Excel©

Formulas and Functions
# Excel Formulas and Functions

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ENTERING A FORMULA

USAGE: Formulas are used to obtain answers based on mathematical equations that you design. Formulas can be as simple as "2+2" or as complex as calculating the depreciation of fixed assets. When creating formulas, you may use actual values, cell addresses or a combination of the two.

The equal sign (=) is used to indicate to Excel that you are about to enter a formula. This also ensures that formulas beginning with a cell address are not mistaken for text.

Next, you must enter the actual formula for Excel to calculate. When entering these formulas, the following basic mathematical operators are used:

+ (add)
- (subtract)
* (multiply)
/ (divide)

When a formula is complete and the ENTER key has been pressed, the result will be displayed in the current cell. The formula itself is displayed in the formula bar (located in the upper-left of the screen next to the cell address).

NOTE: In order to view a formula, you must select the cell in which it is stored.
TIP: If you select a group of cells and look at the status bar (at bottom of the screen), Excel will display the total (sum) of the selected cells.

CORRECTING FORMULAS

Excel can help to locate errors by checking your formulas for common mistakes and offering a suggested correction.

When you press the ENTER key after typing in a formula, Excel checks the formula for possible syntax errors.

If an error is encountered, a dialog box will pop-up explaining what Excel thinks is the problem with the formula and asking if it should correct the formula based on its suggestion.

Select Yes to have Excel change the formula based on its suggestion.

Click on No to cancel this box and correct the error yourself.

NOTE: If you enter one of the natural language formulas (discussed on the previous page) and include a label with spaces (e.g., 1st Qtr), Excel will display an error message and suggest that quotes be added to the labels in the formula.
WORKING WITH BUILT-IN FUNCTIONS

USAGE: General mathematical built-in functions are provided with Excel to carry out calculations on data within the spreadsheet and can take the place of certain types of formulas.

Functions begin with the = sign just as formulas do. For example, if you had a large column of numbers to be added (A1:A100), you might think you need a long formula to include all of the addresses (=A1+A2+A3....+A99+A100). However, Excel provides a mathematical function which is used primarily to add blocks of numbers. The formula could be re-written as =SUM(A1:A100) which is much shorter.

To calculate the sum of a block of numbers, move to the cell where the answer is to be placed and use this built-in function:

=SUM(FIRST CELL:LAST CELL)

You must define the block just like any other block by specifying the first and last cell addresses.

To calculate the average value for a block of cells:

=AVERAGE(FIRST CELL:LAST CELL)

To return the largest value in a block of cells:

=MAX(FIRST CELL: LAST CELL)

To return the smallest value in a block of cells:

=MIN(FIRST CELL:LAST CELL)

To count the number of numeric entries in a block of cells:
=COUNT(FIRST CELL:LAST CELL)

USING THE FORMULA PALETTE

If you would like some guidance, Excel can list the most common functions and then prompt you for the various arguments required by displaying the Formula Palette.

As soon as you type the ™ sign in a cell, this button will be listed along the left side of the Formula Bar.

The last function you chose will be displayed on the button. If you simply click on the button that function will be selected.

To choose a different function, click on the down arrow to the right of the button and then select a new function from the list.

Once the function has been selected, Excel will display the Formula Palette, as shown below:

The palette will display a description of the currently selected function and list the arguments required for the function.
The next required argument will be displayed in bold. This helps guide you through each step properly.

Notice as you begin entering the arguments, the palette displays the current result.

When you are done, click on OK to actually enter the function and close the palette.

NOTE: You can access the Formula Palette at any time while entering a function by clicking on the button (displayed along the left side of the Formula Bar).

THE AUTOSUM FEATURE

Excel can make somewhat of an intelligent decision on its own and determine which cells of a row or column should be "summed". This is called the AutoSum feature.

To quickly add the contents of a column or row, follow the steps shown below:

Select the cell either to the right or below the cells that are to be totaled.

Double-Click on this tool (which is located on the standard tool bar).

NOTE: If you only click on the AutoSum tool once, Excel will highlight the cells it assumes you want to include in the formula. The second click is used to confirm the selection.

