no justification for needing that many characters in a cell.

If you need to display a lot of text, think about using a text box in a worksheet. To create a text box and start typing, choose Insert > Text > Text Box, then choose the worksheet. Working with large amounts of text in a text box is easier than editing cells. Additionally, a text box's dimensions can be easily moved, resized, or modified. Text must be stored in cells if formulas and functions are required to handle it.

A Number That Isn't Handled Like a Number

If you import data into Excel, you may have encountered a common problem: the imported values are sometimes treated as text.

Based on your error-checking settings, Excel displays errors to identify numbers saved as text. An error signal is displayed as a green triangle in the upper-left corner of cells. The cell is also accompanied by a symbol. Clicking the icon will expand to reveal a menu of options, which you can use to activate the cell. Select Convert to Number from the available options to make the number into a real number.

To select the error-checking rules that are in use, go to File > Options, then the Formulas tab. You can select one or more of the nine error types under Error Checking Rules.

Here is another way to translate these non-numbers into real values: From any empty cell, select Home > Clipboard > Copy (or press Ctrl+C). Next, pick the range that contains the values you want to modify. Choose Paste Special from the drop-down menu under Home > Clipboard. Click OK after selecting the Add action in the Paste Special dialog box. With this method, each cell is simply added with zero, which forces Excel to treat non-numbers as real values.

Text-Based Functions

The text handling worksheet features in Excel are very diverse. Like you might anticipate, you can access these functions by using the Text control on the Formulas tab's Function Library group.

Many of the text-based approaches can function with cell numeric values as well as text, making them useful for both. Excel is surprisingly adaptable when it comes to treating numbers as text.

This section's examples demonstrate a number of well-liked (and useful) text-manipulation strategies. Depending on your requirements, some of these examples might need to be modified.

connecting text strings

One of the most basic text manipulation techniques is joining strings of text. In this instance, combining the first and last names creates a complete name column.

In this illustration, the ampersand (&) operator is used. The ampersand operator in Excel is used to concatenate elements. Cell value combinations are possible with content. In this example, we are linking the values in cells B3 and C3, which are spaced apart (created by entering a space in quotes).

	A	B	C	D
1				
2		FirstName	LastName	Full Name
3		Guy	Gilbert	=B3&" "&C3
4		Kevin	Brown	Kevin Brown
5		Roberto	Tamburello	Roberto Tamburello
6		Rob	Walters	Rob Walters
7		Thierry	Alexander	Thierry Alexander
8		David	Bradley	David Bradley
9		JoLynn	Dobney	JoLynn Dobney
10		Ruth	Ellerbrock	Ruth Ellerbrock
11		Doris	Hartwig	Doris Hartwig
12		John	Campbell	John Campbell

Dealing with more intricate situations is made easier by Excel's new TEXTJOIN feature.

For this new function, only a few parameters are needed:

TEXTJOIN (delimiter, ignore empty values, text) (delimiter, ignore empty values, text)

The initial input tells the computer what character should go between the two cells being linked. The function will divide the combined numbers with a comma if you specify a comma as the "delimiter."

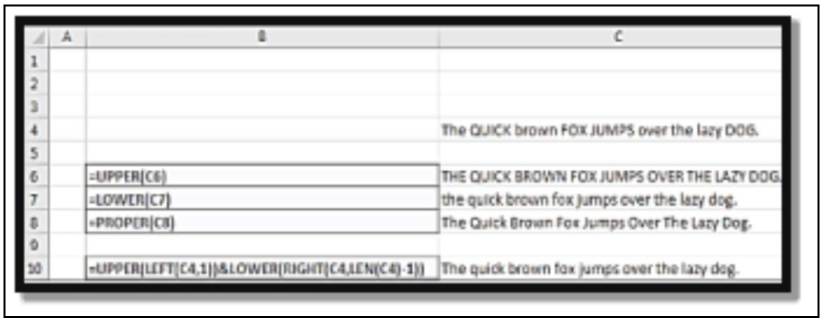
The second option dictates what happens if Excel detects an empty cell. Excel will disregard empty cells if you set this value to TRUE. Excel will disregard empty cells if it is set to FALSE. Considering where you want Excel to place your delimiter is the simplest way to tackle this argument. In the event that the selected region contains blank cells, Excel will not insert further commas between your connected text if this option is set to TRUE.

The third argument is the text that must be linked. A single text string or an array of strings, like a collection of cells, could be used here. To use the TEXTJOIN function, this parameter must include at least one value or cell reference.

Setting the text case for sentences

The upper, lower, and appropriate functions in Excel are three useful options for changing text case. Rows 6, 7, and 8's examples demonstrate how these techniques only require a reference to the text you intend to modify. The text is changed to all uppercase with the UPPER function, all lowercase with the LOWER function, and all title case with the PROPER function, as would be expected.

Excel lacks a sentence case conversion function that capitalizes only the first letter of each word.



If you look attentively at this formula, you'll see that it's made up of two sections connected by an ampersand.

NOTE: The LEFT function in Excel is used in the first portion.

UPPER(LEFT(C4,1)

The LEFT function can be used to remove a predetermined number of characters from a text string's left side. The text string to be evaluated and how many characters to be taken from the left of the text string are the two inputs for the LEFT function. In this example, the leftmost letter is being taken out of the text in cell C4. The UPPER function is then used to convert it uppercase.

The second part is a little more challenging. Excel's RIGHT function will be used in this case:

SHORT (RIGHT (C4, LEN(C4)-1)

Similar to the LEFT function, the RIGHT function also takes two arguments: the text to be evaluated and the number of characters to be taken off the right side of the text string. In this case, we can't just pass a hard-coded integer as the second parameter to the RIGHT function. To get to that number, we must subtract 1 from the total length of the text string. We take away 1 to account for the first letter, which is already capitalized because of the first part of the calculation.

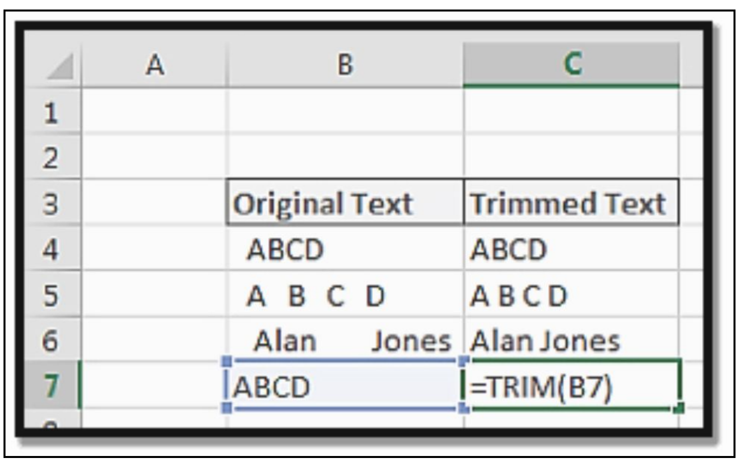
Use the LEN method to get a text string's complete length. To find the number of characters we'll need for our RIGHT function, we subtract 1 from that.

All of the information may then be fed into the LOWER function, which lowercases all letters save the first one.

A text string's spaces are removed

You'll almost likely find the text has extra spaces if you're importing data from external databases or out-of-date systems. The text may contain these extra spaces at the beginning, end, or even in the middle of text strings.

Extra spaces are generally undesirable as they may cause problems with lookup computations, graphing, column scaling, and printing.



The **TRIM feature** is rather simple to use. Simply type some text into it, and it will eliminate all spaces except single spaces between words.

You can nest the **TRIM function** in other functions, much like other functions, to tidy up your text while doing anything else.

This function, for example, cuts the text in cell A1 and transforms it to uppercase in a single step:

=UPPER(TRIM(A1)

It's worth noting that the **TRIM function** was created to just remove the ASCII space character from the text. The ASCII code for the space character is 32. However, there is an extra space character in the Unicode character set known as the nonbreaking space character. This character has the Unicode value of 160 and is often used on websites.

Only CHAR (32) space characters are supported by the TRIM function. It is unable to handle CHAR(160) space characters on its own. To deal with this kind of space, use the SUBSTITUTE function to locate CHAR(160) space characters and replace them with CHAR(32) space characters so that the TRIM function can correct them.

Taking out specific text from a string

One of the most crucial methods for modifying text in Excel is the capacity to extract certain text segments.

With the help of Excel's LEFT, RIGHT, and MID functions, you can do something like this:

• Reducing postal codes from nine to five digits.

• Have phone numbers without the area code.

• Repurpose pieces of employee or job codes in other contexts.

The LEFT method allows you to take a specific amount of characters out of a text string's left side. The text being evaluated and the number of characters to be extracted from the left side of the text string are the two arguments for the LEFT function. In this example, we are removing the first five characters from the value in column A4:

=LEFT(A4,5)

The RIGHT function removes a predetermined number of characters from a text string's right side. The text string to be evaluated and the number of characters to be extracted from the text string's right side are the two inputs that the RIGHT function requires.

In this example, we are removing the appropriate eight characters from the value in column A9:

=RIGHT(A9,8)

	A	B	C
1			
2	Convert these 9 digit postal codes into 5 digit postal codes.		
3	Zip	Zip	
4	70056-2343	70056	=LEFT(A4,5)
5	75023-5774	75023	=LEFT(A5,5)
6			
7	Extract the phone number without the area code.		
8	Phone	Phone	
9	(214)887-7765	887-7765	=RIGHT(A9,8)
10	(703)654-2180	654-2180	=RIGHT(A10,8)
11			
12	Extract the 4th character of each Job Code.		
13	Job Code	Job Level	
14	2214001	4	=MID(A14,4,1)
15	5542075	2	=MID(A15,4,1)
16	1113543	3	=MID(A16,4,1)

You could use the **MID function** to extract a specified number of characters from the center of a text string. The MID function takes three arguments: the text string to be evaluated, the character position in the text string to begin extraction from, and the number of characters to be extracted.

In this example, we'll extract one character from our text string beginning at the fourth character:

=MID(A14,4,1)

Finding a particular character in a text string

The **LEFT, RIGHT, and MID** functions in Excel are wonderful for extracting text, but only if you know where the letters, you're looking for are located. What can you do if you're not sure where to begin the extraction?

For example, how would you remove all of the content after the hyphens from the following list of product codes?

- PRT-432
- COPR-6758
- SVCCALL-58574

Because you'll require the correct few characters, the **LEFT function** won't work. Because you need to tell it precisely how many characters to extract from the right of the text string, the RIGHT function by itself won't work. Any value you provide will extract either too many or too few characters from the text. Because you must tell it precisely where in the text to start extracting, the MID function alone will not work. Any number you provide will either retrieve too many or too few characters from the text.

In actuality, you'll often need to locate certain characters to get the proper extraction starting point. The **FIND tool** in Excel comes in helpful here. You may acquire the position number of a specific character using the FIND function and utilize that character position in subsequent operations.

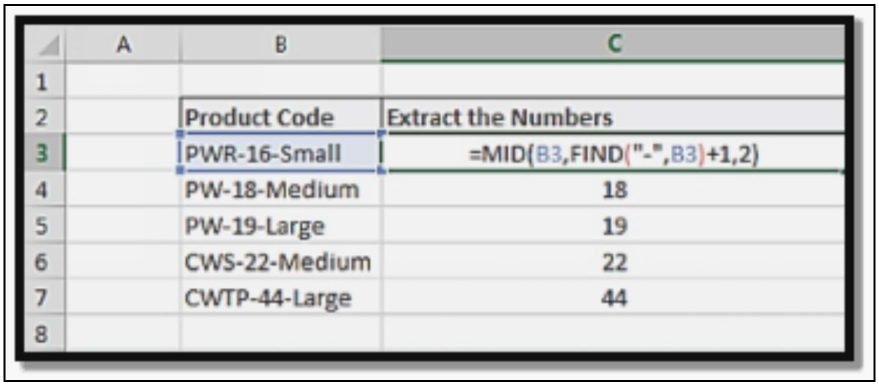
We utilize the location of the hyphen to input the MID function, as you can see from the calculation.

=MID(B3,FIND("-",B3)+1,2)

Two parameters are needed for the FIND function. The first parameter is the text that you're looking for. The text you wish to search is the second parameter. The FIND function returns the position number of the character you're looking for by default. The FIND function will provide the position number of the first encounters if the text you're seeking includes more than one of your search characters.

For example, in the text string PWR-16-Small, the following algorithm will look for a hyphen. Because the first hyphen it sees is the fourth letter in the text string, the outcome will be a number four.

=FIND("-","PWR-16-Small")



	A	B	C
1			
2		Product Code	Extract the Numbers
3		PWR-16-Small	=MID(B3,FIND("-",B3)+1,2)
4		PW-18-Medium	18
5		PW-19-Large	19
6		CWS-22-Medium	22
7		CWTP-44-Large	44
8			

The FIND function can be used as an input in a MID function to extract a predetermined number of characters after the FIND function returns a position number.

When you type this formula into a cell, you'll get the two integers that come after the first hyphen in the text. The +1 in the formula should be noted. This guarantee that you shift one-character forward after the hyphen to reach the content.

=MID ("PWR-16-Small”, FIND("-","PWR-16-Small”) +1

Tracking down a character's second appearance

The position number of the first instance of the character you're searching for is what the FIND function default returns. Get the position number of the second instance using the optional Start Num parameter. With this choice, you can set the search to begin at a specific text-string character.

This calculation will produce the position number of the second hyphen since we are instructing the FIND function to begin scanning at position 5 (from the first hyphen):

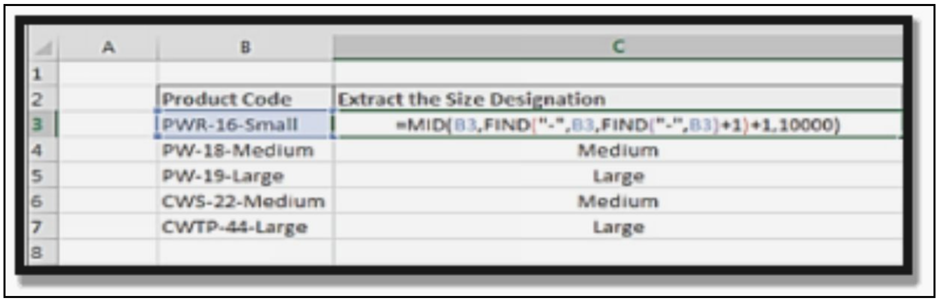
=FIND("-","PWR-16-Small",5)

In order to accomplish this dynamically, you can nest a FIND function and use it as the Start Num parameter in another FIND function.

Use the Excel formula below to determine where the second hyphen should be located:

We can extract the size property from the product code by using the formula =FIND ("-","PWR-16-Small", FIND("-","PWR-16-Small") +1). To do this, we need to find the second instance of the hyphen and use that position number as the starting point in the MID function. Cell C3's equation is as follows:

B3, FIND ("-", B3, FIND ("-", B3)+1)+1,10000)



	A	B	C
1			
2		Product Code	Extract the Size Designation
3		PWR-16-Small	=MID(B3,FIND("-",B3,FIND("-",B3)+1)+1,10000)
4		PW-18-Medium	Medium
5		PW-19-Large	Large
6		CWS-22-Medium	Medium
7		CWTP-44-Large	Large
8			

This formula instructs Excel to locate the second hyphen's position number, shift one-character forward, and then retrieve the following 10,000 characters. Although there aren't 10,000 characters, this guarantees that everything after the second hyphen gets retrieved.

Changing text strings

Sometimes it's advantageous to substitute one text with another. An example of this is when using the PROPER function and running into the annoying apostrophe S ('S) quirk. To see what we mean, type the following formula into Excel:

=APPROPRIATE ("STARBUCK'S COFFEE")

The provided text will be changed to title case using this algorithm.

What the formula actually produces is as follows:

Coffee Startbuck's

It's important to note that the PROPER function capitalizes the S following the apostrophe, which is unattractive.

With a little help from Excel's SUBSTITUTE function, you can get out of this jam. The SUBSTITUTE function, which is used in our formula, accepts three arguments: the target text, the existing text that needs to be replaced, and the new text that should be used in its stead.

You'll see that there are two SUBSTITUTE functions used in the entire formula. There are two formulas in this formula. The phrase "The first formula is the part that reads, " in the section. The phrase "The first PROPER(SUBSTITUTE(B4,"'","qzx")")" appears in the first formula.

In this section, replace the apostrophe (') with qzx using the SUBSTITUTE function. Although it can appear like an odd idea, there is a strategy behind it. The PROPER function will capitalize all letters that follow a symbol. In order to trick the PROPER function, the apostrophe is replaced with a benign string of letters that are unlikely to be connected in the original text.

The second formulation serves as a container for the first.

In this formula, an apostrophe is used in place of the harmless qzx:

=SUBSTITUTE(PROPER(SUBSTITUTE(B4,"'","qzx"),"qzx","'")

The consequence is that the entire formula replaces the apostrophe with the character qzx, then executes the PROPER function before changing the qzx back to an apostrophe.

A cell's characters can be counted individually

It's useful to be able to determine how many times a particular character appears in a text string. Excel does this in a pretty amazing way.

For instance, you could count by hand the instances of the letter s in the word Mississippi, but you could also count them methodically by doing the following:

1. Calculate the character count for the word "Mississippi" (11 characters).

2. Determine the character's length after removing every letter s. (7 characters).

3. Subtract the modified length from the original length.

By following these steps, you'll be able to recognize that the word Mississippi contains the letter s four times. This method of counting specific characters can be applied in Excel to calculate the word count. The number of words entered in cell B4 (in this case, nine words) is calculated using the formula below:

=LEN(B4)-LEN(SUBSTITUTE(B4," ","") (B4," ","") +1

This formula substantially adheres to the setup steps described in the preceding section.

The LEN function is initially used to determine the length of the text in cell B4:

LEN(B4)

The SUBSTITUTE function is then used to eliminate the spaces from the text:

AS A REPLACEMENT (B4," ","")

We can get the length of the text without the spaces by wrapping the SUBSTITUTE function in a LEN function. To account for the fact that the final word will not have an accompanying space, we must add one (+1) to that answer:

LEN(SUBSTITUTE(B4," ",""(+1

We get our word count by subtracting the modified length from the initial length:

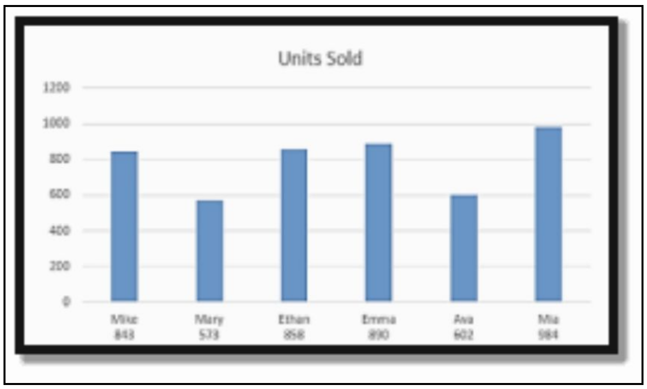
=LEN(B4)-LEN(SUBSTITUTE(B4," ","")- +1

A formula's line break can be added.

Sometimes it helps to force line breaks when creating charts in Excel to produce better representations. Consider the graph as an example. The data value for each sales rep is represented by the x-axis labels in this graph. This is useful when you don't want your chart to be cluttered with data labels.

The key to this method is using the CHAR() function inside a formula to create your chart labels.

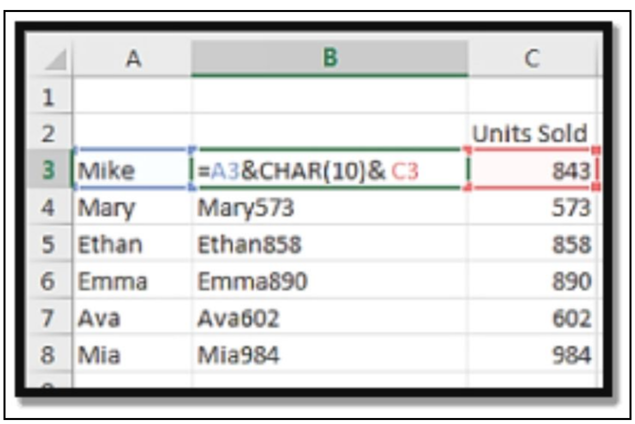
Each Excel character is given a code by the American National Standards Institute (ANSI). The characters that appear on your screen are defined by a group of Windows system codes known as the ANSI character set. The ANSI character set has 255 characters that are numbered from 1 to 255. The capital letter A is character number 65. The number 9 appears in character 57.



Codes exist for even non-printing characters. Space is represented by the number 32. A line break is represented by the number 10.

The CHAR() method may be used to get any character from a formula.

=A3&CHAR(10)&C3



	A	B	C
1			
2			Units Sold
3	Mike	=A3&CHAR(10)& C3	843
4	Mary	Mary573	573
5	Ethan	Ethan858	858
6	Emma	Emma890	890
7	Ava	Ava602	602
8	Mia	Mia984	984

Unless you apply wrap text to the cell, the line break will not be seen. However, even if you haven't, any chart that uses this kind of formula will show the data supplied by the formula with line breaks.

The removal of unusual characters from text fields

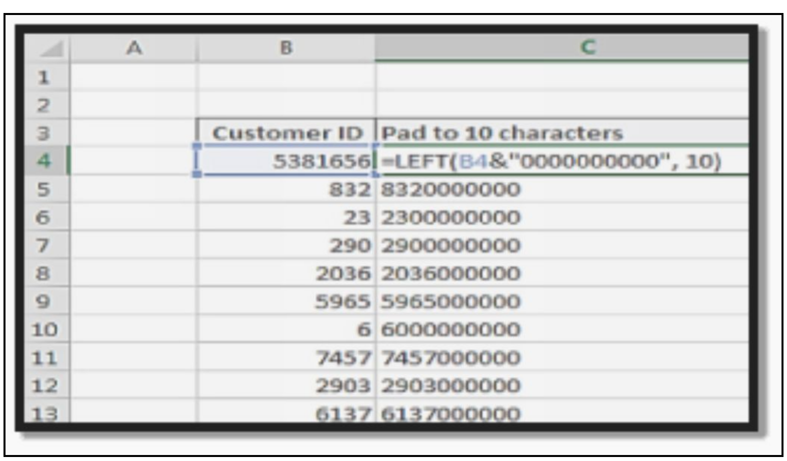
When you import data from outside sources like text files or online feeds, strange characters could show up in your data. Instead of cleaning them up by hand, you might utilize Excel's CLEAN tool.

Nonprintable characters are removed from any text you give to the CLEAN function. Wrapping the CLEAN function within the TRIM function will remove both unnecessary spaces and unprintable characters at once. =TRIM(CLEAN(B3))

Using zeros to pad integers

Your work in Excel frequently finds its way into other database systems used by the business. A particular minimum number of characters are frequently required due to field length limits in some database systems. A common method for ensuring that a field contains a predefined number of characters is to pad data with zeros.

The idea of padding data using zeros is straightforward. You must include enough zeros to satisfy the requirement if the Customer ID field has to be 10 characters long. The output would be Customer ID 2345000000, which would require padding with six zeros. By doing this, a brand-new text string is created with a Customer ID value of 10.



	A	B	C
1			
2			
3		Customer ID	Pad to 10 characters
4		5381656	=LEFT(B4&"0000000000", 10)
5		832	8320000000
6		23	2300000000
7		290	2900000000
8		2036	2036000000
9		5965	5965000000
10		6	6000000000
11		7457	7457000000
12		2903	2903000000
13		6137	6137000000

The LEFT function is then used to extract the first 10 characters of the new text string.

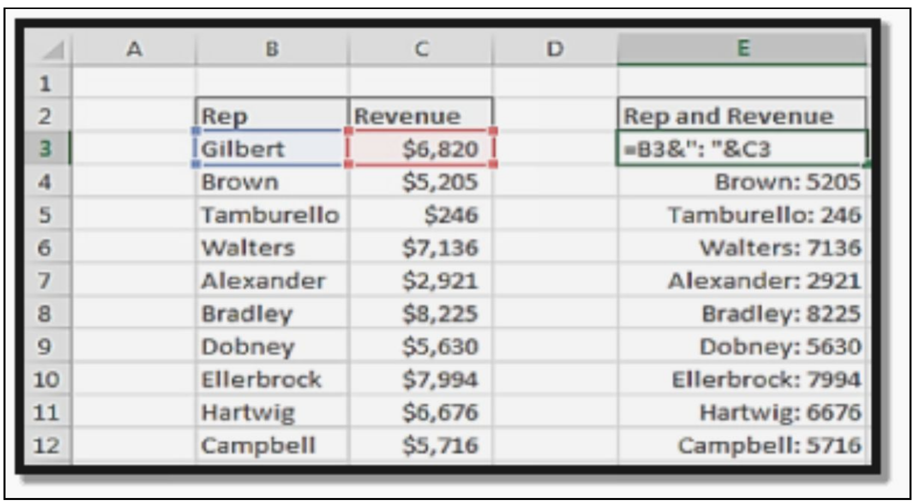
Formatting a text string's numbers

Combining text and numbers in reporting is somewhat uncommon.

For instance, you could need to add a sentence to your report that highlights a salesperson's accomplishments, like this:

To John Hutchison, $5,000

The problem is that the formatting for numbers is lost when they are merged in a text string. It's important to note that the format of the integers in the combined string differs from that of the source cells.



	A	B	C	D	E
1					
2		Rep	Revenue		Rep and Revenue
3		Gilbert	$6,820		=B3&": "&C3
4		Brown	$5,205		Brown: 5205
5		Tamburello	$246		Tamburello: 246
6		Walters	$7,136		Walters: 7136
7		Alexander	$2,921		Alexander: 2921
8		Bradley	$8,225		Bradley: 8225
9		Dobney	$5,630		Dobney: 5630
10		Ellerbrock	$7,994		Ellerbrock: 7994
11		Hartwig	$6,676		Hartwig: 6676
12		Campbell	$5,716		Campbell: 5716

To address this issue, use the **TEXT function** to encapsulate the cell reference for your numeric value. You may apply the necessary formatting on the fly using the TEXT function.

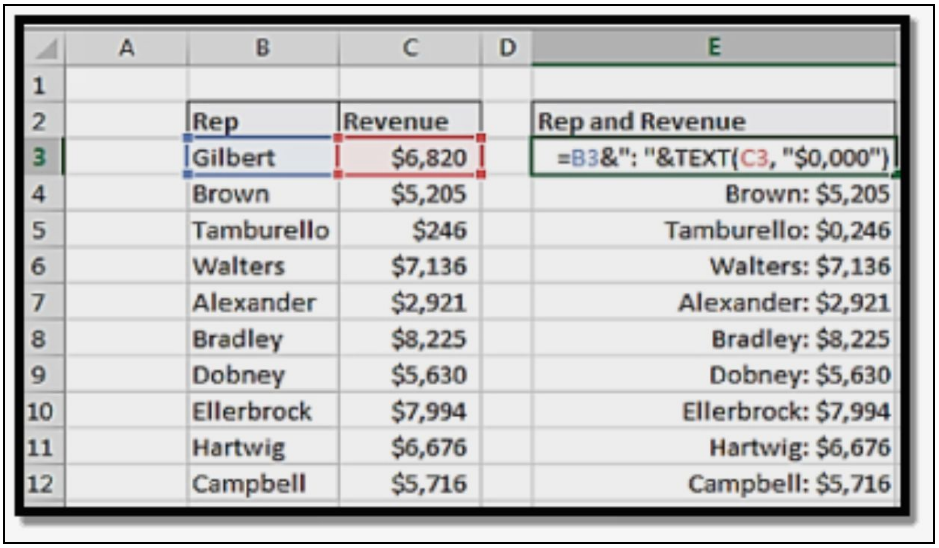
The TEXT function takes two arguments: a value and an Excel format that is valid. You may format a number in any way you like as long as it's a format that Excel understands.

You may use this formula in Excel to show $99, for example:

=TEXT (99.21,"$#, ###")

To show 9921 percent, put the following formula into Excel:

TEXT = (99.21,"0 percent ")



	A	B	C	D	E
1					
2		Rep	Revenue		Rep and Revenue
3		Gilbert	$6,820		=B3&": "&TEXT(C3, "$0,000")
4		Brown	$5,205		Brown: $5,205
5		Tamburello	$246		Tamburello: $0,246
6		Walters	$7,136		Walters: $7,136
7		Alexander	$2,921		Alexander: $2,921
8		Bradley	$8,225		Bradley: $8,225
9		Dobney	$5,630		Dobney: $5,630
10		Ellerbrock	$7,994		Ellerbrock: $7,994
11		Hartwig	$6,676		Hartwig: $6,676
12		Campbell	$5,716		Campbell: $5,716

This formula may be entered into Excel to show 99.2:

=TEXT (99.21,"0.0")

A quick way to understand the syntax for a particular number format you're interested in is to look at the Number Format screen.

Follow these instructions:

1. By right-clicking any cell, choose Format Cell from the context menu.

2. On the Number Format tab, choose the desired formatting.

3. Select Custom from the Category list on the left side of the Number Format dialog box.

4. Copy the syntax and paste it into your page.

By means of the DOLLAR function

If you want to connect a numeric value with text that is a dollar amount, use the DOLLAR function. The provided text is formatted into a local currency using this technique. Two parameters are passed to the DOLLAR function: an integer value and the number of displayed decimals.

"&DOLLAR" =B3&" (C3,0)

CHAPTER 4

Utilizing Formulas with Dates and Times

Many spreadsheets contain cells with dates and times. For instance, you may create a timetable or organize information by date. For beginners, using dates and timings in Excel may be challenging. An in-depth understanding of Excel's handling of time-based data is necessary when working with dates and timings.

You may get all the information you need to create reliable date and time formulas in this area.

The dates listed below are in the month/day/year format common in the US. For instance, the number 3/1/1952 refers to March 1 rather than January 3. Despite the fact that we understand this arrangement to be absurd, that is the way Americans have been trained. We have no doubt that readers from other countries will be able to make the required modifications.

Excel Date and Time Handling: An Understanding

You may get a quick overview of Excel's date and time handling in this section. This section covers Excel's date and time serial number system. Some instructions on how to input and format dates and timings are also included.

Acquiring knowledge about date serial numbers

Excel only treats dates as numbers. A date is a serial number that represents the duration of time since the fictitious date of January 0, 1900. A serial number of 1 corresponds to the first day of the year 1900; a serial number of 2 to the second day; and so on. You can create formulas that do calculations depending on dates using this approach. You may create a formula to determine how many days there are between two dates, for instance (just subtract one from the other).

Regarding January 1, 1900, you might be interested. The term "nondate" is used to describe times that are not associated with a particular day.

To display a date serial number as a date, format the cell as a date. Choose the option Home > Number > Number Format. This drop-down menu offers two different date formats.

Select a Date System: 1900 Or 1904

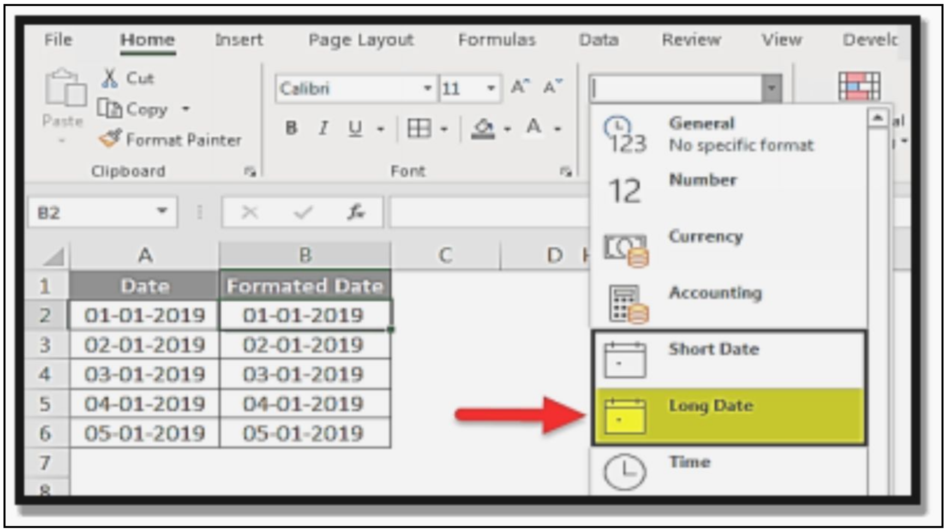
Excel is compatible with both the 1900 and the 1904 date systems. Depending on the method you use, you can choose which date is used as the starting point for dates in a worksheet. January 1, 1900, is the date assigned to date serial number 1 in the 1900 date system. The 1904 date system was established on January 1st of that year. Before 2011, Excel for Mac used the 1904 date system, whereas Excel for Windows defaults to the 1900 date system.

Excel for Windows supports the 1904 date format to be compatible with older Mac files. You can choose the date system for the current worksheet in the Advanced section of the Excel Options dialog box. When calculating This Workbook, it is found in the section titled general, you should use the 1900 year default date system. Using two different date systems in linked workbooks requires caution as well. Assume that cell A1 has the date 1/15/1999 and that Book 1 use the 1904 calendar. Assume that Book2 connects to Cell A1 in Book1 and uses the 1900 calendar. Book 2 takes place on January 14, 1995. Both workbooks utilize the same date serial number (34713) but are read in distinct ways.

The 1904 date system has the advantage of enabling the display of negative time values. A calculation that yields a negative time cannot be presented using the 1900 date system. When using the 1904 date system, the negative time is displayed as -1:30. (that is, a difference of 1 hour and 30 minutes).

Dates Entry

If you know the serial number, you can input the date as a serial number and then format it as a date. A date is often entered using one of the several common date formats. Excel converts your data into the corresponding date serial number (used for calculations) and forms the cell with the standard date format, showing it as an actual date rather than a mysterious serial number.



You could input June 18, 2018, for instance, into a cell if you wanted to enter that date. Excel examines your data and gives the serial number for that date the value 43269. Additionally, the default date format is used, so the contents of the fields might not display exactly as you entered them.

Depending on your locale settings, entering a date in the format June 18, 2018, can appear as a text string. In this case, you must supply the date in the format required by your regional settings, such as June 18, 2018. When a cell containing a date is activated, the Formula bar shows the contents of the cell formatted according to the system's short date format, which corresponds to the default date format. The Formula bar does not display the date's serial number. In order to retrieve the serial number for a particular date, format the cell using the General format.

To change the default date format, you must modify a system-wide setting. The Region dialog box will open after you choose Clock and Region in the Windows Control Panel. The actual procedure varies depending on the Windows version you're using. Locate the drop-down menu so you can change the Short Date's format. The choice you select determines the default date format Excel uses to display dates in the Formula bar.

When it comes to recognizing dates placed into a cell, Excel is rather forgiving. It isn't ideal, however. When you input a date that is outside of the supported date range, Excel treats it as text. When you try to format a serial number as a date that is beyond the permitted range, the result appears as a sequence of hash marks (##########).

Browsing for Dates

To find a specific date in a worksheet with many dates, use the Find and Replace dialog box (Home > Editing > Find & Select > Find, or Ctrl+F). Excel can be a little picky when it comes to dates. The date needs to be entered precisely as it appears in the Formula bar. The date is shown in the Formula bar using your system's short date format, such as 6/19/2016, if a cell contains a date that is set to display as of June 19, 2016. If you search for the date in the cell as it appears, Excel won't find it. However, if you use the formula bar to search for the date, it will find the cell.

knowledge of time serial numbers

Decimals can be added to the Excel date serial number system when working with time data. In other words, when it comes to time, Excel works with fractional days. For instance, the date serial number for June 1, 2016, is 42522. The internal time code for noon is 42522.5.

Time of Day	Time Serial Number
12:00:00 AM (midnight)	0.00000000
1:30:00 AM	0.06250000
7:30:00 AM	0.31250000
10:30:00 AM	0.43750000
12:00:00 PM (noon)	0.50000000
1:30:00 PM	0.56250000
4:30:00 PM	0.68750000

6:00:00 PM	0.75000000
9:00:00 PM	0.87500000
10:30:00 PM	0.93750000

One minute has a serial number equal to roughly 0.00069444. This figure is calculated by multiplying 24 hours by 60 minutes and then dividing the result by 1. The numerator is the total number of minutes in a day (1,440).

=1/(24*60)

Likewise, the serial number equivalent to one second is around 0.00001157, which may be calculated using the formula:

=1/(24*60*60)

The denominator in this situation is the number of seconds in a day (86,400).

The lowest unit of time in Excel is one-thousandth of a second. The following time serial number corresponds to 23:59:59.999 (one-thousandth of a second before midnight):

0.99999999

Entering times

You usually don't have to care about the exact time serial numbers, just as you don't have to worry about dates. Simply type the time into a field in the appropriate format.

Entry	Excel Interpretation
11:30:00 AM	11:30 AM
11:30:00 AM	11:30 AM
11:30 PM	11:30 PM
11:30	11:30 AM
13:30	1:30 PM

Excel assigns a date serial number of 0 to the previous samples since they don't have a particular day associated with them. This corresponds to nonday January 0, 1900. You'll often need to mix the date and time. Use a recognized date input format, a space, and then a recognized time entry format to do this. If you type 6/18/2016 11:30 in a cell, Excel will read it as 11:30 a.m. on June 18, 2016. 42539.47917 is the date/time serial number.

When you provide a time that is longer than 24 hours, the time's associated date advances correspondingly. If you type 25:00:00 into a cell, for example, it will be read as 1:00 a.m. on January 1, 1900. Because the time surpasses 24 hours, the day portion of the input increases. Keep in mind that if a time value is entered without a date, the date is set to January 0, 1900.

In the same way, if you input a date and a time (and the time exceeds 24 hours), the date you entered will be modified. For example, if you type 9/18/2016 25:00:00, it will be translated as 9/19/2016 1:00:00 AM.

The maximum time you may put into an unformatted cell if you merely enter a time (without an accompanying date) is 9999:59:59. (just less than 10,000 hours). Excel calculates the correct number of days. In this scenario, 9999:59:59 corresponds to 3:59:59 PM on February 19, 1901. When you input a time that is longer than 10,000 hours, it is treated as a text string rather than a time.

Manipulating times and dates

There are numerous formatting options available when it comes to cells that include dates and timings. The cell can be formatted to, for instance, display just the date portion, just the time portion, or both the date and time portions.

Dates and timings can be formatted by selecting the cells, then using the Number tab in the Format Cells dialog box. To open the dialog box, click the dialog box launcher icon located in the Home tab's Number group, or click the Number Format control and choose More Number Formats from the list that appears.

Built-in date formats appear in the Date category, whereas built-in time formats appear in the Time category. On some forms, the date and time are both displayed. From the Type drop-down menu, select the necessary format, then click OK.

Excel may format the formula cell as a date or time by default when you write a formula that references a cell that includes a date or time. Sometimes, this automation is advantageous; other times, it is completely inappropriate and annoying. To return the number formatting to the standard General format, go to Home > Number > Number Format and select General from the drop-down box. As an alternative, press Ctrl+Shift+ (tilde).

Challenges with dates

Excel has some problems handling dates. The fact that Excel was developed so long ago may be the cause of many of these problems. The limited date and time capabilities of the Lotus 1-2-3 program, which feature a horrible flaw that was deliberately reproduced in Excel, were effectively imitated by Excel designers (described next). If Excel were designed from the bottom up today, I have no doubt that it would be far more flexible when handling dates. Users are currently forced to use a product with a date selection that is far from ideal.

The leap year glitch in Excel

There is a leap year, which has an additional day, every four years (February 29). If a year is equally divisible by 100, it is not a leap year unless it is also evenly divisible by 400. Despite the fact that 1900 was not a leap year, Excel treats it as one. In other words, when you enter the date

2/29/1900 into a column, Excel accepts it as a valid date and assigns it a serial number of 60.

However, if you put 2/29/1901, Excel recognizes it as a typo and does not convert it to date. Instead, the cell entry is simply converted to a text string.

How can a product utilized by millions of people every day have such a glaring flaw? The solution is based on history. Lotus 1-2-3 faulted the first edition that led it to consider 1900 as a leap year. When Excel was introduced later, the designers were aware of the defect and opted to replicate it in Excel to keep Lotus 1-2-3 worksheet files compatible.

Why is this problem still present in subsequent Excel versions? According to Microsoft, the drawbacks of fixing this defect outweigh the benefits. Millions of existing workbooks would be messed up if the problem was fixed. Furthermore, resolving this issue may have an impact on Excel's interoperability with other date-based tools. Because most people don't utilize dates before March 1, 1900, this defect currently causes relatively few issues.

Pre-1900 dates

Of course, the world did not begin on January 1, 1900. Excel users who deal with historical data often need to work with dates before January 1, 1900. Unfortunately, the only option to deal with dates before 1900 is to type them into a cell. For example, Excel will not object if you type July 4, 1776, into a cell.

If you want to arrange information by dates from the past, start with a four-digit year, then a two-digit month, and finally a two-digit day—for example, 1776-07-04. Although you won't be able to use these text strings as dates, this format will allow for precise sorting.

In certain cases, using text as a date works, but the fundamental issue is that you can't manipulate a date that's been input as text. For example, you can't modify the date's numeric formatting, figure out what day of the week it happened on, or compute the date seven days later.

Dates that are inconsistent

Be careful when entering dates with two digits for the year. Excel offers several guidelines that specify which century to utilize when doing so.

Dates with two digits from 00 to 29 are regarded as 21st-century ones, while those with two numerals from 30 to 99 are regarded as 20th-century ones.

Excel, for instance, will interpret the number 12/15/28 as December 15, 2028. Excel understands 12/15/30 as December 15, 1930, whereas Windows uses 2029 as the boundary year by default. You can either stick with the default settings or make changes in the Windows Control Panel. To access the Customize Format dialog box, click the Additional Settings button in the Region dialog box. Change the year after selecting the Date tab.

To prevent any surprises, just input all years with the full four numbers for the year.

Using Excel's Date and Time Functions

There are many functions in Excel that operate with dates and timings. **Formulas > Function Library > Date & Time** is where you'll find these functions.

Dates and times are nothing more than a numbers system behind the covers, therefore these functions take use of that. This opens the door to a plethora of interesting formula-based investigations. You'll go through some of these fascinating studies in this section. You'll learn a few approaches that will help you construct your formulae along the road.

Getting the current date and time

You may use one of two Excel functions instead of inputting the current date and time. The current date is returned by the TODAY function:

=TODAY()

The NOW () method returns the current date and time as follows:

=NOW ()

The TODAY and NOW operations both return date serial numbers that indicate the system's current date and time. The TODAY method sets the time to noon, while the NOW function returns the current time.

It's crucial to remember that both of these methods will recalculate each time you alter or access your worksheet, so don't use them as a recorded timestamp.

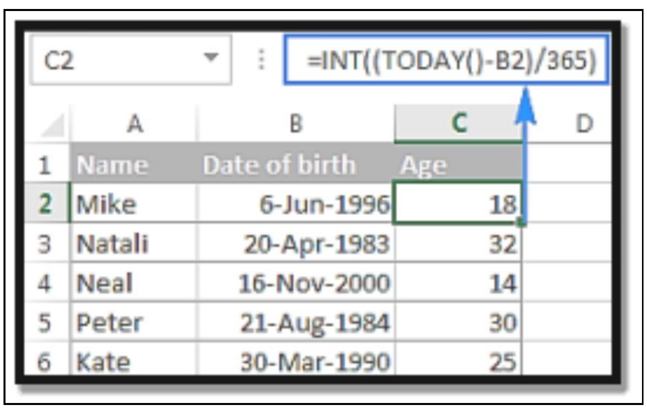
Press **Ctrl+; (semicolon)** on your keyboard to enter a fixed date that will not change. In the active cell, a static date will be inserted.

