

# Excel 2016: Formulas & Functions

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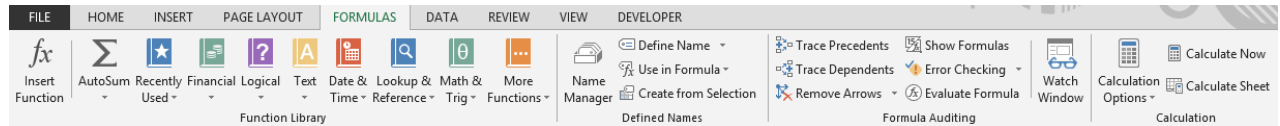
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## Formulas and Functions

There is a whole new formula bar in Excel 2013 to make entering Formulas and Functions easier.



### Formulas

#### Rules and Syntax

All Formulas or Functions start with an “=”

Formulas use these operators (all of these operators can be found on the numeric keypad) and are calculated in the following order:

- “\*” Multiplication
- “/” Division
- “+” Addition
- “-” Subtraction

Example of a Formula and its Answer:

**=5+4\*2** would the answer be 18 or 13?

**IMPORTANT:** The answer would be 13 because the Mathematical Hierarchy states the multiplication and division always occur before addition and subtraction unless parenthesis are used. If parentheses are used, that operation will override the default hierarchy. In other words, if you wish the answer to be 18, the formula must be  
= (5+4)\*2.

#### Relative versus Absolute Cell Referencing

##### Relative Cell Reference

When you type a formula or function in a cell (like the one shown below – B2+C2) you would then generally copy or fill that formula to the cells remaining cells. If the formula were truly copied, each cell would contain =B2+C2 which, in this case, would not be what you want. You would want Excel to increase the row number for you as you copied the formula down to the other cells, which it does! Notice that =B2+C2 becomes =B3+C3 and then =B4+C4 etc. This same technique would increase/decrease column letters if you copied to the right or left. Relative cell referencing is the default in Excel.

	A	B	C	D	E
1		January	February	Total	
2	Ice Cream	100	10	=B2+C2	
3	Cones	150	12	=B3+C3	Notice how the row number changed as the formula was copied or filled down.
4	Cherries	200	14	=B4+C4	
5	Nuts	250	16	=B5+C5	
6	Total	=SUM(B2:B5)	=SUM(C2:C5)	=SUM(D2:D5)	

### Absolute Cell Reference

There are times, however that you do NOT want relative cell addressing. Sometimes you need your reference to stay put. That is when Absolute cell addressing comes into play. To make a cell reference absolute, press F4 in the part of the formula you want to stay referencing the same cell. F4 makes an address absolute by placing dollar signs (\$) in front of the column letter and row number (i.e. \$B\$4). This means that as you copy that formula, the reference to \$B\$4 will not change.

	A	B	C	D	E
1		January	February	Total	
2	Ice Cream	100	10	=B2+C2	
3	Cones	150	12	=B3+C3	
4	Cherries	200	14	=B4+C4	
5	Nuts	250	16	=B5+C5	
6	Total	=SUM(B2:B5)	=SUM(C2:C5)	=SUM(D2:D5)	
7	Tax Amount - Incorrect Formula	=B6*B10	=C6*C10	=D6*D10	<b>Relative</b> - notice how the cell B7 multiplies B6*B10 which is correct, but when this formula is copied into cells C7 and D7, the second half of the formula B10, incorrectly changes to C10 and then D10 - which are blank (relative cell referencing)!
8	Tax Amount - Correct Formula	=B6*\$B\$10	=C6*\$B\$10	=D6*\$B\$10	<b>Absolute</b> - notice how the cell B8 multiplies B6*B10 which is correct, and when you make B10 absolute, by typing a \$ before the B and a \$ before the 10 (or pressing F4 - the absolute key), this formula stays correct when it is copied into cells C8 and D8. Notice the reference to \$B\$10 stays \$B\$10 (absolute cell referencing)!
9					
10	Tax Rate	0.08			

### Functions – Make Calculations Easier Than Using Formulas

Example – add B5 through B10

Using a formula: =B5+B6+B7+B8+B9+B10

Using the formula to Add a Range: =SUM(B5:B10)