If, by chance, Excel has selected the wrong group of cells, you can...
ACCESSING OTHER FUNCTIONS

In addition to adding a column or row, the AutoSum tool can also be used to perform a variety of other built-in functions.

To access one of the other available functions, follow the steps outlined below:

1. Select the cell where you want the function to be stored.
2. Click on the down arrow beside this tool.
3. Excel will provide a pull-down list of the most commonly used functions.
   - If you look in the current cell, you will see that Excel has placed the selected function in the cell.
   - You will need to confirm that this is correct by clicking on the autosum tool a second time to accept the function.

Select the function you want to use from the list provided.
USING THE INSERT FUNCTION DIALOG BOX

To have Excel perform a function that is not displayed in the pull-down list, you will need to access the Insert Function dialog box, as outlined in the steps below:

Be sure that the current cell is the one in which you want the function to be placed.

Click on the down arrow beside the AutoSum tool (which is located on the standard tool bar).

Excel will provide a pull-down list of the most commonly used functions.

Select More Functions... from the list provided.

The following dialog box will be displayed:
The dialog box is divided into two main sections. The top section of the box allows you to either enter an explanation as to the type of function you want to perform or select the category of function you are searching for. After entering the explanation or selecting the category, click on Go to view a list of related functions.

The bottom of the dialog box lists the results of your search.

Select the function you want to use and click on OK.

You will be taken to a second dialog box where you will enter the block of cells to apply the function to, as shown below:
Type the block of cells in the box provided or click back in the worksheet to highlight the desired cells.

If you click on the button (within in the “Insert Function” dialog box), the dialog box will be temporarily set aside and you will be returned to the worksheet where you can use the mouse to select the block for the function.

A bar will be displayed while you select the block of cells to include in the formula, as illustrated below:

Once you have selected or entered the block of cells to use for the function, re-activate the “Insert Function” dialog box by clicking on the button (located in the upper right corner of the bar).

When done, choose or press the key.
SEVEN USEFUL FUNCTIONS

The IF Function

The IF worksheet function checks a condition that must be either true or false. If the condition is true, the function returns one value; if the condition is false, the function returns another value. The function has three arguments: the condition you want to check, the value to return if the condition is true, and the value to return if the condition is false. The returned value is placed into the answer cell (the cell containing the function).

=IF(logical_test,value_if_true,value_if_false)

The logical test is the condition that you want to check, for example, is the value in a given cell greater than a certain number, or is the value of a given cell less than the contents of another cell, etc.

The value if true is the value that will be placed in the answer cell if the logical test is true.

The value if false is the value that will be placed in the answer cell if the logical test is false.

Examples:

=IF(C2>10000, C2*.10,C2*.06)

=IF(A6>0,A6,”NO DATA”)

The SUMIF Function

The SUMIF worksheet function checks for a value within a range and then sums all the corresponding values in another range. SUMIF has three arguments: the range to be checked, the value to check for within the range (the criteria), and the range containing the values to be summed.
The COUNTIF Function

The COUNTIF function will allow you to produce a count of cells within your data list that meet your criteria. COUNTIF has two arguments: the range to be checked and the value to check for within the range (the criteria).

=COUNTIF(range,criteria)

Range is the range of cells that you want to count. Criteria is the address of the cell that contains the value you are counting.

Example:

=COUNTIF(C2:C23,A6)

The function counts the number of times the contents of cell A6 (the criteria argument) appears within cells C2 through C23 (the range argument).
The Pmt Function

Another formula you might want to create at some point could may contain the PMT function. Suppose you want to buy a house. You can use this function to quickly calculate what your monthly payment would be based on the value of your loan, the interest rate and the number of total payments you will be making.

\[=\text{PMT}(\text{interest rate}, \text{number of payments}, \text{loan value})\]

The first section lists the interest rate while the second section contains the total number of payments you will make over the course of the loan, and the third section lists the value of the loan.

Example: \[=\text{PMT}(8\%/12,360,100000)\]

Since loans are calculated based on an annual interest rate, you will need to divide that rate by 12 for a monthly rate.

If you prefer, you can build the PMT function using cells in your worksheet rather than simply entering the values. This would allow you to play “what-if” scenarios by changing the interest rate, terms, and loan value cells.