By wrapping the **TODAY function** in the **TEXT function** and adding some date formatting, you may utilize it as part of a text string. This formula will produce text that displays the current date in Month Day, Year format.

="Today is "&TEXT (TODAY (),"mmmm d, yyyy

Calculating age

Using Excel's DATEDIF function is one of the simplest methods to figure out how old something is. This utility simplifies the process of computing date comparisons.



You can use the DATEDIF function to compute a person's age by using a formula like this:

=DATEDIF ("5/16/1972", TODAY(),"y")

Of course, you may refer to a cell containing a date:

=DATEDIF (B4, TODAY(),"y")

The DATEDIF function determines how many days, months, or years there are between two dates. Three parameters are required: a start date, an end date, and a time unit.

You can simply compute the number of years, months, and days between two dates using these time codes. If someone was born on May 16, 1972, the following formulae may be used to calculate their age in years, months, and days:

=DATEDIF("5/16/1972”, TODAY(),"y")

=DATEDIF("5/16/1972”, TODAY(),"m")

=DATEDIF("5/16/1972”, TODAY(),"d")

Calculating the number of days between two dates

Calculating the number of days between two dates is one of the most frequent date computations in the business sector. It's used by project managers to monitor performance against a deadline, HR departments to track time to complete a requisition, and finance departments to track receivables aging. Fortunately, owing to the DATEDIF function, it's one of the simplest computations to complete.

	A	B	C	D
1				
2				
3			Invoice Date	Days Outstanding
4			25-Jun-18	=DATEDIF(C4,TODAY(),"d")
5			04-Jun-18	70
6			04-Jun-18	70
7			22-Apr-18	113
8			31-Mar-18	135
9			28-Mar-18	138
10				

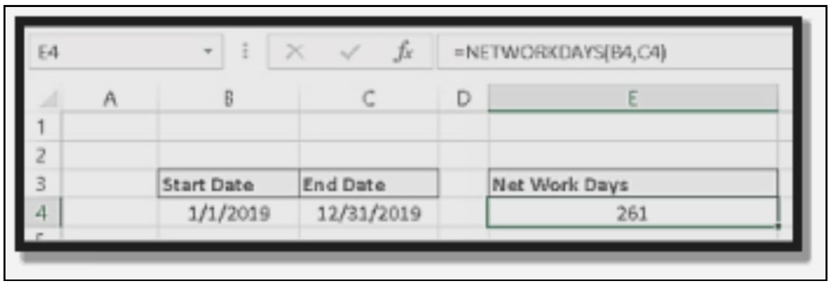
=DATEDIF(C4, TODAY(),"d")

The DATEDIF function is used with the time code d in this formula. This instructs Excel to calculate the number of days based on the start (C4) and finish (C5) dates (TODAY).

Calculating the number of workdays between two dates

Counting weekends in the final number of days when reporting on the elapsed number of days between a start date and an end date is not always suitable. Because operations are often closed on weekends, you should avoid counting those days.

The **NETWORKDAYS function** in Excel is used to compute the number of days between a start and finish date, excluding weekends.



In cell E4, the NETWORKDAYS function is used to determine the number of workdays between January 1, 2019, and December 31, 2019.

This is a simple formula to follow. The start date and end date are both mandatory inputs for the NETWORKDAYS function. This formula would provide the number of workdays (excluding Saturdays and Sundays)

if your start date is in cell B4 and your finish date is in cell C4:

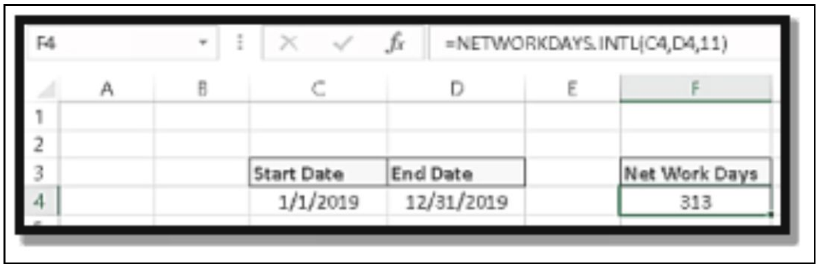
=NETWORKDAYS (B4, C4)

Using NETWORKDAYS.INTL

The **NETWORKDAYS function** has one disadvantage: it excludes Saturday and Sunday by default. But what if you work in a location where Fridays and Saturdays are the weekends? Worse, what if your weekends are limited to Sundays?

The **NETWORKDAYS.INTL function** in Excel can help you out. This method contains an optional third parameter, a weekend code, in addition to the mandatory start and finishes dates. You can use the weekend code to designate which days are not considered weekends.

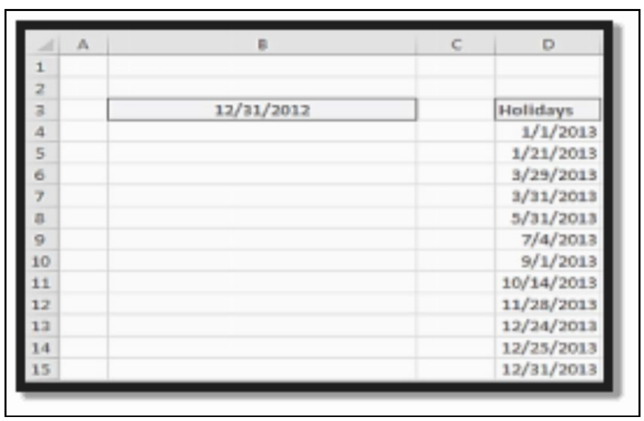
As soon as you input the third parameter in the NETWORKDAYS.INTL function, Excel shows a menu. Simply press Enter after selecting the proper weekend code.



Generating a list of business days excluding holidays

It's typically helpful to have a helper table that provides a list of dates that reflect business days when building dashboards and reports in Excel (that is, dates that are not weekends or holidays). This kind of assistance table may aid in calculations such as revenue per business day, unit revenue per business day, and so on.

The **WORKDAY.INTL function** is one of the simplest methods to construct a list of business days. Begin with a spreadsheet that includes the previous year's end date as well as a list of your company's holidays.



Enter the following formula in the box under the previous year's last date:

=WORKDAY.INTL(B3,1,1,$D$4:$D$15)

You can now replicate the formula to generate as many business days as you need. The INTL function generates a workday date depending on the number of days you provide.

There are two necessary parameters and two optional arguments for this function:

- **Commencement Date (required):** This is the date from which to begin.
- **Number of days (required):** This option specifies the number of days to return from the start date.
- **Holidays and weekends (optional):** The WORKDAY is selected by default. Saturdays and Sundays are excluded from the INTL function, but the third option enables you to select which weekdays should be excluded as weekend days. Excel provides a menu where you may pick the proper weekend code as soon as you input the WORKDAY.INTL function.
- **Vacations (optional):** In addition to the weekend days, this parameter enables you to offer Excel a list of dates to omit.

In this case, we're instructing Excel to begin on December 31, 2012, and then increment up one day to get the following business day after that. We state in our optional arguments that Saturdays and Sundays, as well as the holidays specified in cells $D$4: $D$15, must be excluded.

=WORKDAY.INTL(B3,1,1, $D$4: $D$15)

Make careful to use absolute references to lock down the range for your list of holidays so that it stays locked when you copy your formula down.

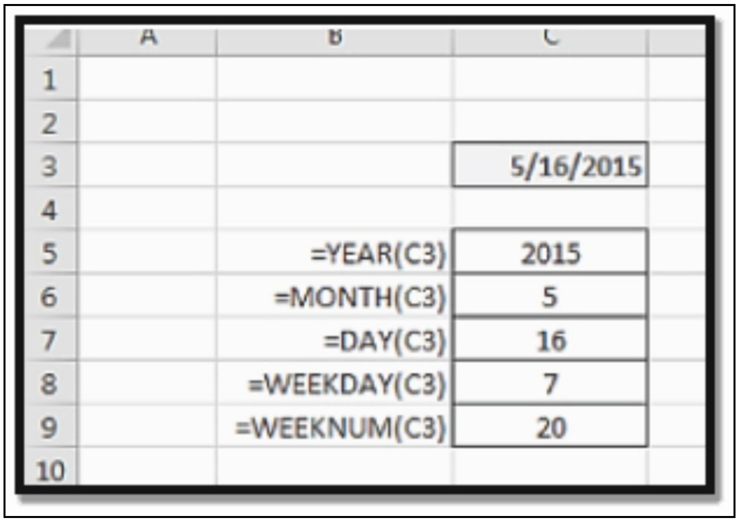
Extracting parts of a date

Although it may seem little, picking out a particular area of a date may be quite useful. For example, you could need to select all records with order dates during a certain month or all workers having Saturday time. You'll need to extract the month and workday number from the formatted dates in these cases.

To break down dates into their component components, Excel offers a basic collection of functions. The following are the functions:

- YEAR is a function that extracts the year from a given date.
- MONTH is a function that extracts the month from a given date.

- From a given date, DAY derives the month day number.
- For a given date, WEEKDAY returns the weekday number.
- For a given date, WEEKNUM returns the week number.



	A	B	C
1			
2			
3			5/16/2015
4			
5		=YEAR(C3)	2015
6		=MONTH(C3)	5
7		=DAY(C3)	16
8		=WEEKDAY(C3)	7
9		=WEEKNUM(C3)	20
10			

These are rather easy functions.

The YEAR function provides a four-digit value representing the year of a given date. This calculation yields the year 2015.

=YEAR("5/16/2015")

The MONTH function produces an integer between 1 and 12 representing the month of a given date. The result of this formula is 5.

=MONTH("5/16/2015")

The DAY function provides a number between 1 and 31 that represents the month day on a given date. The result of this formula is 16.

=DAY("5/16/2015")

The WEEKDAY function produces a number between 1 and 7 that indicates the day of the week (Sunday through Saturday) on which the given date falls. The number 1 is returned if the date occurs on a Sunday. The number 2 is returned if the date occurs on a Monday, and so on. Because 5/16/2015 occurs on a Saturday, this calculation yields 7.

=WEEKDAY("5/16/2015")

This method provides an optional return type parameter that allows you to choose which day of the week is in the first place. Excel offers a menu where you may pick the proper return type code as soon as you input the WEEKDAY function.

You can change the algorithm to represent Monday through Sunday with return values 1 through 7. Because the algorithm returns 6 in this situation, Saturdays are now designated as the 6th day of the week.

=WEEKDAY("5/16/2015",2)

The WEEKNUM method returns the year's week number for the week that the supplied date falls inside. Because 5/16/2015 occurs in week 20 of 2015, this algorithm yields 20.

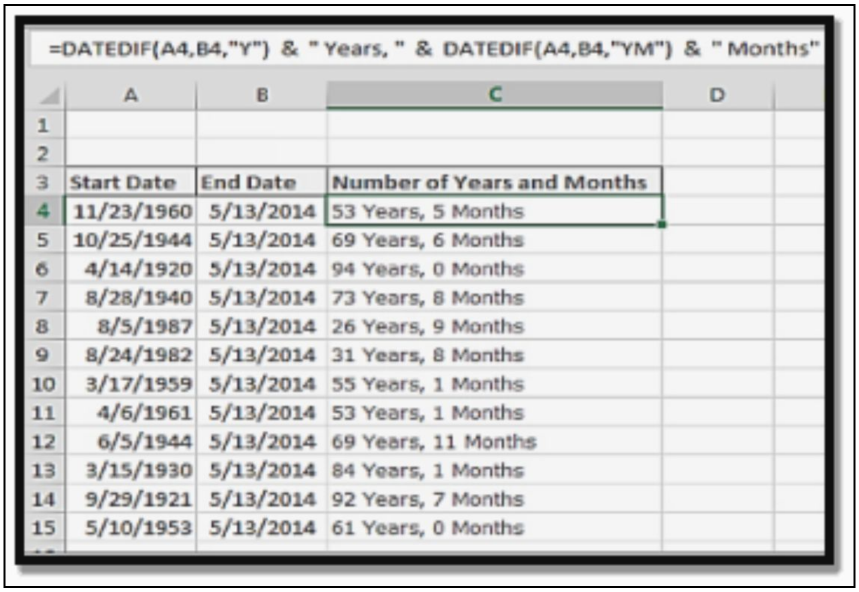
=WEEKNUM("5/16/2015")

This method contains an optional return type parameter that allows you to choose which day of the week determines the week's start. The WEEKNUM function sets the start of the week to Sunday by default. Excel offers a menu where you may choose a different return type code as you type in the WEEKNUM function.

Calculating the number of years and months between dates

You may be requested to state the difference between two dates in years and months in certain circumstances. In these circumstances, two DATEDIF functions may be used to construct a text string.

Two DATEDIF functions are combined in a text string using the ampersand (&) operator to accomplish this purpose.



=DATEDIF(A4,B4,"Y") & " Years, " & DATEDIF(A4,B4,"YM") & " Months"

	A	B	C	D
1				
2				
3	Start Date	End Date	Number of Years and Months	
4	11/23/1960	5/13/2014	53 Years, 5 Months	
5	10/25/1944	5/13/2014	69 Years, 6 Months	
6	4/14/1920	5/13/2014	94 Years, 0 Months	
7	8/28/1940	5/13/2014	73 Years, 8 Months	
8	8/5/1987	5/13/2014	26 Years, 9 Months	
9	8/24/1982	5/13/2014	31 Years, 8 Months	
10	3/17/1959	5/13/2014	55 Years, 1 Months	
11	4/6/1961	5/13/2014	53 Years, 1 Months	
12	6/5/1944	5/13/2014	69 Years, 11 Months	
13	3/15/1930	5/13/2014	84 Years, 1 Months	
14	9/29/1921	5/13/2014	92 Years, 7 Months	
15	5/10/1953	5/13/2014	61 Years, 0 Months	

The first DATEDIF function uses the year time unit (Y) to compute the number of years between the start and finish dates:

DATEDIF(A4,B4,"Y")

The second DATEDIF method ignores the year component of the date and calculates the number of months using the YM time unit:

DATEDIF (A4, B4, "YM")

We combine these two routines with some custom text to inform customers which number represents years and which month:

=DATEDIF(A4,B4,"Y") & " Years, " & DATEDIF(A4,B4,"YM") & " Months" =DATEDIF(A4,B4,"YM") & " Months"

Converting dates to Julian date formats

Julian dates are often used as a timestamp and fast reference for batch numbers in production contexts. Retailers, customers, and service agents may use date coding to determine when a product was manufactured and consequently its age. Julian dates are widely utilized in astronomy, programming, and the military.

Different industries use different Julian dates, but the most popular is made up of two parts: a two-digit number denoting the year and the number of days that have passed since the year began. The Julian date for January 1, 1960, for example, would be 601. The Julian date for December 31, 2014, is 14365.

To convert a standard date to a Julian date, Excel does not provide a built-in function. This formula is two formulae that have been put together as a text string using the ampersand (&).

	A	B
1		
2		
3	Standard Date	Julian Date
4	1/1/1960	=RIGHT(YEAR(A4),2)&A4-DATE(YEAR(A4),1,0)
5	10/25/1944	44299
6	4/14/1920	20105
7	8/28/1940	40241
8	8/5/1987	87217
9	8/24/1982	82236
10	3/17/1959	5976
11	4/6/1961	6196
12	6/5/1944	44157
13	3/15/1930	3074
14	9/29/2000	00273
15	5/10/2014	14130

The first formula uses the RIGHT function to retrieve the year's right two digits. It's worth noting that we're extracting the year component of the date using the YEAR function.

=RIGHT(YEAR(A4),2)

The second formula is a little more difficult. We must determine how many days have passed since the start of the year. To do so, we must first deduct the desired date from the preceding year's last day.

A4-DATE(YEAR(A4),1,0)

You'll see that the DATE function is used. We may create a date on the fly using the DATE method by passing three arguments: the year, month, and day. From 1900 to 9999, the year may be any whole number. Any positive or negative number may be used for the month and date.

This calculation, for example, would provide the December 1, 2013 date serial number:

DATE= (2013, 12, 1)

It's worth noting that the day argument in our Julian date calculation is zero. When you provide 0 as the day argument, Excel understands that you want the day before the first of the month. The day before January 1 in this case is December 31.

If you type this formula into a blank cell, you'll get the following result: December 31, 1959:

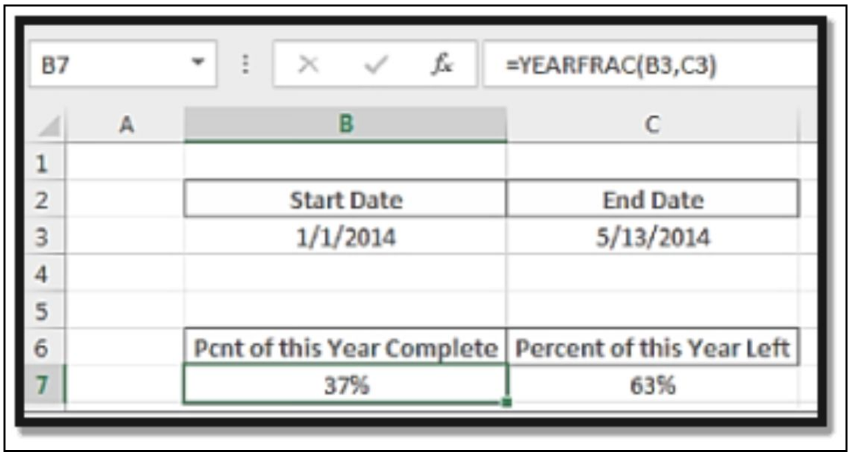
=DATE (1960,1,0)

The Julian date is formed by joining our two formulae with an ampersand:

A4-DATE(YEAR(A4),1,0) & =RIGHT(YEAR(A4),2)

Calculating the percent of the year completed and remaining

When creating Excel reports and dashboards, it's helpful to know what percentage of the year has passed and what percentage remains. These percentages might be utilized in other computations or as a simple reminder to your readers.



The start date and end date are all that are required for the YEARFRAC function. It then calculates the percentage of the year that represents the number of days between both the start and finish dates once it knows those two variables.

=YEARFRAC (B3, C3)

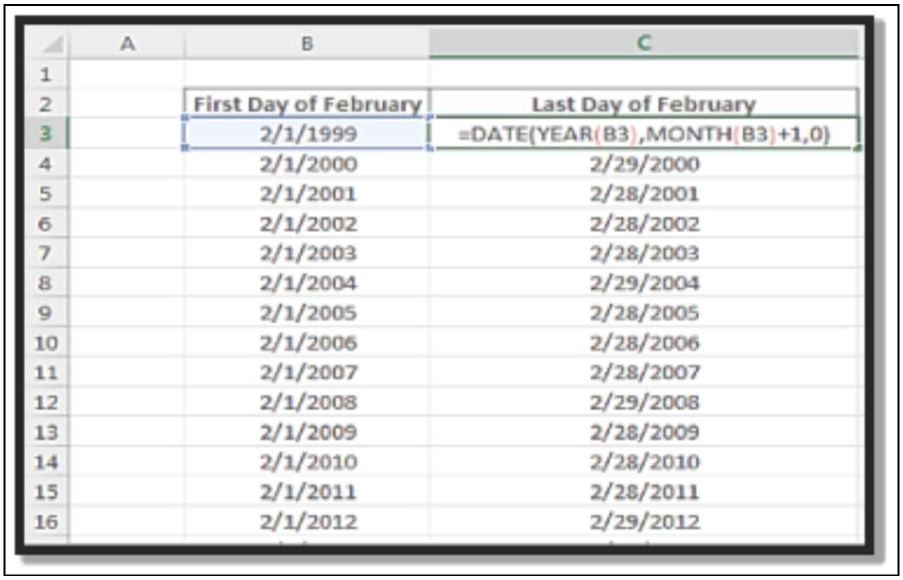
Simply remove 1 from the YEARFRAC calculation to obtain the percent left:

=1-YEARFRAC (B3, C3)

Returning the last date of a given month

When dealing with dates, calculating the last date of a particular month dynamically is a typical need. The final day of most months is set, but the last day of February fluctuates depending on whether or not the year is a leap year.

The DATE method uses three inputs to create a date on the fly: the year, month, and day. From 1900 to 9999, the year may be any whole number. Any positive or negative number may be used for the month and date.



	A	B	C
1			
2		First Day of February	Last Day of February
3		2/1/1999	=DATE(YEAR(B3),MONTH(B3)+1,0)
4		2/1/2000	2/29/2000
5		2/1/2001	2/28/2001
6		2/1/2002	2/28/2002
7		2/1/2003	2/28/2003
8		2/1/2004	2/29/2004
9		2/1/2005	2/28/2005
10		2/1/2006	2/28/2006
11		2/1/2007	2/28/2007
12		2/1/2008	2/29/2008
13		2/1/2009	2/28/2009
14		2/1/2010	2/28/2010
15		2/1/2011	2/28/2011
16		2/1/2012	2/29/2012

This calculation, for example, would provide the December 1, 2013 date serial number:

DATE= (2013, 12, 1)

You inform Excel and you want the day before the 1st of the month when you use 0 as the day argument. If you type this formula into a blank cell, you'll get the following result: February 29, 2000:

=DATE (2000,3,0)

We utilize the YEAR function to obtain the chosen year and the MONTH function to get the desired month in our example, rather than hard-coding the year and month. We proceed into the following month by adding one to the month. When we utilize the number 0 as the day, we receive the final day of the month we're interested in.

=DATE(YEAR(B3), MONTH(B3) +1,0)

Remember that the method may be used to find the final day of any month, not simply February.

Using the EOMONTH function

The **EOMONTH function** is a convenient replacement for the DATE function. You may retrieve the end date of any future or previous month using the EOMONTH function. Only two arguments are required: a start date and the number of months in the future or past.

This formula, for instance, will return the final day of April 2015:

=EOMONTH ("1/1/2015", 3) =EOMONTH ("1/1/2015", 3) =EOMONTH ("1/

A date in the past will be returned if you provide a negative number of months. On the final day of October 2014, this formula will return:

=EOMONTH ("1/1/2015", -3) =EOMONTH ("1/1/2015", -3)

You can retrieve the final day of the current month by combining the EOMONTH and TODAY functions.

=EOMONTH (TODAY (),0)

Calculating the calendar quarter for a date

Excel has no built-in function for calculating quarter numbers, believe it or not. You'll need to construct your formula if you need to figure out which calendar quarter a given date belongs to.

Simple math is the key to this formula's success. Here, you're dividing the supplied month's number by three and then rounding it up to the closest integer. Let's imagine you're trying to figure out which quarter August belongs to. You might divide 8 by 3 since August is the eighth month of the year. As a result, the solution is 2.66. You get 3 if you round that number up. As a result, August falls into the third quarter of the year.

The formula below accomplishes the same goal. The MONTH function is used to derive the month number from a date, while the ROUNDUP function is used to force rounding up.

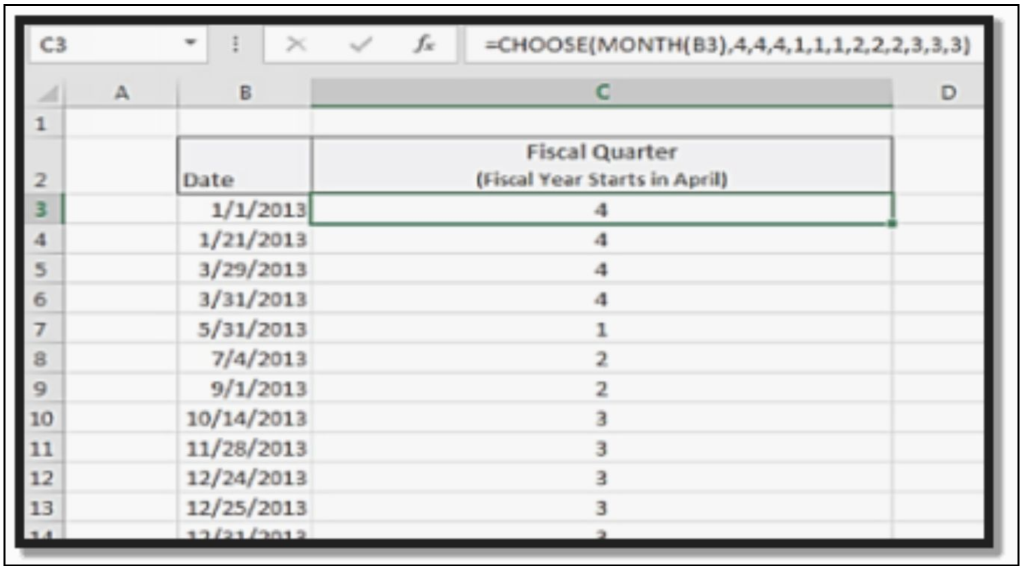
=ROUNDUP(MONTH(B3)/3,0)

Calculating the fiscal quarter for a date

Many of us work for companies that do not begin their fiscal year in January. Rather, it may begin in October, April, or any other month. Fiscal quarters cannot be computed in the same manner as calendar quarters in these companies.

When our fiscal year begins in April, we calculate the fiscal quarters in this manner. The following is the formula in the Formula bar:

=CHOOSE(MONTH(B3),4,4,4,1,1,1,2,2,2,3,3,3)



C3 =CHOOSE(MONTH(B3),4,4,4,1,1,1,2,2,2,3,3,3)

	A	B	C	D
1				
2		Date	Fiscal Quarter (Fiscal Year Starts in April)	
3		1/1/2013	4	
4		1/21/2013	4	
5		3/29/2013	4	
6		3/31/2013	4	
7		5/31/2013	1	
8		7/4/2013	2	
9		9/1/2013	2	
10		10/14/2013	3	
11		11/28/2013	3	
12		12/24/2013	3	
13		12/25/2013	3	

Based on a position number, the **CHOOSE function** delivers an answer from a list of options. Because Silver is the second choice in your list of options, you would obtain Silver if you used the formula =CHOOSE (2, "Gold", "Silver", "Bronze", "Coupon"). A coupon, the fourth option, would be obtained by replacing the 2 with a 4.

The first input to the CHOOSE function is a mandatory index number. This parameter is a number between 1 and the number of options listed in the following set of arguments. Which of the following parameters is returned is determined by the index number?

The following 254 parameters describe your options and control what is returned when an index number is supplied (just the first one is necessary). The first option is returned if the index number is 1. The second option is returned if the index number is 2.

The goal is to feed date to a list of quarter numbers using the CHOOSE function:

=CHOOSE(MONTH(B3),4,4,4,1,1,1,2,2,2,3,3,3)

Excel uses the month number for the supplied date and selects a quarter that matches that number, as seen in column C3. Excel returns the first option in this situation since the month is January (January is the first month). The number four is the first option. The fourth fiscal quarter begins in January.

Assume your company's fiscal year begins in October rather than April. You may easily compensate for this by aligning your list of options with the start month of your fiscal year.

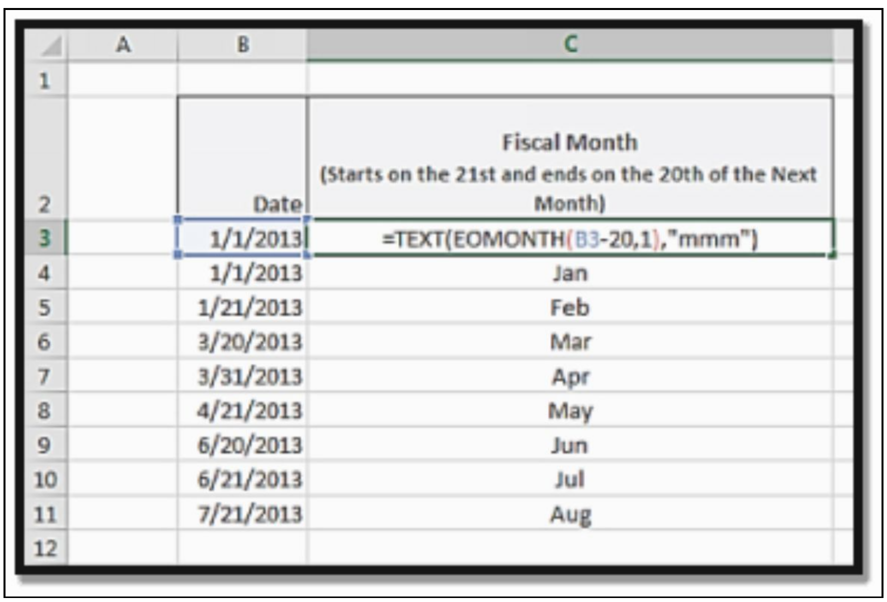
=CHOOSE(MONTH(B3),2,2,2,3,3,3,4,4,4,1,1,1)

Returning a fiscal month from a date

The operationally recognized months in certain companies do not begin on January 1st and conclude on December 30th or 31st. Instead, they use precise dates to designate the start and conclusion of each month. For example, you may work for a company where each fiscal month begins on the 21st and finishes on the 20th of the following month. These businesses must be able to convert a standard date into their fiscal months.

In this case, we're computing the fiscal month, which begins on the 21st of the month and ends on the 20th of the next month. The following is the formula in cell C3:

=TEXT(EOMONTH(B3-20,1),"mmm")



	A	B	C
1			
2		Date	Fiscal Month (Starts on the 21st and ends on the 20th of the Next Month)
3		1/1/2013	=TEXT(EOMONTH(B3-20,1),"mmm")
4		1/1/2013	Jan
5		1/21/2013	Feb
6		3/20/2013	Mar
7		3/31/2013	Apr
8		4/21/2013	May
9		6/20/2013	Jun
10		6/21/2013	Jul
11		7/21/2013	Aug
12			

In this method, we start with our current date (in B3) and subtract 20 days to travel back 20 days. Then we use that updated date in the EOMONTH function to calculate the final day of the next month:

EOMONTH(B3-20,1)

The resultant date is then wrapped in a TEXT function to format it into a three-letter month name:

TEXT(EOMONTH(B3-20,1),"mmm")

Calculating the date of the Nth weekday of the month

Understanding the dates of certain occurrences is necessary for many analytical techniques. For instance, if payroll processing takes place on the second Friday of each month, knowing which days in the year correspond to the second Friday of each month is helpful.

You can create dynamic date tables that automatically give you the essential dates you require using the date methods presented so far in this chapter.

For each month indicated in this table, formulae determine the Nth weekday. Fill in the years and months you want, and then tell it how many occurrences of each weekday you require. In this case, cell B2 indicates that we're seeking for each weekday's second occurrence.

The following formula is found in cell C6:

=DATE($A6,$B6,1)+C$4-WEEKDAY(DATE($A6,$B6,1)+($B$2-(C$4>=WEEKDAY(DATE *7

Given a specified week number and frequency, this method uses simple algebra to determine which day within the month should be returned.

Simply enter the years and months you want to target in fields A6 and B6 to utilize the table. Then, in column B2, change the number of occurrences you need.

Enter a 1 in cell B2 and look in the Monday column if you're searching for the first Monday of each month. Enter a 3 in cell B2 and look in the Thursday column to get the third Thursday of each month.

Calculating the date of the last weekday of the month

Simply create a dynamic date table using the techniques discussed so far in this chapter to automatically supply you with the last occurrence of a specific weekday.

	A	B	C	D	E	F	G	H	I
1									
2			7	6	5	4	3	2	1
3	YEAR	MONTH	Last Sun of the Month	Last Mon of the Month	Last Tues of the Month	Last Wed of the Month	Last Thurs of the Month	Last Fri of the Month	Last Sat of the Month
4	2014	1	1/26/2014	1/27/2014	1/28/2014	1/29/2014	1/30/2014	1/31/2014	1/25/2014
5	2014	2	2/23/2014	2/24/2014	2/25/2014	2/26/2014	2/27/2014	2/28/2014	2/22/2014
6	2014	3	3/30/2014	3/31/2014	3/25/2014	3/26/2014	3/27/2014	3/28/2014	3/29/2014
7	2014	4	4/27/2014	4/28/2014	4/29/2014	4/30/2014	4/24/2014	4/25/2014	4/26/2014
8	2014	5	5/25/2014	5/26/2014	5/27/2014	5/28/2014	5/29/2014	5/30/2014	5/31/2014
9	2014	6	6/29/2014	6/30/2014	6/24/2014	6/25/2014	6/26/2014	6/27/2014	6/28/2014
10	2014	7	7/27/2014	7/28/2014	7/29/2014	7/30/2014	7/31/2014	7/25/2014	7/26/2014
11	2014	8	8/31/2014	8/25/2014	8/26/2014	8/27/2014	8/28/2014	8/29/2014	8/30/2014
12	2014	9	9/28/2014	9/29/2014	9/30/2014	9/24/2014	9/25/2014	9/26/2014	9/27/2014
13	2014	10	10/26/2014	10/27/2014	10/28/2014	10/29/2014	10/30/2014	10/31/2014	10/25/2014
14	2014	11	11/30/2014	11/24/2014	11/25/2014	11/26/2014	11/27/2014	11/28/2014	11/29/2014
15	2014	12	12/28/2014	12/29/2014	12/30/2014	12/31/2014	12/25/2014	12/26/2014	12/27/2014

The following formula is found in cell C4:

WEEKDAY(DATE($A4,$B4+1,C$2) =DATE($A4,$B4+1,1)

Given a year, month, and week number, this method uses simple algebra to determine which day within the month should be returned.

Simply enter the years and months you want to target in fields A4 and B4 to utilize the table. The aim is to utilize this table in your Excel models as a source of dates that you can connect to or just copy from.

Portioning out a time

Isolating a particular time period is usually advantageous. Excel provides a fundamental set of tools for breaking down time into its component parts.

The actions are as follows:

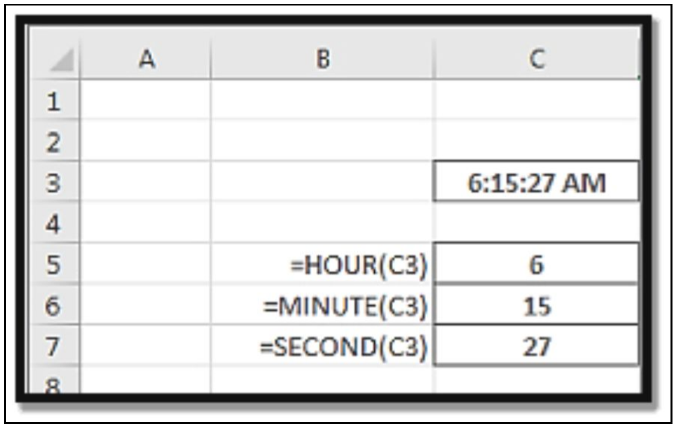
• The HOUR function separates out the hour portion of a time value.

• The MINUTE function separates out the minute portion of a time value.

A function called SECOND can be used to get the second half of a given time value.

These are quite simple operations. The current hour is represented as a number between 0 and 23 that is generated by the HOUR function. This formula yields the number 6.

ONE HOUR ("6:15:27 AM")



	A	B	C
1			
2			
3			6:15:27 AM
4			
5		=HOUR(C3)	6
6		=MINUTE(C3)	15
7		=SECOND(C3)	27
8			

The MINUTE function produces a number ranging from 0 to 59 that represents the minutes of a given time. This formula yields a result of 15.

=ONE MINUTE ("6:15:27 AM")

The SECOND function produces a value between 0 and 59, which represents the number of seconds in a given time. The result of this formula is 27.

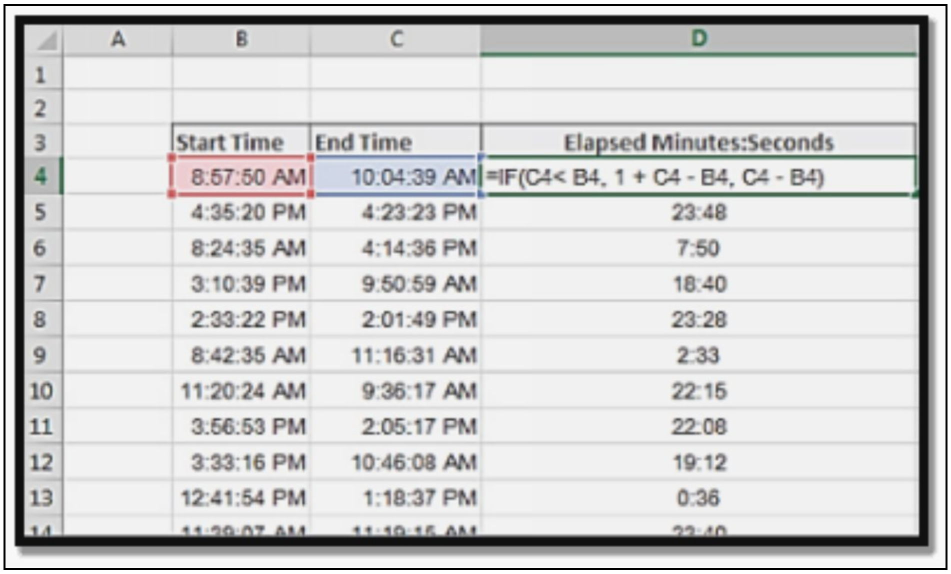
SECOND = ("6:15:27 AM")

Calculating elapsed time

Calculating the elapsed time, or the number of hours and minutes between a start and an end time is one of the most typical computations done using time data.

A list of start and finish timings, as well as computed elapsed times, is shown in the table. Cell D4 has the following formula:

=IF(C4 B4, 1 + C4 - B4, C4 - B4) =IF(C4 B4, 1 + C4 - B4, C4 - B4)



	A	B	C	D
1				
2				
3		Start Time	End Time	Elapsed Minutes:Seconds
4		8:57:50 AM	10:04:39 AM	=IF(C4< B4, 1 + C4 - B4, C4 - B4)
5		4:35:20 PM	4:23:23 PM	23:48
6		8:24:35 AM	4:14:36 PM	7:50
7		3:10:39 PM	9:50:59 AM	18:40
8		2:33:22 PM	2:01:49 PM	23:28
9		8:42:35 AM	11:16:31 AM	2:33
10		11:20:24 AM	9:36:17 AM	22:15
11		3:56:53 PM	2:05:17 PM	22:08
12		3:33:16 PM	10:46:08 AM	19:12
13		12:41:54 PM	1:18:37 PM	0:36

To calculate the elapsed time between two times, just subtract the start and finish times. However, there is a catch. If the end time is smaller than the start time, you must assume the clock has been operating for the whole 24-hour period, thus looping the clock backward.

In these circumstances, you must double the time by one to reflect on a complete day. This prevents you from having negative elapsed times.

We utilize a **Whether function** in our elapsed time calculation to see if the end time is smaller than the start time. If this is the case, we must add a 1 to our basic subtraction. If it isn't the case, we may just subtract.

=IF(C4 B4, 1 + C4 - B4, C4 - B4) =IF(C4 B4, 1 + C4 - B4, C4 - B4)

Rounding time values

It's common to need to round time to a certain increment. If you're a consultant, for example, you may want to round up to the next 15-minute increment or down to 30-minute increments all the time.

Start Time	End Time	Elapsed Minutes:Seconds	Round Up to Nearest 15 Minutes	Round Down to Nearest 30 minutes
8:49:12 AM	10:03:56 AM	1:14	10:15	10:00
10:58:31 AM	10:18:55 AM	23:20	10:30	10:00
9:23:37 AM	1:48:26 PM	4:24	14:00	13:30
8:39:16 AM	4:40:22 PM	8:01	16:45	16:30

Cell E4 has the following formula:

=ROUNDUP(C4*24/0.25,0)*(0.25/24)

Cell F4 has the following formula:

=ROUNDDOWN(C4*24/0.5,0)*(0.5/24)

By multiplying a time number by 24, sending it through the ROUNDUP function, and then dividing the result by 24, you may round a time value to the closest hour.

This formula, for example, would yield 7:00:00 AM:

=ROUNDUP ("6:15:27"*24,0)/24

Simply split 24 by 0.25 to get to 15-minute intervals (a quarter). This formula would provide the following result at 6:30 a.m.:

=ROUNDUP ("6:15:27"*24/0.25,0) *(0.25/24)

Divide 24 by 0.5 to get to 30-minute intervals (a half). 6:00:00 AM would be returned by this formula:

=ROUNDDOWN ("6:15:27"*24/0.5,0) *(0.5/24)

Converting decimal hours, minutes, or seconds to a time

It's fairly unusual to get a feed with timings recorded in decimal hours from an external source. For example, instead of the typical 1:30, you'll see 1.5 for 1 hour and 30 minutes. By dividing the decimal hour by 24 and presenting the result as a time, you can easily remedy this.

When you divide a decimal hour by 24, you get a decimal that Excel understands as a time value.

Divide the number by 1440 to convert decimal minutes to time. 1:04 (one hour and four minutes) is the result of this formula:

=64.51/1440

Divide the value by 86400 to convert decimal seconds to the time. 0:06 (six minutes) will be returned by this formula:

=390.45/86400

Adding hours, minutes, or seconds to a time

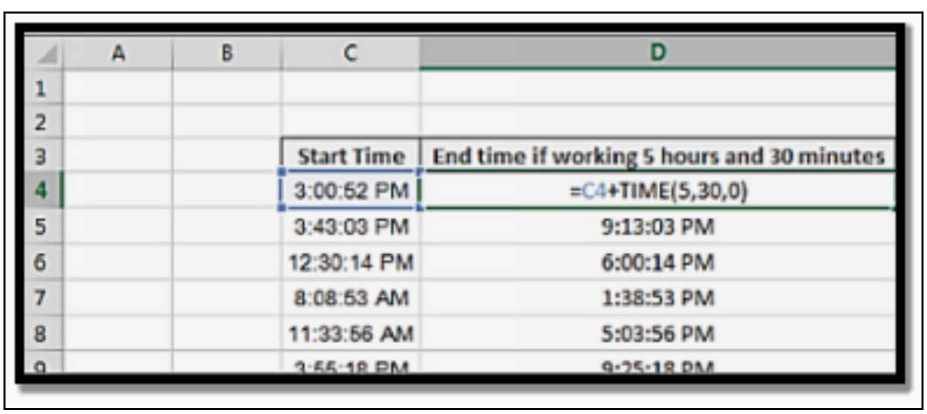
You can put two-time values together to generate a cumulative time value since time values are only a decimal extension of the date serial number system. You may wish to add a certain number of hours and minutes to an existing time value in various instances. You may utilize the TIME function in these instances.

We're going to add 5 hours and 30 minutes to all of the timings in this example.

The TIME function takes three arguments: hour, minute, and second, and generates a time value on the fly.

This formula, for instance, would produce the time value 2:30:30 PM:

=TIME (14,30,30)



	A	B	C	D
1				
2				
3			Start Time	End time if working 5 hours and 30 minutes
4			3:00:52 PM	=C4+TIME(5,30,0)
5			3:43:03 PM	9:13:03 PM
6			12:30:14 PM	6:00:14 PM
7			8:08:53 AM	1:38:53 PM
8			11:33:56 AM	5:03:56 PM
9			3:55:18 PM	9:25:18 PM

Simply use the **TIME function** to create a new time value and then add them together to add a specified number of hours to an existing time value.