### Syntax

The syntax of a function is generally “=function name(range)” see examples below

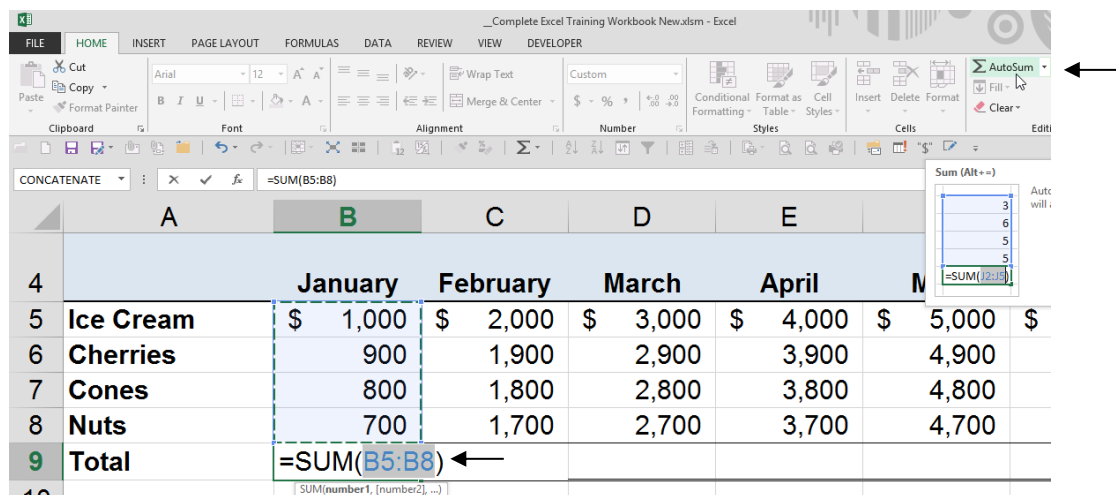
Sum:	=SUM(B5:B10)
Minimum:	=MIN(B5:B10)
Maximum:	=MAX(B5:B10)
Average:	=AVERAGE(B5:B10)
Count:	=COUNT(B5:B10)

## The AutoSum Tool on the Home tab

### Sum a Column

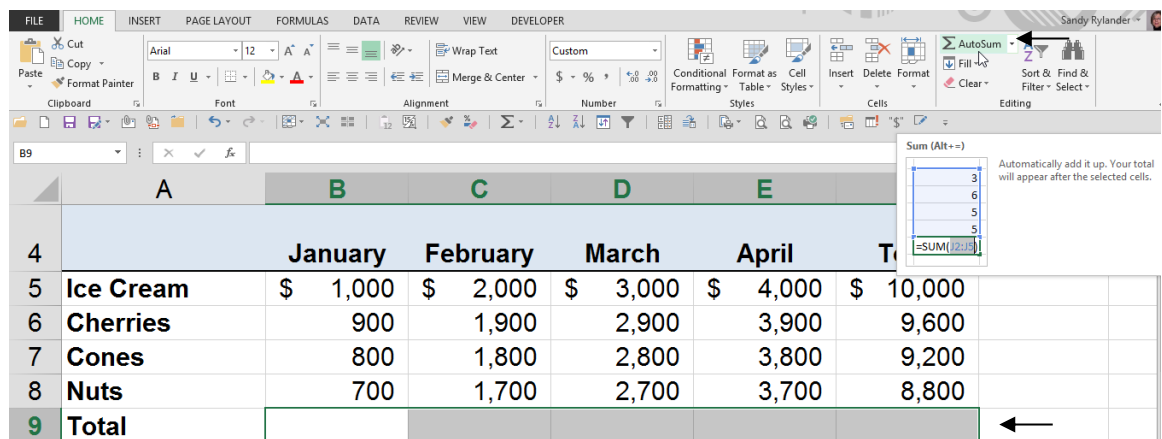
Using the example below:

1. Click in cell **B9** - the cell directly below the data.
2. Click the **AutoSum** tool.  
Notice that the cells it thinks you want to add have a marquis, a dotted line, around them.
3. If the cells you wish to add have a marquis around them, simply press **Enter** or click the **AutoSum** tool again to remove the marquis.