Example: \[=\text{PMT}(A4/12,B4,C4)\]

The result is displayed as a negative number since it represents an expense. If you would prefer to see the value as a positive number, simply add a negative sign \((-\)\) before the loan value.
The FV Function

This function can be used to calculate the future value of an investment, or the total payback amount of a loan with interest. For example, you might be contributing to your 401k account each month and want to know what it's value will be in 20 years, or you may borrow a sum of money for five years and want to know how much it will actually cost you to pay back that loan with interest.

\[=FV(\text{interest rate}, \text{payments}, \text{amount of each payment})\]

The first section contains the interest rate, while the second lists the number of deposits or payments made, and the third gives the amount of each deposit or payment.

Example: \[=FV(5\%/12,240,100)\]

Since interest is calculated based on an annual rate, you will need to divide that rate by 12 for a monthly rate.

If you prefer, you can build the FV function using cells in your worksheet rather than simply entering the values. This would allow you to play “what-if” scenarios by changing the interest rate, the time period and how much you pay or deposit each month.

Example: \[=FV(A4/12,B4,C4)\]

The result is displayed as a negative number since it represents an expense. If you would prefer to see the value as a positive number, simply add a negative sign (-) before entering the value representing the amount of each payment.
**The Date Function**

You can perform simple mathematical calculations on dates, such as calculating the number of days between two dates or finding the date 30 days from today (or any day).

To perform a mathematical equation using specific dates, use the `=DATE` function as shown in the examples below.

To get the date a certain number of days from another date (e.g., 30 days from an invoice due date), you would simply add the number of days to a date, as illustrated in the example below:

\[ =\text{DATE}(\text{YY,MM,DD})+30 \]

This will result in a date 30 days after the original date.

Or calculate the date a specific number of days in the past, as illustrated in the example below:

\[ =\text{DATE}(\text{YY,MM,DD})-30 \]

This will result in a date 30 days before the original date.

**The Today Function**

Returns the serial number of the current date. The serial number is the date-time code used by Microsoft Excel for date and time calculations. If the cell format was General before the function was entered, the result is formatted as a date.

**Syntax**

\[ =\text{TODAY}() \]

**Examples:**

\[ =\text{TODAY}()-30 \]
THE CONDITIONAL SUM WIZARD

The Conditional Sum Wizard will help you to quickly build a function that check for multiple conditions that contain multiple conditions. In the wizard, you specify the location of the list, the condition to check, and the cell(s) where you want to place the result.

The Conditional Sum Wizard is an add-in program supplied with Excel.

To add the wizard to the Tools menu, choose,

Tools

Add-Ins

- The Add-Ins dialog box is displayed. Click into the checkbox to select the Conditional Sum Wizard.

- Click OK. The Wizard will now be a selection on your Tools Menu.

To use the Conditional Sum Wizard, from the menu choose:

Tools

Wizard

Conditional Sum
In Step 1, indicate the area that contains your data list.

In Step 2, set up the condition(s) that you want to check for by selecting the column to work with, choosing an operator, and then indicating the value you are checking for. Click the Add Condition button to set up the condition. Repeat for any additional conditions that you want to set.
In Step 3, select the kind of results you would like displayed.

In Step 4, select the cell where the answer should appear.

Note: If you choose to copy the formula and the conditional values, you may alter the formula by typing new conditional values into the results area. Also note that you can copy the original results area, and then change to conditional values on each copy to display a variety of results.
ABOUT CELL AND RANGE REFERENCES

A reference identifies a cell or a range of cells on a worksheet and tells Microsoft Excel where to look for the values or data you want to use in a formula. With references, you can use data contained in different parts of a worksheet in one formula or use the value from one cell in several formulas. You can also refer to cells on other sheets in the same workbook, and to other workbooks. References to cells in other workbooks are called links.

The A1 reference style

By default, Excel uses the A1 reference style, which refers to columns with letters (A through IV, for a total of 256 columns) and refers to rows with numbers (1 through 65536). These letters and numbers are called row and column headings.

To refer to a cell, enter the column letter followed by the row number. For example, B2 refers to the cell at the intersection of column B and row 2.