This formula adds 30 minutes to the current time, yielding a 3:00 PM time value:

+ TIME="2:30:00 PM" + TIME="2:30:00 PM" + TIME="2:30:00 PM" (0, 30, 0)

CHAPTER 5

CONDITIONAL ANALYSIS IMPLEMENTING FORMULAS

Conditional analysis can be carried out using a number of worksheet functions in Excel. Several of those features will be used in this section. Depending on whether or not a set of criteria is met, different actions can be taken using conditional analysis.

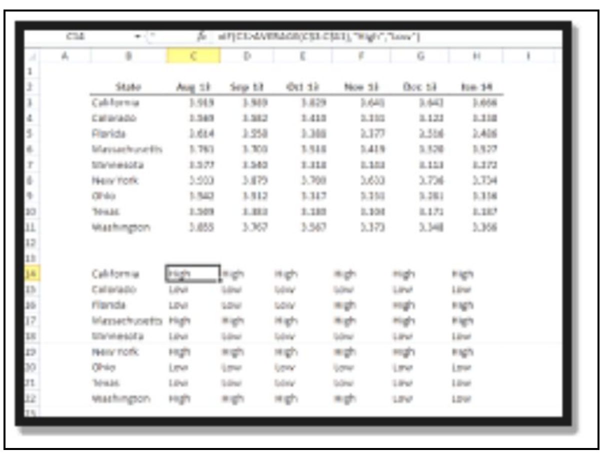
Conditional Analysis: An Overview

A condition is a value that, when TRUE or FALSE, results in TRUE or FALSE. Depending on how the condition is evaluated, a formula may branch into two separate calculations. When the condition evaluates TRUE, only one object or phrase is considered, leaving the other out. With a FALSE condition, the formula's direction of flow is reversed, and the first value or expression is ignored while the other is considered.

Verifying a straightforward condition is met

The table below shows a list of states and six-month gas prices. Say you want to compare each price to the national average for that month to determine whether it is greater or cheaper. For prices that are more or lower than average, you should report "High" for higher prices and "Low" for lower prices. A grid will be used to present the findings beneath the data.

=IF(C3>AVERAGE(C$3:C$11),"High", “Low")



The IF function in Excel is the most fundamental conditional analysis function. The condition, what to do if the condition is true, and what to do if the condition is false are the three arguments.

C3>AVERAGE(C$3:C$11) is the condition parameter in this case. Condition parameters must be designed to return TRUE or FALSE, which typically involves using a comparison operation (like as equals or greater-than). The greater-than sign in the example condition calculates the amount in C3 to the average of all the values in C3:C11.

The second parameter of the IF function is returned to the cell if our condition argument returns TRUE. The second argument is High, and because the number in C3 is higher than the average, the word High appears in cell C14.

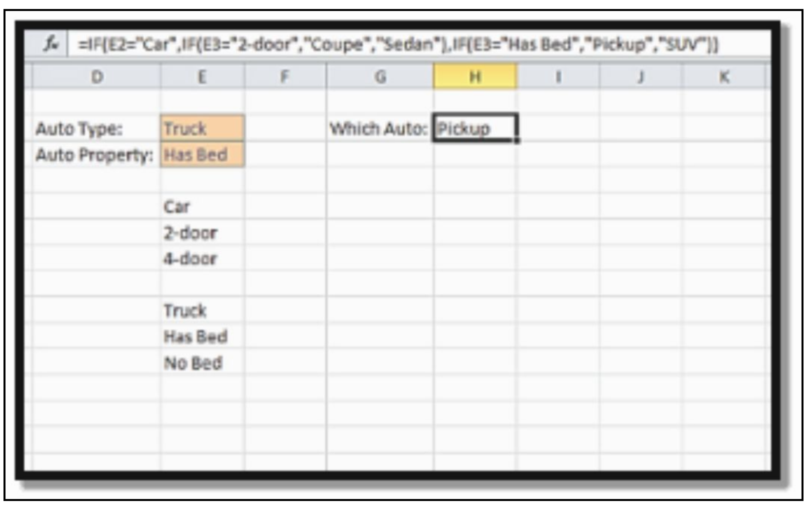
The value in C4 is compared to the average in cell C15. The condition argument returns FALSE since it is lower, and the third argument is returned. Low, the third parameter of the IF function, is seen in cell C15.

Multiple conditions are being checked

Simple circumstances can be connected in a chain. They are known as nesting functions. To the value if true and value if false parameters, simple conditions may be applied. This enables you to test various assumptions, each of which depends on the preceding one.

Two ranges of the attributes are displayed underneath the user input fields. If the user chose a coupe, sedan, truck, or SUV when choosing the kind and property, we want a formula to show which one they chose.

=IF (E2="Car”, IF(E3="2-door","Coupe","Sedan"),IF(E



The outcome of the first condition leads the second condition to change in certain conditional analyses. If the first requirement is Car, the second condition is 2-door or 4-door in this instance. If the first condition is Truck, however, the second criterion becomes Has Bed or No Bed.

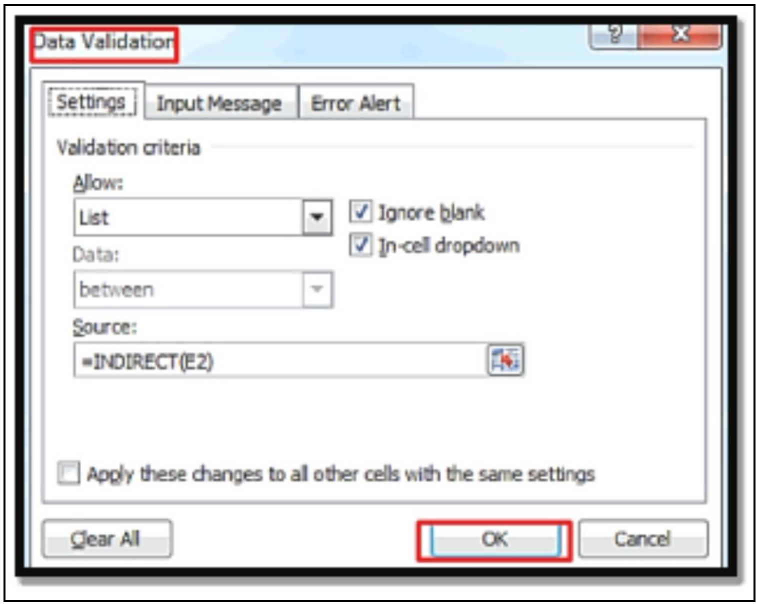
You've seen that the IF function in Excel can be used to do conditional analysis. When you need to check several conditions, you can nest IF functions by passing another IF function as a parameter to the first IF function. The first IF in this example verifies the value of E2. The second input is an IF formula that verifies the value of cell E3 rather than returning a value if TRUE. Similarly, the third parameter comprises a third IF function that evaluates cell E3 in addition to returning a result of FALSE.

Because E2 does not equal Car, the first IF yields FALSE, and the FALSE argument is processed. E3 is observed to be equal to Has Bed in that argument, and the TRUE condition (Pickup) is returned. The FALSE condition (SUV) would have resulted if the user had chosen No Bed.

Confirming conditional data

To fill out the user input fields, data validation lists are employed. The user may select from a drop-down box instead of entering data. By using an INDIRECT function to update its list in response to the value in Cell E2, Cell E3's data validation takes an unusual approach.

Two defined ranges can be found on the spreadsheet. In comparison to the Truck range, the Car range points to E6:E7, and vice versa. As with the E2 data validation list options, the names are the same. The source is a function that is INDIRECT when E2 is used as a parameter.

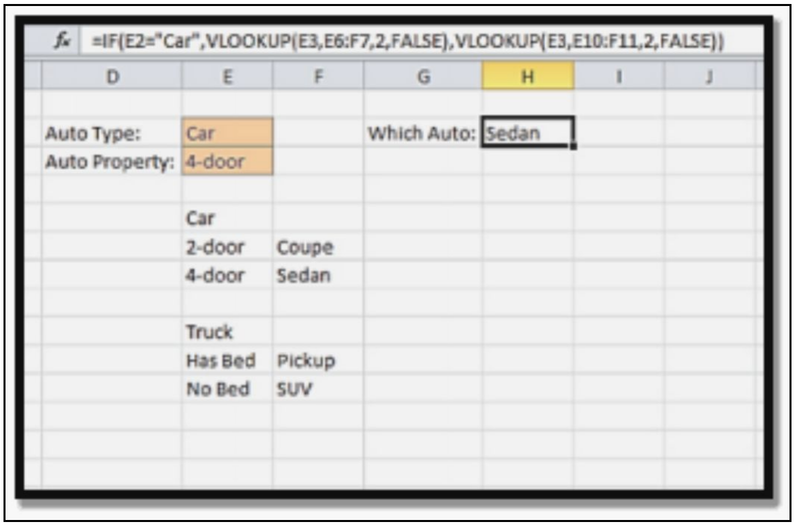


The **INDIRECT function** takes a text parameter and converts it to a cell address. Because E2 is Truck in this example, the formula becomes **=INDIRECT ("Truck")**. INDIRECT delivers a reference to E10:E11 since Truck is a named range, and the values in those cells become the options. INDIRECT would return E6:E7 if E2 contained Car, and those values would be the options.

When the value in E2 is modified, the value in E3 does not change, which is an issue with this form of conditional data validation. The options in E3 change, but the user must still choose from the available options or your calculations will provide incorrect results.

Looking up values

Your formulae grow lengthy and difficult to maintain if you use too many nested IF functions. The results are inserted into the cells adjacent to their attributes, rather than being hard-coded in nested IF functions (for example, Sedan is entered in the cell next to 4-door).



The following is the updated formula:

=IF (E2="Car",VLOOKUP(E3,E6:F7,2,FALSE),VLOOKUP(E3,E10:F11,2,FALSE))

This formula may now be utilized to get the car back to you. The IF condition remains the same, but a TRUE result now searches up the correct value in E6:E7, and a FALSE result looks it up in E10:F11.

Determining if both conditions 1 and 2 are satisfied

In addition to nested conditional functions, they can be evaluated collectively within an AND function. When two or more criteria need to be evaluated simultaneously, this is crucial for figuring out where the formula should branch.

In the table below, you can see a list of inventory goods, their prices, and the discounts that are applied when they are sold. The inventory items have three divisions, which are separated by hyphens. The item's department is the first condition, followed by a second condition indicating whether it is a component, a subassembly, or a finished assembly, and a third condition being a special four-digit number. A 10% discount will only be applied to items in Department 202 that are final assembly. Other products are not subject to any discounts.

=IF(AND(LEFT(B3,3)="202",MID(B3,5,3)="FIN"),10

=IF(AND(LEFT(B3,3)="202",MID(B3,5,3)="FIN"),10%,0%)

	A	B	C	D	E	F
1						
2		Inventory Item	Quantity	Discount		
3		202-PRT-3013	76	0%		
4		201-FIN-1452	69	0%		
5		202-FIN-8206	12	10%		
6		201-FIN-8238	79	0%		
7		203-FIN-8882	16	0%		
8		202-PRT-9587	87	0%		
9		203-FIN-4614	97	0%		
10		201-PRT-2478	25	0%		
11		202-SUB-1955	14	0%		
12		201-SUB-8641	67	0%		
13		202-FIN-9069	40	10%		
14		202-PRT-7937	61	0%		
15		201-SUB-3124	70	0%		
16		203-SUB-4369	16	0%		
17		202-FIN-6273	74	10%		
18		203-SUB-3972	85	0%		
19		203-PRT-3335	84	0%		
20		201-SUB-1022	48	0%		
21		203-FIN-3507	17	0%		

The IF function gives a 10% return if TRUE and a 0% return if FALSE. If both the first and second portions of the item number are 202, your expression for the condition parameter (the first argument) must return TRUE. Excel's AND function makes this possible. The AND function accepts comma-separated parameters of up to 255 bits each. Logical arguments are statements that can only result in TRUE or FALSE. In this case, there are only two logical arguments employed.

When the first three characters of B3 are equal to 202, the first logical argument, LEFT(B3,3)="202," returns TRUE. The second logical argument, MID(B3,5,3)="FIN," returns TRUE if the first three integers are equal to FIN.

functions for text manipulation

The AND function can only return TRUE if all of its logical parameters are TRUE. Any logical input that returns FALSE causes the AND function to return FALSE.

Because the first three characters of the item number are 202, the first logical condition in cell D3 returns TRUE. Because the center portion of the item number is PRT, not FIN, the second logical condition yields FALSE. A

TRUE and a FALSE condition both yield FALSE, and the outcome is 0%. In contrast, cell D5 returns TRUE since both logical requirements are true.

Referring to logical conditions in cells

Two logical criteria that evaluate TRUE or FALSE are included in the AND function. Cells may be referenced in AND arguments as long as they evaluate to TRUE or FALSE. When using the AND function in a formula, it's a good idea to separate the logical conditions into their cells. Two more columns are added to the inventory listing. These columns may be examined to see whether a certain item is eligible for a discount or not.

The outcome does not change as a consequence of these changes, but the formula does.

=IF(AND(D3,E3),10%,0%)

Checking if Condition1 OR Condition2 are met

Certain goods received a discount depending on their item number. In this case, we'd want to increase the number of goods that qualify for the discount. Only final assembly items will be eligible for the discount, as previously, but the departments will be enlarged to include both departments 202 and 203.

=IF(AND(OR(LEFT(B9,3)="202",LEFT(B9,3)="203"),MID(B9,5,3)="FIN"),10%,0%)

	A	B	C	D
1				
2		Inventory Item	Quantity	Discount
3		202-PRT-3013	76	0%
4		201-FIN-1452	69	0%
5		202-FIN-8206	12	10%
6		201-FIN-8238	79	0%
7		203-FIN-8882	16	10%
8		202-PRT-9587	87	0%
9		203-FIN-4614	97	10%
10		201-PRT-2478	25	0%
11		202-SUB-1955	14	0%
12		201-SUB-8641	67	0%
13		202-FIN-9069	40	10%
14		202-PRT-7937	61	0%
15		201-SUB-3124	70	0%
16		203-SUB-4369	16	0%
17		202-FIN-6273	74	10%
18		203-SUB-3972	85	0%
19		203-PRT-3335	84	0%
20		201-SUB-1022	48	0%
21		203-FIN-3507	17	10%
22		203-SUB-8304	31	0%

=IF(AND(OR(LEFT(B3,3) ="202”, LEFT(B3,3) ="203"),

To cater to the changes in the discount system, we've added a conditional parameter to the IF function. Because all of the inputs must be TRUE for AND to return TRUE, it is a restrictive function. The OR function, on the other hand, is inclusive. If any of the parameters is TRUE OR returns TRUE for the whole function. We've nested an OR function inside the AND function and made it one of the parameters in this example.

Cell D9 depicts a previously undiscounted product that now qualifies for the new scheme's discount. Because one of its arguments returns TRUE, the OR section, OR(LEFT(B9,3) ="202”, LEFT(B9,3)="203"), returns TRUE.

Making conditional computations

Typically, simple conditional methods like IF only affect one value or cell at a time. Two conditional methods in Excel that can be used to aggregate data are summing and average.

You'll discover some of the techniques for performing calculations based on a set of parameters in this section.

adding up all values that satisfy a particular criterion

The table displays a list of accounts with both positive and negative values. To ensure that they are equal, we will add up all the negative balances and compare them to the sum of all the positive balances. To sum numbers based on a condition, use Excel's SUMIF function.

=SUMIF(C3:C12,"<0")

=SUMIF(C3:C12,"<0")

	A	B	C
1			
2		Account	Balance
3		1510 Equipment	9,863.00
4		1540 Accumulated Depreciation	(9,502.00)
5		1690 Land	5,613.00
6		1915 Other Assets	8,653.00
7		2320 Wages Payable	(6,937.00)
8		2420 Current Portion of Long-term Debt	(6,826.00)
9		2440 Deposits from Customers	(3,717.00)
10		5800 Cost of Goods Sold, Other	73.00
11		5900 Purchase Returns and Allowances	(4,443.00)
12		6300 Charitable Contributions Expense	7,223.00
13			
14		Negative Balances	(31,425.00)
15		Positive Balances	31,425.00

Each value in C3:C12 is compared to the condition by SUMIF. If the amount is less than zero, it fulfills the requirement and is added to the total. The value is disregarded if it is zero or more. Blank cells and text values are likewise disregarded. Cell C3 is assessed first in this case. It is disregarded since it is bigger than zero. Cell C4 is then assessed. It gets added to the total since it fits our requirement of being less than zero. This is repeated for each cell. Cells C4, C7, C8, C9, and C11 are included in the total after it's finished, but the rest aren't.

SUMIF's second argument, the condition to be satisfied, is surrounded by quotations. We need to generate a string to represent the phrase since we're using a less-than sign in this case.

The sum range is an optional third input to the SUMIF function. We've been applying the condition to the numbers we've been summing so far. We may sum a set of numbers but apply our criteria to a separate set of numbers by utilizing the third parameter. Use the formula =SUMIF to add up the sales for the East region (B2:B11, "East", C2:C11).

Summing greater than zero

=SUMIF (C3:C12,">0") is the formula for that computation. The expression string is the sole difference here between the formula and our example formula. This formula uses ">0" as the second input instead of **"0."**

Because we're summing, and zero never modifies a total, we don't need to include zero in our computation. We couldn't just use "1000" and ">1000" as our second arguments if we wanted to sum numbers larger or less than 1,000 since we'd never include anything that was precisely 1,000.

Make the greater than a greater than or equal to, such as ">=1000," or the less than a less than or equal to, such as "=1000," when using more than or less than a nonzero value in a SUMIF. Instead of using the equal sign for both, use just one. This ensures that any values that are precisely 1,000 are included in one of the calculations but not both.

It may be difficult to remember the syntax required to utilize your comparison operators.

In the second parameter, you may use the TODAY function (to retrieve the current date) or most other functions. Use the formula =SUMIF(B3:B11,TODAY(),C3:C11) to sum a range of values that correspond to today. Concatenate the less-than-or-equal-to sign to the function, such as =SUMIF(B3:B11,"="&TODAY(),C3:C11), to sum only those numbers that are today or earlier.

In the condition parameter to SUMIF, you may use one of two wildcard characters. The asterisk (*) indicates zero, one, or any number of characters, whereas the question mark (?) represents any single character. =SUMIF(B2:B11,"?o*", C2:C11) sums all values in C2:C11 that match to values in B2:B11 where the second letter is a lowercase o. Because both the North and South contain a lowercase o as the second letter while the East does not, if we apply that formula to the data, we will receive the total for sales in both areas.

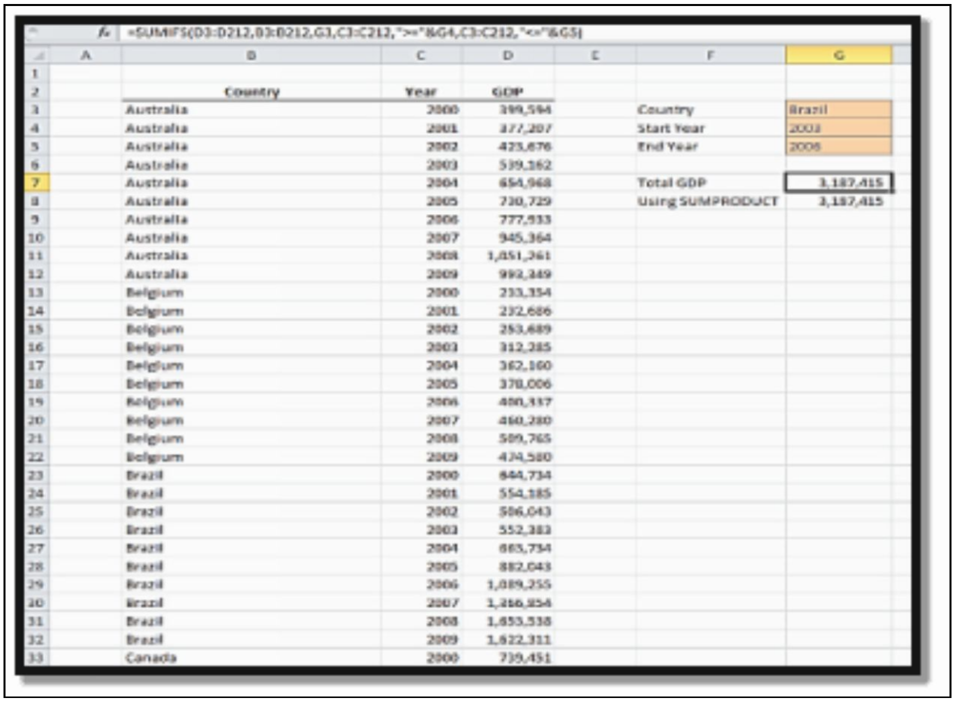
To Set a Condition…	…Follow These Rules	For Example
Equal to a number or cell reference	Don't use an equal sign or any double quotes.	=SUMIF(A1:A10,3)
Equal to a string	Don't use an equal sign, but put the string in quotes.	=SUMIF(A1:A10,"book")
Nonequal comparison to a number	Put both the operator and the number in double quotes.	=SUMIF(A1:A10,">=50")
Nonequal comparison to a string	Put both the operator and the string in double quotes.	=SUMIF(A1:A10,"<>Payroll")

Adding up all figures that fall under two or more conditions

SUMIF has the limitation that it only functions under one condition. The SUMIFS function can be used when many conditions are necessary.

The table lists a select group of countries from 2000 to 2009 along with their GDP (GDP). We want to sum the GDP of Brazil from 2003 to 2006. When two or more requirements must be met, like in this case, Country and Year, the SUMIFS worksheet function in Excel is used to sum data.

=SUMIFS(D3:D212,B3:B212,G3,C3:C212,">="&G4,C3


=SUMIFS(D3:D212,B3:B212,G3,C3:C212,">="&G4,C3:C212,"<="&G5)

	A	B	C	D	E	F	G
1							
2		Country	Year	GDP			
3		Australia	2000	399,594		Country	Brazil
4		Australia	2001	377,207		Start Year	2003
5		Australia	2002	423,676		End Year	2006
6		Australia	2003	539,162			
7		Australia	2004	654,968		Total GDP	3,187,415
8		Australia	2005	730,729		Using SUMPRODUCT	3,187,415
9		Australia	2006	777,933			
10		Australia	2007	945,364			
11		Australia	2008	1,051,261			
12		Australia	2009	992,349			
13		Belgium	2000	233,354			
14		Belgium	2001	232,686			
15		Belgium	2002	253,689			
16		Belgium	2003	312,285			
17		Belgium	2004	362,160			
18		Belgium	2005	378,006			
19		Belgium	2006	400,337			
20		Belgium	2007	460,280			
21		Belgium	2008	509,765			
22		Belgium	2009	474,580			
23		Brazil	2000	644,734			
24		Brazil	2001	554,185			
25		Brazil	2002	506,043			
26		Brazil	2003	552,383			
27		Brazil	2004	663,734			
28		Brazil	2005	882,043			
29		Brazil	2006	1,089,255			
30		Brazil	2007	1,366,854			
31		Brazil	2008	1,653,538			
32		Brazil	2009	1,622,311			
33		Canada	2000	739,451			

The SUMIFS parameters begin with the range containing the value to be summed. The remaining parameters are in pairs, with criteria range, criteria as the pattern. SUMIFS will always have an odd number of arguments due to the way the arguments are written out. The first criterion pair is essential; SUMIFS would be the same as SUM if it didn't have at least one condition. The remaining condition pairings, which may total up to 126, are optional.

=SUMIFS(D3:D212,B3:B212,G3,C3:C212,">="&G4,C3:C212,"<="&G5)

Each cell in D3:D212 is added to the total only if the equivalent values in B3:B212 and C3:C212 fulfill the constraints in this example. The B3:B212 criterion is that it must match whatever is in cell G3. Because we need to identify the bottom and upper bounds of our year range, we have two-year conditions. Cell G4 has the lower limit, whereas cell G5 has the upper bound. The year conditions are created by concatenating the two cells with more than or equal to and less than or equal to, respectively. The value is only included in the total if all three requirements are met.

Summing if values fall between a given date range

Adding or subtracting several SUMIF computations is one technique to utilize SUMIF with two or more criteria. This is a good technique to employ multiple conditions if the two conditions operate on the same range. When you wish to test various ranges, the formulae get more complicated since you must avoid double counting numbers.

The total of the data between June 23 and June 29, inclusive, is what we're looking for. Cells F4 and F5 will be used to record the start and end dates, respectively.

=SUMIF(B3:B20,"<="&F5,C3:C20) -SUMIF(B3:B20,"

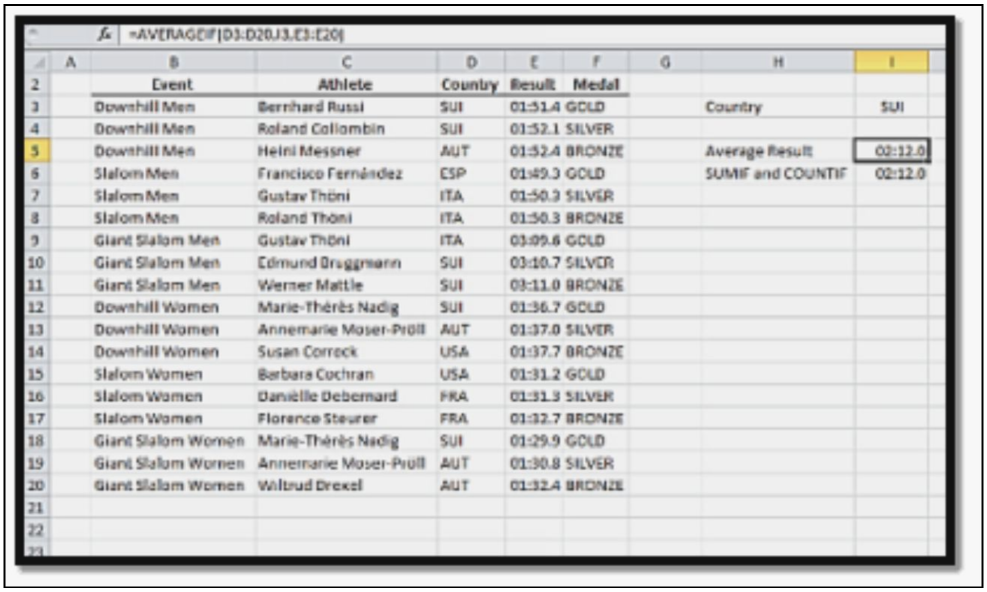
To reach the required result, this approach subtracts one SUMIF from another. SUMIF(B3:B20,"="&F5, C3:C20) gives the total of the values less than or equal to the date in F5, which in this case is June 29. The less-than-or-equal-to operator is concatenated with the cell reference F5 as the conditional argument. The result would be 5,962.33 if it was the whole formula. However, only values greater than or equal to June 23 are acceptable. That is, we want to exclude our numbers lower than June 23. This is accomplished in the second SUMIF. To find the total of values between the two dates, add everything less than or equal to the later date and remove everything less than the older date.

Using SUMIFS

You could even find SUMIFS easier to use than the subtraction method. The formula =SUMIFS(C3:C20,B3:B20,"="&F5,B3:B20,">="&F4) adds the values in C3:C20 that match the criteria pairs to the values in B3:B20. The first criterion pair, "="&F5, is the same as the first SUMIF criteria. The second set of criteria restricts dates to those that are larger than or equal to the commencement date.

Getting a count of values that meet a certain condition

In Excel, aggregation isn't limited to summing values. Excel has methods for conditionally counting values in a range, similar to SUMIF and SUMIFS.



=AVERAGEIF(D3:D20,I3,E3:E20)

	A	B	C	D	E	F	G	H	I
2		Event	Athlete	Country	Result	Medal			
3		Downhill Men	Bernhard Russi	SUI	01:51.4	GOLD		Country	SUI
4		Downhill Men	Roland Collombin	SUI	01:52.1	SILVER			
5		Downhill Men	Heini Messner	AUT	01:52.4	BRONZE		Average Result	02:12.0
6		Slalom Men	Francisco Fernández	ESP	01:49.3	GOLD		SUMIF and COUNTIF	02:12.0
7		Slalom Men	Gustav Thöni	ITA	01:50.3	SILVER			
8		Slalom Men	Roland Thöni	ITA	01:50.3	BRONZE			
9		Giant Slalom Men	Gustav Thöni	ITA	03:09.6	GOLD			
10		Giant Slalom Men	Edmund Bruggmann	SUI	03:10.7	SILVER			
11		Giant Slalom Men	Werner Mattle	SUI	03:11.0	BRONZE			
12		Downhill Women	Marie-Thérès Nadig	SUI	01:36.7	GOLD			
13		Downhill Women	Annemarie Moser-Pröll	AUT	01:37.0	SILVER			
14		Downhill Women	Susan Corrock	USA	01:37.7	BRONZE			
15		Slalom Women	Barbara Cochran	USA	01:31.2	GOLD			
16		Slalom Women	Danièlle Debernard	FRA	01:31.3	SILVER			
17		Slalom Women	Florence Steurer	FRA	01:32.7	BRONZE			
18		Giant Slalom Women	Marie-Thérès Nadig	SUI	01:29.9	GOLD			
19		Giant Slalom Women	Annemarie Moser-Pröll	AUT	01:30.8	SILVER			
20		Giant Slalom Women	Wiltrud Drexel	AUT	01:32.4	BRONZE			

From 2000 to 2009, a limited list of nations and their gross domestic product is available. We're curious how many times the GDP was larger than or equal to one million dollars. Cell G3 will contain the criteria that will be used.

=COUNTIF(D3:D212,G3)

The COUNTIF function is comparable to the SUMIF function. The apparent distinction, as the name implies, is that it counts rather than sums items that fit the requirements. Another distinction is that, unlike SUMIF, there is no optional third parameter. You may use SUMIF to sum a range that isn't the same as the range to which the condition is applied. That wouldn't work with COUNTIF since counting a different range would provide the same result.

The criterion argument in this formula is constructed using a slightly different method. Rather than in the function's second parameter, the string concatenation happens entirely in cell G3. Instead of merely pointing to G3, the second argument would look like ">=1000000" or ">="&G3 if we had done it the same way as SUMIF. It's also worth noting that the formula in G3, =">="&106, calculates 1 million using the exponent operator, or a caret (). Using the caret to represent huge numbers may help you avoid problems caused by miscounting the number of zeros you wrote.

Counting values that satisfy two or more criteria

The SUMIF function has a cousin called COUNTIF. Without simultaneously developing COUNTIFS for counting them, Microsoft could not have introduced

SUMIFS for summing multiple conditions.

Here is a list of the 1972 Winter Olympics Alpine Skiing medal winners. How many silver medalists' last names begin with the letter ö? Enter the letter we're looking for in cell I3 and the type of medal in cell I4.

=COUNTIFS(C3:C20,"*"&I3&"*",F3:F20,I4)

Like in SUMIFS, the criteria range and criteria arguments occur in pairs. COUNTIFS always has an even number of parameters, but SUMIFS always has an odd number.

The list of athlete names in C3:C20 is the first criteria range parameter. The "*"&I3&"*" matching criteria argument encircles whatever is in I3 with asterisks. In COUNTIFS, asterisks are wildcard characters that can represent zero, one, or more characters of any kind. We're telling Excel to count all of the names that have that character anywhere in the name by using an asterisk both before and after the character. That is, we don't mind whether there are zero, one, or more characters before ö, or if there are zero, one, or more characters following ö as long as that character appears somewhere.

In the second criteria range, the criteria argument pair counts the number of SILVER items in F3:F20 (the value typed into I4). Only rows in which both the first and second argument pairs match (only rows in which the athlete's name includes the letter ö and the medal won was silver) are counted. In this case, Gustav Thöni took silver in the Men's Slalom, while Annemarie Moser-Pröll finished third in both the Women's Downhill and the Women's Giant Slalom.

finding unusual characters

The ö was typed into cell I3 by pressing and holding the Alt key while typing 0246 on the numeric keypad. If you try to type those digits on the number keys that run across the top of your keyboard, nothing will happen. The ASCII code 246 is used to represent the letter ö. Every character in this chapter has an ASCII code.

Cell H8 has a small database of characters and their codes.

I12. =MID($C$8,ROW(),1) obtains the eighth character from the name in column C8 in cell H8. (The eighth character was randomly chosen.) The character we were looking for was almost there but not quite.) Until the character we're seeking for shows up, this method is repeated down a few rows. We're looking for the person in H10. The anchoring function of the dollar signs in $C$8 ensures that the cell reference does not change while the formula is replicated. The ROW() function returns the row of the cells it is in without taking an argument. As the formula is copied down, ROW() produces the values 8, 9, and so forth.

The formula =CODE appears in cell I8 (H8). The ASCII code for the letter supplied is returned by the CODE worksheet function. A capital T is ASCII code 84, a lowercase I is ASCII code 105, and ö is ASCII code 246 in this example. With this information, we may hold down the Alt key and input the code to utilize that character anywhere we wish.

Getting the average of all numbers that meet a certain condition

After summing and counting, the most common aggregator is taking an average of a set of numbers. The average is the total of the numbers divided by the count of the numbers, commonly known as the arithmetic mean.

We only want to look at the average outcome for skiers from Switzerland. Cell I3 contains the country code, which may be readily changed to another nation.

=AVERAGEIF(D3:D20,I3,E3:E20)

The AVERAGEIF function in Excel allows us to do exactly what we want. AVERAGEIF, like its cousin SUMIF, contains a criteria range and a criterion argument. The range to average is the last argument. In this example, depending on whether the relevant cell in D3:D20 fits the requirements, each cell in E3:E20 is either included in or removed from the average.

The function returns the #DIV/0! error if no rows fit the conditions in AVERAGEIF.

Getting the average of all numbers that meet two or more conditions

AVERAGEIFS, along with **SUMIFS and COUNTIFS**, was created by Microsoft to enable you to average a range of data depending on many conditions.

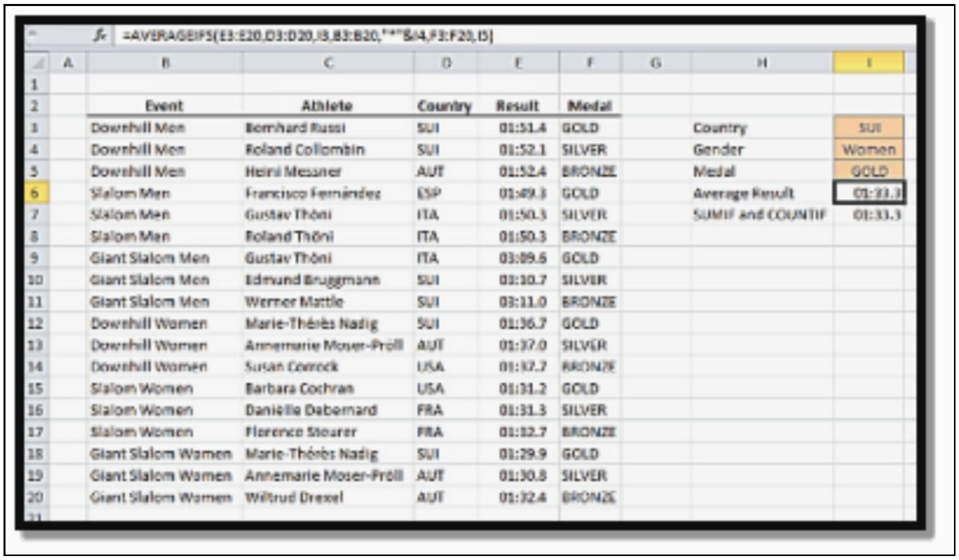
The table below provides some results from the 1972 Winter Olympics, as we continue our research of skiing timings. In this example, we wish to calculate the average time depending on many factors. Cells I3:I5 are used to record the nation, gender, and medal. Only the results that match all three criteria should be averaged.

=AVERAGEIFS (E3:E20,D3:D20,I3,B3:B20,"*"&I4,F3

The structure of the AVERAGEIFS function is identical to that of the SUMIFS function. The range to average is the first parameter, which is followed by up to 127 criteria range/criteria arguments.

The following are the three criterion pairs:

- Only the rows with the country code SUI are included in D3:D20, I3.
- B3:B20,"*"&I4 only contain rows containing the term Women at the end of the event name.
- Only the rows where the medal is GOLD are included in F3:F20, I5.



=AVERAGEIFS(E3:E20,D3:D20,I3,B3:B20,"*"&I4,F3:F20,I5)

	Event	Athlete	Country	Result	Medal		
3	Downhill Men	Bernhard Russi	SUI	01:51.4	GOLD	Country	SUI
4	Downhill Men	Roland Collombin	SUI	01:52.1	SILVER	Gender	Women
5	Downhill Men	Heini Messner	AUT	01:52.4	BRONZE	Medal	GOLD
6	Slalom Men	Francisco Fernández	ESP	01:49.3	GOLD	Average Result	01:33.3
7	Slalom Men	Gustav Thöni	ITA	01:50.3	SILVER	SUMIF and COUNTIF	01:33.3
8	Slalom Men	Roland Thöni	ITA	01:50.3	BRONZE		
9	Giant Slalom Men	Gustav Thöni	ITA	03:09.6	GOLD		
10	Giant Slalom Men	Edmund Bruggmann	SUI	03:10.7	SILVER		
11	Giant Slalom Men	Werner Mattle	SUI	03:11.0	BRONZE		
12	Downhill Women	Marie-Thérès Nadig	SUI	01:36.7	GOLD		
13	Downhill Women	Annemarie Moser-Pröll	AUT	01:37.0	SILVER		
14	Downhill Women	Susan Corrock	USA	01:37.7	BRONZE		
15	Slalom Women	Barbara Cochran	USA	01:31.2	GOLD		
16	Slalom Women	Danièlle Debernard	FRA	01:31.3	SILVER		
17	Slalom Women	Florence Steurer	FRA	01:32.7	BRONZE		
18	Giant Slalom Women	Marie-Thérès Nadig	SUI	01:29.9	GOLD		
19	Giant Slalom Women	Annemarie Moser-Pröll	AUT	01:30.8	SILVER		
20	Giant Slalom Women	Wiltrud Drexel	AUT	01:32.4	BRONZE		

The time in the Result column is averaged when all three requirements are satisfied.

CHAPTER 6

APPLICATION OF MATCHING AND LOOKUPS FORMULAS

This section describes many approaches for looking up a value in a set of data. LOOKUP, VLOOKUP, and HLOOKUP are three worksheet functions in Excel that were created specifically for this purpose, but you might find that they are not enough.

In this section, you'll also look at a variety of lookup scenarios and alternative approaches that go beyond Excel's built-in lookup features.

Explanation of Lookup Formulas

In order to retrieve a value from a table, a lookup formula searches for a related value. An appropriate analog is a regular phone book (remember those?). You must first identify the person's name in order to retrieve their phone number if you want to check up on them.

Nota Bene: A table is any rectangular range of data. The table that results from choosing Insert > Tables > Table is not need to be a "official" table.

Many Excel functions are useful for creating formulas to look up information in tables.

Function	Description
CHOOSE	Returns a specific value from a list of values supplied as arguments.
HLOOKUP	Horizontal lookup. Searches for a value in the top row of a table and returns a value in the same column from a row you specify in the table.
IF	Returns one value if a condition you specify is TRUE and returns another value if the condition is FALSE.

IFERROR	If the first argument returns an error, the second argument is evaluated and returned. If the first argument does not return an error, then it is evaluated and returned.
INDEX	Returns a value (or the reference to a value) from within a table or range.
LOOKUP	Returns a value from either a one-row or one-column range. Another form of the LOOKUP function works like VLOOKUP but is restricted to returning a value from the last column of a range.
MATCH	Returns the relative position of an item in a range that matches a specified value.

Using the Lookup Functions in Excel

Excel computations frequently require data to be located in a list or table. There are various functions in Excel that can be used to search for data horizontally, vertically, left to right, or right to left. By layering several of these methods, you may create a formula that looks for the appropriate data even if your table's layout changes.

Let's find one of the most common ways to use Excel's lookup functions.

Searching for a certain value using the left lookup column

The most crucial information, the material that sets one row apart from another, is frequently placed in the far-left column in tables. Excel has a number of lookup functions, but VLOOKUP was made with this exact use in mind. We wish to use information from this database to fill out a more straightforward paystub form when an employee's ID is selected.

The user will select an employee ID from a data validation list and enter it in cell L3. The form of the data will include the name, address, and other data related to the employee.

In the calculation, the employee's name is retrieved using the VLOOKUP function. The four inputs of VLOOKUP are lookup value, lookup range, column, and match. VLOOKUP will look through the first column of the lookup range until it locates the desired value. Once the lookup value has been located, VLOOKUP returns the value in the column specified by the column parameter. In this case, the second input column is where VLOOKUP pulls the employee's name from.

In this example, FALSE is the final parameter for all VLOOKUP procedures. Only an exact match will be returned by VLOOKUP if the match option is set to FALSE, otherwise it will not. If an exact match cannot be found, VLOOKUP returns N/A#.

Although there are some differences, VLOOKUP is used in the other formulae as well. Although they use information from a different column, the address and insurance calculations work in the same way as the method for the employee's name. In the payment formula, two VLOOKUPs are employed, and one of them is divided by the other.

The employee's annual salary is taken from the fifth column, and the pay for one paystub is calculated by dividing it by the frequency from the fourth column.

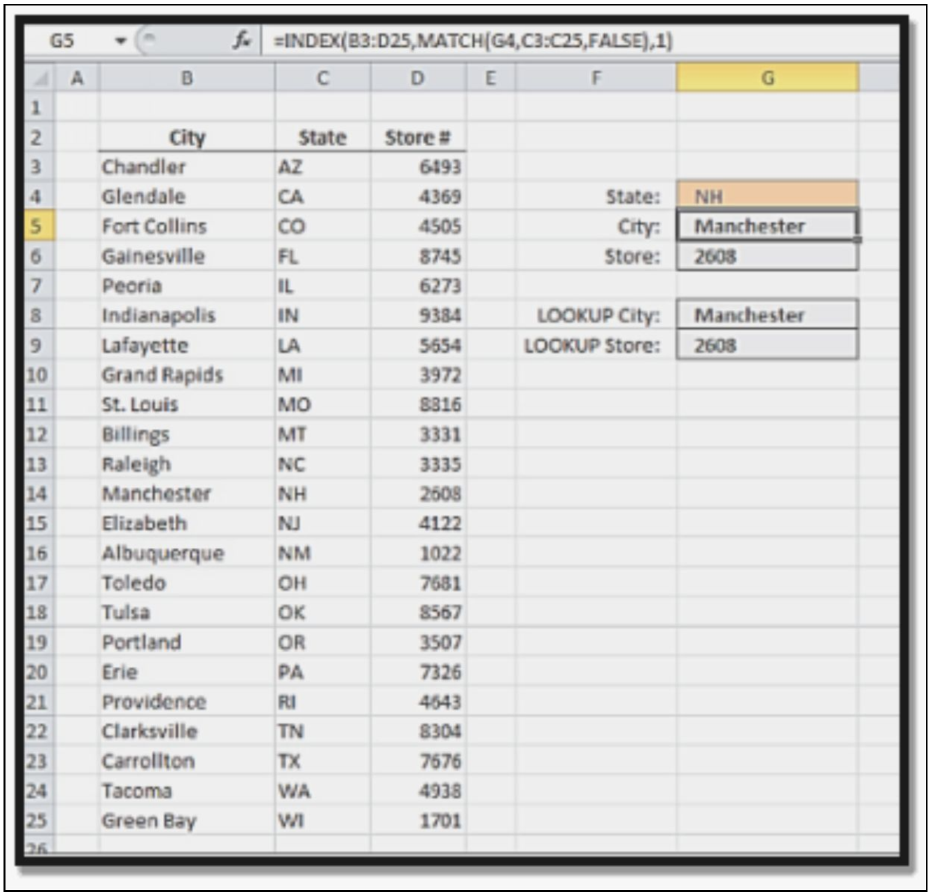
The percentage from the eighth column is taken by the retirement calculation and multiplied by the gross wage to determine the deduction. The tax formula then divides the gross salary by the tax rate, which is found using VLOOKUP in the sixth column, after deducting insurance and retirement from the total.