### Sum Multiple Columns

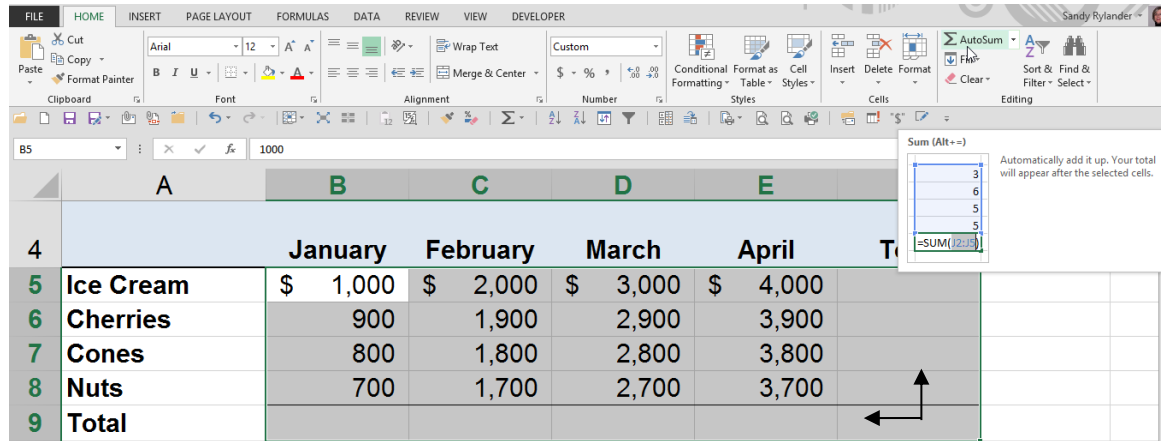
4. Select all the cells where you want the totals to appear.



5. Click the **AutoSum** tool  
(i.e. Select **B9:F9** to sum all the rows at once, or **F5:N9** to sum all the columns at once.)

### Sum Rows and Columns Simultaneously

- Select the data you wish to add plus one extra row and one extra column.  
(so Excel knows where you want the totals to appear).
- Click the **AutoSum** tool.  
(i.e. in the example above, select **B5:F9** to sum all the rows and columns at once.)



**Tip!** If there are any gaps in your data (i.e. blank cells) it is a good idea to select the data in addition to the cell where you want the total to appear, before clicking the AutoSum tool. This will cause Excel to include all highlighted cells in the total, rather than stopping at the first blank cell. See example below.

Selecting only B9 before hitting Autosum includes only data up to the first blank cell in total.

	A	B
4	January	
5	Ice Cream	\$ 1,000
6	Cherries	
7	Cones	800
8	Nuts	700
9	Total	=SUM(B7:B8)

Selecting B3:B7 before hitting Autosum includes all data in total.

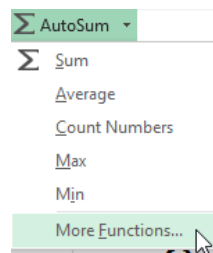
	A	B
4	January	
5	Ice Cream	1000
6	Cherries	
7	Cones	800
8	Nuts	700
9	Total	\$ 2,500



## Insert Excel Functions – 4 Methods

- The More Functions Option on the AutoSum tool
- The Insert Function tool on the left side of the Formula bar
- The Function Library on the Formulas bar
- Typing an equals and then using Excel's formula entry help.