<table>
<thead>
<tr>
<th>To refer to</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>The cell in column A and row 10</td>
<td>A10</td>
</tr>
<tr>
<td>The range of cells in column A and rows 10 through 20</td>
<td>A10:A20</td>
</tr>
<tr>
<td>The range of cells in row 15 and columns B through E</td>
<td>B15:E15</td>
</tr>
<tr>
<td>All cells in row 5</td>
<td>5:5</td>
</tr>
<tr>
<td>All cells in rows 5 through 10</td>
<td>5:10</td>
</tr>
<tr>
<td>All cells in column H</td>
<td>H:H</td>
</tr>
<tr>
<td>All cells in columns H through J</td>
<td>H:J</td>
</tr>
<tr>
<td>The range of cells in columns A through E and rows 10 through 20</td>
<td>A10:E20</td>
</tr>
</tbody>
</table>
To refer to | Use
---|---
Reference to another worksheet in the same workbook | In the following example, the AVERAGE worksheet function calculates the average value for the range B1:B10 on the worksheet named Marketing in the same workbook.

<table>
<thead>
<tr>
<th>Name of the worksheet</th>
<th>Reference to cell or range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>B1:B10</td>
</tr>
</tbody>
</table>

The difference between relative and absolute references

Relative references
A relative cell reference in a formula, such as A1, is based on the relative position of the cell that contains the formula and the cell the reference refers to. If the position of the cell that contains the formula changes, the reference is changed. If you copy the formula across rows or down columns, the reference automatically adjusts. By default, new formulas use relative references. For example, if you copy a relative reference in cell B2 to cell B3, it automatically adjusts from =A1 to =A2.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=A1</td>
</tr>
<tr>
<td>3</td>
<td>=A2</td>
</tr>
</tbody>
</table>

Copied formula with relative reference

Absolute references
An absolute cell reference in a formula, such as $A$1, always refer to a cell in a specific location. If the position of the cell that contains the formula changes, the absolute reference remains the same. If you copy the formula across rows or down columns, the absolute reference does not adjust. By default, new formulas use relative references, and you need to switch them to absolute references. For example, if you copy a absolute reference in cell B2 to cell B3, it stays the same in both cells =$A$1.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=$A$1</td>
</tr>
<tr>
<td>3</td>
<td>=$A$1</td>
</tr>
</tbody>
</table>
Copied formula with absolute reference

Mixed references  A mixed reference has either an absolute column and relative row, or absolute row and relative column. An absolute column reference takes the form $A1, $B1, and so on. An absolute row reference takes the form A$1, B$1, and so on. If the position of the cell that contains the formula changes, the relative reference is changed, and the absolute reference does not change. If you copy the formula across rows or down columns, the relative reference automatically adjusts, and the absolute reference does not adjust. For example, if you copy a mixed reference from cell A2 to B3, it adjusts from =A$1 to =B$1.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>=A$1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>=B$1</td>
<td></td>
</tr>
</tbody>
</table>

Copied formula with mixed reference

Switch between relative, absolute, and mixed references

1. Select the cell that contains the formula.
2. In the formula bar (formula bar: A bar at the top of the Excel window that you use to enter or edit values or formulas in cells or charts. Displays the constant value or formula stored in the active cell.) select the reference you want to change.
3. Press F4 to toggle through the combinations. The "Changes To" column reflects how a reference type updates if a formula containing the reference is copied two cells down and two cells to the right.

The 3-D reference style

If you want to analyze data in the same cell or range of cells on multiple worksheets within the workbook, use a 3-D reference. A 3-D reference includes the cell or range reference, preceded by a range of worksheet names. Excel uses any worksheets stored between the starting and ending names of the reference. For example,

=SUM(Sheet2:Sheet13!B5)

adds all the values contained in cell B5 on all the worksheets between and including Sheet 2 and Sheet 13.

You can use 3-D references to create formulas by using the following functions: SUM, AVERAGE, AVERAGEA, COUNT, COUNTA, MAX, MAXA, MIN, MINA, PRODUCT, STDEV, STDEVA, STDEVVP, STDEVP, VAR, VARA, VARP, and VARPA.