Of course, payroll calculations are more complicated, but once you know how VLOOKUP works, you can create more sophisticated models.

Searching for a certain value using any lookup column

It's possible that not all tables will include the value you want to look for in the leftmost column. Thankfully, Excel offers several options for retrieving values that are to the right of the value you are looking for.

Our stores are located in the cities and states listed in the table below. We want to return the city and store number when a user selects a state from a drop-down menu.



=INDEX(B3:D25, MATCH(G4,C3:C25,FALSE),1)

=INDEX(B3:D25,MATCH) =INDEX(B3:D25,MATCH) =INDEX(B3:D (G4,C3:C25,FALSE),

The INDEX function returns the value of a range's first row and column. We provide it with our table of stores, a row parameter in the form of a MATCH function, and a column number in this example. We want the first column for the City formula, thus the column argument is 1. We want the third column for the Store formula; thus, the column argument is 3.

The row and column in the spreadsheet will not match the row and column in the spreadsheet unless the range you choose begins in A1. They only apply to the range's top-left cell, not the whole spreadsheet. The value in cell H3 would be returned by a formula like =INDEX(G2:P10,2,2). In the range G2:P10, cell H3 is in the second row and second column.

The MATCH function's second input can only be a one-row tall or one-column wide range. MATCH returns the #N/A error if you provide it with a rectangle-shaped range.

We utilize the **MATCH function** to find the relevant row. The place in the list where the lookup value is located is returned by the MATCH function. It is supported by three reasons.

- **Lookup value:** the value we're looking for.
- **Lookup array:** A single column or row in which to look.
- **Match type:** Set this option to FALSE or 0 for exact matches only.

The state in cell G4 is the value we're searching for in the range C3:C25, which is our list of states. MATCH searches the whole range for NH. INDEX uses 12 as the row parameter because it finds it in 12th place.

INDEX now has all it needs to return the correct value, thanks to MATCH. It moves to the 12th row of the range and extracts the value from either the first (for City) or third (for Store #) column.

INDEX returns the #REF! error if you supply it with a row number that is more than the number of rows in the range or a column number that is greater than the number of columns in the range.

Looking up values horizontally

If your lookup value is in the first row rather than the first column, and you want to seek data along the rows rather than across the columns, Excel provides a function just for you.

You'll restore the temperature to the cell right below it once the user selects a city from a drop-down box.

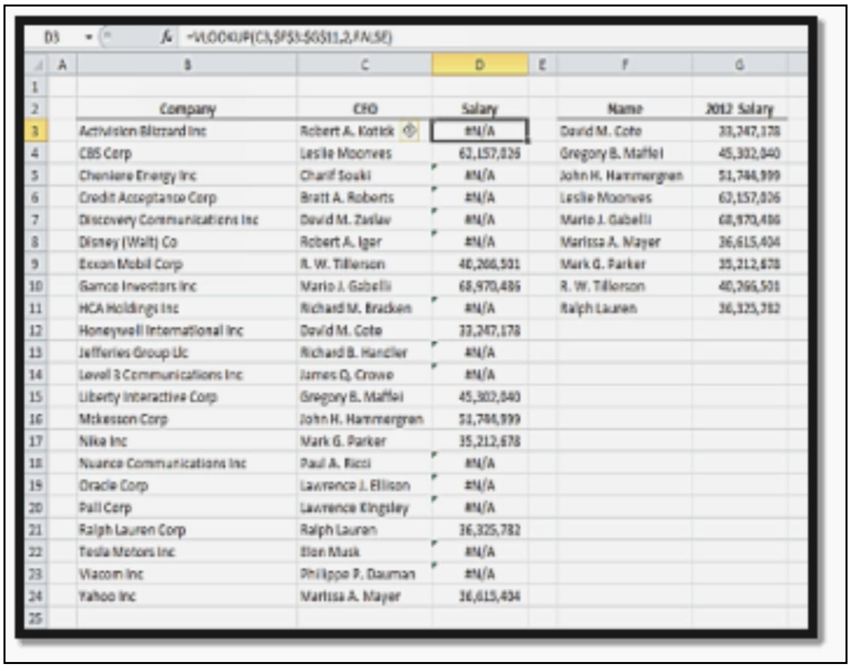
=HLOOKUP(C5,C2:L3,2,FALSE)

The parameters for the **HLOOKUP function** are the same as for VLOOKUP. The letter H in HLOOKUP stands for **"horizontal,"** whereas the letter V stands for **"vertical."** HLOOKUP searches across the first row instead of down the first column for the lookup value parameter. It gives a value from the second row of the matching column when it detects a match.

Hiding errors returned by lookup functions

At this time, we've used FALSE as the final parameter in our search routines to ensure that only precise matches are returned. The **#N/A error** is returned when we demand a lookup function to deliver an exact match and it can't locate one.

In Excel models, the #N/A error is beneficial since it warns you when a match cannot be found. However, you can be reporting on all or part of your model, and #N/As are unattractive. Excel offers features that may detect problems and deliver different results.



D3 =VLOOKUP(C3,$F$3:$G$11,2,FALSE)

	Company	CEO	Salary		Name	2012 Salary
3	Activision Blizzard Inc	Robert A. Kotick	#N/A		David M. Cote	33,247,178
4	CBS Corp	Leslie Moonves	62,157,026		Gregory B. Maffei	45,302,840
5	Cheniere Energy Inc	Charif Souki	#N/A		John H. Hammergren	51,744,999
6	Credit Acceptance Corp	Brett A. Roberts	#N/A		Leslie Moonves	62,157,026
7	Discovery Communications Inc	David M. Zaslav	#N/A		Mario J. Gabelli	68,970,486
8	Disney (Walt) Co	Robert A. Iger	#N/A		Marissa A. Mayer	36,615,404
9	Exxon Mobil Corp	R. W. Tillerson	40,266,501		Mark G. Parker	35,212,678
10	Gamco Investors Inc	Mario J. Gabelli	68,970,486		R. W. Tillerson	40,266,501
11	HCA Holdings Inc	Richard M. Bracken	#N/A		Ralph Lauren	36,325,782
12	Honeywell International Inc	David M. Cote	33,247,178			
13	Jefferies Group Llc	Richard B. Handler	#N/A			
14	Level 3 Communications Inc	James Q. Crowe	#N/A			
15	Liberty Interactive Corp	Gregory B. Maffei	45,302,840			
16	Mckesson Corp	John H. Hammergren	51,744,999			
17	Nike Inc	Mark G. Parker	35,212,678			
18	Nuance Communications Inc	Paul A. Ricci	#N/A			
19	Oracle Corp	Lawrence J. Ellison	#N/A			
20	Pall Corp	Lawrence Kingsley	#N/A			
21	Ralph Lauren Corp	Ralph Lauren	36,325,782			
22	Tesla Motors Inc	Elon Musk	#N/A			
23	Viacom Inc	Philippe P. Dauman	#N/A			
24	Yahoo Inc	Marissa A. Mayer	36,615,404			

The other list includes the names of CEOs as well as their compensation. The two tables are joined using the VLOOKUP function. However, we do not have pay data for all of the CEOs, and there are several #N/A inaccuracies.

=VLOOKUP(C3,$F$3:$G$11,2,FALSE)

The first parameter to the **IFERROR function** is a value or formula, and the second argument is an alternative return value. When the first argument fails, the second argument is used instead. When the first argument does not return an error, the first argument's results are returned.

We've made our alternative return value an empty string in this case. This maintains the report looking neat. You may, however, return whatever value you choose, such as "No information" or zero.

Note: #N/A, #DIV/0!, and #VALUE is among the errors that Excel may produce and the IFERROR function checks for them all. It's worth noting that you can't choose which faults IFERROR will capture.

There are three more error catching functions in Excel:

- If any error is returned by its argument, ISERROR returns TRUE.
- If its argument returns any error other than #N/A, ISERR returns TRUE.
- If the input returns #N/A, ISNA returns TRUE; otherwise, including other failures, it returns FALSE.

All of these error-trapping methods return TRUE or FALSE, and they're usually used with an IF function.

The process of selecting the closest match from a list of banded values

The VLOOKUP, HLOOKUP, and MATCH functions allow the data to be sorted in any direction. Each of them has a final parameter that requires the function to try for an exact match or, if it is unsuccessful, to return an error.

If you only need a close match, you may also apply these techniques on sorted data. The withholding table contains bands of values rather than every possible value that could be. The employee's pay band must first be determined, then the withholding in column D16 must be calculated using the information from that row.

=VLOOKUP(D15,B3:E10,3,TRUE)+(D15-

	A	B	C	D	E	F
1						
2		Wages over	But not over	Base amount	Percentage	
3		-	325	-	0.0%	
4		325	1,023	-	10.0%	
5		1,023	3,163	69.80	15.0%	
6		3,163	6,050	390.80	25.0%	
7		6,050	9,050	1,112.56	28.0%	
8		9,050	15,906	195.56	33.0%	
9		15,906	17,925	4,215.03	35.0%	
10		17,925		4,921.68	39.6%	
11						
12			Bi-weekly wage:	2,307.69		
13			Withholding allowances:	2		
14			Allowance:	303.80		
15			Wage less allowance:	2,003.89		
16			Withholding amount:	216.93		
17						
18						

To extract three pieces of data from the table, the formula employs three VLOOKUP functions. Each VLOOKUP formula's last input is set to TRUE, indicating that we only want a close match.

When using a final parameter of TRUE, the data in the lookup column must be sorted from lowest to highest to produce the right result. When the next value is greater than the lookup value, VLOOKUP stops looking down the first column. It finds the biggest value that isn't greater than the lookup value in this manner.

A lookup function that finds an approximate match does not locate the closest match. Rather, if the next highest value is closer to the lookup value, it finds the greatest match that isn't bigger than the lookup value.

You won't receive an error if the data in the lookup column isn't ordered lowest to highest, but you'll almost certainly get an inaccurate result. To discover an approximate match, the lookup routines perform a binary search.

A binary search begins in the lookup column's midpoint and decides whether the match will be in the first or second half of the values. Then it divides that half in half and, depending on the middle value, looks ahead or backward. This procedure is continued until the desired outcome is obtained.

Unsorted values may lead the lookup function to pick the incorrect half to look in and return bad data in a binary search.

Because 1,023 is the greatest number in the list that isn't bigger than our lookup value of 2,003.89, VLOOKUP stops at row 5.

The formula's three portions function as follows:

- The first **VLOOKUP** returns 69.80, which is the base amount in the third column.
- The second **VLOOKUP** subtracts the total wages from the **"Wages over"** amount.
- The fourth-column percentage is returned by the last VLOOKUP. The result of multiplying this percentage by the **"extra wages"** is added to the current amount.

The formula computes as follows when all three VLOOKUP functions are evaluated:

15.0 percent =69.80 + (2,003.89 – 1,023.90)

The lookup routines employ a significantly quicker way to discover an approximate match than an exact match. The function must check each value in the lookup column for an exact match. Setting the last option to TRUE reduces computation time if you know your data will always be ordered lowest to highest and will always include an exact match. If an exact match exists and the data is sorted, an approximate match search will always discover it.

The INDEX and MATCH functions are used to find the closest match.

All of our lookup formulas, including the INDEX and MATCH combination, are interchangeable. Similar to VLOOKUP and HLOOKUP, MATCH offers a conclusion that is used to identify approximations. Additionally, data that is ordered from highest to lowest can be used with MATCH.

The table's VLOOKUP-based calculation yields #N/A, as seen in cell D16. This is because VLOOKUP only examines the data that is present before the middle value of the lookup column when it determines that it is greater than the lookup value. Since our data is ordered ascendingly, the middle value is the only value that comes before any values lower than the lookup value.

Cell D18's INDEX and MATCH formula yields the right answer, as demonstrated here:

=INDEX(B3:E10,MATCH(D15,B3:B10,-1)+1,3)+(D15-INDEX(B3:E10,MATCH(D15,B3:B10,-1)+1,1))

*INDEX(B3:E10,MATCH (D15,B3:B10,-1)+1,4)*INDEX(B3:E10,MATCH (D15,B3:B10,-1)+1,4)*INDEX(B3

MATCH's last argument might be 1, 0, or 1.

- For data that is ordered from highest to lowest, 1 is utilized. It retrieves the lowest number bigger than the lookup value in the lookup column. There is no VLOOKUP or HLOOKUP comparable technique.
- For unsorted data, 0 is utilized to locate the precise match. It's the same as putting FALSE as the last parameter of VLOOKUP or HLOOKUP.
- For data that is ranked from lowest to highest, 1 is utilized. It determines the lookup column's biggest value that is less than the lookup value. It's the same as setting TRUE as the last parameter of VLOOKUP or HLOOKUP.

MATCH finds a value that is bigger than the lookup value with a final parameter of 1, and the formula adds 1 to the result to obtain the correct row.

Looking up values from multiple tables

Depending on the user's decision, the data you wish to look up may originate from many tables. A comparable computation is a withholding calculation. The user may choose whether the employee is a bachelor or married, which is a significant distinction. If the user selects Single, the information is retrieved from the single-person database; if the user selects Married, the information is retrieved from the married table.

To guide our search to the correct table in Excel, we may utilize named ranges and the INDIRECT function. We need to identify two ranges before we can create our formula: Married for the married-person table and Single for the single-person database.

To create the specified ranges, follow these steps:

1. Choose the B4:E11 range.
2. From the **Formulas tab** on the Ribbon, choose **Define Name**.
3. Select **Married** in the Name box.
4. Select OK.
5. Choose the B15:E22 range.
6. On the Ribbon, select **Define Name** from the Formulas option.
7. Select **Single** in the Name box.
8. Select **OK**.

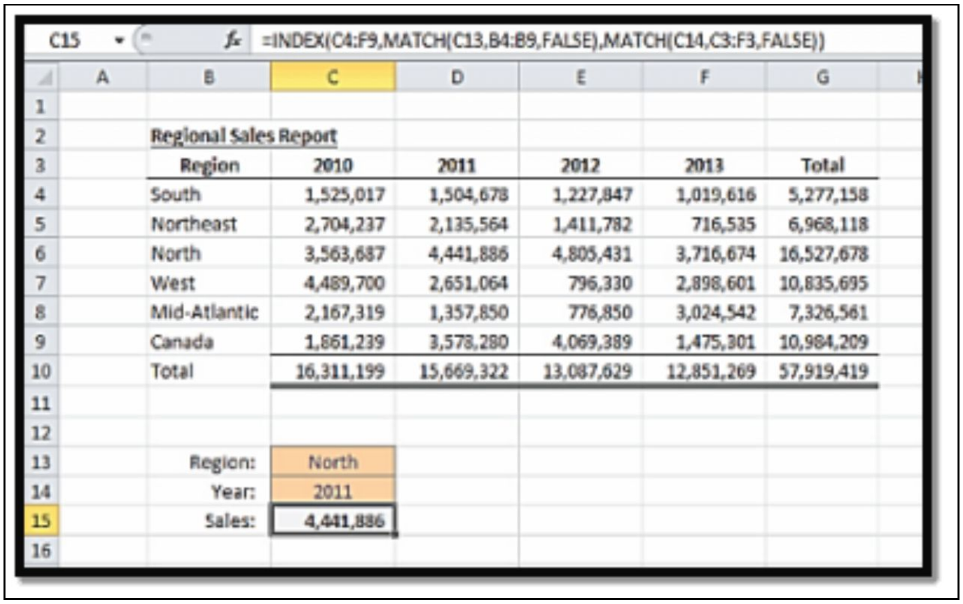
In cell D25, there is a data validation drop-down menu. The phrases Married and Single, which is similar to the names we just made, are available in the drop-down box. The value in D25 will be used to identify which table we should search at, thus the values must be similar.

	A	B	C	D	E	F
1						
2		*Married person*				
3		**Wages over**	**But not over**	**Base amount**	**Percentage**	
4		-	325	-	0.0%	
5		325	1,023	-	10.0%	
6		1,023	3,163	69.80	15.0%	
7		3,163	6,050	390.80	25.0%	
8		6,050	9,050	1,112.56	28.0%	
9		9,050	15,906	195.56	33.0%	
10		15,906	17,925	4,215.03	35.0%	
11		17,925		4,921.68	39.6%	
12						
13		*Single person*				
14		**Wages over**	**But not over**	**Base amount**	**Percentage**	
15		-	87	-	0.0%	
16		87	436	-	10.0%	
17		436	1,506	34.90	15.0%	
18		1,506	3,523	195.40	25.0%	
19		3,523	7,254	699.65	28.0%	
20		7,254	15,667	1,744.33	33.0%	
21		15,667	15,731	4,520.62	35.0%	
22		15,731		4,543.02	39.6%	

The following is the new formula for calculating the withholding:

=VLOOKUP(D29,INDIRECT(D25),3,TRUE)+(D29-VLOOKUP(D29,INDIRECT(D25),1,TRUE)+(D29-VLOOKUP(D29,INDIRECT(D25),1, TRUE)

*VLOOKUP(D29,INDIRECT(D25),4,TRUE)


C15 =INDEX(C4:F9,MATCH(C13,B4:B9,FALSE),MATCH(C14,C3:F3,FALSE))

Regional Sales Report					
Region	2010	2011	2012	2013	Total
South	1,525,017	1,504,678	1,227,847	1,019,616	5,277,158
Northeast	2,704,237	2,135,564	1,411,782	716,535	6,968,118
North	3,563,687	4,441,886	4,805,431	3,716,674	16,527,678
West	4,489,700	2,651,064	796,330	2,898,601	10,835,695
Mid-Atlantic	2,167,319	1,357,850	776,850	3,024,542	7,326,561
Canada	1,861,239	3,578,280	4,069,389	1,475,301	10,984,209
Total	16,311,199	15,669,322	13,087,629	12,851,269	57,919,419

Region:	North
Year:	2011
Sales:	4,441,886

This example's formula is surprisingly similar to the previous one. The only change is that instead of the table's location, an INDIRECT function is utilized.

The ref text parameter is sent to INDIRECT. A text representation of a cell reference or a named range is provided by the ref text parameter. INDIRECT tries to translate this into a cell or range reference. If the ref text is not a valid range reference, as it is in our situation, INDIRECT looks for a match in the listed ranges. INDIRECT would have returned the #REF! error if we hadn't previously defined a range called Single.

INDIRECT has a1 as a second optional parameter. If ref text is in the A1 style of cell references, the a1 argument is TRUE, and if ref text is in the R1C1 style of cell references, it is FALSE. A1 may be TRUE or FALSE for specified ranges, and INDIRECT will return the right range.

Ranges from other worksheets or even workbooks may be returned using INDIRECT. If it refers to another worksheet, however, that workbook has to be open.

Looking up a value based on a two-way matrix

A rectangular range of cells makes up a two-way matrix. It's a range having more than one row and more than one column, in other words. We've utilized the **INDEX and MATCH** combination as a substitute for some of the lookup functions in other formulae. INDEX and MATCH, on the other hand, were designed for two-way matrices.

Each column represents a year, and each row represents an area. The user should be able to pick an area and a year, and the sales figure should be returned at the intersection of those two rows and columns.

=INDEX(C4:F9,MATCH(C13,B4:B9,FALSE),MATCH(C14,C3

You've probably heard about INDEX and MATCH by now. Unlike other formulae, the INDEX function has two MATCH functions. Rather than hard-coding a column number, the second MATCH method returns the INDEX column parameter.

Remember that MATCH provides the matched value's position in a list. Because it's the third item in the list, MATCH returns 3 for the North region. INDEX takes this as the row parameter. The year 2012 is matched across the header row, and MATCH returns 2 since 2011 is the second item. The correct value is then returned by INDEX using the 2 and 3 given by the MATCH methods.

Making use of default values to match

Our sales search methodology will be modified. By changing the algorithm, the user will be given the option to select just a region, just a year, or neither. If one of the options is left empty, we'll assume the user wants the sum. The sum of the table as a whole will be returned if neither option is selected.

=INDEX(C4:G10,IFERROR(MATCH(C13,B4:B10,FALSE),COUNTA(B4:B10)),IFERROR(MATCH(C14,C3:G3,FALSE),COUNTA(C3:G3)))

The formula's general structure hasn't altered, but a few subtleties have. Row 10 and column G are now included in the INDEX range. The range of each MATCH function has also been expanded. Finally, an IFERROR function surrounds both MATCH functions, returning the Total row or column.

A COUNTA function may be used as an alternative to IFERROR. COUNTA counts both numbers and text and, as a result, returns the last row or column in our range. We could have hard-coded those numbers, but COUNTA will adapt to always return the last one whenever we enter a row or column.

MATCH returns #N/A because the column headers have no blanks. IFERROR sends the control to the value if error argument when it detects that error, and the last column is sent to INDEX.

Calculating a value based on certain criteria

We need a formula that will output the budget when the user selects a department and an area. We are unable to use VLOOKUP for this computation since it only supports a single lookup value. There are many instances of the regions and departments, so you'll need two values.

To retrieve the row that has both lookup values, use the SUMPRODUCT function as follows:

=SUMPRODUCT (($B$3:$B$45=H5)*($C$3:$C$45=H6)*($E$3:$E$45))

SUMPRODUCT compares each cell in a range to a value and, based on the outcome, outputs an array of TRUEs or FALSEs. TRUE becomes 1 when multiplied by another array, but FALSE becomes 0. Because that range comprises the value we wish to return, the third parenthetical part of the SUMPRODUCT function does not contain a comparison.

The sum for that line will be 0 if either the Region comparison or the Department comparison is FALSE. Anything times zero equals zero, therefore a FALSE result is turned to zero. Both comparisons yield 1 if both Region and Department match. The number returned is the result of multiplying the two 1s with the matching row in column E.

When SUMPRODUCT reaches row 12, it multiplies 1 * 1 * 697,697 in the example. That number is added to the other rows, which are all zero since at least one FALSE is present. 697,697 is the value of the SUM as a result.

SUMPRODUCT is used to return text.

SUMPRODUCT works this manner only when we want to return a number. All text values will be treated as zero if we want to return text, and SUMPRODUCT will always return zero.

However, by combining SUMPRODUCT with the ROW and INDEX techniques, we can obtain text. For instance, the following formula could be used to find the manager's name:

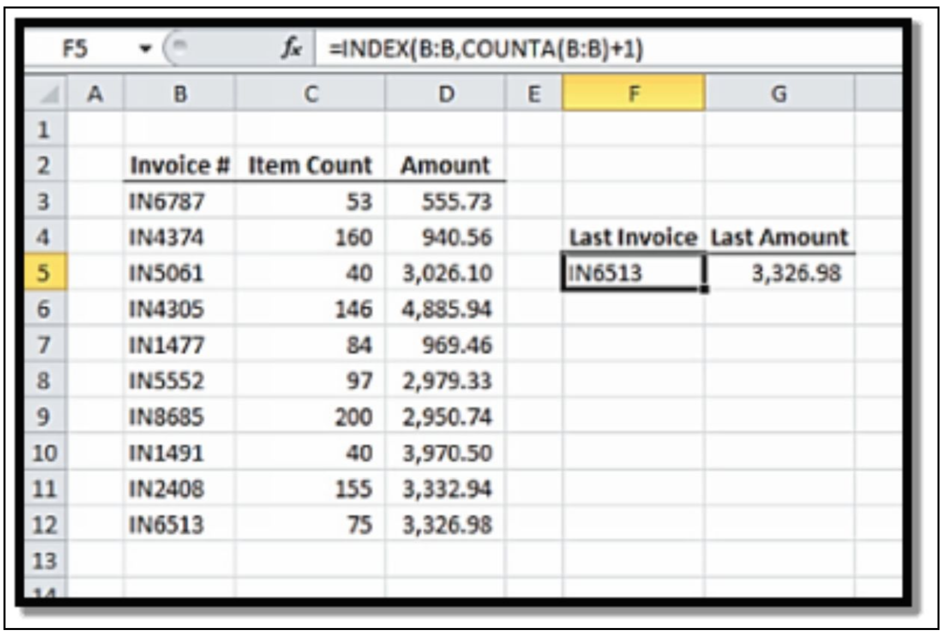
=INDEX(D:D,SUMPRODUCT(($B$3:$B$45=H5)*($C$3:$C$45=H6)*(ROW($E$3:$E$45))),1)

The ROW function is always included the row numbers in the array instead of the values from column E. When it comes to row 12, SUMPRODUCT now computes 1 * 1 * 12. The row parameter in INDEX is then set to 12 for the full column D: D. INDEX takes the whole column as its range since the ROW function returns the row in the worksheet rather than the row in our table.

How to determine a column's latest value

We're searching for the last invoice on the list. It is simple to get the last item in the column by counting the items in the list and using the INDEX function to find the last row.

=INDEX(B:B,COUNTA(B:B)+1)


F5 =INDEX(B:B,COUNTA(B:B)+1)

	A	B	C	D	E	F	G
1							
2		Invoice #	Item Count	Amount			
3		IN6787	53	555.73			
4		IN4374	160	940.56		Last Invoice	Last Amount
5		IN5061	40	3,026.10		IN6513	3,326.98
6		IN4305	146	4,885.94			
7		IN1477	84	969.46			
8		IN5552	97	2,979.33			
9		IN8685	200	2,950.74			
10		IN1491	40	3,970.50			
11		IN2408	155	3,332.94			
12		IN6513	75	3,326.98			
13							

When used on a single column, the INDEX function only requires a row parameter. The third parameter indicates that the column isn't required. COUNTA is used to count the cells in column B that are not blank. Because there is a blank cell in the first row, the count is incremented by one. Column B's 12th row is returned by the INDEX function.

COUNTA counts anything except blanks, including numbers, text, and dates. COUNTA will not yield the required result if your data contains blank rows.

Using LOOKUP, determining the final number

INDEX and COUNTA assist in locating values when there are no empty cells in the range. If there are blanks along with the values you're searching for, you can use LOOKUP and a very large number.

D:D =LOOKUP(9.99E+307)

The maximum number that Excel can handle is the lookup value. The result is returned because LOOKUP defaults to the last value it finds because it can't find a value this large.

A number such as 9.99E+307 is written in exponential notation. The number that comes before the letter E has two numbers to its right and one number to its left. The number that comes after the letter E specifies how many decimal places need to be dropped in order to write the number normally. If the number is positive, the decimal should be shifted to the right; if it is negative, it should be shifted to the left. The equivalent of 0.0432 is a value like 4.32E-02.

The last integer is returned by this LOOKUP function regardless of whether the range contains text, blank spaces, or errors.

CHAPTER 7

APPLICATION OF FORMULAS TO FINANCIAL ANALYSIS

When everything was done by hand using paper and pencil, spreadsheets were initially employed in the accounting and finance departments. Even though Excel has developed much beyond a simple computerized ledger sheet, it is still an essential tool for business.

This chapter will teach you about some formulas that are frequently used in accounting, finance, and other business-related fields.

Making Regular Business Calculations

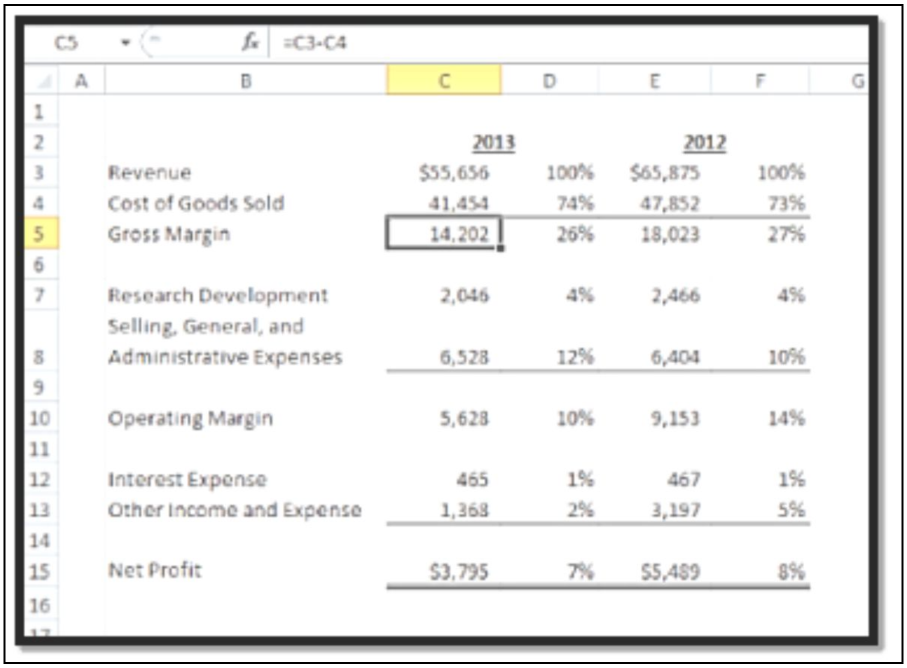
This section is a collection of some of the more well-known financial and business formulas that you could be asked to create in Excel while working as a business analyst.

Gross profit margin and gross profit margin percentage calculations

Gross margin is the amount that remains after revenue is subtracted from the cost of goods sold. It is the portion of revenue that goes toward covering overhead and other indirect costs. To calculate the gross margin, subtract the revenue from the total cost of the goods sold. To calculate the gross margin percent, divide the revenue by the gross margin. The gross margin is displayed in cell C5 whereas the gross margin % is displayed in cell D5.

=C3-C4 Gross Margin

=C5/$C$3 Gross Margin Percentage



C5 fx =C3-C4

	A	B	C	D	E	F	G
1							
2			2013		2012		
3		Revenue	$55,656	100%	$65,875	100%	
4		Cost of Goods Sold	41,454	74%	47,852	73%	
5		Gross Margin	14,202	26%	18,023	27%	
6							
7		Research Development	2,046	4%	2,466	4%	
8		Selling, General, and Administrative Expenses	6,528	12%	6,404	10%	
9							
10		Operating Margin	5,628	10%	9,153	14%	
11							
12		Interest Expense	465	1%	467	1%	
13		Other Income and Expense	1,368	2%	3,197	5%	
14							
15		Net Profit	$3,795	7%	$5,489	8%	
16							

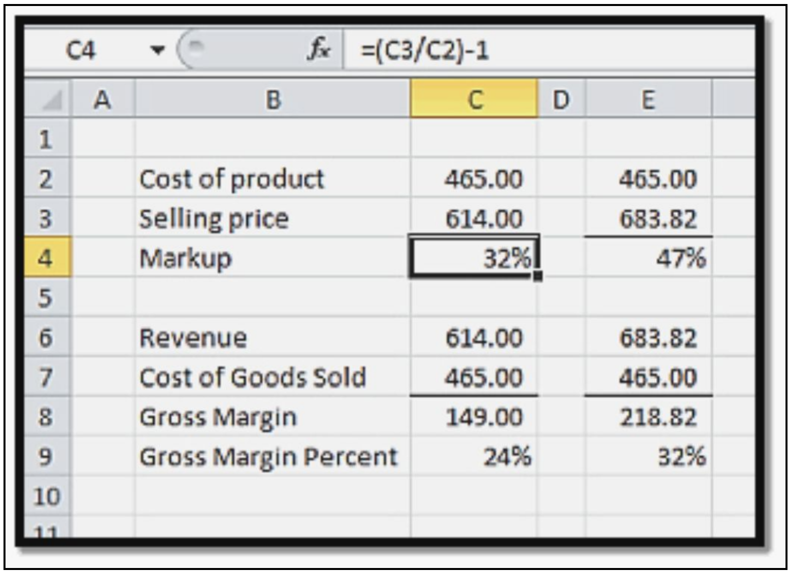
Cell C4 is subtracted from cell C3 in the gross margin calculation. The gross margin % is calculated by dividing C5 by C3, but keep in mind that the C3 reference is absolute due to the dollar signs. This enables you to duplicate the formula to other lines on the income statement to calculate the percentage of revenue, which is a frequent income statement analysis.

Markup calculation

Despite their frequent confusion, the words "markup" and "gross margin percent" are not the same. Markup is the portion of costs that are increased to produce a selling price.

The markup is computed by removing one from the sales price after dividing it by the cost.

=(C3/C2)-1



C4 =(C3/C2)-1

	A	B	C	D	E
1					
2		Cost of product	465.00		465.00
3		Selling price	614.00		683.82
4		Markup	32%		47%
5					
6		Revenue	614.00		683.82
7		Cost of Goods Sold	465.00		465.00
8		Gross Margin	149.00		218.82
9		Gross Margin Percent	24%		32%
10					

You generate a 24 percent gross margin by marking up the product's cost by 32 percent.

Use the following formula to mark up a product to generate a 32 percent profit margin:

=1/(1-E9)-1

If you want your income statement to display a 32 percent gross margin, you'll need to mark up this product at 47 percent using this method.

Calculating EBIT and EBITDA

EBIT (earnings before interest and taxes) and EBITDA (earnings before interest, taxes, depreciation, and amortization) are two typical methods for assessing a company's performance. Both are calculated by subtracting specific expenditures from profits, resulting in net profit.

C20 =C18+VLOOKUP("Interest Expense",$B$2:$C$18,2,FALSE)+VLOOKUP("Income Tax Expense",$B$2:$C$18,2,FALSE)

	A	B	C	D	E	F
1						
2		Revenue	65,245			
3		Cost of Goods Sold	39,147			
4		Gross Margin	26,098			
5						
6		Selling Expenses				
7		Adminstrative Expenses	8,213			
8		Depreciation Expense	7,245			
9		Amortization Expense	2,444			
10		Total Operating Expenses	17,902			
11						
12		Operating Income	8,196			
13						
14		Other Expenses	654			
15		Interest Expense	6,215			
16		Income Tax Expense	3,215			
17						
18		Net Income (Loss)	(1,888)			
19						
20		EBIT	7,542			
21		EBITDA	17,231			
22						

The income statement and the results of the EBIT and EBITDA computations are shown in the table below.

EBIT

- =C18+VLOOKUP("Interest Expense",$B$2:$C$18,2,FALSE)+VLOOKUP("Income Tax Expense",$B$2:$C$18,2,FALSE)+VLOOKUP("Income Tax Expense",$B$2:$C$18,2,FALSE)

EBITDA

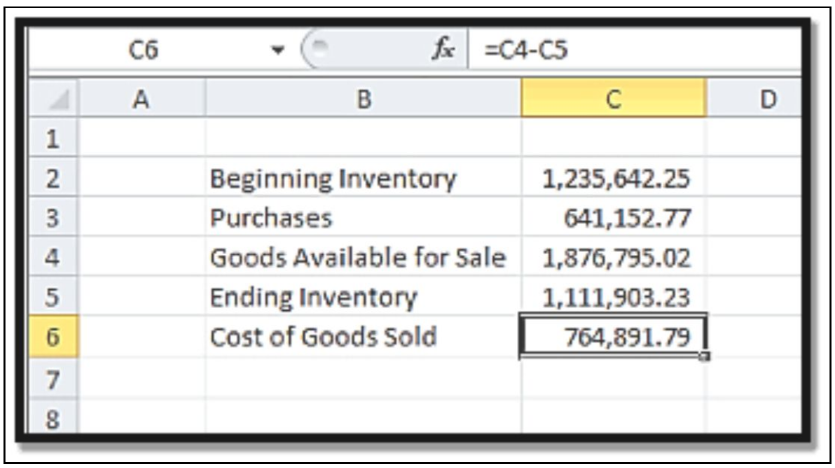
- =C20+VLOOKUP("Depreciation Expense",$B$2:$C$18,2,FALSE)+VLOOKUP ("Amortization Expense",$B$2:$C$18,2,FALSE)+VLOOKUP ("Amortization Expense",$B$2:$C$18,2,FALSE)

The EBIT calculation begins with a net loss in C18 and utilizes two VLOOKUP functions to extract the interest and income tax expenses from the income statement. The formula for EBITDA begins with the outcome of the EBIT calculation and adds back the depreciation and amortization expenses using the same VLOOKUP approach.

Utilizing VLOOKUP rather than merely using the cell references to those expenditures has advantages. The EBIT and EBITDA calculations do not need to be adjusted if the income statement lines are shifted around.

Making a cost-of-sale calculation

The cost of goods sold is the total cost of everything you sold. It plays a significant role in the gross computation. If you use a perpetual inventory system, you calculate the cost of goods sold for each sale that is made. For simpler systems, you might calculate it using a physical inventory after the accounting period.



C6 | =C4-C5

	A	B	C	D
1				
2		Beginning Inventory	1,235,642.25	
3		Purchases	641,152.77	
4		Goods Available for Sale	1,876,795.02	
5		Ending Inventory	1,111,903.23	
6		Cost of Goods Sold	764,891.79	
7				
8				

The example below demonstrates how to compute the cost of goods sold using simply the starting and ending inventory counts, as well as the amount of all inventory acquired throughout the time.

Goods Available for Sale

- =SUM(C2:C3)

Cost of Goods Sold

- =C4-C5

The commodities for sale include the initial inventory as well as any acquisitions. It's an intermediate computation that displays how much inventory you'd have at the end of the day if you didn't sell anything.

The ending inventory is subtracted from the products available for sale in the cost of goods sold calculation. If you had the products at the beginning of the time or purchased them throughout the term but don't have them at the end, they must have been sold.

Calculating the asset return

Return on assets (ROA) is a metric that assesses how effectively a business generates revenue from its assets. For instance, by using fewer or less expensive assets, a company with a higher ROA may be able to achieve the same profit as one with a lower ROA.

To calculate ROA, divide the whole earnings by the average of the starting and ending total assets. The table below includes a simple balance sheet, income statement, and the resulting ROA.

=G15/AVERAGE (C12:D12)

The numerator is just the income statement's net profit. The AVERAGE function is used in the denominator to calculate the average total assets for the time.

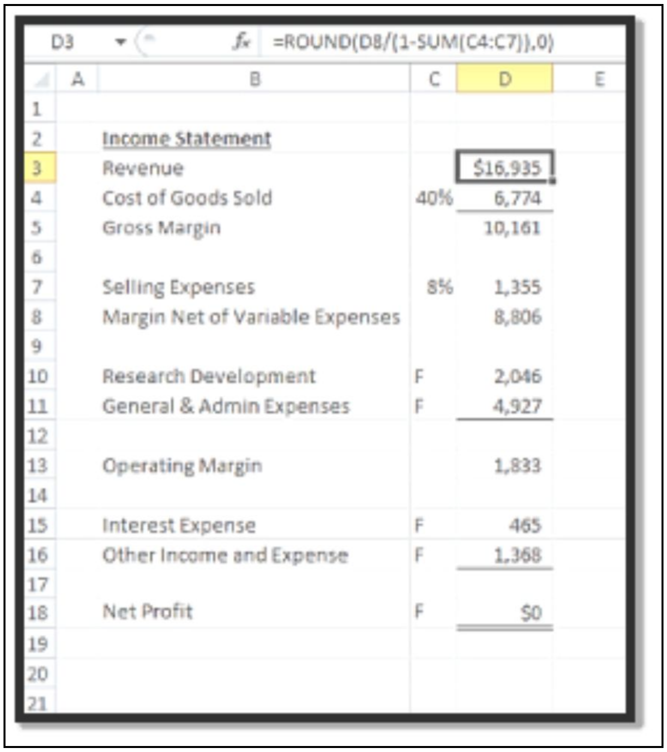
How to calculate return on equity

Another widely used indicator of profitability is return on equity (ROE). An investor may use ROE to determine whether their investment in the company is being used effectively. Similar to ROA, ROE is computed by subtracting net profit from the average of a balance sheet item over the same time. ROE, on the other hand, makes use of average total equity rather than average total assets. The ROE calculation formula is as follows:

=G15/AVERAGE (C25:D25)

Calculating break-even

A company could wish to figure out how much sales it needs to have a net profit of precisely $0. This is referred to as break even. The company will calculate its fixed expenditures as well as the proportion of each variable expense. It is possible to convert such figures into a revenue amount that will result in a break-even point.



D3 | fx =ROUND(D8/(1-SUM(C4:C7)),0)

	A	B	C	D	E
1					
2		Income Statement			
3		Revenue		$16,935	
4		Cost of Goods Sold	40%	6,774	
5		Gross Margin		10,161	
6					
7		Selling Expenses	8%	1,355	
8		Margin Net of Variable Expenses		8,806	
9					
10		Research Development	F	2,046	
11		General & Admin Expenses	F	4,927	
12					
13		Operating Margin		1,833	
14					
15		Interest Expense	F	465	
16		Other Income and Expense	F	1,368	
17					
18		Net Profit	F	$0	
19					
20					
21					

Column C displays an F for a fixed expenditure or a percentage for a variable expense as revenue fluctuates. For instance, research and development will be funded according to a budget that remains constant regardless of income fluctuations. If the company pays a commission, on the other hand, the selling costs will fluctuate with income.

The formulae utilized were as follows:

Margin of Operation

- =SUM(D15:D18)

Net of Variable Expenses Margin

- =SUM(D10:D13)

Gross Profit Margin

- =SUM(D7:D8)

Revenue

- =ROUND(D8/(1-SUM(C4:C7)),0)

By multiplying the revenue amount by the percentage, the two variable expenditures, cost of goods sold and selling expenses, are computed.

The following are the formulas:

Cost of Goods Sold

- =ROUND(D3*C4,0)

Expenses for Sale

- =ROUND(D3*C7,0)

Follow these steps to create the break-even model:

1. To show a zero net profit, enter **0 in column D18**.
2. In column D, write the fixed expenditure amounts next to their designations in column B.
3. In cell C7, enter the commission percentage paid by the firm (8 percent in this example).
4. In column C4, enter a percentage equal to 1 minus the projected gross margin. In this case, the corporation anticipates a 60 percent gross margin, hence 40 percent is recorded in C4.
5. In cell D13, put the operating margin formula given before. The total interest cost and other revenue and expenditure must equal the operating margin.
6. In column D8, input the margin net of variable expenditures calculation from the previous step. The operating margin is added to the fixed operating expenditures in this computation. It will be used to calculate revenue.
7. In cell D7, type the formula for selling expenditures that were previously presented. Because we haven't yet input the revenue formula, this will be 0 for the time being. However, after revenue is input, the figure will be shown correctly.
8. In column D4, enter the cost of goods sold formula. This will return 0 until revenue is determined, much as the selling expenditures

formula.

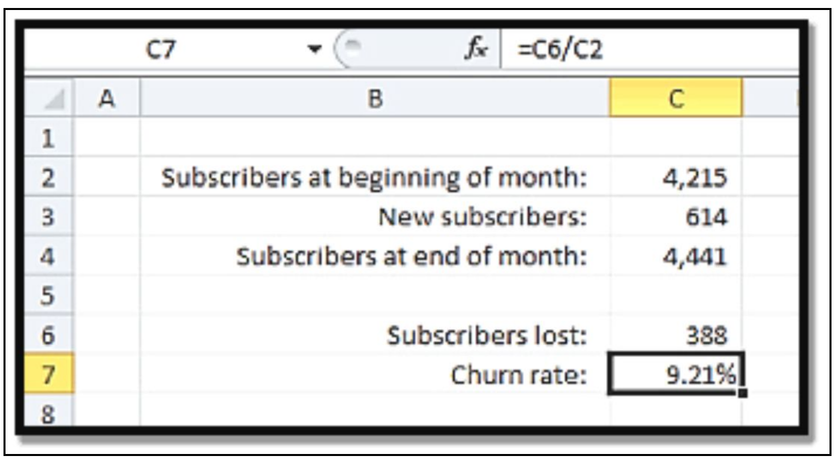
9. Finally, in column D3, put the revenue formula. The margin net of variable expenditures is divided by 1 minus the total of the variable percentages in the revenue computation. The two variable expenditures will account for 48 percent of income (40 percent plus 8%). The revenue is calculated by dividing one minus that amount, 52 percent, by the margin net of variable expenditures.

If this firm has a 60% gross margin, pays 8% commissions, and has appropriately predicted fixed expenditures, it will need to sell $16,935 to break even.

Estimating customer churn

Customer churn is the term used to describe how many customers you lose at one time. It's an essential metric for firms that rely on subscriptions, but it may be applied to other revenue models as well. If you are gaining new clients faster than you are losing them, this means that your clientele is growing. If not, you're losing customers more quickly than you're acquiring them, so something needs to happen.

Both the overall number of clients and the number of new customers at the beginning and the end of the month are necessary to know.



C7 =C6/C2

	A	B	C
1			
2		Subscribers at beginning of month:	4,215
3		New subscribers:	614
4		Subscribers at end of month:	4,441
5			
6		Subscribers lost:	388
7		Churn rate:	9.21%
8			

Subscribers Lost

- =C2+C3-C4

Rate of churn

- =C6/C2

The number of new customers is added to the number of customers at the beginning of the month to calculate the number of consumers lost throughout the month. The sum is then deducted from the number of clients at the end of the month. Finally, the churn rate is calculated by dividing the number of customers lost throughout the month by the number of customers at the start of the month.

In this case, the company's turnover rate is 9.21 percent. Because it is gaining more consumers than it is losing, churn may not be considered an issue. If the turnover rate is greater than intended, the organization may want to look into why customers are leaving and adjust the price, product features, or other aspects of the business.

Computing the churn rate annually

If a business receives recurring revenue every month, customers sign up and pay for one month at a time. For these companies, it makes logical to compute the turnover rate each month. Any new clients obtained throughout the month won't churn the next month because they've already paid for the month.

In contrast, a typical magazine asks subscribers to join up for an annual membership. For them, a useful churn rate estimate would be the annual rate. The technique alters somewhat if a company needs to calculate a churn rate for a period longer than its repetitive revenue model, such as yearly churn for a company with monthly customers. By the quantity of lost subscribers, the average of beginning and ending subscribers is calculated. Because the churn rate is different from the recurring revenue period, some of the 7,415 new members cancelled their memberships within the year, albeit in a different month than when they first signed up.

The average client lifetime value calculation

Customer lifetime value (CLV) is a metric that measures a customer's contribution to gross margin over the course of the relationship. The computed churn rate is one factor that goes into CLV.

How to calculate CLV using the previously identified churn rate is demonstrated in the example below. As a first step, figure out the average gross margin per customer.

F7 =F6/C7

	A	B	C	D	E	F	G
1							
2		Subscribers at beginning of month:	4,215		Monthly revenue	564,810	
3		New subscribers:	614		Cost of goods sold	225,924	
4		Subscribers at end of month:	4,441		Gross Margin	338,886	
5							
6		Subscribers lost:	388		Average customer margin	76.31	
7		Churn rate:	9.21%		Customer Lifetime Value	828.97	
8							

Gross Profit Margin

- =F2-F3

Customer Margin on Average

- =F4/AVERAGE(C4,C10)

Customer Value Over Time

- =F6/C7

Follow these procedures to compute CLV:

1. Determine the gross profit margin.
2. Divide the gross margin by the average number of clients for the month to get the average customer margin. Because the gross margin was obtained over a month, you must divide by the average number of customers rather than the total number of customers.
3. Divide the average customer margin by the turnover rate to get the CLV.

In this case, each client will contribute $828.97 throughout their lifetime.

Calculating employee turnover

Employee turnover is a metric for how successfully a company hires and retains employees. A high turnover rate suggests that the business is not recruiting or keeping the proper personnel, potentially due to insufficient perks or poor compensation. Both voluntary and involuntary terminations are prevalent in separations.

F18 =F17/F16

	A	B	C	D	E	F
1						
2		Month	Beg. Employees	New Hires	Separations	End. Employees
3		Jan	625	10	7	628
4		Feb	628	2	7	623
5		Mar	623	4	1	626
6		Apr	626	6	3	629
7		May	629	5	1	633
8		Jun	633	5	2	636
9		Jul	636	2	5	633
10		Aug	633	3	5	631
11		Sep	631	2	6	627
12		Oct	627	4	2	629
13		Nov	629	10	5	634
14		Dec	634	8	2	640
15						
16			Average monthly employment			630.75
17					Separations	46.00
18					Employee Turnover	7.29%
19						

The graph below depicts an organization's employment changes over 12 months. To achieve the ending employee, count, new hires are added and separations are removed from the number of workers at the beginning of the month.

Monthly Employment Average

- =AVERAGE(F3:F14)

Separations

- =SUM(E3:E14)

Employee Attrition

- =F17/F16

The ratio of separations to average monthly employment is known as employee turnover. The AVERAGE function is used to compute the average monthly ending count of workers. SUM is used to add the separations, which are then divided by the average monthly employment.

The outcome may be compared to industry averages or similar firms. Because the turnover rates in various sectors vary, comparing them might lead to incorrect conclusions. Although you are not required to measure turnover over 12 months, doing so eliminates seasonal employment changes that might bias findings.

Leveraging Excel's Financial Functions

It's a reasonable assumption that the most prevalent use of Excel is to do financial computations. Hundreds of thousands of financial choices are made every day based on statistics generated on a spreadsheet. These choices vary from straightforward ("Can I afford a new car?") to more complicated **("Will buying XYZ Corporation result in positive cash flow in the next 18 months?")**.

Converting interest rates

F21 | f_x =EFFECT(F20,12)

	A	B	C	D	E	F
1						
2		Date	Payment	Principal	Interest	Balance
3						152,151.73
4		1/10/2015	-	(475.47)	475.47	152,627.20
5		2/10/2015	-	(476.96)	476.96	153,104.16
6		3/10/2015	-	(478.45)	478.45	153,582.61
7		4/10/2015	-	(479.95)	479.95	154,062.56
8		5/10/2015	-	(481.45)	481.45	154,544.01
9		6/10/2015	-	(482.95)	482.95	155,026.96
10		7/10/2015	-	(484.46)	484.46	155,511.42
11		8/10/2015	-	(485.97)	485.97	155,997.39
12		9/10/2015	-	(487.49)	487.49	156,484.88
13		10/10/2015	-	(489.02)	489.02	156,973.90
14		11/10/2015	-	(490.54)	490.54	157,464.44
15		12/10/2015	9,169.68	8,677.60	492.08	148,786.84
16						
17				Total interest paid		5,804.79
18				Effective Rate		3.815%
19						
20				Given Nominal Rate		3.750%
21				Compute Effective Rate		3.815%
22						
23				Given Effective Rate		3.815%
24				Compute Nominal Rate		3.750%

The nominal rate and the effective rate are two typical approaches for quoting interest rates.

- **Nominal Interest Rate:** This is the stated rate, which is frequently accompanied by a compounding term, such as 3.75 percent APR compounded monthly, for example. The nominal rate in this example is 3.75 percent, APR stands for annual percentage rate (which means the rate is applied on an annual basis), and the compounding period is one month.
- **Rate of Return on Investment:** This is the rate that was paid. If the nominal rate period and the compounding period are the same, the nominal and effective rates are the same. When interest accumulates over a shorter time than the nominal rate period, the effective rate is greater than the nominal rate, as is generally the case.

During a 30-year loan, 12 compounding periods are shown below. The initial loan amount was $165,000, with a nominal annual percentage rate of

3.75 percent compounded monthly and 30 yearly installments of $9,169.68 each.

The debt increases by the amount of interest for each month in which interest accumulates but no payment is made. When you make a payment, a portion of it goes toward the previous month's interest and the rest goes toward the principle.

To get the effective rate, add all of the interest accumulated during the year in cell F17 and divide it by the starting amount in cell F18. To convert interest rates, we don't need to build a whole amortization schedule. To do this, Excel includes the EFFECT and NOMINAL worksheet functions.

Rate of Return on Investment

- =EFFECT(F20,12)

Nominal Interest Rate

- =NOMINAL(F23,12)

The rate to be converted and the napery parameter is both sent to EFFECT and NOMINAL. The effective rate for NOMINAL and the nominal rate for EFFECT are the rates to be converted. Because the word APR was used, the nominal rate, in this case, is yearly. Because there are 12 months in a year, our nominal rate has 12 compounding periods. If you had a debt with a daily compounded APR, for example, the napery argument would be 365.

Using FV to compute the effective rate

The effective rate can also be determined using the FV function. When you have a useful function like EFFECT, there is no need to utilize FV, but knowing how they are related might be helpful.

=FV(3.75% /12,12,0,-1) =FV(3.75% /12,12,0,-1) =FV(3.75% /12,-1

This method subtracts the initial $1 from the future value of a $1 loan compounded monthly at 3.75 percent for a year. If you took out this loan, you would have to repay $1.03815 at the end of the year. This implies you'd owe an extra $0.03815 on top of what you borrowed, or 3.815 percent in total.

The development of a loan payment calculator

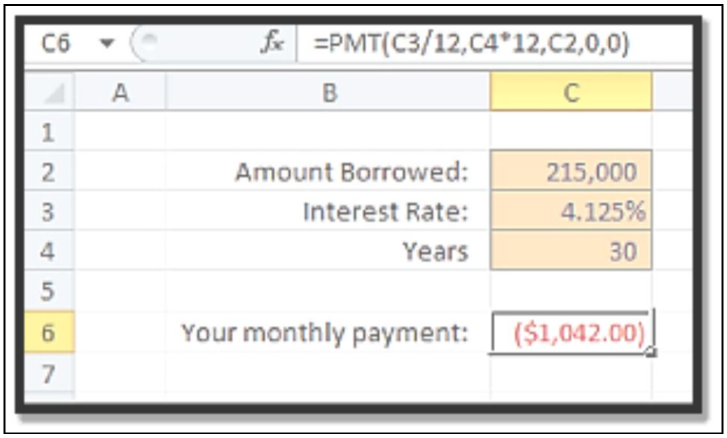
Your monthly loan payment is determined using Excel's PMT worksheet function. The parameters of the function can be hard-coded with values like the loan amount and interest rate, but by putting the values in cells and using the cells as arguments, you can easily change the values to see how the payment changes.

In C6, the following formula is used to calculate the payment: The user enters values in the range C2:C4.

=PMT(C3/12,C4*12,C2,0,0)

Three mandatories parameter and one optional argument are sent to the PMT function:

- **Calculate your score (required):** The annual nominal interest rate divided by the number of compounding periods in a year is the rate argument. Because interest accumulates monthly in this case, the interest rate in C3 is divided by 12.
- **Napery (required):** The napper input specifies the number of payments to be paid throughout the loan's duration. The number of years in C4 is increased by 12 since our user input asks for years and our payments are made monthly.
- **Photovoltaic (required):** The amount being borrowed is represented by the pv parameter or present value. The loan functions in Excel, including PMT, operate on a cash flow basis. It's simpler to comprehend when present value and payments should be positive or negative when you conceive of them as cash inflows and outflows. In this case, the bank is lending us $215,000, which is a positive cash inflow. Because the payments will represent cash outflows, the PMT function returns a negative result.



Change the PV parameter to a negative integer if you want the PMT function to produce a positive result. It's the same as calculating the payment from the bank's point of view: The loan represents a financial outflow, while the payments represent a cash inflow.

NOTE: A mismatch between compounding periods and payment frequency is the most prevalent error in financial calculations. The rate is divided by 12 to get a monthly rate, and the napery is multiplied by 12 to get a monthly payment in this case. Both arguments are converted to monthly, ensuring that the results are valid.

If we forget to divide our rate by 12, Excel will interpret it as a monthly rate, resulting in a payment that is much too large. Similarly, if we typed years for our napper and a monthly rate, Excel assumed we only paid once a year.

Excel has no idea if you're entering months, years, or days. It just matters whether the rate and napery are the same.

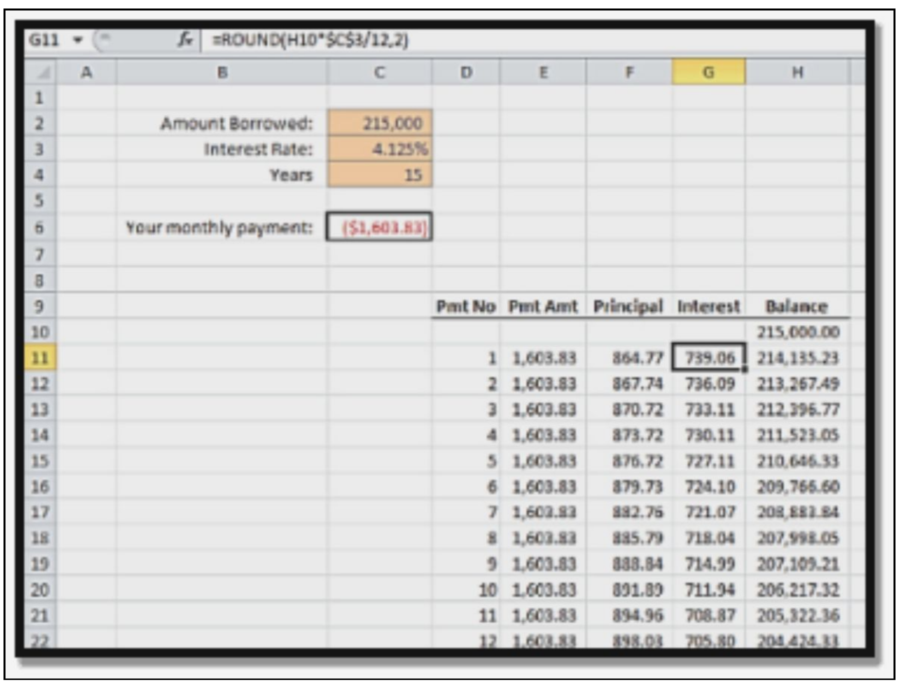
Creating an amortization schedule

We may design an amortization schedule using the payment amount to illustrate how much of each payment is principle and interest, as well as what the loan balance will be after each payment.

The following are the columns from the amortization schedule:

- **Message No**. The amount of the payment that is being made. In D11, a 1 is inserted. D12 has the formula =D11+1, which is duplicated down to D370 (our amortization schedule can handle 360 payments).

- **Pmt Amount**. The PMT calculation amount is rounded to the closest cent. We can only write a check for dollars and cents, even though Excel can compute to many decimal places. This implies that after the loan, there will be a tiny balance. In E11, the formula =-ROUND($C$6,2) is inserted and filled down to E370.
- **Principal**. The loan debt is reduced by the amount of each payment. In F11, the formula =E11-G11 is input and filled down to F370.
- **Interest**. The interest component of each payment. The interest rate divided by 12 is multiplied by the balance after the previous payment. The amount has been rounded to the nearest two decimal places. G11 has the formula =ROUND(H10*$C$3/12,2), which is filled down to G370.
- **Balance.** The remaining amount of the loan after the payment has been made. In H10, the formula =C2 is used to express the loan's initial amount. The formula =H10-F11 decreases the amount by the principal component of the payment starting in C3 and continuing down to C370.



G11 =ROUND(H10*$C$3/12,2)

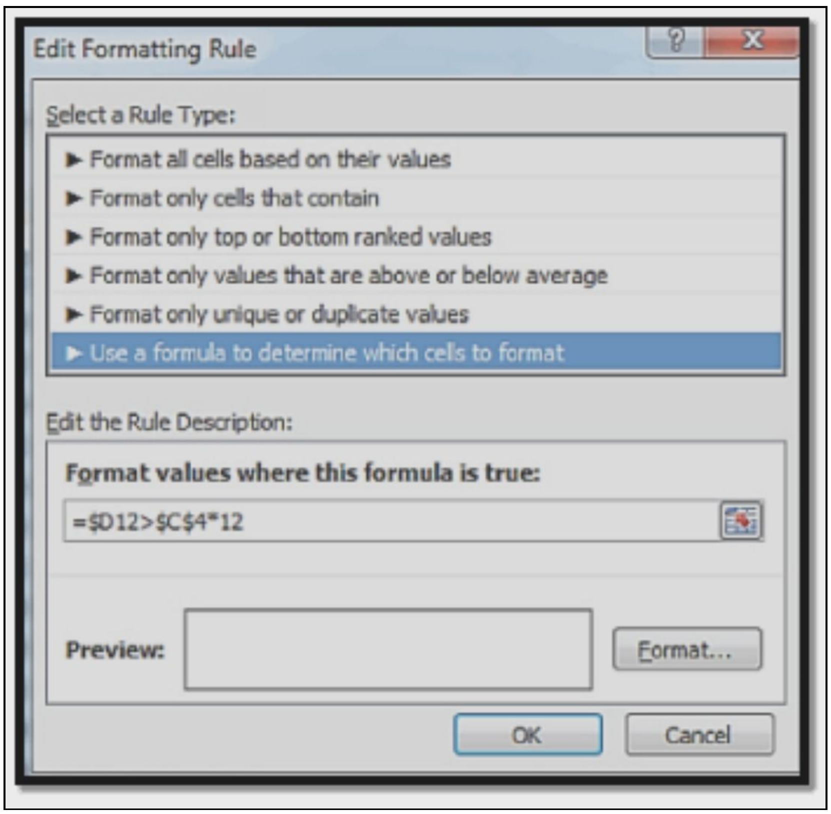
	A	B	C	D	E	F	G	H
1								
2		Amount Borrowed:	215,000					
3		Interest Rate:	4.125%					
4		Years	15					
5								
6		Your monthly payment:	($1,603.83)					
7								
8								
9				Pmt No	Pmt Amt	Principal	Interest	Balance
10								215,000.00
11				1	1,603.83	864.77	739.06	214,135.23
12				2	1,603.83	867.74	736.09	213,267.49
13				3	1,603.83	870.72	733.11	212,396.77
14				4	1,603.83	873.72	730.11	211,523.05
15				5	1,603.83	876.72	727.11	210,646.33
16				6	1,603.83	879.73	724.10	209,766.60
17				7	1,603.83	882.76	721.07	208,883.84
18				8	1,603.83	885.79	718.04	207,998.05
19				9	1,603.83	888.84	714.99	207,109.21
20				10	1,603.83	891.89	711.94	206,217.32
21				11	1,603.83	894.96	708.87	205,322.36
22				12	1,603.83	898.03	705.80	204,424.33

The number of years was put as 15, rather than 30, in the example. The amount of the payment rises when the period of the loan is reduced.

The last step is to hide rows that are longer than the loan duration. This is accomplished via conditional formatting, which turns the font color white. The data is successfully hidden by a white font color on a white backdrop.

The conditional formatting formula is as follows:

The payment number in column D is compared to the number of years in column C4 multiplied by 12. The formula returns TRUE when the payment amount is greater, and the white font color formatting is applied. No conditional formatting is used when the payment number is less than or equal to the total number of payments.



Creating a variable-rate mortgage amortization schedule

We produced an amortization plan for a loan with a fixed interest rate in the table. There are other loans with variable interest rates that alter over time. The interest rate on these loans is often linked to a public index, such as the London Interbank Offered Rate (LIBOR), plus a predetermined percentage. For example, **"LIBOR plus 3%"** is a common expression for these interest rates.

An amortization plan for a loan with a variable interest rate is shown below. The amortization schedule now includes a Rate column to make it clear when changes occur. When the rate changes, it is recorded in a separate table.

The following formula is used in the Rate column to choose the appropriate rate from the rate table:

=VLOOKUP(D11,$K$11:$L$23,2,TRUE)

The calculation for the Interest column now uses the rate in column G rather than the rate in column C3:

=ROUND(I10*G11/12,2)

A VLOOKUP with the fourth parameter of TRUE is used in the Rate column. The rate table must be sorted in ascending order according to the fourth parameter of TRUE. The payment number is then looked up in the rate table via VLOOKUP. It doesn't have to be an exact match, but it will return the row where the next payment number exceeds the search value. Because the payment number in the following row, 98, is bigger than the lookup value, VLOOKUP returns the second row of the rate table when the lookup value is 16.

The interest rate column formula is identical to the one in the example, but a reference to column G replaces the absolute reference to $C$3 (G11 for the formula in row 11).

Using dates instead of payment numbers

The payment number is used to identify each payment in the two amortization schedules for this part and the preceding one. Those payments will be due on the same day of the month in reality. This makes it possible to utilize the amortization plan for loans that begin on any date.

Follow these procedures to change the schedule to display the dates:

1. In cell D11, write the initial payment date.
2. Fill in the blanks in D12 using the following formula: =DATE(YEAR(D11),MONTH(D11)+1,DAY(D11))

3. In the rate table column, adjust the Pmt No column to the date the rate changed.
4. Replace the conditional formatting formula with the following formula:
   =$D12>=DATE(YEAR($D$11),MONTH($D$11)+($C$4*12),DAY($D$11))

Depreciation calculation

Some of the depreciation-related Excel spreadsheet functions are DB, DDB, SLN, and SYD. In this section, we'll examine the formulas for calculating straight line (SLN) and variable-declining balance (VDB) depreciation.

An asset often depreciates differently in the beginning and end years compared to the middle year. To avoid taking a full year's worth of depreciation in the first year, a convention is utilized. Midyear, midmonth, and mid-quarter are typical intervals. According to the half-year convention, the asset is considered to have been acquired at the halfway point of the year, and one-half of a typical year's depreciation is recorded for that year.

The following user-entered data is found in columns B through E:

- **Asset number:** Each object has its unique identification. It isn't required for the timetable, but it is useful for asset management.
- **Cost:** The cost of putting the asset into service. This comprises the asset's purchase price, any applicable taxes, the cost of shipping the item to its location of service, and any expenses connected with installing the asset so that it's ready to use. This is also known as the cost basis or basis.
- **Year of Purchase:** The year in which the asset went into service. This might be different from the year in which the asset was purchased. It establishes the onset of depreciation.
- **Long Service Life:** The estimated number of years the object will be useful.

The formula in F3:N7 is as follows:

=IF(OR(YEAR(F$2)<$D3,YEAR(F$2)>$D3+$E3),0,SLN($C3,0,$E3))*IF(OR(YEAR(F$2)=$D3+$E3,YEAR(F$2)=$D3),0.5,1)IF(OR(YEAR (F$2)=$D3),0.5,1) IF(OR(YEAR (F$2)=$D3),0.5,1) IF

SLN($C3,0,$E3) is the most important portion of this formula. The SLN spreadsheet function calculates one-period straight-line depreciation. There are three points to consider: cost, salvage, and life. The salvage value is set to zero in this example for simplicity, implying that the asset's cost will be depreciated at the end of its useful life.

The SLN function is straightforward. However, since this is a depreciation schedule, there is still more work to be done. The first IF function determines if the column is within the useful life of the asset. If the year of the date in F2 is less than the year of acquisition, the asset has not yet been put into service, and depreciation is zero.

If F2 exceeds the year of acquisition plus the useful life, the asset is completely depreciated and the depreciation is zero. Both of these conditionals are wrapped in an OR function, which means that if one of them is true, the whole expression returns TRUE. However, if both are FALSE, the SLN function is returned.

The formula's second portion is likewise an IF and OR combination. These conditional expressions decide whether or not the year in F2 is the first or final year of depreciation. If one of these conditions is met, the straight-line result is multiplied by 0.5, which represents the half-year convention used in this case.

This formula's cell references are all anchored so that the formula may be copied down and to the right without the cell references changing. Row 2 references are anchored on the row such that the date in row 2 is always evaluated. Cost, Year Acquired, and Useful Life remain the same when the formula is copied because references to columns C: E are anchored on the columns.

Making an accelerated depreciation calculation

The straight-line method equalizes an item's depreciation across the course of its useful life. Some businesses use an accelerated depreciation method, which depreciates assets more quickly in the beginning and more slowly at the end of their useful life. The idea is that an asset loses value more quickly during its first year of use than during its final year.

Excel contains a DDB function for accelerated depreciation (double-declining balance). DDB uses the straight-line method to determine the value of the remaining assets and doubles it. The problem with DDB is that it only depreciates an asset partially over the course of its useful life. The asset's useful life is up before the amount of depreciation approaches zero, albeit it does decline over time.

Starting with a diminishing balance approach and switching to a straight-line strategy if the depreciation falls below the straight-line amount is the most usual application of accelerated depreciation. Thankfully, Excel offers a VDB function that incorporates that reasoning.

This formula is a bit more sophisticated than the SLN formula from the last example, as you may have observed.

Don't worry, we'll go through everything step by step so you understand everything:

=IF(OR(YEAR(F$2) <$D3, YEAR(F$2)>$D3+$E3),0, VDB(...)

The initial component of the formula is the same as the SLN formula previously stated. Depreciation is zero if the date in row 2 is not within the useful life. If that's the case, the VDB function is used:

VDB ($C3,0, $E3*2, starting period, ending period)

The first three parameters in VDB are identical to the first three arguments in SLN: cost, salvage value, and life. We don't have to tell SLN which period to compute since it delivers the same result for every period. However, depending on the period, VDB returns a varying amount. VDB's last two parameters tell it which period to calculate. In E3, life is doubled, as detailed in the next section.

Starting period

•IF(YEAR(F$2)=$D3,0,IF(YEAR(F$2)=$D3+$E3,$E3*2-1,
(YEAR(F$2)-$D3)*2-1))

The convention is ignored by none of Excel's depreciation tools. That is, Excel calculates depreciation as though all of your assets were purchased on

January 1st of each year. That isn't a very practical solution. We'll use a half-year pattern in this section, so only half of the depreciation is taken in the first and final years. To do so using VDB, we must convince Excel that the asset has a useful life of twice as long as it does.

The period for the first year moves from 0 to 1 for an item having a five-year useful life. The periods for the second year are 1–3. Periods 3–5 make up the third year. This pattern continues until the last year, which spans 9–10 months (10 is double the five-year life).

The formula's initial period is calculated as follows:

- Make the beginning period 0 if the year to calculate is the acquisition year.
- If the year to be computed is the previous year, double the useful life by 2 and deduct 1.
- Remove the acquisition year from the year to calculate, multiply by 2, and subtract 1 for all other years.

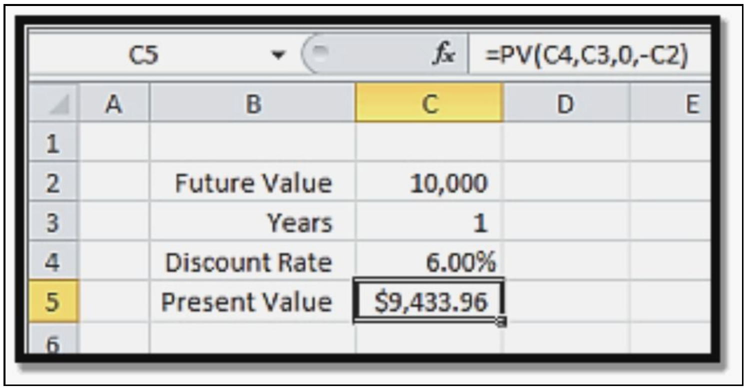
The formula's ending period part is comparable to the beginning period section. It terminates at period 1 during the first year. It finishes at the useful life times 2 for the past year. It conducts the same computation for the intermediate years, but instead of removing one, it adds one.

We can integrate the half-year convention into a declining balance function like VDB by doubling the usable life, say from 7 to 14 periods for a 7-year asset.

The present value calculation

The temporal value of money (TVM) is a key idea in accounting and finance. According to the argument, a dollar today isn't worth as much as one tomorrow. The amount of money you can make with that dollar is represented by the difference between the two numbers. The source of income could be the interest from a savings account or the profit from an investment.

The PV function in Excel, which determines present value, is one of the many tools available for working with TVM. In its simplest form, PV determines the present value by applying a discount rate to a future value amount. If I told you I'd give you $10,000 in a year, how much would you take instead of waiting?


C5 =PV(C4,C3,0,-C2)

	A	B	C	D	E
1					
2		Future Value	10,000		
3		Years	1		
4		Discount Rate	6.00%		
5		Present Value	$9,433.96		
6					

The table shows that you should accept $9,434 now rather than $10,000 a year from now, according to the present value calculator. If you took the $9,434 and earned 6% over the following year, you'd wind up with $10,000 at the end of the year.

There are five parameters to the PV function:

- **Rate:** The rate argument, sometimes known as the discount rate, is the expected return on your money over the charge fees. It is the most important aspect in establishing the current value, as well as the most difficult to determine. If you're a cautious person, you can choose a lesser rate—one that you're certain you can meet. The discount rate would be straightforward to calculate if the money was used to pay down a fixed-rate loan.
- **Nper:** The nper is the time interval over which the future value is discounted. The nper is 1 year in this case, and it is recorded in cell C3. The rate must be expressed in the same units as the period. That instance, nper must be given in years if you provide an annual rate. If you're using a monthly rate, you'll need to write nper in months.
- **Pmt:** The recurring payments received during the discount period are the pmt argument. When just one payment is made, as in this case, the amount paid is the future value, and the payment amount is zero. The pmt and nper arguments must both be the same. PV thinks that if your nper is 10 and you input pmt, you'll get that payment

amount 10 times throughout the discount term. A present value computation with payments is shown in the following example.

- **FV:** The amount you will get after the discount term is the future value amount. The financial functions in Excel operate on a cash flow basis. That is, the current value and the future value have polar opposite signs. The future value was made negative in this example so that the formula result would produce a positive number.
- **Type:** If the payments are received at the end of the period, the type argument may be 0; if the payments are received at the beginning of the period, it can be 1. Because our payment amount is 0 in this case, this argument has no impact. If the type argument is missing, the value is presumed to be 0.

Making a present-value calculation for future payments

The present value of a series of equal future payments can also be calculated using PV. You can use PV to determine how much you'd be prepared to pay to break the lease if, for instance, you owe $5,000 in rent over the next ten years.

If your landlord thought he could make 3% on the money, he might be willing to accept $43,930 rather than ten $5,000 payments over the following ten years. The type parameter is set to 1 because rent is often paid at the beginning of the semester.

C5 =PV(C4,C3,-C2,0,1)

	A	B	C	D	E
1					
2		Rent	5,000		
3		Years	10		
4		Discount Rate	3.00%		
5		Present Value	43,931		
6					
7		Year	Rent	PV	
8		1	5,000	5,000	
9		2	5,000	4,854	
10		3	5,000	4,713	
11		4	5,000	4,576	
12		5	5,000	4,442	
13		6	5,000	4,313	
14		7	5,000	4,187	
15		8	5,000	4,065	
16		9	5,000	3,947	
17		10	5,000	3,832	
18				43,931	
19					
20					

When used for payments, the PV function calculates the present value of each payment separately and adds the totals. Because the first payment is due now, its present value is the same as the payment amount. Year 2 payment is due in one year, and it is decreased to $4,854. The last payment, which is due in nine years, is lowered to $3,832. All of the estimates for present value are totaled. Fortunately, PV takes care of the tough lifting.

Calculating the net present value

If all the cash flows are the same, the PV function may compute the present value of future cash flows. But this isn't always the case. Excel's NPV (net present value) tool calculates the present value of unbalanced future cash flows.

Assume you were asked to invest $30,000 in a new firm. You would get an annual dividend for the following seven years in return for your investment. The schedule shows the projected amounts of such dividends. Assume you want to make an 8% return on your investment.

You can use the NPV formula to calculate the net present value of an investment to see whether it's worth your time:

=NPV (C2, C5:C11)

NPV, like PV value, discounts each cash flow individually depending on the rate. NPV, on the other hand, accepts a range of future cash flows rather than a fixed payment amount, unlike PV. Because the number of values in the range influences the number of future cash flows, NPV does not have a nper argument.

Even if the payments are for different amounts, they are expected to be made at regular periods (one year in this example). The rate period, like the other TVM functions in this chapter, must match the payment period. The 8% return you want is an annual return in this case, and the payments are also yearly, so they match. You'd have to change the rate to a quarterly return if you were collecting a quarterly dividend.

The net present value (NPV) of these cash flows is $33,068. These would be favorable investments since the needed investment to generate those cash flows, $30,000, is less than the NPV (provided the figures are true). The data indicates that you would earn more than the 8% return you desired.

The calculation of both positive and negative cash flows

In the previous scenario, you were advised to make a sizable initial commitment in order to receive future cash flows. You can use NPV if you make smaller payments at the beginning of the financing period with the expectation of additional payments at the end.

Instead of making a single $30,000 commitment, think about making investments of $15,000 the first year, $10,000 the second year, and $5,000 the third year. The amount you must invest goes down as the company grows and may use its income to expand. By year four, there won't be any more investment required, and the business should be successful enough to start paying dividends.

The payment schedule shown in the chart below entails paying for the first three years and receiving a return for the next four. The inputs only differ from the last iteration of the NPV calculation.

=NPV (C2, C5:C11)

The amount invested was not taken into account in the first NPV case. We simply compared the NPV function's outcome to the amount of money invested. Because a part of the investment is in the future in this example, the invested amounts are displayed as negatives (cash outflows), but the forthcoming dividends are shown as positives (cash inflows).

This NPV computation is compared to zero instead of an initial investment amount. If the NPV is larger than zero, the sequence of cash flows will provide a return of more than 8%. The return is less than 8% if it is less than zero.

Internal rate of return calculation

In the scenario before, we calculated the net present value of the anticipated future cash flows and contrasted it with the sum of our initial investment. Since the net present value exceeded the initial investment, we were aware that the rate of return would be higher than what we had anticipated. But what is the actual rate of return?

The IRR function in Excel can be used to calculate the internal rate of return of future cash flows. NPV and IRR are indissolubly related. IRR determines the rate of return at which those identical cash flows have a negative net present value.

C12 =IRR(C3:C10,0.08)

	A	B	C
1			
2		Date	Expected Future Cash Flow
3		12/31/2014	(30,000)
4		12/31/2015	4,000
5		12/31/2016	4,760
6		12/31/2017	5,664
7		12/31/2018	6,797
8		12/31/2019	7,477
9		12/31/2020	8,225
10		12/31/2021	9,458
11			
12		Internal Rate of Return:	10.53%
13			

We need to change the way we organize our data for IRR. In the values range, there must be at least one positive and one negative cash flow. If all of your values are positive, you've invested nothing and received nothing in return. That would be a fantastic investment, but it isn't feasible. Cash withdrawals usually occur at the start of the investment term, while cash inflows occur at the conclusion. However, as long as there is at least one of each, this isn't necessarily the case.

It is important to note that for IRR to operate, we must include the original investment. The first row was inserted to indicate the original investment of $30,000.

The investment return is 10.53 percent, according to the following IRR formula:

=IRR (C3:C10,0.08)

The range of cash flows is the first justification for IRR. The second point is an educated estimation of the internal rate of return. If you don't provide an estimate, Excel guesses 10%. The present value of each cash flow is calculated using the predicted rate in IRR. If the total is more than zero, the pace is reduced and the process is repeated. Excel repeats the process of accumulating current values and iterating through rates until the total is zero. It returns that rate once the current numbers add up to zero.

Future non-periodic cash flows calculation

For both the NPV and IRR functions, it is assumed that the future cash flows will occur at regular intervals. This might not always be the case, though. Excel's XIRR function is helpful for cash flows that happen at unpredictable times.

In contrast to IRR, XIRR requires an additional justification: dates. The IRR does not require the dates because it is anticipated that the cash flows will occur at equal intervals. IRR doesn't care if there is a day or a year between them. It will yield a return proportional to the cash flows. If the cash flows are yearly, the rate will be an annual rate. If the cash flows are quarterly, the rate will be quarterly as well.

Note: XIRR provides a function named XNPV that calculates the net present value of non-periodic cash flows. XNPV, like XIRR, needs a matching set of dates.

The investment loses money sometimes, necessitating a cash infusion. On other days, the investment is profitable and pays the investor a profit. The investor earns an annual return of 10.14 percent on all cash flows.

The return is calculated using XIRR in the following formula:

=XIRR(C3:C17,B3:B17,0.08)

Internally, XIRR functions similarly to IRR. It evaluates the present value of each cash flow separately, iterating over rate estimates until the total present value is zero. The number of days between the current cash flow and the one before it in chronological order is used to calculate the present value. The rate of return is then annualized.

Performing financial forecasting

Forecasting is the process of projecting future values based on previous ones. Start with historical, time-based data, such as monthly sales, to construct a prediction. Monthly sales statistics from 2012 to 2015 may be found in Column B. We also generated a graph that demonstrates that sales are cyclical, with fewer sales during the summer months. The purpose is to anticipate revenues for the following two years monthly.

Begin by choosing the data. We choose the range A1:B49 for this example. Excel shows the **Create Forecast Worksheet dialog box** when you choose Data Forecast Sheet. (Clicking Options brings up a list of other settings.) The dialog box displays a graphic that shows the historical data, predicted data, and forecast confidence bounds.

The confidence interval (shown in the graphic as thinner lines) sets the prediction's "plus or minus" values and reflects the degree of confidence in the forecast. A larger prediction range is achieved with a bigger confidence interval. As you alter the parameters, the chart in the dialog box updates.

When you click **Create**, Excel creates a new worksheet with a table and a chart. The projected values, as well as the lower and upper confidence ranges, are shown in the table. The new FORECAST.ETS and FORECAST.ETS.CONFINT functions are used to create these values. Excel handles all of the work since these are very sophisticated functions.

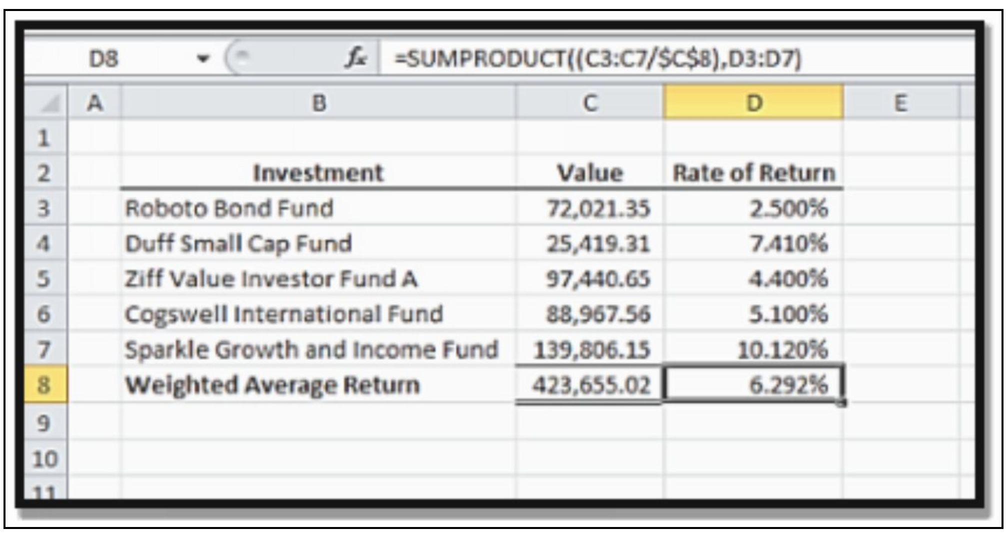
CHAPTER 8

APPLICATION OF FORMULAS IN STATISTICAL ANALYSIS

Because it has so many statistical capabilities, Excel is a great tool for conducting statistical analysis. You'll learn how to use formulae to conduct statistical studies like moving averages, descriptive statistics, and frequency distributions in this section.

Working with Weighted Averages

When each value has a different impact on the total set of values, a weighted average is used to average the data. For each fund in the portfolio, the investment's total amount as well as its return are displayed. We are looking for the portfolio's overall return. A simple average will not do because each investment raises the total portfolio's value, so it is insufficient.


D8 =SUMPRODUCT((C3:C7/$C$8),D3:D7)

Investment	Value	Rate of Return
Roboto Bond Fund	72,021.35	2.500%
Duff Small Cap Fund	25,419.31	7.410%
Ziff Value Investor Fund A	97,440.65	4.400%
Cogswell International Fund	88,967.56	5.100%
Sparkle Growth and Income Fund	139,806.15	10.120%
Weighted Average Return	423,655.02	6.292%

The weighted average is calculated by multiplying the proportion that each investment contributes to the overall value of the portfolio by the rate of return on that investment. The SUMPRODUCT function is appropriate for multiplying and summing two sets of data. SUMPRODUCT accepts up to 255 parameters separated by commas, however, this formula only requires two.

=SUMPRODUCT((C3:C7/$C$8),D3:D7)

The first parameter divides the total value by the value of each investment. As a consequence, each investment's weight is represented by five percentages. The weight for the Roboto Bond Fund is 17 percent, which is calculated by dividing 72,021.35 by 423,655.02. The rate of return is the second parameter.

SUMPRODUCT multiplies each of the first argument's elements by the second argument's corresponding element. The elements C3/C8 and C4/C8 are multiplied by D3, C4/C8 is multiplied by D4, and so on. SUMPRODUCT adds together the results of multiplying all five components.

The basic average of the results would be 5.906 percent if we used AVERAGE to find it. Because assets like the Sparkle Growth and Income Fund have a greater return than average and make up a bigger share of the portfolio, this is lower than our weighted average.

Instead, all of the work that SUMPRODUCT undertakes to get the weighted average might be done in neighboring cells using simpler functions.

Data Smoothing Using Moving Averages

Data is smoothed using a moving average so that the overall trend of the data may be seen more clearly. It performs admirably when the independent variables are erratic. Any player who has participated in the game is aware of how variable the results can be from round to round. It's challenging to understand how this golfer's game is developing given the chart's abrupt peaks and valleys.

E3 =IF(ROW()<12,NA(),AVERAGE(OFFSET(D3,-9,0,10,1)))

	A	B	C	D	E	F
1						
2		Date	Course	Score	Moving Avg	
3		5/13/2013	Tiburon Golf Club	98	#N/A	
4		5/20/2013	Colbert Hills	88	#N/A	
5		5/27/2013	Colbert Hills	84	#N/A	
6		6/3/2013	Colbert Hills	94	#N/A	
7		6/10/2013	Tiburon Golf Club	85	#N/A	
8		6/17/2013	Tiburon Golf Club	88	#N/A	
9		6/24/2013	Tiburon Golf Club	89	#N/A	
10		7/1/2013	Iron Horse Golf Club	84	#N/A	
11		7/8/2013	Tiburon Golf Club	84	#N/A	
12		7/15/2013	Tiburon Golf Club	97	89.1	
13		7/22/2013	Tiburon Golf Club	97	89.0	
14		7/29/2013	Tiburon Golf Club	84	88.6	
15		8/5/2013	Iron Horse Golf Club	86	88.8	
16		8/12/2013	Tiburon Golf Club	89	88.3	
17		8/19/2013	Tiburon Golf Club	89	88.7	
18		8/26/2013	Tiburon Golf Club	93	89.2	
19		9/2/2013	Tiburon Golf Club	90	89.3	
20		9/9/2013	Tiburon Golf Club	90	89.9	
21		9/16/2013	Tiburon Golf Club	85	90.0	
22		9/23/2013	Indian Creek Golf Course	90	89.3	
23		9/30/2013	Iron Horse Golf Club	94	89.0	
24		10/7/2013	Indian Creek Golf Course	93	89.9	
25		10/14/2013	Bent Tree	90	90.3	
26		10/21/2013	Indian Creek Golf Course	100	91.4	

We want to make a graph that smooths out the highs and lows to illustrate how the scores are moving. We may achieve this by calculating the moving average of the scores and plotting the results on the graph.

=IF(ROW()<12,NA(),AVERAGE(OFFSET(D3,-9,0,10,1)))

This formula accomplishes our goal by using a variety of Excel functions. For the first few scores, an IF function is utilized to return the #N/A error. With no arguments, the ROW method returns the current cell's row. The formula returns #N/A for the first nine rows since we don't want to start our moving average computation until we have adequate data.

Note: #N/A mistakes are not shown in Excel charts. For values that you don't want to display on your charts, utilize the NA function.

The AVERAGE function is used to return the arithmetic mean of the previous 10 scores for the later scores. Because our numbers are in a contiguous range, we only need to submit one parameter to AVERAGE.

The **OFFSET function** returns a range of values that are offset from the beginning point.

The following are the justifications to OFFSET:

- **Reference:** The OFFSET function begins in this cell.
- **Rows:** The number of rows in the returned range begins from the beginning cell. Negative values add to the spreadsheet's total, whereas positive ones subtract from it.
- **Cols:** The number of columns beginning from the first cell. Positive numbers count from left to right, whereas negative numbers count from left to right.
- **Height:** How many rows should the returned range have?
- **Width:** How many columns should the returned range have?

NOTE: OFFSET's height and width inputs must be positive integers.

If we make cell D12 the reference argument, OFFSET will begin counting there. OFFSET will count up to nine rows to D3 if the rows parameter is set to -9. The cols input of 0 (zero) indicates that OFFSET remains in the same column. OFFSET has calculated that the start of the returned range will be D3 after the first two parameters.

Because the height option is set to 10, our range will be ten rows tall, or D3:D12. The width parameter of 1 maintains a one-column range. The range D3:D12 is the outcome of OFFSET and what is sent into AVERAGE. The previous 10 scores are averaged as the formula is copied down.

Depending on the data, the number of values to include in a moving average varies. You may display the preceding 12 months, 5 years, or any other quantity that makes sense given your data. The average of the previous ten scores gives a better idea of where this golfer's game is going.

Exponential smoothing applied to volatile data

A good tool for data smoothing is the moving average. Moving averages have the drawback of assigning the same weight to each data point in the collection. In a six-week moving average, for instance, each week's value is given 1/6 of the total weight. In some data sets, more recent data points should be given more weight.

The Demand column displays the actual product that was sold. In an effort to gauge demand, the Moving Average column employs a straightforward six-week moving average. Exponential smoothing is used in the final column to give the most recent weeks more weight than earlier weeks.

=(C8*$H$2)+(E8*(1-$H$2))

The alpha value in cell H2 is the weight assigned to the most recent data item, which in this case is 30%. The remaining 70% of the data items are given a 70 percent weighting. The second most recent is weighted at 30% of the remaining 70% (21%); the third most recent is weighted at 30% of 70% of 70% (14.7%), and so on.

The value from the previous week is multiplied by the alpha value, which is then added to the remaining percentage multiplied by the previous projection. All of the preceding computations are already integrated into the previous projection.

The exponential smoothing prediction is less affected by demand values that are farther away. In other words, the figure from last week is more significant than the number from the week before. Take note of how the exponential prediction reacts to demand variations faster than the moving average.

How to Produce Descriptive Statistics Using Functions

You can present data in concise, quantitative summaries using descriptive statistics. Data are accumulated, counted, and averaged to produce descriptive statistics. In this section, we'll take a look at some of the comparison and profiling tools that can be used to prepare data sets for further analysis.

Obtaining either the biggest or least value

The monthly low temperatures for Marietta, Georgia are shown in the table below. The highest and lowest monthly average temperatures are what we're looking for. The first formula will be used to calculate the highest average low temperature.

=MAX(C3:C14)

The month that corresponds to the temperature determined in the preceding calculation will be returned using the following formula:

=INDEX(B3:B14,MATCH(E5,C3:C14,FALSE),1)

MAX and MIN are two Excel functions for determining the greatest and lowest values in a range. Both formulae have a maximum of 255 parameters. Our data is in the range C3:C14, which is what MAX and MIN are looking for. The biggest number in the range, 70, is returned by MAX, whereas the least is returned by MIN.

The **INDEX function** is used to identify which months certain temperatures correspond to. The list of months in B3:B14 is the range supplied into INDEX. The MATCH function, which returns the location of the lookup item in a list, is the second parameter to INDEX. MATCH returns 7 when we match 70 to our list of temps since 70 is the seventh item on the list. INDEX returns the seventh row of the month listings, or JUL, using that 7. MIN returns JAN, the month with the least value, using the same structure.

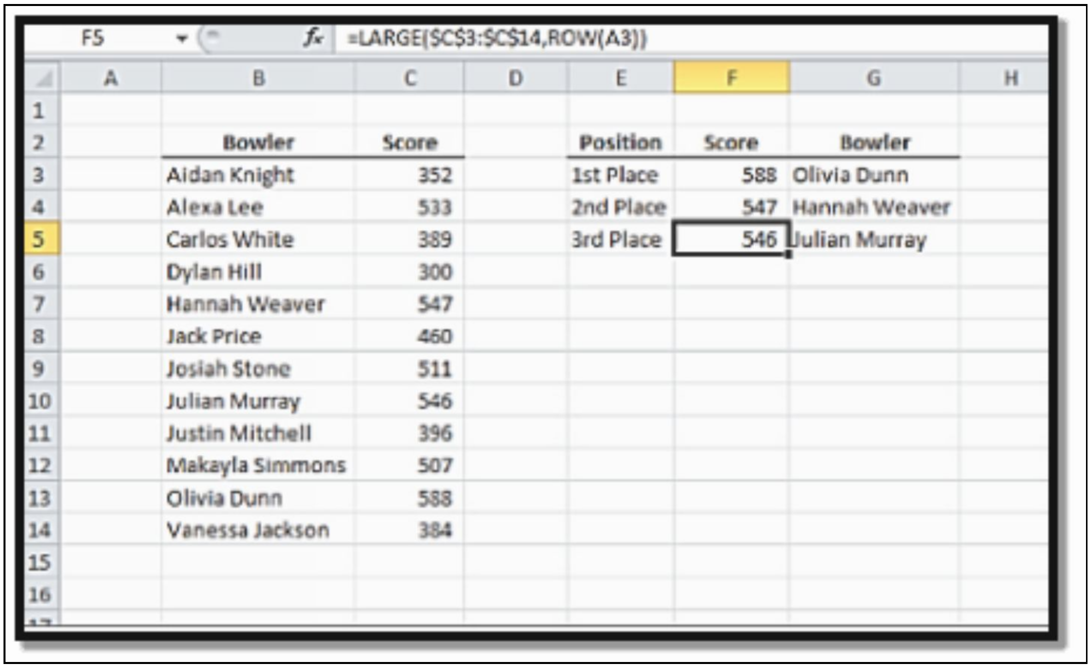
Both MAX and MIN disregard any text in the range, but they will return an error if the range contains errors. MAX and MIN return 0 if all of the errors are text.

Obtaining the Nth biggest or least value

The MIN and MAX algorithms make it simple to determine the largest and smallest numbers. However, there may be times when you need to figure out the fifth- or second-smallest value. It's tough to tell who the winners are because the bowlers are organized alphabetically by last name. The bowlers who finished first through third, along with their scores, are needed.

The third-largest number from the list of scores is returned by this formula:

=LARGE($C$3:$C$14,ROW(A3))



F5 =LARGE($C$3:$C$14,ROW(A3))

	A	B	C	D	E	F	G	H
1								
2		Bowler	Score		Position	Score	Bowler	
3		Aidan Knight	352		1st Place	588	Olivia Dunn	
4		Alexa Lee	533		2nd Place	547	Hannah Weaver	
5		Carlos White	389		3rd Place	546	Julian Murray	
6		Dylan Hill	300					
7		Hannah Weaver	547					
8		Jack Price	460					
9		Josiah Stone	511					
10		Julian Murray	546					
11		Justin Mitchell	396					
12		Makayla Simmons	507					
13		Olivia Dunn	588					
14		Vanessa Jackson	384					
15								
16								

To get the Nth greatest and smallest values in a list, use the LARGE and SMALL functions. We send a range of numbers to LARGE, just as we do with MAX. LARGE, on the other hand, has a different explanation for the N in the Nth greatest number.

LARGE and SMALL return the same value for the Nth value and the Nth + 1 value if two entries in the list have the same value. =LARGE($C$3:$C$14,1) and =LARGE($C$3:$C$14,2) would both yield 588 if two competitors had a score of 588.

To get N in cell F3, we utilize ROW(A1). In this scenario, the **ROW function** returns row 1 for the cell supplied to it. We could just send 1 to the LARGE function, but we can replicate this calculation down to increase the row by using ROW(A1). The A1 reference is relative; thus the formula becomes ROW when transferred to cell F4 (A2). The LARGE function in F4 then returns the second largest number, which is 2.

Because larger bowling scores are preferable, the LARGE function is suitable here. If we had a list of race timings instead, we'd use the SMALL function since lower times are desirable.

The RANK function is another approach to getting the Nth greatest or lowest integer. The RANK function accepts three arguments: the number to rank, a list of all numbers, and the sort order. It also has a column for ranking each result, and the formula is as follows:

=RANK(C3,$C$3:$C$14,1)

We pass the time in C3, the total list of times in C3:C14, and the order into RANK to obtain Gianna Ruiz's rank. In this case, the order is 1, since we want the lowest number to be ranked first. The last argument would be 0 if we want the greatest number to be listed first.

Note: When two or more values are tied, RANK returns the same result for all of them. RANK would return 1 for both racers with a time of 20:35. The next-lowest time would be ranked at number three. Because the linked values take up both the 1 and 2 rankings, none of the values would rank 2.

RANK.AVG and RANK.EQ are two new functions in Excel 2010 for dealing with ties in ranking. The RANK.EQ function replicates the RANK findings from previous versions. That is, if you use the same value, you'll get the same result. The RANK.AVG function operates uniquely. It gives the average rating for all matching values.

Assume the data revealed four runners with the second-lowest time of 21:38. RANK. AVG would yield 1 for the best time and 3.5 for four second-place times that were all the same. Those four occasions are ranked 2, 3, 4, and 5 respectively. These four ranks have a combined average of 3.5.

RANK returns the position of the item in the list if the list was sorted according to the last parameter, unlike LARGE and SMALL, which return the actual values. In the same way that we used INDEX and MATCH to acquire the names, we'll need to utilize INDEX and MATCH to retrieve the actual values.

The formula for returning the time of the first-place contender in cell G3 is as follows:

=INDEX($C$3:$C$14,MATCH(ROW(A1),$D$3:$D$14,FALS

Calculating mean, median, and mode

When someone says "average," they typically mean the arithmetic mean, which is the total of the values divided by the number of values. The median and mode are two more averages that Excel may compute.

We want to look at the grades and make inferences from them by calculating the mean, median, and mode.

=AVERAGE (C3:C22)

=MEDIAN (C3:C22)

=MODE (C3:C22)

The mean is 85.1, the median is 90.5, and the mode is 93.0, as you can see. The **AVERAGE function** adds all of the values in the range and divides by the number of values to get the mean. The median and mode's relationship to the average may provide some information about the data.

G5 fx =MEDIAN(C3:C22)

	A	B	C	D	E	F	G
1							
2		Student	Grade	Count of Grades			
3		Addison Gray	96	1			
4		Alex Palmer	90	1		Average	85.1
5		Andrew Stone	98	1		Median	90.5
6		Bryan Wilson	93	4		Mode	93.0
7		Charles Alexander	71	2			
8		Chloe Carpenter	80	2			
9		Christopher Rose	91	2			
10		Connor Hill	93	4			
11		Dylan Edwards	91	2			
12		Ella Bradley	93	4			
13		Grace Mitchell	71	2			
14		Isaac Rice	73	1			
15		Joshua Thomas	93	4			
16		Juan Armstrong	95	1			
17		Kimberly Morales	77	2			
18		Lily Harrison	72	1			
19		Madison Ortiz	80	2			
20		Ryan Long	92	1			
21		Sarah Cunningham	76	1			
22		Sophia Nichols	77	2			
23							

The **MEDIAN function** is used to calculate the median. MEDIAN delivers the value that is exactly in the center if all the grades are provided in sequence. There is no precise midway value since we have an even number of grades. MEDIAN returns the mean of the two numbers closest to the center in this situation.

A significant disparity between AVERAGE and MEDIAN suggests that grades are not distributed equally throughout the population. There seems to be a significant disparity between the higher-scoring pupils and the lower-scoring students in our scenario. In other circumstances, one extremely big or tiny number may affect the AVERAGE but not the MEDIAN.

The MODE function is used to determine the mode. The grade that occurs the most often is returned by MODE. A count of each grade is shown next to the grade. You can see that 93 appears four times, which is the most of any grade. MODE returns #N/A if all of the values occur the same number of times.

Data allocation into percentiles

To examine how each number relates to the whole, data can be separated into buckets or bins. The individuals who process a product are listed in part in the table below, along with the number of errors the quality assurance department discovered per 1,000 goods. In order to identify top performers and employees who can benefit from additional training, we want to divide this information into four groups. The demarcation line between each quartile can be calculated using Excel's QUARTILE function. A data bucket called a quartile holds 25% of the data.

=QUARTILE($C$3:$C$32,5-ROW(A1))

The demarcation lines are provided by the QUARTILE function. The **MATCH formula** in cell D3 determines which quartile the value in cell C3 belongs to. The formula is then duplicated for each value.

=MATCH(C3,$G$3:$G$6,-1)

The QUARTILE function accepts a set of numbers and an integer that indicates which quartile should be returned (the quart argument). 0 represents the lowest value, 1 represents the 25th percentile, 2 represents the 50th percentile, 3 represents the 75th percentile, and 4 represents the highest value. QUARTILE gives an error if the quart argument is not in the range 0–4. The value of the quart parameter is trimmed if it contains a decimal, and only the integer part is utilized.

The 5-ROW expression is used in the quart parameter of our QUARTILE function (A1). As the formula is duplicated down, the quart argument decreases by one. The equation yields 4 for the largest value in the range for cell G3. The A1 reference changes to A2 when the formula is transferred down to G4, and the equation yields 5-2 or 3 for the 75th percentile.

To discover the two values that surround the demarcation line, the QUARTILE function applies a percentage to one less than the count of values. The result is then calculated by interpolating between those two variables.

QUARTILE calculates the 75th percentile by multiplying the 30 numbers by.75*(30-1) to obtain 21.75. The data is then sorted from lowest to highest, and the lowest value is counted down 21 rows. It interpolates between the two numbers since the first calculation's result isn't a whole integer. In this scenario, the number 43 is obtained by counting down 21 rows, and the following value is obtained by counting down 45 rows. The interpolation utilizes the decimal component of 21.75 to get the number that is 75% of the way between 43 and 45, or 43+((45-43)*.75), which is 44.5.

QUARTILE computes.5*(30-1) for the 50th percentile, yielding 14.5. The 50th percentile is between Alex Cox and Katelyn Howard, counting down from the lowest numbers. Because both numbers are the same, interpolation is simple and yields 31.

The **MATCH function** is used in the range of QUARTILE computations to determine which quartile each number belongs to. The final parameter of MATCH is -1— Greater than since our quartile data is in decreasing order. When the next value is less than the lookup value, MATCH returns the place in the list where the value was located, but it pauses when the next value is greater. MATCH notices that the second value (44.5) is smaller than the lookup value and stops at the first location while trying to match the value 47.

Interquartile Range for Statistical Outlier Identification

In the previous calculation, data were bucketed using the QUARTILE function. Although it narrows the gap between the upper and lower quartiles, the QUARTILE function is only beneficial when you need roughly symmetrical quartiles (making it more difficult to identify true statistical outliers).

Another helpful tool is Excel's QUARTILE function.

EXC removes the median (middle number) from the population. The quartiles are further away from the entire's center as a result of this function. This offers a more exact picture of which numbers should be classified as outliers as well as a more accurate estimate of the true population.

This data collection has a wider range of values. Finding the employees who deviate from the norm and require further investigation is our goal.

D3 =IF(C3<$G$10,"Low",IF(C3>$G$9,"High",""))

Employee	Defects per 1000	Outliers
Alex Cox	64	
Alyssa Cook	104	High
Amelia Rivera	44	
Anna Garcia	56	
Audrey Cox	46	
Chloe Marshall	46	
Eli Green	66	
Evan Stone	6	Low
Evelyn Harris	47	
Genesis Bailey	52	
Jeremiah Palmer	10	
Joseph Morgan	5	Low
Katelyn Howard	46	
Kyle Washington	7	Low
Lillian Matthews	46	
Mason Marshall	110	High
Samuel Chavez	90	
Sean Gomez	101	High
Victoria Freeman	42	
William Cox	52	

75th percentile	65.5
25th percentile	42.5
Interquartile Range	23.0
Fence Factor	1.5
Upper Fence	100.00
Lower Fence	8.00

Use a strategy called a leveraged interquartile range to find outliers. The data in the center half of the interquartile range is called an interquartile range (between the 75th percentile and the 25th percentile). The "leveraged" component refers to the fact that we increase the center range by a factor and set up fences. Any data that falls beyond the fence is regarded as an anomaly.

Here are the formulae that were used:

=QUARTILE.EXC($C$3:$C$22,3) =QUARTILE.EXC($C$3:$C$22,3) =QUARTILE.EXC($C$3:C

=QUARTILE.EXC($C$3:$C$22,1) =QUARTILE.EXC($C$3:$C$22,1) =QUARTILE.EXC($C$3:C

=G4-G5 Interquartile Range

1.5 Fence Factor

=G4+(G6*G8) Upper Fence

=G5-(G6*G8) =G5-(G6*G8) =G5-(G6*G8)=G5

=IF(C3$G$10,"Low,"IF(C3>$G$9,"High","")) outliers

The 75th percentile and 25th percentile are calculated using the QUARTILE.EXC function with inputs of 3 and 1, respectively. The difference between these two is the interquartile range.

You would simply remove the interquartile range from the 25th percentile to create a lower fence and add it to the 75th percentile to achieve a higher fence in a non-leveraged interquartile range. This strategy may produce an excessive number of outliers. We enlarge the gates to isolate the genuinely extreme values by doubling the interquartile range by a factor (1.5 in this example). The table provides the same data sorted by faults, as well as the quartile, interquartile range, and upper and lower fence demarcation lines.

We multiply the fence factor by the interquartile range and add the result to the 75th percentile to get the upper fence. The lower barrier is established by subtracting the same result from the 25th percentile.

You can notice that a fence factor of 1.5 excludes or includes results that you deem outliers or typical. 1.5 is not a magical number. If the factor doesn't suit your data, just increase or decrease it.

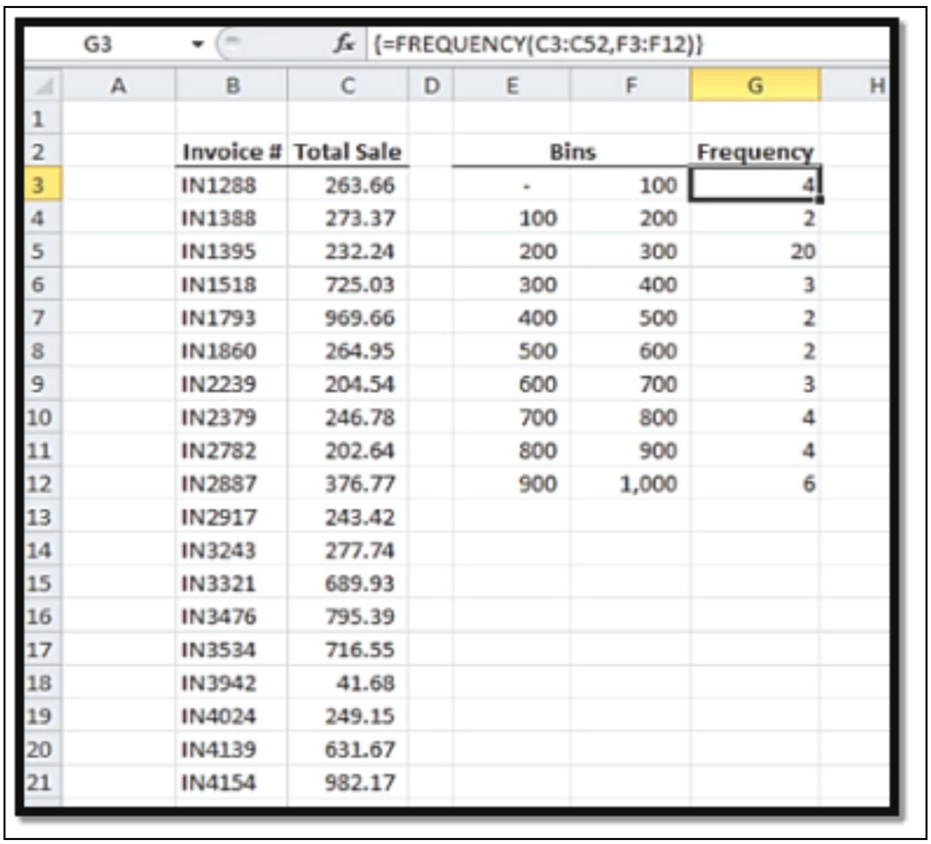
After we've created our fences, we utilize a nested Whether formula to see if each number is larger than or less than the upper or lower fence. The nested IF formula returns the text "High" or **"Low"** for the outliers, and an empty string **("")** for those who are within the gates.

Creating a Frequency Distribution

Because quartiles are a common technique to divide data into bins, Excel offers a dedicated QUARTILE function. However, you might wish to divide your data into defined bins on occasion. We want to know how often transactions between $1 and $100, $101 and $200, and so on are for our consumers.

The FREQUENCY function in Excel will count all invoices that fall within the defined buckets.

=FREQUENCY(C3:C52,F3:F12)



G3 | {=FREQUENCY(C3:C52,F3:F12)}

	A	B	C	D	E	F	G	H
1								
2		Invoice #	Total Sale		Bins		Frequency	
3		IN1288	263.66		-	100	4	
4		IN1388	273.37		100	200	2	
5		IN1395	232.24		200	300	20	
6		IN1518	725.03		300	400	3	
7		IN1793	969.66		400	500	2	
8		IN1860	264.95		500	600	2	
9		IN2239	204.54		600	700	3	
10		IN2379	246.78		700	800	4	
11		IN2782	202.64		800	900	4	
12		IN2887	376.77		900	1,000	6	
13		IN2917	243.42					
14		IN3243	277.74					
15		IN3321	689.93					
16		IN3476	795.39					
17		IN3534	716.55					
18		IN3942	41.68					
19		IN4024	249.15					
20		IN4139	631.67					
21		IN4154	982.17					

The **function FREQUENCY** is an array function. This implies that instead of hitting Enter, you must use **Ctrl+Shift+Enter** to commit the calculation.

Excel will wrap the formula in curly brackets () to indicate that it has been array-entered.

FREQUENCY requires two arguments: a set of data to be binned and a set of integers to indicate the maximum quantity in each bin. To begin, fill in the bin values in column F. The bottom limit of each bin is shown in Column E, which has no bearing on the formula.

To write FREQUENCY in column G, choose the range G3:G12 first, then input the formula. While you'll just be typing the formula into G3, pressing **Ctrl+Shift+Enter** will populate the formula throughout the whole range you've picked.

The FREQUENCY calculation reveals that a high percentage of clients spend between $200 and $300 every visit.

A replacement for the FREQUENCY function

If you attempt to delete a cell from the FREQUENCY formula section, Excel will inform you that "You cannot change part of an array." Excel treats FREQUENCY and all array functions as a single entity. Individual array cells cannot be modified, only the entire array. If you want to change the bins, you must exit and re-enter the array.

The COUNTIFS function can also be used to generate a frequency distribution. COUNTIFS is not an array formula, making it much easier to alter the bins or alter the range. Here is an example of the COUNTIFS function for the following data:

=COUNTIFS($C$3:$C$52,">"&E3,$C$3:$C$52,">="&

G3 =COUNTIFS($C$3:$C$52,">"&E3,$C$3:$C$52,"<="&F3)

	A	B	C	D	E	F	G	H	I
1									
2		Invoice#	Total Sale		Bins		Frequency		
3		IN1288	263.66		-	100	4		
4		IN1388	273.37		100	200	2		
5		IN1395	232.24		200	300	20		
6		IN1518	725.03		300	400	3		
7		IN1793	969.66		400	500	2		
8		IN1860	264.95		500	600	2		
9		IN2239	204.54		600	700	3		
10		IN2379	246.78		700	800	4		
11		IN2782	202.64		800	900	4		
12		IN2887	376.77		900	1,000	6		
13		IN2917	243.42						

COUNTIFS, unlike **FREQUENCY**, requires the bin's lower limit (column E). It adds up all the numbers that are higher than the lower limit but less than or equal to the upper bound. This formula is just copied down for as many bins as we've specified, rather than using an array.

CHAPTER 9

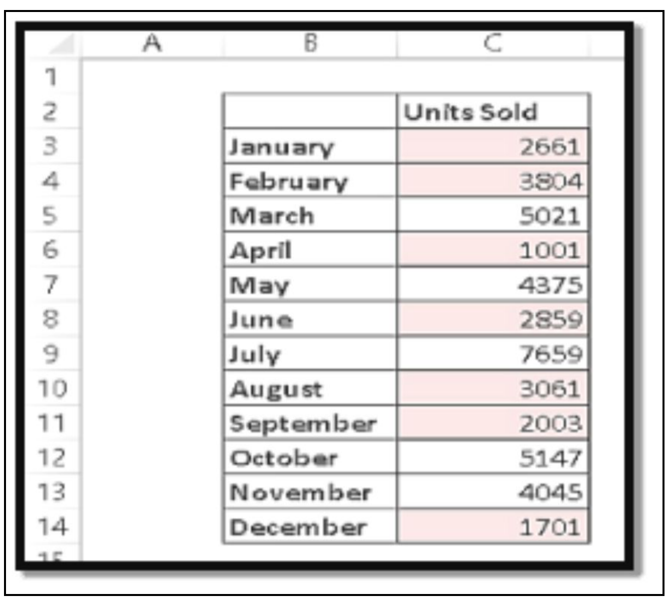
TABLES AND CONDITIONAL FORMATTING IN FORMULAS

The term "conditional formatting" refers to an Excel function that enables you to change the formatting of a value, cell, or range of cells based on a number of predefined conditions. With conditional formatting, you may quickly and solely based on formatting identify which values are "good" and which are "poor" in your Excel reports.

In this chapter, we'll demonstrate how to use Excel's conditional formatting tool along with formulas to add a layer of visuals to your investigation.

Cells That Meet Specific Criteria Are Highlighted

One of the most basic conditional formatting rules you may create highlights cells that meet specific business requirements. This first illustration illustrates how to format cells that have values lower than the hard-coded threshold of 4000.

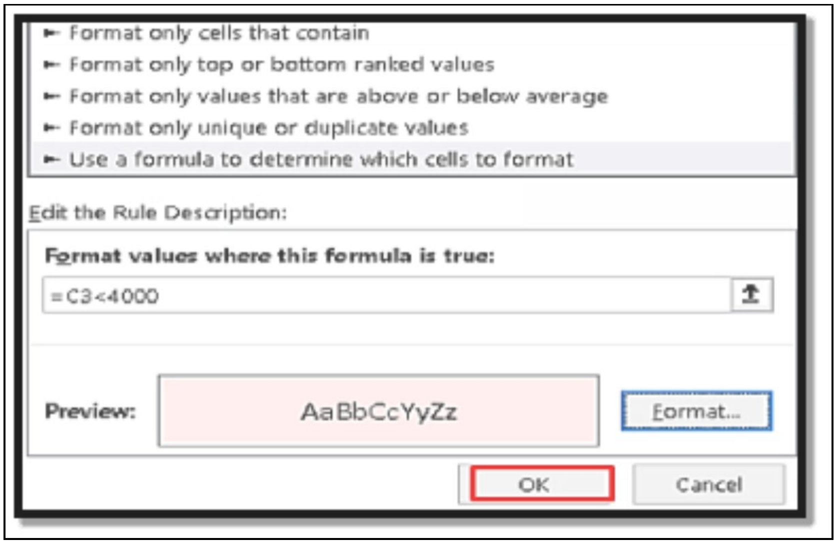


	Units Sold
January	2661
February	3804
March	5021
April	1001
May	4375
June	2859
July	7659
August	3061
September	2003
October	5147
November	4045
December	1701

Follow these steps to create this simple formatting rule:

1. In your target range, choose the data cells you want to work with.

2. Select **Conditional Formatting > New Rule > New Rule** from the Home tab of the Excel Ribbon.



3. Select Use a formula to select which cells to format from the list box at the top of the dialog box.
4. **NB:** This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
5. Type the formula indicated below into the formula input box. It's worth noting that we're just referring to the first cell in our target range. It is not necessary to refer to the complete spectrum. =C3<4000

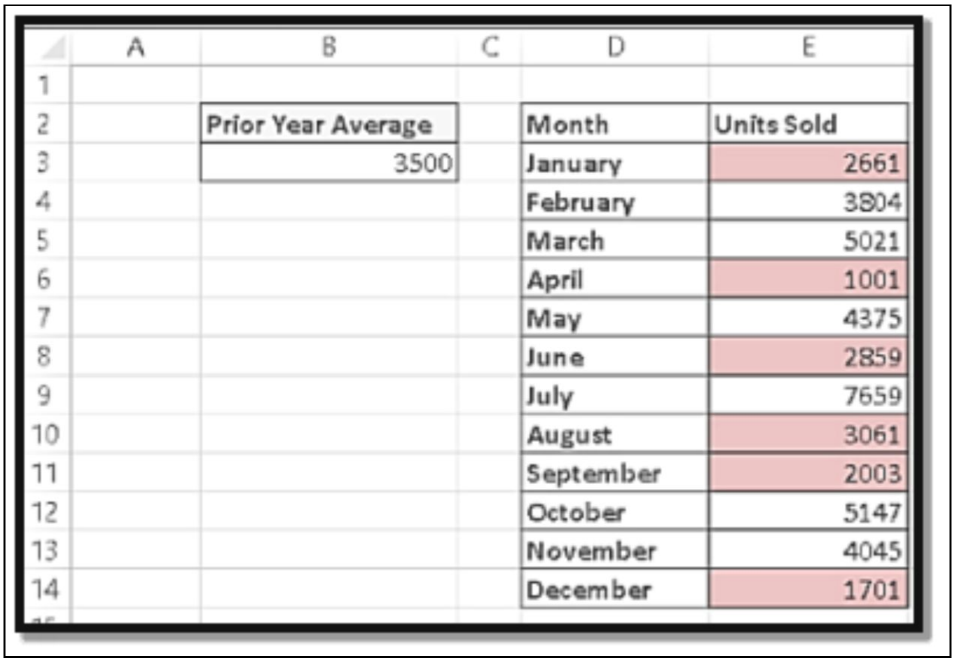
Note: The absolute reference dollar symbols ($) for the target cell are not included in the calculation (C3). Excel will instantly make your cell reference absolute if you click cell C3 with your mouse rather than putting it in. Because you require Excel to apply this formatting rule based on each cell's value, you mustn't use the absolute reference dollar symbols in your target cell.

6. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.
7. When you've finished selecting your formatting choices, click OK.
8. Return to the New Formatting Rule dialog box and double-click the **OK button** to finalize your formatting rule.

If you need to change your conditional formatting rule, just set your cursor in any of the data cells in your formatted range, then click **Conditional Formatting Manage Rules** from the Home tab. The **Conditional Formatting Rules Manager dialog box** will appear. Then, on the **Edit Rule button**, choose the rule you wish to change.

Cells can be highlighted dependent on another cell's value.

In many cases, how the values of your cells compare to one another will dictate the formatting rules that apply to that cell. Conditionally highlighted cells are those whose values are less than the Prior Year Average value indicated in cell B3.



	A	B	C	D	E
1					
2		Prior Year Average		Month	Units Sold
3		3500		January	2661
4				February	3804
5				March	5021
6				April	1001
7				May	4375
8				June	2859
9				July	7659
10				August	3061
11				September	2003
12				October	5147
13				November	4045
14				December	1701

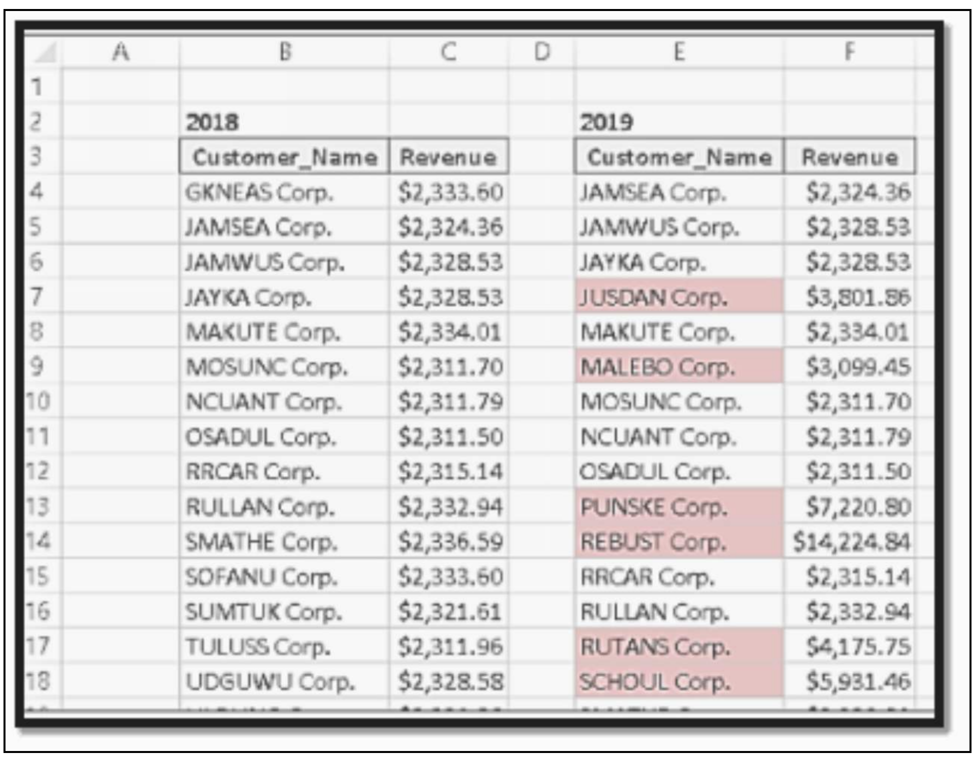
Follow these steps to create this simple formatting rule:

1. In your target range, choose the data cells you want to work with (cells E3:E14 in this example).
2. Select **Conditional Formatting > New Rule** from the Home tab of the Excel Ribbon.
3. Select Use a formula to select which cells to format from the list box at the top of the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.

4. Type the formula indicated below into the formula input box. It's worth noting that we're just comparing the value in our target cell (E3) to the value in the comparison cell ($B$3). You'll need to utilize absolute references, just as in conventional formulae, to guarantee that each value in your range gets compared to the proper comparison cell. =E3<$B$3
5. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.
6. When you've finished selecting your formatting choices, **click OK**.
7. Return to the New Formatting Rule dialog box and double-click the OK button to finalize your formatting rule.

Highlighting Values That Exist in List1 but Not List2

You'll often be asked to compare two lists and identify the values that are present in one but not in the other. The use of conditional formatting to display your results is excellent. The table shows a conditional formatting exercise that compares clients from 2018 and 2019, emphasizing those who are new customers in 2019, i.e. those who did not exist in 2018.



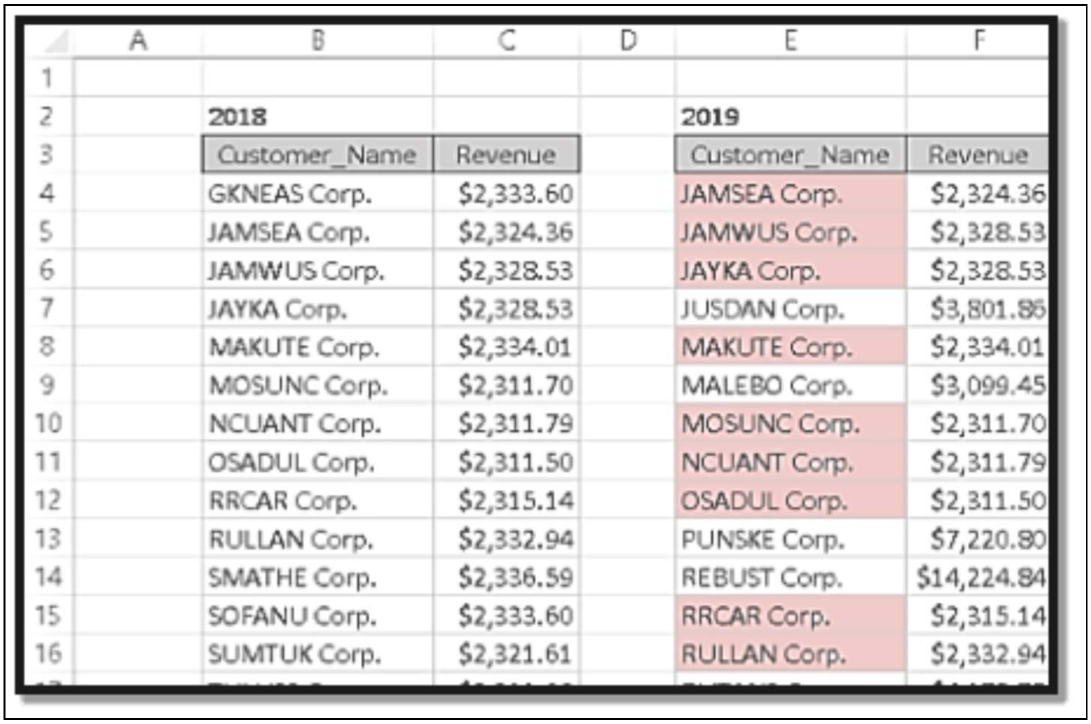
	A	B	C	D	E	F
1						
2		2018			2019	
3		Customer_Name	Revenue		Customer_Name	Revenue
4		GKNEAS Corp.	$2,333.60		JAMSEA Corp.	$2,324.36
5		JAMSEA Corp.	$2,324.36		JAMWUS Corp.	$2,328.53
6		JAMWUS Corp.	$2,328.53		JAYKA Corp.	$2,328.53
7		JAYKA Corp.	$2,328.53		JUSDAN Corp.	$3,801.86
8		MAKUTE Corp.	$2,334.01		MAKUTE Corp.	$2,334.01
9		MOSUNC Corp.	$2,311.70		MALEBO Corp.	$3,099.45
10		NCUANT Corp.	$2,311.79		MOSUNC Corp.	$2,311.70
11		OSADUL Corp.	$2,311.50		NCUANT Corp.	$2,311.79
12		RRCAR Corp.	$2,315.14		OSADUL Corp.	$2,311.50
13		RULLAN Corp.	$2,332.94		PUNSKE Corp.	$7,220.80
14		SMATHE Corp.	$2,336.59		REBUST Corp.	$14,224.84
15		SOFANU Corp.	$2,333.60		RRCAR Corp.	$2,315.14
16		SUMTUK Corp.	$2,321.61		RULLAN Corp.	$2,332.94
17		TULUSS Corp.	$2,311.96		RUTANS Corp.	$4,175.75
18		UDGUWU Corp.	$2,328.58		SCHOUL Corp.	$5,931.46

Follow these steps to create this simple formatting rule:

1. In your target range, choose the data cells you want to work with (cells E4:E28 in this example).
2. Select **Conditional Formatting > New Rule** from the Home tab of the Excel Ribbon.
3. Select Use a formula to select which cells to format from the list box at the top of the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
4. Type the formula indicated below into the formula input box. Note that we're evaluating if the value in the target cell (E4) is found in our comparison range ($B$4:$B$21) using the COUNTIF function. The **COUNTIF function** will return a 0 if the value is not found, activating the conditional formatting. You'll need to utilize absolute references, just as in conventional formulae, to guarantee that each value in your range gets compared to the proper comparison cell. =COUNTIF($B$4:$B$21,E4)=0
5. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.
6. When you've finished selecting your formatting choices, click OK.
7. Return to the New Formatting Rule dialog box and double-click the OK button to finalize your formatting rule.

Highlighting Values That Exist in List1 and List2

You may need to compare two lists and choose just the values that appear in both lists on occasion. Conditional formatting is an excellent technique to display your results once again. The table is a conditional formatting exercise that compares customers from 2018 and 2019, emphasizing those in both lists in 2019.



	A	B	C	D	E	F
1						
2		2018			2019	
3		Customer_Name	Revenue		Customer_Name	Revenue
4		GKNEAS Corp.	$2,333.60		JAMSEA Corp.	$2,324.36
5		JAMSEA Corp.	$2,324.36		JAMWUS Corp.	$2,328.53
6		JAMWUS Corp.	$2,328.53		JAYKA Corp.	$2,328.53
7		JAYKA Corp.	$2,328.53		JUSDAN Corp.	$3,801.86
8		MAKUTE Corp.	$2,334.01		MAKUTE Corp.	$2,334.01
9		MOSUNC Corp.	$2,311.70		MALEBO Corp.	$3,099.45
10		NCUANT Corp.	$2,311.79		MOSUNC Corp.	$2,311.70
11		OSADUL Corp.	$2,311.50		NCUANT Corp.	$2,311.79
12		RRCAR Corp.	$2,315.14		OSADUL Corp.	$2,311.50
13		RULLAN Corp.	$2,332.94		PUNSKE Corp.	$7,220.80
14		SMATHE Corp.	$2,336.59		REBUST Corp.	$14,224.84
15		SOFANU Corp.	$2,333.60		RRCAR Corp.	$2,315.14
16		SUMTUK Corp.	$2,321.61		RULLAN Corp.	$2,332.94

Follow these steps to create this simple formatting rule:

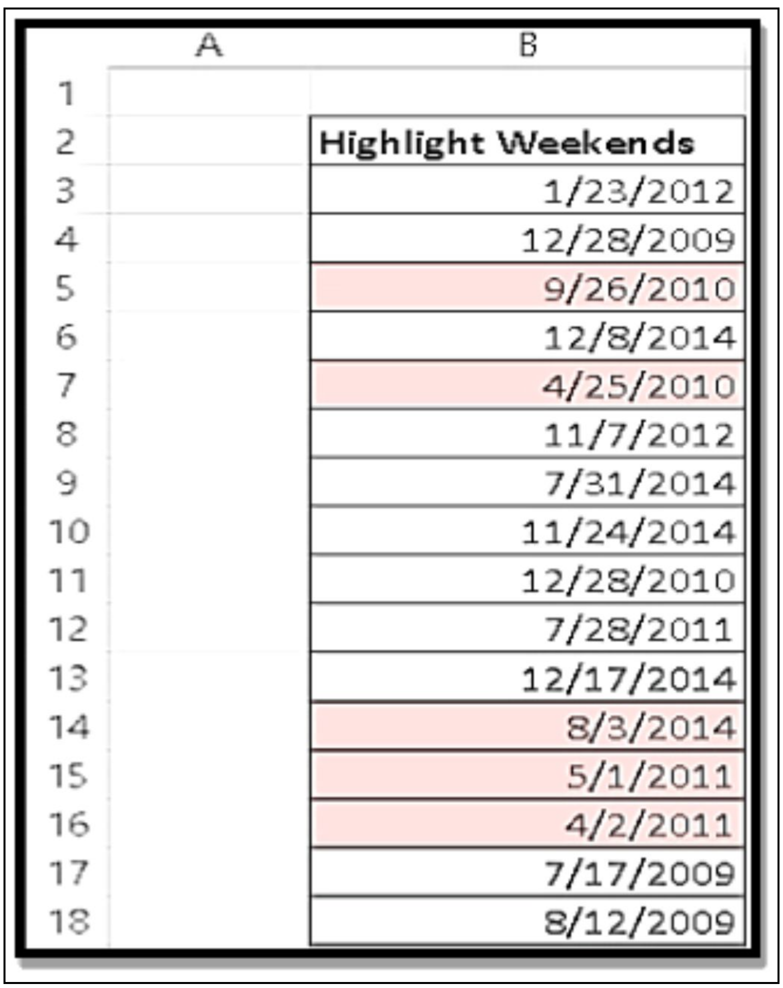
1. In your target range, choose the data cells you want to work with (cells E4:E28 in this example).
2. Select **Conditional Formatting > New Rule** from the Home tab of the Excel Ribbon.
3. Select **Use a formula** to select which cells to format from the list box at the top of the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
4. Type the formula indicated below into the formula input box. Note that we're evaluating if the value in the target cell (E4) is found in our comparison range ($B$4:$B$21) using the COUNTIF function. The COUNTIF function will return a number larger than 0 if the value is discovered, activating the conditional formatting. You'll need to utilize absolute references, just as in conventional formulae,

to guarantee that each value in your range gets compared to the proper comparison cell. =COUNTIF($B$4:$B$21,E4)>0

5. Select your preferred formatting by clicking the Format option. This will open the **Format Cells dialog box**, where you may format the font, border, and fill for your target cell using a variety of settings.
6. When you've finished selecting your formatting choices, click OK.
7. Return to the **New Formatting Rule dialog box** and double-click the OK button to finalize your formatting rule.

Highlighting Based on Dates

You might find it handy to graphically highlight when particular dates set off a certain scenario. When dealing with timecards and scheduling, for example, it's typically helpful to be able to quickly identify any days that occur on weekends.



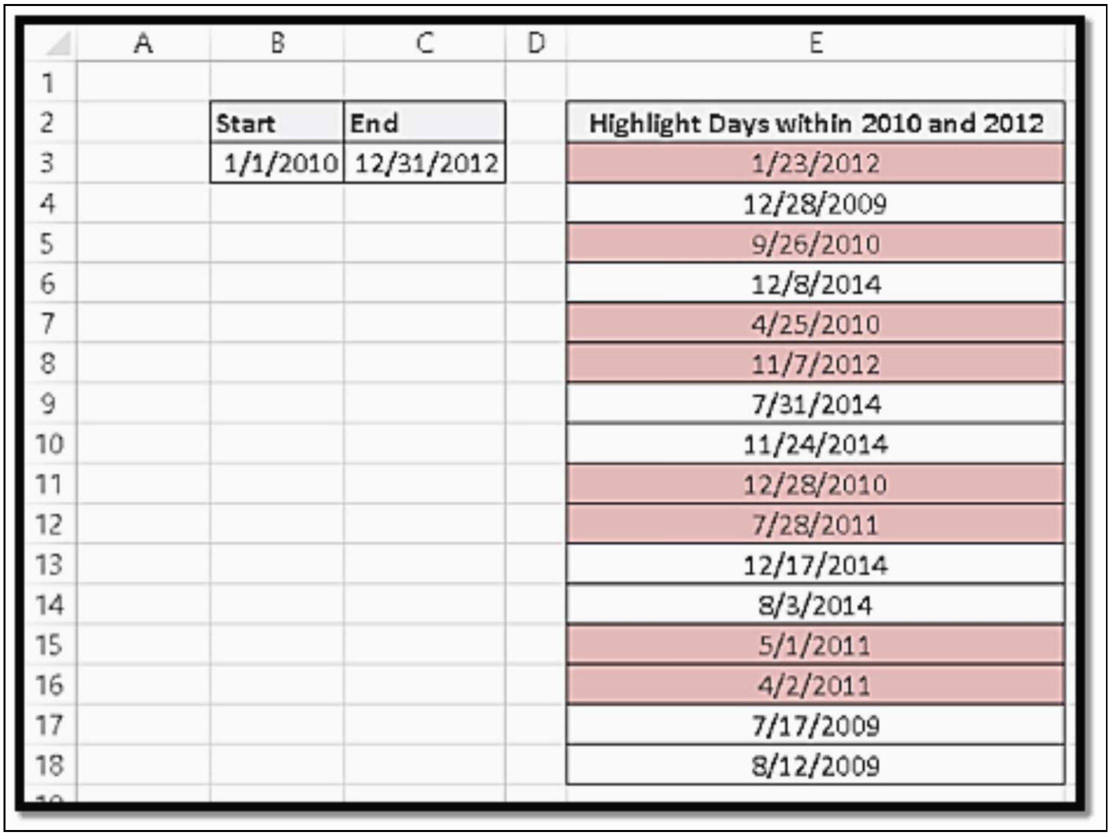
	A	B
1		
2		Highlight Weekends
3		1/23/2012
4		12/28/2009
5		9/26/2010
6		12/8/2014
7		4/25/2010
8		11/7/2012
9		7/31/2014
10		11/24/2014
11		12/28/2010
12		7/28/2011
13		12/17/2014
14		8/3/2014
15		5/1/2011
16		4/2/2011
17		7/17/2009
18		8/12/2009

Follow these steps to create this simple formatting rule:

1. In your target range, choose the data cells you want to work with (cells B3:B18 in this example)
2. Select **Conditional Formatting > New Rule** from the Home tab of the Excel Ribbon.
3. Select Use a formula to select which cells to format from the list box at the top of the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
4. Type the formula indicated below into the formula input box. Note that we're evaluating the target cell's weekday number using the WEEKDAY function (B3). If weekday 1 or 7 is returned in the target cell, the date in B3 is a weekend date. The conditional formatting will be used in this scenario. =OR(WEEKDAY(B3)=1, WEEKDAY(B3)=7)
5. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.
6. When you've finished selecting your formatting choices, click OK.
7. Return to the **New Formatting Rule dialog box** and double-click the OK button to finalize your formatting rule.

Highlighting days between two dates

Some analyses need the selection of dates that fall inside a certain time frame. The table below shows how conditional formatting may be used to highlight dates depending on a start and end date. The conditional formatting adapts when the start and end dates are changed.



Follow these steps to create this simple formatting rule:

1. Click the **Home tab** of the **Excel Ribbon**, then **Conditional Formatting > New Rule**, and then pick the data cells in your desired range (cells E3:E18 in this example).
2. Select Use a formula to select which cells to format from the list box at the top of the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
3. Type the formula indicated below into the formula input box. Note that we're comparing the date in our target cell (E3) to the start and end dates in cells $B$3 and $C$3, respectively, using the AND function. The formula will evaluate to TRUE if the target cell is between the start and finish dates, activating conditional formatting. =AND(E3>=$B$3,E3<=$C$3)
4. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.

5. When you've finished selecting your formatting choices, click OK.
6. Return to the **New Formatting Rule dialog box** and double-click the OK button to finalize your formatting rule.

Using a due date to highlight dates

The example demonstrates how to conditionally format dates that are overdue by a specific amount of days. The dates in this scenario that are more than 90 days past due are highlighted in red.

Follow these steps to create this simple formatting rule:

1. Select the Home tab of the Excel Ribbon, then **Conditional Formatting > New Rule**, and then pick the data cells in your desired range.
2. Select Use a formula to select which cells to format from the list box that appears in the dialog box. This option calculates values using a formula that you define. The conditional formatting is applied to a cell if a given value evaluates to true.
3. Type the formula indicated below into the formula input box. We're determining if today's date is more than 90 days beyond the date in our target cell using this formula (C4). The conditional formatting will be applied if this is the case. =TODAY()-C4>90
4. Select your preferred formatting by clicking the Format option. This will open the Format Cells dialog box, where you may format the font, border, and fill for your target cell using a variety of settings.
5. When you've finished selecting your formatting choices, click OK.
6. Return to the **New Formatting Rule dialog box** and double-click the OK button to finalize your formatting rule.

CHAPTER 10

COMPREHENSION AND USE OF ARRAY FORMULAS

One of the most intriguing (and useful) features of Excel is its ability to work with arrays in equations. Once you understand this idea, you'll be able to create stunning formulas that appear to perform magical spreadsheet tricks.

Anyone interested in mastering Excel formulas must read this part, which introduces the concept of arrays.

Knowing how to use array formulas

If you've ever done any computer programming, you've probably encountered the idea of an array. A group of items that can be handled jointly or individually make up an array. In Excel, an array can have one or two dimensions. These dimensions correspond to rows and columns. An example of a one-dimensional array would be one that has either one row (horizontal array) or one column (vertical array) (a vertical array). A two-dimensional array may fit into a rectangle range of cells. In Excel, three-dimensional arrays are not supported (but its VBA programming language does).

You'll learn that arrays don't necessarily have to be stored in cells. You can also work with arrays that are stored exclusively in Excel's memory. After that, you can modify the data using an array formula and then output the changes.

There are two kinds of array formulae in Excel:

- **Formulas for single-cell arrays:** Work with arrays that are stored in ranges or memory to create a single-cell output.
- **Formulas for multicell arrays:** Work with arrays that are stored in ranges or memory to create an array. A multicell array formula is an input into a range of cells since each cell can only contain one value.

This section contains two array formula examples, one of which fills many cells and the other of which only occupies one cell.

An array with several cells

The table below displays a simple spreadsheet for determining product sales. In a typical scenario, you would use a formula similar to this one to find the value in column D and then repeat it along the column.

=B2*C2

The spreadsheet now has six formulae in column D after you replicate the formula.

	A	B	C
1	Product	Units Sold	Unit Price
2	AR-998	3	$50
3	BZ-011	10	$100
4	MR-919	5	$20
5	TR-811	9	$10
6	TS-333	3	$60
7	ZL-001	1	$200

An alternate technique calculates all six values in D2:D7 using a single formula. This single formula takes up six cells and yields a six-value array.

Follow these steps to generate a multicell array formula to execute the calculations:

1. Choose a range in which to store the findings. The range is D2:D7 in this example. Because a single cell cannot show more than one value, you must choose six cells to make this array function.
2. Fill in the blanks using the following formula:
   =B2:B7*C2:C7
3. To input the formula, press **Ctrl+Shift+Enter**. To input a formula, you normally hit Enter. However, since this is an array formula, hit **Ctrl+Shift+Enter** instead.

Note: A multicell array formula cannot be inserted into a range that has been defined as a table (by selecting **Insert Tables > Table**). A table cannot be created from a range that has a multicell array formula.

The formula is input into each of the six cells that have been chosen. When you look at the Formula bar, you'll see the following:

{=B2:B7*C2:C7}

Excel wraps the formula in curly brackets to show that it's an array formula.

This formula works out the numbers and produces a six-item array. The array formula is used in conjunction with two additional arrays, both of which are kept in ranges. The first array's values are saved in B2:B7, whereas the second array's values are kept in C2:C7.

The values returned by this multicell array formula are the same as the values returned by these six standards formulae placed into individual cells in D2:D7:

- =B2*C2
- =B3*C3
- =B4*C4
- =B5*C5
- =B6*C6
- =B7*C7

There are a few benefits to using a multicell array formula rather than separate formulas:

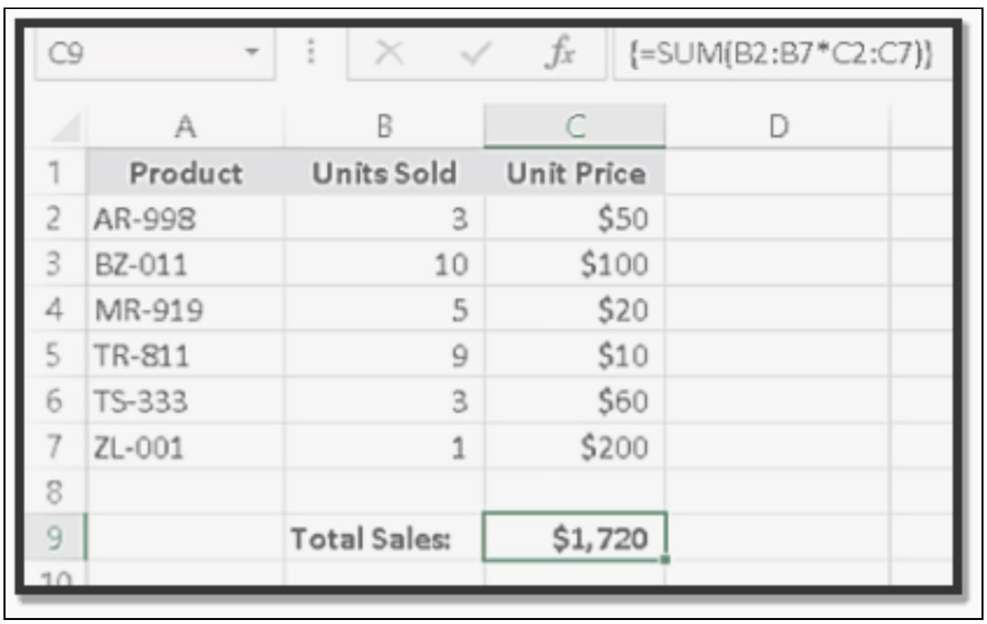
- It's a handy technique to make sure that every formula in a range is the same.
- Using a multicell array formula reduces the chances of mistakenly overwriting a formula. In a multicell array formula, you can't edit or remove only one cell. If you try to do so, Excel will give you an error warning.
- Using a multicell array formula almost eliminates the possibility of beginners messing with your formulae.

There are various drawbacks to using a multicell array formula as mentioned in the previous list:

- It is difficult to add a new row to the range. In other circumstances, though, the inability to introduce a row is a benefit. You may not want users to add rows to a worksheet because it will influence other areas of the worksheet.
- If you want to add fresh data at the bottom of the range, you'll need to change the array formula.

A single-cell array formula

It is the right time to look at a formula for a single-cell array. The formulae in column D, on the other hand, have been removed. The purpose is to add up all of the product sales without having to use the individual computations from column D.



C9 {=SUM(B2:B7*C2:C7)}

	A	B	C	D
1	Product	Units Sold	Unit Price	
2	AR-998	3	$50	
3	BZ-011	10	$100	
4	MR-919	5	$20	
5	TR-811	9	$10	
6	TS-333	3	$60	
7	ZL-001	1	$200	
8				
9		Total Sales:	$1,720	

In cell C9, write the following array formula:

{=SUM(B2:B7*C2:C7)}

Make sure you hit **Ctrl+Shift+Input** to enter this formula (and don't worry about the curly brackets; Excel will add them for you).

This formula uses two arrays, one of which is kept in a cell and the other in a table. The first array is kept in B2:B7, whereas the second is kept in C2:C7. The formula multiplies the values in these two arrays and generates a new one (that exists only in memory). The new array has six values, which are expressed as follows (the rationale for the semicolons is explained later):

{150;1000;100;90;180;200}

The SUM function is then used in this new array, and the sum of its values is returned.

In this situation, you may get the same answer without utilizing an array formula by using the SUMPRODUCT function:

=SUMPRODUCT (B2:B7, C2:C7)

However, as you can see, array formulae enable a wide range of computations that would otherwise be impossible.

How to Create an Array Constant

In the examples in the preceding section, arrays that were saved in worksheet ranges were used. The examples in this section demonstrate a key idea: an array need not be stored as a collection of cells. A type of array that is stored in memory is referred to as a "array constant."

Write a list of the items and enclose it in curly brackets to create an array constant. An illustration of a horizontal array constant with five entries is given below:

{1,0,1,0,1}

The SUM function is used in the following formula, using the previous array constant as its parameter. The total of the items in the array (which is 3) is returned using the formula:

=SUM({1,0,1,0,1})

Although this formula makes use of an array, it is not an array formula in and of itself. As a result, you don't need to use **Ctrl+Shift+Enter** to enter the formula; nonetheless, entering it as an array formula will have the same effect.

You must include the curly brackets around the array items when specifying an array directly (as seen earlier). The curly brackets, on the other hand, are not required when using an array formula.

You probably don't see any benefit in utilizing an array constant at this time. For example, the following formula yields the same outcome as the preceding formula. The benefits, on the other hand, will become apparent:

=SUM(1,0,1,0,1)

Here's an example of a formula that makes use of two array constants:

=SUM({1,2,3,4}*{5,6,7,8})

The formula builds a new array (in memory) that is the product of the two arrays' corresponding items. The new array looks like this:

{5,12,21,32}

The SUM function is then called with this new array as a parameter, and the result is returned (70).

The following formula, which does not employ arrays, is identical to the previous one:

=SUM (1*5,2*6,3*7,4*8)

On the other hand, the SUMPRODUCT function may be used. Although the following formula is not an array formula, it does employ two array constants as arguments:

=SUMPRODUCT({1,2,3,4},{5,6,7,8})

Both an array constant and an array stored in a range may be used in a formula.

The sum of the values in A1:D1 multiplied by the corresponding element in the array constant, for example, is returned using the following formula:

=SUM ((A1:D1*{1,2,3,4})

The following is the corresponding formula:

=SUM(A1*1,B1*2,C1*3,D1*4)

Numbers, text, logical values (TRUE or FALSE), and even error values like #N/A may be stored in an array constant. Integer, decimal, and scientific numbers are all acceptable. Double quotation marks must be used to enclose content. In the same array constant, you may utilize several sorts of values, like in this example:

{1,2,3,TRUE,FALSE, TRUE,"Moe","Larry","Curly"}

Formulas, functions, or other arrays cannot be included in an array constant. Dollar signs, commas, parenthesis, and percent signs are not allowed in numerical numbers.

The following is an example of an incorrect array constant:

SQRT (32), $56.32,12.5% SQRT (32), $56.32,12.5%

Identifying an Array's Dimensions

As was already said, an array can be either one or two dimensions. A one-dimensional array can be vertical or horizontal, which corresponds to many rows or one row respectively (corresponding to a single column).

Horizontal arrays in one dimension

One-dimensional horizontal array members are separated by commas and can be displayed as a row of cells. A semicolon can be used as a list separator if you're using Excel in a language other than English.

A one-dimensional horizontal array constant is shown below:

{1,2,3,4,5}

This array must be shown in a range of five cells in a row. Select a range of cells with one row and five columns to input this array into a range.

Then press Ctrl+Shift+Input to enter the following formula:

={1,2,3,4,5}

If you put this array into a horizontal range with more than five cells, the excess cells will be filled with #N/A. (which denotes unavailable values). Only the first item (1) will display in each cell if you insert this array into a vertical range of cells.

Another horizontal array, with seven entries and made out of text strings, is seen below:

{"Sun","Mon","Tue","Wed","Thu","Fri","Sat"}

Select seven cells in a row and write the following (and then press Ctrl+Shift+Enter) to enter this array:

={"Sun","Mon","Tue","Wed","Thu","Fri","Sat"}

One-dimensional vertical arrays

Semicolons separate the items of a one-dimensional vertical array, which may be shown in a column of cells.

A six-element vertical array constant is as follows:

{10;20;30;40;50;60}

Six cells in a column are required to display this array in a range. Select a range of cells with six rows and one column to input this array into a range.

Then press Ctrl+Shift+Input and enter the following formula:

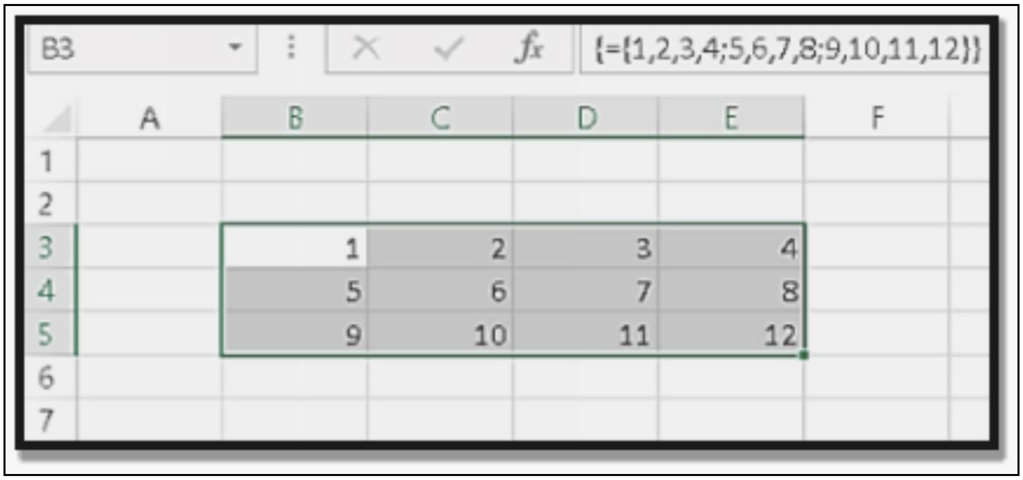
= {10;20;30;40;50;60}

Another example of a vertical array with four components is as follows:

{"Widgets";"Sprockets";"Doodads";"Thingamajigs"}

Two-dimensional arrays

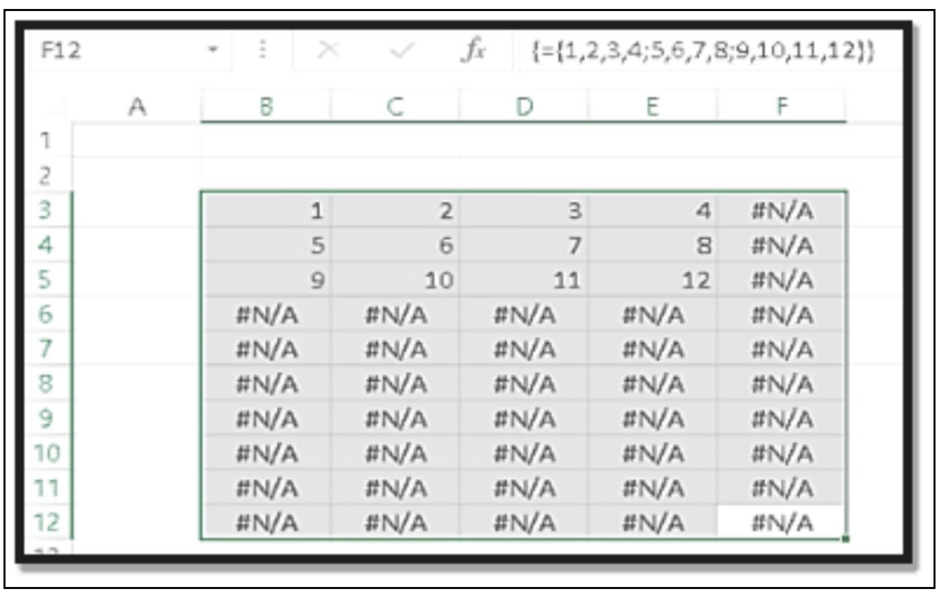
A two-dimensional array uses the horizontal and vertical members of a two-dimensional array are separated by commas and semicolons, respectively. If you're using Excel in a language other than English, the item-separator character might be a semicolon (for horizontal items) or a backslash (for vertical elements) (for vertical elements).



If you're not sure, look at the two-dimensional array in the section's example file. The item-separator characters are converted to your language version automatically.

A 3 4 array constant is shown in the following example:

{1,2,3,4;5,6,7,8;9,10,11,12}



This array needs 12 cells to display in a range. Select a range of cells with three rows and four columns to input this array into a range.

Then hit Ctrl+Shift+Enter and input the following formula:

= {1,2,3,4;5,6,7,8;9,10,11,12}

Excel shows #N/A in the additional cells when you input an array into a range with more cells than array elements.

A two-dimensional array must have the same number of elements in each row.

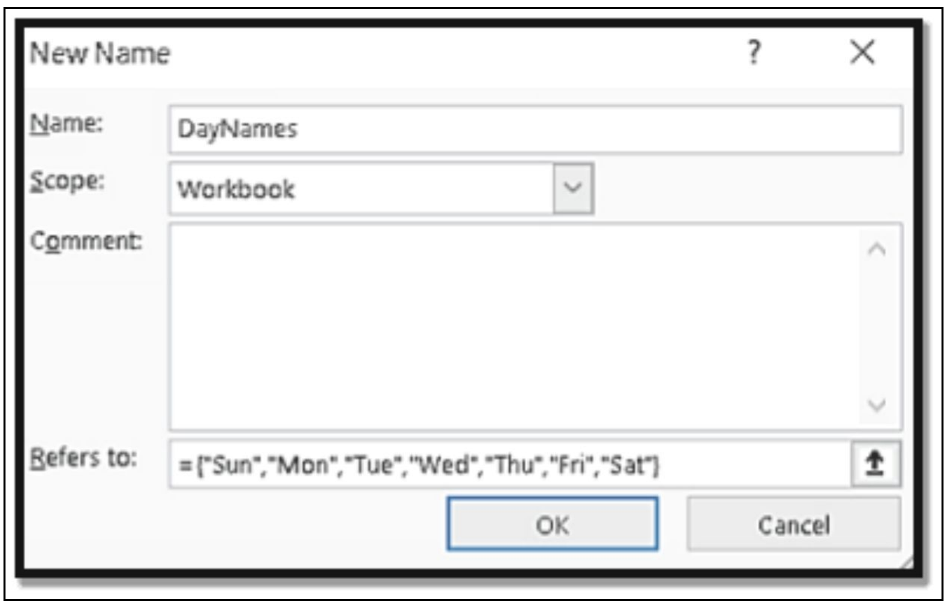
The following array, for example, is invalid since the third row only includes three items:

{1,2,3,4;5,6,7,8;9,10,11}

Excel won't let you insert a formula with an incorrect array in it.

Naming Array Constants

You can create an array constant, name it, and then utilize it in a calculation. A named array is a named formula in technical terms.



The array's name is DayNames, and it relates to the array constant DayNames:

{"Sun","Mon","Tue","Wed","Thu","Fri","Sat"}

The array is specified (in the Refers To field) in the New Name dialog box with a leading equal sign (=). The array is regarded as a text string rather than an array without this equal sign. When creating a named array constant, you must type the curly brackets yourself; Excel does not do it for you.

You can use this named array in a formula once you've created it.

The following is the formula:

{=DayNames}

Select seven cells in a row, type =DayNames, and press **Ctrl+Shift+Enter** to enter the formula.

The array has a horizontal orientation since the array items are separated by commas. Create a vertical array using semicolons, or insert a horizontal array into a vertical range of cells with the Excel **TRANSPOSE function**.

The TRANSPOSE function is used in the following array formula, which is inserted into a seven-cell vertical range:

{=TRANSPOSE(DayNames)}

/The **Excel INDEX function** may also be used to retrieve specific items from the array.

For example, the following formula yields Wed, the fourth entry in the DayNames array:

=INDEX(DayNames,4)

Working with Array Formulas

This section covers how to select cells that contain arrays, as well as how to input and amend array formulae. Working with regular ranges and formulae differs somewhat from these approaches.

Entering an array formula

When you input an array formula into a cell or range, you must use a unique process to tell Excel that you want an array formula instead of a regular formula. By hitting Insert, you may enter a standard formula into a cell. By using **Ctrl+Shift+Input**, you can enter an array formula into one or more cells.

When you write an array formula, Excel automatically adds the curly brackets. If an array formula returns more than one value, you must first select all of the cells in the results range before entering the formula. If you don't, you'll just get the first element of the result.

You may use the regular cell selection processes to manually choose the cells that contain a multicell array formula, or you can use one of the following methods:

- Select any cell in the array formula range to activate. Choose **Editing Find & Select Go To from the Home menu,** or just press F5. The dialog box **"Go-To"** displays. Click the Special button in the **Go To dialog box**, then the Current Array option. To exit the dialog box, click OK.
- Select the cells that make up the array by pressing Ctrl+/ (forward slash) on any cell in the array formula range.

Choosing a formula range for an array

If an array formula covers more than one cell, you must alter the entire range as if it were a single cell. It's crucial to realize that you cannot simply change one component of a multicell array formula.

To change an array formula, select every cell in the array range and use the Formula bar as usual. (Click it or press F2.) Excel removes the curly brackets while editing the calculation. After modifying the formula, hit Ctrl+Shift+Enter to apply the changes. The array's cells have all been updated to reflect your changes (and the curly brackets reappear).

The formulas for multicell arrays must adhere to the following guidelines.

If you attempt to perform any of these things, Excel warns you:

- The contents of any individual cell in an array formula cannot be changed.
- Cells that are part of an array formula cannot be moved (but you can move an entire array formula).

- It's impossible to remove cells that are included in an array formula.
- In an array range, you can't add additional cells. This rule allows you to add additional cells to an array range by adding rows or columns.
- You can't utilize multicell array formulae in a table generated using the Insert Tables Table option. Similarly, if a range has a multicell array formula, it cannot be converted to a table.

If you hit **Ctrl+Enter** (rather than Ctrl+Shift+Enter) after altering an array formula, the formula will be put into each chosen cell, but it will no again be an array formula and will most likely yield an inaccurate result. Simply click this button once again, press F2, then Ctrl+Shift+Enter.

Although you can't modify the contents of every individual cell in a multicell array formula, you may apply formatting to the whole array or just sections of it.

Expanding or contracting a multicell array formula

You might need to enlarge or decrease a multicell array formula regularly (to include fewer cells).

To do so, you'll need to do the following steps:

1. Select the full range in which the array formula is included.
2. To enter **Edit mode**, **press F2**.
3. Press **Ctrl+Enter** on your keyboard. This phase fills each chosen cell with an identical (non-array) formula.
4. Adjust your range selection to include more or fewer cells, but make sure the active cell is one of the original array's cells.
5. To return to Edit mode, **press F2**.
6. Press **Ctrl+Shift+Enter** on your keyboard.

THE CONTRARY OF ARRAY FORMULAS

You are already aware of certain advantages of using array formulas if you have read this far. The main advantage is that array formulas let you perform calculations that would be otherwise impossible. However, you will find several limitations as you gain more experience utilizing arrays.

One of Excel's most misunderstood features is array formulas. Because of this, it's generally advised to stay away from using array formulae when sharing a worksheet with someone who might need to make modifications. It could be confusing if you don't know what an array formula is.

You could easily forget to enter an array formula while using Ctrl+Shift+Input. (When changing an existing array, keep in mind to press these keys to complete the edits. Aside from logical issues, this is likely the most common problem with array formulas. If you mistakenly press Enter after making changes to an array formula, simply press F2 to restore to Edit mode, then press Ctrl+Shift+Enter.

Another issue with array formulae is that they may slow down the recalculation of your worksheet, particularly if you employ extremely big arrays. This speed difference may not be an issue with a faster system. Utilizing an array formula, on the other hand, is usually always quicker than using a bespoke VBA function.

Using Multicell Array Formulas

This section offers examples that show how to use multicell array formulae in new ways (array formulas that are entered into a range of cells). Arrays can be created from values, operations can be performed, functions can be used, arrays may be transposed, and consecutive integers can be generated.

Creating an array from values in a range

The array formula below produces an array from a set of cells. A single array formula may be found in the range D8:F11:

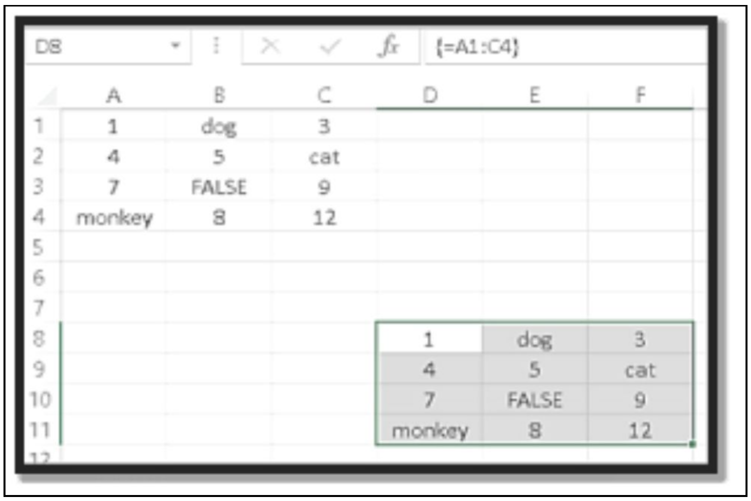
{=A1:C4}

The range A1:C4 is connected to the array in D8:F11. Any modification you make in A1:C4 is reflected in the appropriate cell in D8:F11. Of course, it's a one-way street. In D8:F11, you can't modify any of the values.

Creating an array constant from values in a range

The array formula in D8:F11 in the previous example effectively built a connection between the cells in A1:C4. It's possible to break this connection and make an array constant from the values in A1:C4:

1. Find the cells that have the array formula in them (the range D8:F11, in this example).
2. To change the array formula, press F2.
3. To convert cell references to values, press F9.
4. To re-enter the array formula, press **Ctrl+Shift+Enter** (which now uses an array constant).



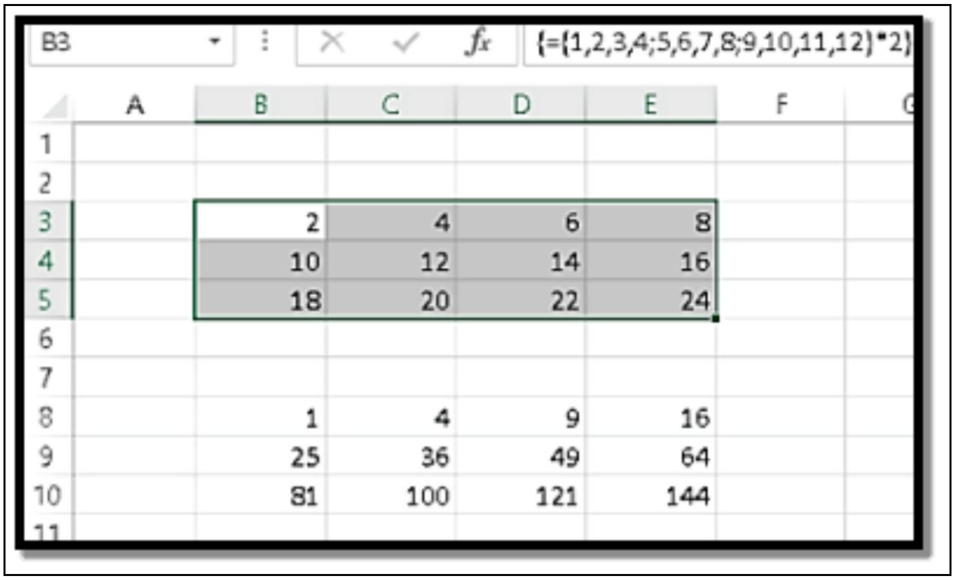
The following is the array constant:

{1,"dog",3;4,5,"cat";7,False,9;"monkey",8,12}

Performing operations on an array

The majority of this chapter's examples have simply inserted arrays into ranges. The array formula below builds a rectangular array by multiplying each array element by two:

{={1,2,3,4;5,6,7,8;9,10,11,12}*2}



Each array element is multiplied by itself using the following array formula:

{={1,2,3,4;5,6,7,8;9,10,11,12}*{1,2,3,4;5,6,7,8;9,10,11,12}}

An easier approach to get the same result is to use the array formula below.

The array formula yields the square of each value in the range if the array is stored in a range (such as B8:E10):

{=B8:E10^2}

Using functions with an array

You can utilize worksheet functions with an array, as you would think.

The square root of each array element in the array constant is calculated using the following array formula, which you may insert into a ten-cell vertical range:

{=SQRT ({1;2;3;4;5;6;7;8;9;10})}

A multicell array formula, like the one below, yields the square root of each value in the range if the array is stored in a range:

{=SQRT (A1:A10)}

Transposing an array

You effectively transform rows to columns and columns to rows when you transpose an array. In other words, a horizontal array can be converted to a vertical array (and vice versa). To transpose an array, use the **TRANSPOSE function**.

Consider the following constant for a one-dimensional horizontal array:

{1,2,3,4,5}

The TRANSPOSE function may be used to input this array into a vertical range of cells. To do so, choose a five-cell range that spans five rows and one column. Then press Ctrl+Shift+Input to enter the following formula:

=TRANSPOSE({1,2,3,4,5})

The array items appear in the vertical range after the horizontal array has been transposed.

Similarly, transposing a two-dimensional array works. The table below illustrates a two-dimensional array that has been input into a range both manually and through the **TRANSPOSE function**.

In A1:D3, the formula is as follows:

{={1,2,3,4;5,6,7,8;9,10,11,12}}

In A6:C9, the formula is as follows:

{=TRANSPOSE ({1,2,3,4;5,6,7,8;9,10,11,12})}

To transpose an array stored in a range, you may, of course, use the TRANSPOSE function. For example, in the calculation below, an array stored in A1:D3 is used (three rows, four columns).

This array formula may be entered into a three-row; four-column range as follows:

{=TRANSPOSE (A1:C4)}

Making an array of sequential integers

It is typical to require the creation of an array of sequential numbers for use in a challenging array formula.

Here is where the ROW method, which yields a row number, is useful. Consider the array formula below, which was entered into a vertical 12-cell range:

{=ROW (1:12)}

With numbers ranging from 1 to 12, this formula creates a 12-element array. Create a range with 12 rows and 1 column to serve as an example before adding the array formula. You'll notice that the range has 12 numbers that follow one another.

A formula like the one presented above is good—but not perfect—for generating an array of consecutive numbers. Insert a new row above the range containing the array formula to observe the issue.

Excel changes the row references to make the array formula look like this:

{=ROW (2:13)}

The method that previously produced numbers ranging from 1 to 12 now produces integers ranging from 2 to 13.

Use this formula for a better result:

{=ROW (INDIRECT ("1:12"))}

The INDIRECT function, which accepts a text string as a parameter, is used in this formula. The references in the INDIRECT function's parameter are not adjusted by Excel. As a result, integers from 1 to 12 are always returned by this array formula.

Worksheet Functions That Return an Array

Arrays are used by many Excel worksheet functions; you must input a formula that employs one of these functions as an array formula into several cells. **FORECAST, FREQUENCY, GROWTH, LINEST, LONGEST,**

MINVERSE, MMULT, and TREND are some of the functions available. For further information, go to the Excel Help system.

Using Single-Cell Array Formulas

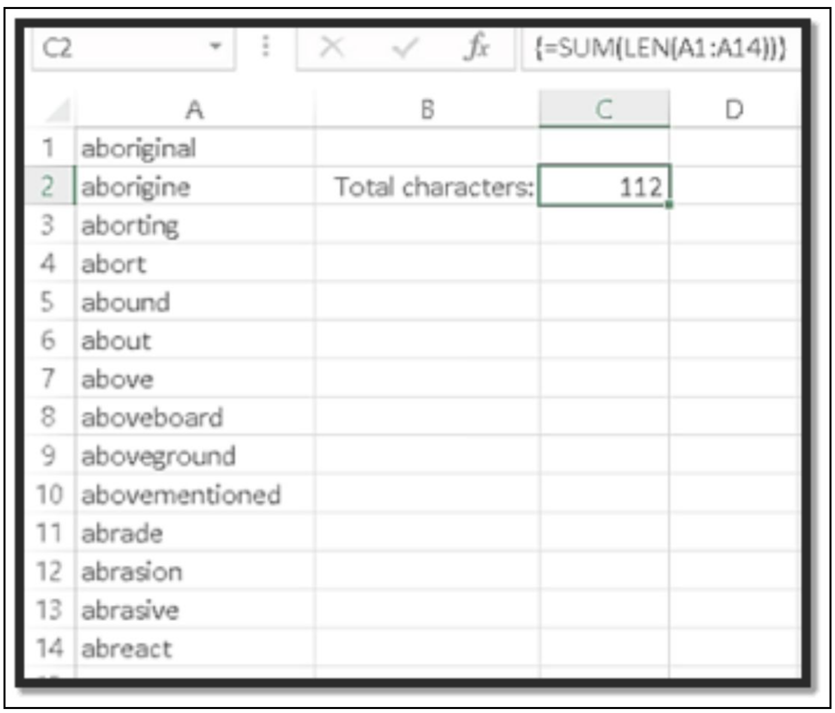
The previous section's examples all employed a multicell array formula, which is a single array formula that is inserted into a set of cells. When you employ single-cell array formulae, the true power of arrays is shown. This section includes instances of array formulae that only take up one cell.

Counting characters in a range

Assume you have a set of cells with text entries in them. The **"conventional"** approach of getting a count of the total number of characters in that range includes developing a formula like the one below and copying it along the column:

=LEN(A1)

The total of the values produced by these intermediary formulae is then calculated using a SUM formula.



Without requiring any intermediary formulae, the following array formula accomplishes the task:

{=SUM (LEN (A1:A14))}

The LEN function is used in the array formula to construct a new array (in memory) with the number of characters in each cell in the range.

The new array in this example is as follows:

{10,9,8,5,6,5,5,10,11,14,6,8,8,7}

After that, the array formula is simplified to:

=SUM({10,9,8,5,6,5,5,10,11,14,6,8,8,7})

The sum of the array items is given using the formula: 112.

Summing the three smallest values in a range

If you have values in a Data range, you can use the SMALL function to get the smallest value:

=SMALL(Data,1)

Using the following formulae, you may get the second and third smallest values:

=SMALL(Data,2)

=SMALL(Data,3)

You can use a formula like this to sum the three lowest values:

=SUM(SMALL(Data,1), SMALL(Data,2), SMALL(Data,3))

Although this technique works, an array formula is more efficient. The array formula below produces the sum of the three lowest values in the Data: range.

{=SUM (SMALL (Data, {1,2,3}))}

The **SMALL function** is called with an array constant as the second parameter. This creates a new array that contains the range's three smallest values. The SUM function is then supplied to this array, and it returns the sum of the items in the new array.

In the table below, the range A1:A10 is labeled Data as an example. The SMALL function is evaluated three times, with each second input being different. The **SMALL function** has a second parameter of 1 the first time it is used, and it returns –5.

The second time, the SMALL function's second parameter is 2, and it returns 0. (The second smallest value in the range). The SMALL function has a second input of 3 for the third time, and it returns the third lowest value of 2.

As a result, the array provided to the SUM method looks like this:

{-5,0,2)

The formula yields the array's sum (–3).

Counting text cells in a range

Consider the situation in which you need to count the number of text cells in a range. The **COUNTIF function** seems to be appropriate for this purpose, however, it isn't. COUNTIF is only helpful if you want to count data in a range that fits a certain set of criteria (for example, values greater than 12).

An array formula is required to count the number of text cells in a range. The IF function is used in the following array formula to inspect each cell in a range. It then constructs a new array of 1s and 0s (of the same size and dimensions as the original range) based on whether the cell contains the text. The SUM function is then supplied to this new array, which returns the sum of the array's components.

The amount of text cells in the range is counted as follows:

{=SUM(IF(ISTEXT(A1:D5),1,0))}

This formula produces the following array:

{0,1,1,1;1,0,0,0;1,0,0,0;1,0,0,0;1,0,0,0}

It's worth noting that this array has five rows of four items (the same dimensions as the range).

This formula may be tweaked to make it significantly more efficient:

{=SUM (ISTEXT (A1:D5) *1)}

This method obviates the requirement for the IF function by using the fact that

1 * TRUE = 1 and 1 * FALSE = 0

The removal of intermediate formulas

The ability to routinely delete intermediate formulas from your worksheet, making it more compact and removing the need to display computations that aren't necessary, is one of the array formula's key benefits. The table below displays a worksheet with students' pre- and post-test scores. The variations between the pre-test and post-test scores are calculated in Column D.

D17 | fx | {=AVERAGE(C2:C15-B2:B15)}

	A	B	C	D	E	F
1	**Student**	**Pre-Test**	**Post-Test**	**Change**		
2	Andy	56	67	11		
3	Beth	59	74	15		
4	Cindy	98	92	-6		
5	Duane	78	79	1		
6	Eddy	81	100	19		
7	Francis	92	94	2		
8	Georgia	100	100	0		
9	Hilda	92	99	7		
10	Isabel	54	69	15		
11	Jack	91	92	1		
12	Kent	80	88	8		
13	Linda	45	68	23		
14	Michelle	71	92	21		
15	Nancy	94	83	-11		
16						
17		**Average Change:**		**7.57**		

You may get rid of column D by using an array formula.

The average of the modifications may be calculated using the array formulae below, which do not need the calculations in column D:

{=AVERAGE (C2:C15-B2:B15)}

What is the mechanism behind it? The formula makes use of two arrays, whose values are kept in two different ranges (B2:B15 and C2:C15). The formula generates a new array that contains the differences between each of the other arrays' corresponding elements. This new array is not saved in a range, but rather in Excel's memory. The result is returned by the **AVERAGE function**, which takes this new array as an input.

The following items make up the new array, which was created by combining the two ranges:

{11,15,-6,1,19,2,0,7,15,1,8,23,21,-11}

As a result, the formula is equal to:

=AVERAGE ({11,15,-6,1,19,2,0,7,15,1,8,23,21,-11})

7.57 is the result of Excel evaluating the function and displaying the results.

Other measurements for the data in this example may be calculated using other array formulae. The following array formula, for example, yields the biggest change (that is, the greatest improvement). The result of this calculation is 23, which corresponds to Linda's test results.

{=MAX (C2:C15-B2:B15)}

The following array formula produces the Change column's lowest value.

This formula yields –11, which corresponds to Nancy's test results:

{=MIN(C2:C15-B2:B15)}

Replacing a range reference with an array

You might be able to use an array constant in place of a range reference if that is what the formula's function requires. This is advantageous when there is no change in the values of the referred range.

One notable exception to using an array constant instead of a range reference in a function is the database functions, which demand a reference to a criterion range (for example, DSUM). Unfortunately, it is not possible to use an array constant in place of a reference to a criterion range.

In the lookup table in D1:E10, searching for the number 9 produces the result 9, for instance. The formula for cell C1 is:

=VLOOKUP (B1, D1:E10,2, FALSE)

Instead of the lookup range, you may use a two-dimensional array. The following formula gives the same answer as the previous one, except it doesn't use the D1:E10 lookup range.

=VLOOKUP (B1,{1,"One";2,"Two";3,"Three";4,"Four"

CHAPTER 11

IMPROVE THE RELIABILITY OF YOUR FORMULAS

It should come as no surprise that you want your Excel spreadsheets to produce accurate results. Unfortunately, it's not always easy to be confident that the results are accurate, especially when working with large, complex workbooks. The methods and tools for identifying, fixing, and preventing problems are described in this section.

Detecting and fixing formula errors

Even a minor change to a worksheet could have a cascading effect and lead to errors in nearby cells. For instance, it's far too easy to enter a value into a cell that once contained a formula. If you notice this small error at all, it might not have a significant impact on other computations until after the modification has been implemented.

Formula mistakes usually fall into one of the following categories:

- **Mistakes in syntax:** You're having trouble with a formula's syntax. A formula, for example, might contain mismatched parenthesis, or a function could have an incorrect amount of parameters.
- **Errors in logic**: A formula does not yield an error, but it does have a logical fault that leads to an inaccurate result.
- **Incorrect reference mistakes:** Although the formula's reasoning is accurate, it utilizes an improper cell reference. The range reference in a Total calculation, for example, may not cover all of the data you wish to sum.
- **Semantic blunders:** A poorly spelled function name is an example. The #NAME? the error will appear if Excel tries to interpret it as a name.
- **References in a circle:** A circular reference arises when a formula, either directly or indirectly, refers to its cell. Circular references are beneficial in a few situations, but they almost always signal a problem.

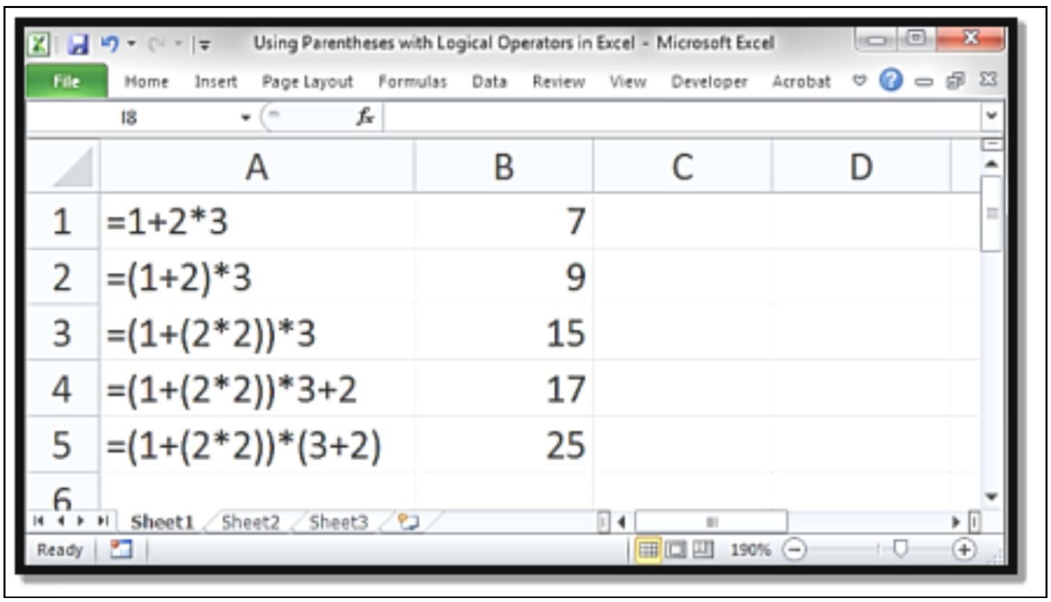
- **Invalid array formula entry:** Entering (or modifying) an array formula requires pressing **Ctrl+Shift+Enter**. If you don't, Excel won't recognize the formula as an array formula, resulting in an error or inaccurate results.
- **Calculation mistakes:** The formulae are just not completely computed. **Ctrl+Alt+Shift+F9** will verify that your formulae are completely computed.

Syntax mistakes are generally the most straightforward to see and remedy. In most circumstances, you'll be able to tell whether your formula has a syntactic issue. Excel, for example, won't let you input a formula that has misaligned parenthesis. Other syntax problems frequently result in the cell displaying an error message.

Erroneous parentheses

A right parenthesis must come after every left parenthesis in a formula. In most cases, Excel won't allow you to insert a formula with incorrect parenthesis. Using a function in a straightforward formula is an exception to this rule. Excel accepts the following formula and adds the missing parenthesis when you input it:

=SUM (A1:A500



Even though a formula has the same amount of left and right parenthesis, the parentheses may not be correctly aligned. Consider the following formula, which changes a text string to uppercase for the first letter and lowercase for the remaining characters. There are five pairs of parentheses in this formula, and they all match:

=UPPER(LEFT(A1)) &RIGHT(LOWER(A1), LEN(A1)-1)

There are five pairs of parentheses in the following formula, however, they are misaligned.

The result shows a syntactically accurate formula that yields the incorrect outcome:

=UPPER(LEFT(A1) &RIGHT(LOWER(A1), LEN(A1)-1))

A syntax error, which is generally a warning telling you that you provided too many or too few parameters for a function, is often caused by parenthesis in the incorrect place.

Note: When it comes to a misaligned parenthesis, Excel can assist. When you move the cursor over a parenthesis in a calculation, Excel highlights it (and its corresponding parenthesis) in bold for roughly a half-second. Furthermore, when revising a calculation, Excel color-codes pairs of nested parentheses.

USING FORMULA AUTOCORRECT

When you input formula with a syntax mistake, Excel tries to figure out what's wrong and suggests a solution.

When accepting Excel's adjustments for your formulae, keep in mind that it doesn't always predict properly.

Let's say you typed in the following formula (which has misaligned parentheses):

=AVERAGE (SUM (A1:A12, SUM (B1:B12))

Excel then suggests the following formula correction:

=AVERAGE (SUM (A1:A12, SUM (B1:B12)))

You can be inclined to accept the proposal without even thinking about it. The recommended formula is syntactically accurate in this circumstance, but it is not what you wanted.

Here's how to use the right formula:

=AVERAGE (SUM (A1:A12), SUM (B1:B12))

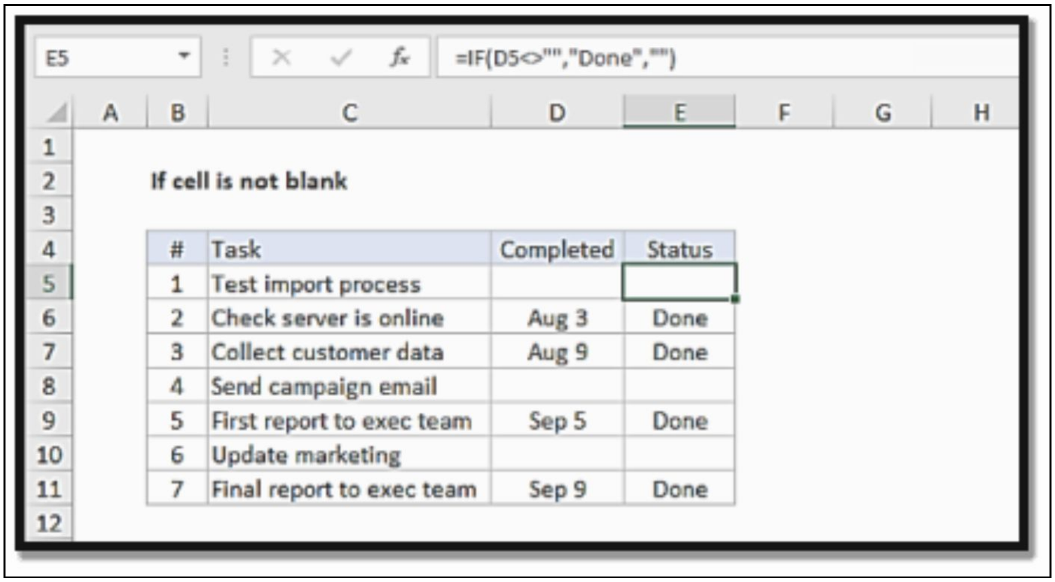
Cells are filled with hash marks

A succession of hash marks (#) is used to fill a cell for one of two reasons:

- The width of the column is insufficient to fit the formatted numeric value. You may make the column broader or use a different number format to fix it.
- A formula in the cell yields an incorrect date or time. Excel, for example, does not allow for dates before 1900 or the usage of negative time values. A cell filled with hash marks is the outcome of a formula that produces one of these values. It won't be fixed by widening the column.

No cell is completely empty.

A common observation among Excel users is that pressing the spacebar appears to empty a cell's contents. The spacebar does not really delete the cell; instead, it inserts an invisible space character.



The following formula, for example, yields the number of nonempty cells in the range A1:A10.

If you use the spacebar to "erase" any of these cells, they are included in the count, and the formula yields an inaccurate result:

=COUNTA (A1:A10)

If your formula fails to disregard blank cells as it should, double-check that the blank cells are indeed blank.

Here's how to look for cells that only have blank letters in them:

1. Press **Ctrl+F** on your keyboard.
2. To enlarge the dialog box and see other choices, click the **Options button**.
3. Type * * in the Find What box. That's an asterisk, then a space, and then another asterisk.
4. Select **Match Entire Cell Contents** from the drop-down menu.
5. Select **"Find All."** Excel provides the cell address at the bottom of the Find and Replace dialog box if any cells contain just space characters.

Characters with extra space

Make sure your text doesn't contain any extra space characters if you have formulas or processes that rely on text comparison. It's extremely common to include a space character when importing data from another source.

However, trailing spaces in text entries are not immediately removed by Excel when you enter numbers. It's difficult to tell from the surface of a cell if one or more trailing space characters are present.

The TRIM function can be used to locate values that contain leading, trailing, or numerous spaces within a text string. This formula will return FALSE if the text in cell A1 contains any leading, trailing, or multiple spaces.

=TRIM(A1) =A1

Formulas returning an error

Any of the following error values may be returned by a formula:

- #DIV/0!
- #N/A
- #NAME?
- #NULL!
- #NUM!
- #REF!
- #VALUE!

The sections that follow go through some of the issues that might be causing these errors.

You can select how error data are displayed in Excel. Display the **Page Setup dialog box** and pick the Sheet tab to use this functionality. You may select to publish incorrect values as blank cells, dashes, or #N/A instead of as presented (the default). To open the Page Setup dialog box, click the **Page Layout > Page Setup group's dialog box launcher**.

TRACING ERROR VALUES

A mistake in one cell is often the consequence of a mistake in a preceding cell. Activate the cell that contains the problem and then choose **Formulas**

> Formula Auditing > Error Checking > Trace Error for assistance in locating the cell that is causing the error value to display. Excel uses arrows to show which cell is causing the problem.

To remove the arrow display, go to Formulas Formula Auditing Remove Arrows once you've identified the issue.

#DIV/0! errors

It is not possible to divide by zero. When you try to divide by zero in a calculation, Excel shows the familiar #DIV/0! error value.

Because Excel considers a blank cell to be zero, if your formula divides by a missing value, you'll see this error.

To prevent the error message, check for a blank cell using an IF function.

If cell B4 is blank or contains 0, for example, this formula will show an empty text; otherwise, it will display the computed value:

=IF (B4=0,"“, C4/B4)

Another option is to check for any error conditions using an IFERROR function.

If any sort of mistake occurs, the following formula, for example, produces an empty string:

=IFERROR(C4/B4,"")

Excel 2007 introduces the IFERROR function. Use this formula for compatibility with prior Excel versions:

=IF(ISERROR(C4/B4),"“, C4/B4)

#N/A errors

If any cell referenced by a formula shows #N/A, the #N/A error occurs.

For missing data, some users prefer to use =NA () or #N/A directly. This strategy makes it quite evident that the data isn't accessible and wasn't unintentionally removed.

When a LOOKUP function (HLOOKUP, LOOKUP, MATCH, or VLOOKUP) can't discover a match, the #N/A error appears.

If you want to replace #N/A with an empty string, use the IFNA function in a calculation like this:

=IFNA (VLOOKUP (A1, C1:F50,4, FALSE),"")

Excel 2013 introduces the IFNA function. Use the following formula for compatibility with prior versions:

==IF(ISNA(VLOOKUP(A1,
C1:F50,4,FALSE)),"",VLOOKUP(A1,C1:F50,4,FALSE))
IF(ISNA(VLOOKUP(A1,C1:F50,4,FALSE)),"“,
VLOOKUP(A1,C1:F50,4,FALSE))

#NAME? errors

The #NAME? an error occurs when the following criteria are met:

- There is an undefined range or cell name in the formula.
- Excel reads the text in the formula as an undefined name. A #NAME? error, for example, is caused by a misspelled function name.
- There is material in the formula that isn't surrounded by quotation marks.
- A range reference in the calculation omits the colon between the cell addresses.
- The formula utilizes a worksheet function specified in an add-in that isn't installed, and the add-in isn't installed.

Range names are a bit of a stumbling block in Excel. If you remove a name for a cell or a range, but the name is still used in a formula, the formula uses the name even if it is no longer defined. As a consequence,, #NAME? appears in the formula. Excel should transform the names to their appropriate cell references automatically, however, this does not happen.

#NULL! Errors

When a formula tries to utilize an intersection of two ranges that don't truly intersect, a #NULL! error occurs. The intersection operator in Excel is a space.

Because the two ranges do not cross, the following calculation produces #NULL:

=TOTAL (B5:B14 A16:F16)

The formula below does not yield #NULL! However, the contents of cell B9, which represents the junction of the two ranges, are displayed:

=TOTAL (B5:B14 A9:F9)

If you forget to include an operator in a formula, you'll get a #NULL! error.

This formula, for example, is lacking the second operator:

= A1+A2+A3+A4+A5+A6+A7+A

#NUM! errors

If any of the following happens in a formula, it will yield a #NUM! error:

- When a number parameter is anticipated, you supply a non-numeric argument to a function (for example, $1,000 instead of 1000).
- You try to compute the square root of a negative value by passing an incorrect parameter to a function. #NUM! is the result of this formula: =SQRT(-12)
- A function that employs iteration is incapable of calculating a result. IRR and RATE are two functions that employ iteration.
- A formula produces a result that is either too big or too tiny. Excel accepts values ranging from –1E-307 to 1E+307.

#REF! errors

When a formula employs an improper cell reference, a #REF! error occurs. The following scenarios may lead to this error:

- You remove the row-column of a cell that the formula refers to. If row 1, column A, or column B are removed, the following calculation produces a #REF! error: =A1/B1
- You remove the worksheet of a cell that the formula refers to. If Sheet2 is removed, for example, the following calculation returns a #REF! error: =Sheet2!A1
- You copy a formula to a position where the related cell references are no longer valid. If you duplicate the following formula from cell A2 to cell A1, for example, the formula returns #REF! because it tries to refer to a cell that doesn't exist: =A1-1
- You clip a cell and then paste it into a formula-referenced cell. #REF! will be displayed by the formula.

#VALUE! Errors

VALUE FOR MONEY! Error is a frequent occurrence that may occur under the following circumstances:

- A function parameter is of the wrong data type, or the formula tries to execute an operation with invalid data. A formula that adds a value to a text string, for example, yields the #VALUE! error.
- The parameter to a function is a range when it should be a single value.
- There is no calculation for a bespoke worksheet function. To force a recalculation, use **Ctrl+Alt+F9**.
- A custom worksheet function tries to do something that isn't possible. Custom functions, for example, cannot affect the Excel environment or make modifications to other cells.
- When inputting an Array formula, you neglect to use **Ctrl+Shift+Enter**.

BE AWARE OF THE COLORS.

When you change a cell using a formula in Excel, the cell and range references are color-coded. Similar colors are also used by Excel to highlight the columns and ranges that were used in the calculation. As a result, you can quickly identify the cells that are used in the formula.

By adjusting the color outline, you can easily change the cell or range reference. To change the references used in a computation, drag the border or fill handle of the outline (at the lower right of the outline). In many cases, this approach is more practical than changing the formula.

issues with operator precedence

As was already indicated, Excel offers some straightforward guidelines for carrying out mathematical operations in the proper order.

When in doubt (or merely to explain your intentions), use parenthesis to guarantee that actions are carried out in the right sequence. The following formula, for example, multiplies A1 by A2 and then adds 1 to **the result. Because it has a greater order of precedence, the multiplication is done first:**

=1+A1*A2

This formula is explained in more detail below. The parenthesis isn't required, although the sequence of operations is evident in this case:

=1+(A1*A2)

The symbol for the negation operator is the same as the symbol for the subtraction operator.

As you may think, this might lead to some uncertainty. Take a look at these two formulas:

=-3^2

=0-3^2

The first formula yields 9, as predicted. The second formula, on the other hand, yields –9. How can Excel return the –9 result when squaring a number always yields a positive result?

The negative sign is a negation operator in the first formula, and it has the greatest precedence. The negative sign, on the other hand, is a subtraction operator in the second formula, which has lower precedence than the exponentiation operator. As a consequence, the number 3 is squared and then subtracted from 0 (zero), resulting in a negative result.

When you use parenthesis in a calculation like this, Excel interprets the operator as a minus sign rather than a negation operator. –9 is the result of this formula:

=-(3^2)

There is no calculation of formulas

If you use specially created spreadsheet functions written in VBA, you'll see that the equations that depend on them don't recalculate, giving erroneous results. Let's say you created a VBA code that, for instance, returns the number format of a referenced cell. If you alter the number format, the function will continue to display the old format. This is due to the fact that changing a number's format does not necessitate a new calculation.

Select the cell, **press F2**, and then press **Enter** to compel a single formula to be computed. **Ctrl+Alt+F9** will require a recalculation of all formulae.

Problems with decimal precision

Computers, by their very nature, do not have unlimited accuracy. Excel uses 8 bytes to store integers in binary format, which can handle values with a 15-digit precision. Because certain numbers cannot be stated properly with 8 bytes, they are saved as an approximation.

Enter the following calculation in cell A1 to see how this lack of accuracy might create issues:

= (5.1-5.2) +1

The final score should be 0.9. If you style the cell to show 15 decimal places, you'll see that Excel calculates the formula as 0.899999999999999. Because the action in parentheses is done first, and the intermediate result is stored in binary code using an approximation, this outcome happens. The formula then multiplies this number by one, propagating the approximation mistake to the final result.

In most circumstances, this sort of inaccuracy isn't a major issue. However, if you need to verify the formula's outcome using a logical operator, this might be an issue. The following formula, for example, yields FALSE (assuming the preceding formula is in cell A1):

=A1=.9

Using the **ROUND function** as a remedy to this sort of issue is one option.

Because the comparison is conducted using the value in A1 adjusted to one decimal point, the following calculation yields TRUE:

=ROUND(A1,1) =0.9

Another example of a **"precision"** issue may be found here.

Try putting the following formula into your calculator:

= (1.333-1.233) -(1.334-1.234)

This formula should give you 0 but instead gives you -2.22045E-16 (a number very close to zero).

If cell A1 has that formula, the following formula yields Not Zero:

=IF(A1=0,"Zero","Not Zero")=IF(A1=0,"Zero","Not Zero")=IF(A1=0

A formula like this may be used to deal with these "extremely near to zero" rounding errors:

=IF(ABS(A1)1E-6,"Zero","Not Zero") =IF(ABS(A1)1E-6,"Zero","Not Zero")

The less-than operator () is used in this formula to compare the absolute value of a number to a very tiny number. The result of this formula is zero.

"Phantom link" errors

When you open a workbook, you could see a prompt asking whether you want to update the workbook's links. Even if a worksheet includes no related formulae, this notice may occur. These phantom connections are often produced when you duplicate a worksheet with names.

To open the **Edit Links to Files dialog box**, go to **File > Info > Edit Links to Files**. Then, for each connection, pick it and click Break Link. If it doesn't work, the phantom link might be created by an incorrect name. Select **Formulas > Defined Names > Name Manager** and navigate through the **Name Manager dialog box's list of names**. If you come across a name that contains the word #REF!, remove it. The **Filter button** in the Name Manager dialog box allows you to filter the names. You may, for example, filter the lists to show just the names that have mistakes.

Using Excel Auditing Tools

Excel comes with a variety of features that might assist you in locating formula problems. The auditing tools integrated into Excel are described in this section.

Identifying cells of a particular type

The Go to Special dialog box is a useful tool for quickly finding cells of a certain kind. Choose **Home > Editing > Find & Select > Go to Special** to open this dialog box.

The command only works inside the chosen cells if you pick a multicell range before showing the Go to Special dialog box. When just one cell is chosen, the command is applied to the whole worksheet.

The **Go to Special dialog box** can be used to select cells of a certain kind, which can help you find mistakes. When you pick the **Formulas option**, for example, Excel selects all of the cells that contain a formula. You can also get a good feel of the worksheet's arrangement by zooming it out to a tiny size.

Use the zoom controls on the right side of the status bar or **press Ctrl** while using your mouse's scroll wheel to magnify a worksheet.

Selecting the formula cells can also help you catch a typical mistake, such as a formula that has been changed by a value by accident. If a cell in a group of chosen formula cells isn't selected, it's likely that the cell formerly had a formula that has been replaced with a value.

Viewing formulas

By presenting the formulae rather than the outcomes of the formulas, you may get comfortable with an unfamiliar worksheet. Choose **Formulas > Formula Auditing > Show Formulas** to alter the presentation of formulas.

Before running this command, you may wish to open a second window for the workbook. You can view the formulae in one window and the formula results in the other window in this manner. To launch a new window, choose **View > Window > New Window**.

Note*:* Toggle between Formula and Normal views, hit Ctrl+' (the accent grave key, normally situated above the Tab key).

Tracing cell relationships

You should be acquainted with the following two principles before learning how to trace cell relationships:

- **Precedents in the cell:** A formula cell's antecedents are all of the cells that contribute to the formula's outcome and are only applicable to cells that include a formula. A direct precedent is a cell that appears in the formula directly. A cell that isn't utilized directly in the formula but is referenced in the formula is known as an indirect precedent.
- **Cell dependents:** These formula cells are dependent on a certain cell. The dependents of a cell are all formula cells that utilize it. The formula cell might be a direct or indirect dependent once again.

Consider the following formula, which was placed into cell A4:

=SUM(A1:A3)

Three antecedent cells (A1, A2, and A3) are all direct precedents in cell A4. At least one dependent cell exists in each of the A1, A2, and A3 cells (cell A4).

Finding cell precedents for a formula cell may frequently reveal why the formula isn't operating properly. Knowing which formula cells are dependent on a certain cell, on the other hand, is useful. Whether you're going to remove the formula, for example, you may want to see if it has any dependencies.

Identifying precedents

There are many approaches to identifying cells in the active cell that are utilized by a formula:

- **Press the F2 key**. The cells that the formula uses directly are highlighted in color, and the color matches the cell reference in the formula. This method can only be used to find cells on the same sheet as the formula.
- Select **Home > Editing > Find & Select** from the drop-down menu. To open the **Go to Special dialog box**, choose **Go to Special**. Select **Precedents,** then **Direct Only** (for direct precedents only) or All Levels (for all levels of precedents) (for direct and indirect precedents). Excel picks the preceding cells for the calculation when you **click OK**. This method can only be used to find cells on the same sheet as the formula.
- Hold down **Ctrl+[**. On the active sheet, this picks all direct precedent cells.
- Hold down **Ctrl+Shift+**. This picks all immediate and indirect previous cells on the current sheet.
- **Formula Auditing > Trace Precedents > Choose Formulas Excel** will generate arrows to show the predecessors of the cell. To view further tiers of precedents, click this icon many times.
- To conceal the arrows, choose **Formulas > Formula Auditing > Remove Arrows**.

Identifying dependents

There are many approaches to discovering formula cells that employ a certain cell:

- Select **Home > Editing > Find & Select** from the drop-down menu. To open the Go to Special dialog box, choose **Go to Special**. Select **Dependents**, then **Direct Only** (for direct dependents only) or All Levels (for all dependents) (for direct and indirect dependents). **Click the OK button**. The cells that are dependent on the active cell are selected by Excel. This method can only be used to identify cells on the active sheet.
- Hold down the **[Ctrl+] key**. On the active sheet, this picks all direct dependent cells.
- Hold down **Ctrl+Shift+.** This picks all direct and indirect dependent cells on the active sheet.
- **Formula Auditing > Trace Dependents > Choose Formulas To identify** the cell's dependencies, Excel will create arrows. To show more layers of dependents, click this icon many times. To conceal the arrows, go to Formulas Formula Auditing Remove Arrows.

Tracing error values

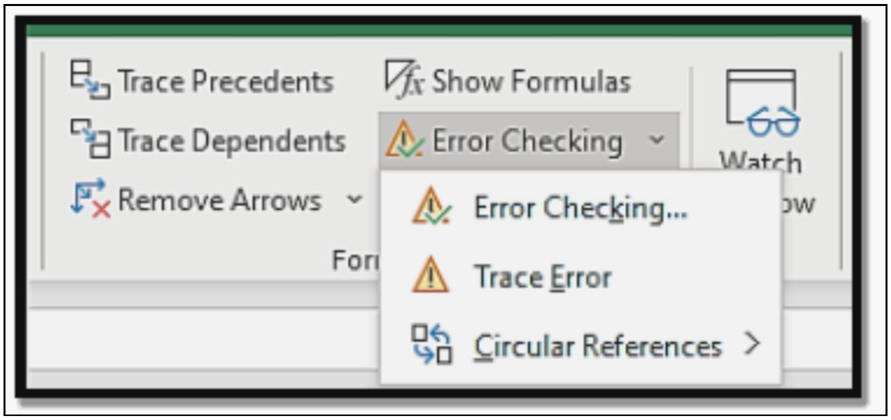
If a calculation returns an erroneous value, Excel can assist you in determining which cell is producing the issue. A mistake in one cell is often the consequence of a mistake in a preceding cell. Select **Formulas > Formula Auditing > Erroneous Checking > Trace Error** after activating a cell that has an error value. The mistake cause is shown by arrows in Excel.

Fixing circular reference errors

If you generate a circular reference formula by mistake, Excel shows a warning message—Circular Reference—in the status bar, along with the cell address. It also creates arrows on the spreadsheet to aid in the identification of the issue. Choose **Formulas > Formula Auditing > Error Checking > Circular References** if you can't figure out where the issue is coming from. This command generates a list of all the cells implicated in the circular references. Begin by picking the top cell on the list and working your way down until you find the issue.

Using the background error-checking feature

Making use of Excel's automated error-checking tool may be beneficial to certain individuals. The **Activate Background Error Checking check box** on the **Formulas tab** of the Excel Options dialog box can be used to enable or disable this capability. You can also select which sorts of problems to check using the checkboxes in the **Error Checking Rules section**.



When error checking is enabled, Excel examines the formulae in your worksheet regularly. If a possible mistake is found, Excel displays a tiny triangle in the cell's upper-left corner. A drop-down control displays when the cell is triggered. This drop-down control gives you alternatives when you click it. Depending on the kind of problem, several choices are available.

In most circumstances, choosing the **Disregard Error option** will allow you to ignore an error. When you choose this option, the cell is no longer checked for errors. All previously ignored errors, on the other hand, maybe reset such that they surface again. (On the Formulas tab of the Excel Options dialog box, click the **Reset Ignored Errors option**.)

You can use **Formulas** > **Formula Auditing** > **Error Checking** to bring up a dialog box that lists each possible error cell in order, similar to how a spell-checking function works.

The error-checking function isn't flawless. It isn't even close to being ideal. In other words, just because Excel doesn't detect possible mistakes doesn't mean your spreadsheet is error-free! Also, keep in mind that this error-checking tool will not capture a typical mistake, such as overwriting a formula cell with a value.

Using Formula Evaluator

The Formula Evaluator displays the different elements of a nested formula in the sequence in which they are computed. To utilize Formula Evaluator, pick the formula cell and then choose **Formulas > Formula Auditing > Evaluate Formula** from the **Formulas Auditing Evaluate Formula dialog box**.

To see the outcome of computing the expressions inside the formula, click the **Evaluate button**. Each button press initiates a new computation. This feature may seem confusing at first, but after spending some time with it, you'll realize how it works and how valuable it is.

Another technique to assess a component of a calculation in Excel is to:

1. Find the cell with the formula in it.
2. To enter **Cell Edit mode**, **press F2**.
3. Highlight the piece of the formula you wish to examine using your mouse, or press Shift and utilize the navigation keys.
4. Press the **F9 key**.

The computed result is shown in the highlighted area of the formula. You can assess additional portions of the formula or cancel it and restore it to its former state by **pressing Esc**.

When you use this approach, be aware that if you hit Enter instead of Esc, the formula will be changed to utilize the computed numbers.

Searching and Replacement

Excel's search and replace feature makes it simple to look for data within a worksheet or across several worksheets in a file. Text can also be searched for and substituted with anything else.

In the Find and Replace dialog box, start by selecting the range you want to search for. If you choose a single cell, Excel does a sheet-wide search. The Home > Editing menu's Find & Select Find option can also be chosen by pressing Ctrl+F.

Select the Find tab if you're only searching for anything in the worksheet. The Replace tab may be used to replace current text with fresh content. Also, the Choices button may be used to show (or conceal) additional options.

Searching for information

In the Find What text box, type the information you want to look for, and then choose one of the following options:

- Within the drop-down menu Indicate the location of the search
- A drop-down menu for searching Indicates the direction.
- Look in the drop-down menu Choose which cell components to look for.
- Tick the **"Match Case" box** If you want the search to be case sensitive, check this box.
- Tick the box that says **"Match Entire Cell Contents"** Specify whether or not the complete contents of the cell must be matched.
- The option to format Click to find cells that have certain formatting.

Find Next to find the corresponding cells one by one, or **Find All** to find all matches at once. The Find and Replace dialog box expands when you click the **Find All button**, displaying the addresses of all matching cells in a list. When you choose an item from this list, Excel scrolls the worksheet to show you how it fits into the larger picture.

After you've used Find All, hit **Ctrl+A** to select all of the worksheet's discovered cells.

You can access the worksheet and make adjustments without having to dismiss the Find and Replace dialog box since it is modeless.

Information replacement

In the Find and Replace dialog box, select the Replace tab to replace text with different text. Enter the text to be changed in the Find What box, and then enter the new text in the Replace With field. As noted in the section before, more choices may be made.

The first item that matches is found by clicking Find Next, and then it is replaced by clicking Replace. Excel searches for the following item that meets your criteria when you click the Replace button. To override the substitution, click Find Next. Click Change All to make all changes without checking them beforehand. Use Ctrl+Z or the Undo button on the Quick Access toolbar if the replacement didn't turn out as planned.

Fill in the **Find What box** with the text you want to erase, but keep the Replace With area blank.

Searching for formatting

You can also use the **Find and Replace dialog box** to find cells that have a certain style of formatting. You have the option of replacing that formatting with a different kind of formatting. Consider the following scenario: you want to find all cells that are formatted as bold and then alter the formatting to bold and italic.

Take the following steps:

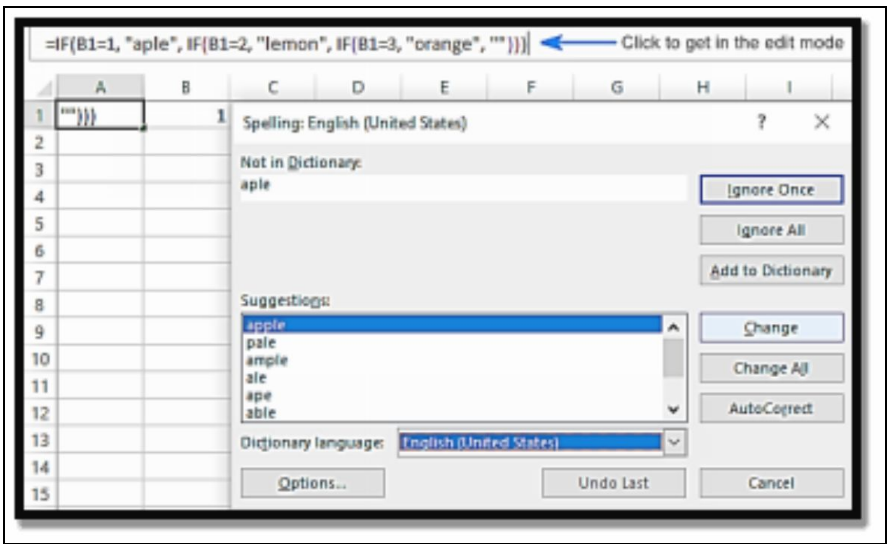
1. Press **Ctrl+H** or go to **Home > Editing > Find & Select Replace**.
2. Check that the **Replace tab** is visible. To enlarge the dialog box, click the **Options button** if required.
3. Delete the contents of the **Find What and Replace With fields** if they are not empty.
4. Select Format from the drop-down menu at the top of the page. The dialog window for finding a format appears. This dialog box looks similar to the Format Cells dialog box.
5. Go to the **Font tab**.
6. Click OK after selecting **Bold** from the **Font Style option**.
7. Select the **Format option** at the bottom of the page. A dialog window called Replace Format opens.
8. Go to the **Font tab**.
9. Click OK after selecting Bold Italic from the Font Style option.
10. Click **Replace All** in the Find and Replace dialog box. Excel searches for all cells with bold formatting and converts them to bold italic.

You may also search for formatting based on a certain cell. Pick the **Choose Format** from Cell button in the **Find Format dialog box**, then click the cell that has the formatting you're searching for.

Note: The Find and Replace dialog box is unable to locate background color formatting in tables that have been applied using table styles or conditional formatting.

Spell-checking your worksheets

If you use a word processor, you almost certainly use the spell-checking option. When spelling errors arise in a spreadsheet, they may be just as humiliating. Fortunately, Excel comes with a spell-checker from Microsoft.



Choose **Review** > **Proofing** > **Spelling** or **press F7** to go to the spell-checker. Before you launch the spell-checker, pick the range you want to verify the spelling in.

Cell contents, text in graphical objects and charts, and page headers and footers are all checked by the spell-checker. The content of concealed rows and columns is also examined.

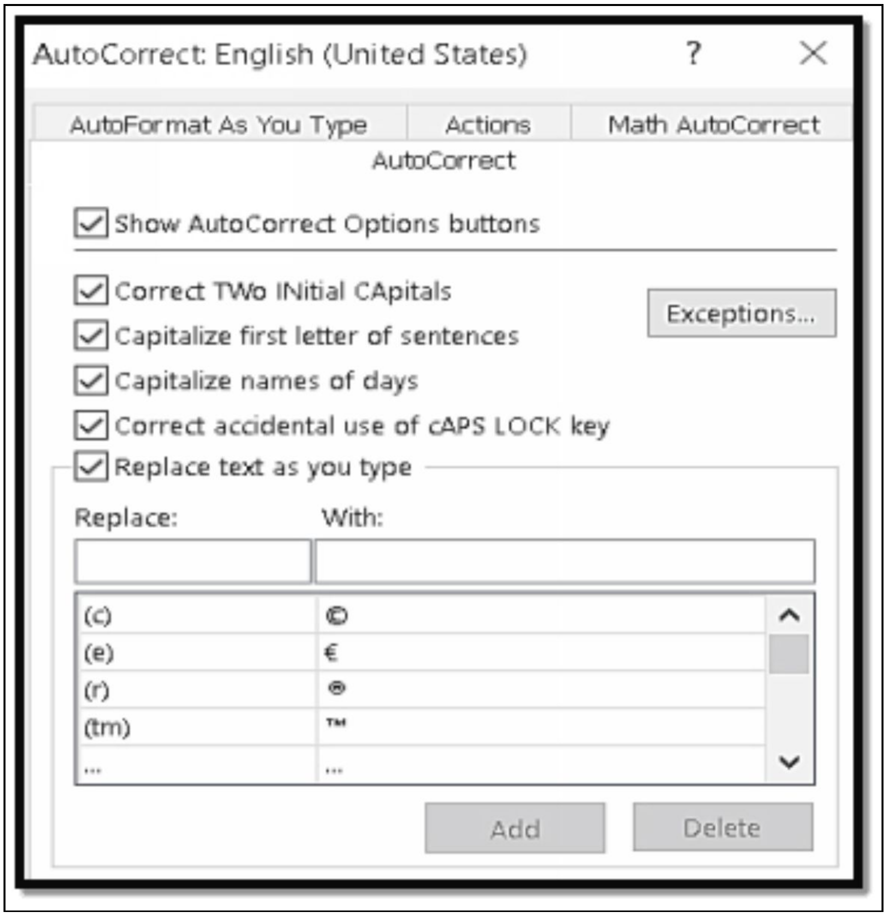
The **Spelling dialog box** functions in a similar way to other spell-checkers you may be acquainted with. Excel provides a list of recommendations if it comes across a term that isn't in the current dictionary or is misspelled.

Click one of the following buttons to respond:

- **Ignore Once:** The term and go on with the spell-check.
- **Ignore everything:** Ignore the term and any further instances of it.
- **Dictionary entry:** Make a note of the term in the dictionary.
- **Change:** Change the term in the Suggestions list to the one you want.
- **Replace everything:** Change the word to the Suggestions list's chosen term, and all future instances of it will be changed without prompting.
- **AutoCorrect:** Add the misspelled word to the AutoCorrect list, along with its proper spelling (which you may choose from a list).

Using AutoCorrect

AutoCorrect is a useful function that corrects frequent typing errors automatically. You may also add words to the list of terms that Excel will automatically fix. Choose **File > Options** to get to this functionality. Select the **Proofing tab** in the **Excel Options dialog box**, then click the **AutoCorrect Options button**.



There are various possibilities in this dialog box:

- **TWO INitial CApitals must be correct:** Words with two initial capital letters are automatically corrected. Budget, for example, is transformed from Budget. This is a frequent blunder made by quick typists. You can define a list of exceptions to this rule by clicking the Exceptions button.
- **The first letter of each sentence should be capitalized:** The initial letter of a sentence is capitalized. The rest of the letters remain the same.
- **Capitalize Days' Names:** The days of the week are capitalized. When you type Monday, Excel automatically converts it to Monday.
- **Correcting the use of the CAPS LOCK key by accident:** Errors caused by mistakenly pressing the CapsLock key while typing are corrected.

- **As You Type, Replace Text:** As you write, AutoCorrect automatically corrects your mistakes.

For often misspelled terms, Excel has a lengthy list of AutoCorrect entries. It also includes AutoCorrect entries for several symbols. (c) is replaced with ®, and (r) is replaced with ®, for example. Additionally, create your AutoCorrect items. If you routinely misspell the word January as January, for example, you may create an AutoCorrect entry to have it corrected automatically. Enter the misspelled word in the Replace box and the properly spelled term in the With field to make a new AutoCorrect entry. You may also get rid of entries that you don't require.

Create shortcuts for frequently used words or phrases using the **AutoCorrect tool**. If you work at **Consolidated Data Processing Corporation**, for example, you may create an AutoCorrect entry for an abbreviation like cdp. Excel will then transform cdp to Consolidated Data Processing Corporation anytime you input it. Just make sure you don't employ a character combination that would ordinarily occur in your text but would be changed incorrectly.

Note: You may wish to override the AutoCorrect function in certain instances. For example, instead of a copyright sign, you may need to write (c). Simply hit Ctrl+Z or click the Undo button on the Quick Access toolbar.

Also, you can alter a few more automatic settings in Excel by using the AutoFormat as You Type tab of the AutoCorrect dialog box.

For specific sorts of data in your workbooks, the Actions tab allows what were formerly known as Smart Tags. Excel detects several sorts of activities based on the software you have installed on your computer. If you activate the **Financial Symbol action**, for example, you can right-click a cell containing a financial symbol (such as MSFT for Microsoft) and choose **Additional Cell Actions** to get a list of possibilities. You may, for example, include a stock price that is updated regularly in your spreadsheet.

Conclusion

Every Excel formula and function has a specific use in the workplace. You must be vigilant and careful while entering formulas and functions in Excel (as described in this guide) to avoid confusing one for another.

Users will learn about manually inputting formulae, entering formulas into worksheets, altering reference types, utilizing formulas in tables, formulas that return errors, making formulas error-free, comprehending the dimensions of an array, generating an array constant, and much more in this guide.

The ideal manual for anyone wishing to enter various formulas and functions into their spreadsheets and workbooks without running into any issues is Microsoft 2023 Formulas and Functions.

INDEX

B

C

D

E

F

G

H

I

N

O

P

Q

R

S

V

W

Y