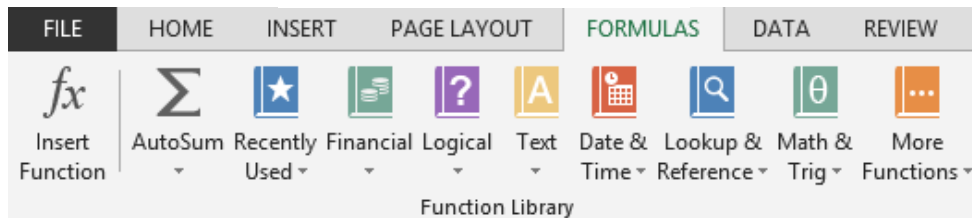
AutoSum: More Functions



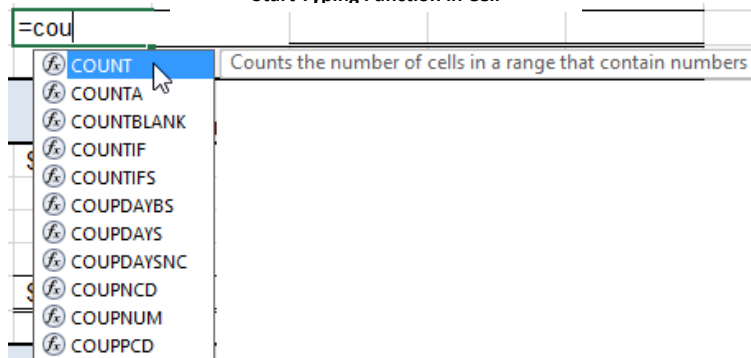
Insert Function on the Formula Bar



Function Library on the Formula Tab



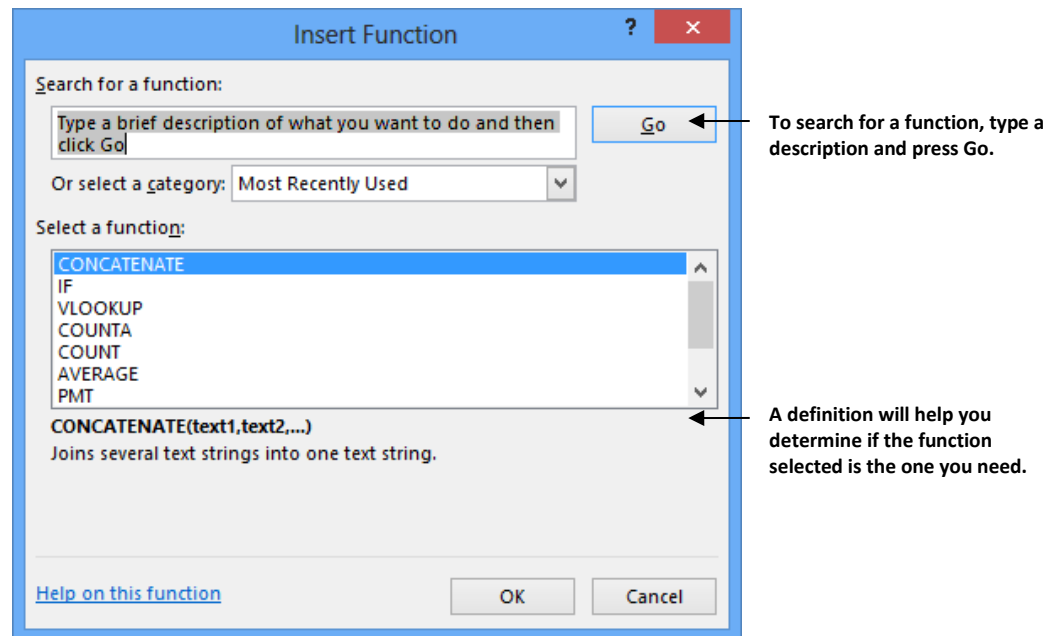
Start Typing Function in Cell



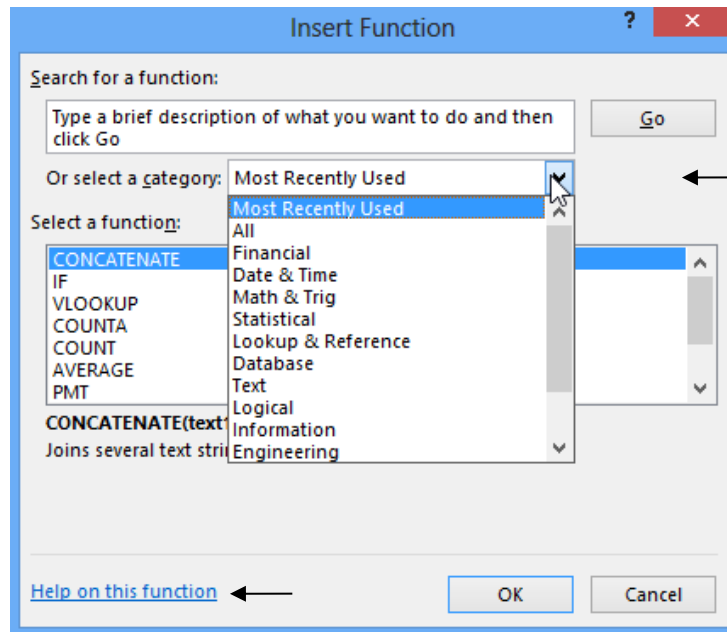
### Insert Function Tool

If you do not know how to enter a Function:

1. Click in the cell where you want the Function to appear and click either:
  - a. the **Insert Function tool on the Formula bar**; or
  - b. The **Insert Function tool on the Formula tab**.
2. The Insert Function Dialog box appears, allowing you to select any of Excel's functions.
  - a. You can search for a function by typing in a description of what you are wanting to find; or



- b. You can search a reduced number of functions by selecting a category.



Select a Function Category to reduce the number of functions displayed or select All to view all functions.

3. Once you find the desired function, you can press Help to get great descriptions and examples of how to correctly use this function. Here is a great example of the Help for the **Count** function. It gives you a description of the function, followed by its syntax, other remarks, and 1 to 5 examples of how to use it in a worksheet!

**COUNT**

Counts the number of cells that contain numbers and counts numbers within the list of arguments. Use COUNT to get the number of entries in a number field that is in a range or array of numbers.

Syntax

COUNT(value1,value2,...)

Value1, value2, ... are 1 to 255 arguments that can contain or refer to a variety of different types of data, but only numbers are counted.

Remarks

- Arguments that are numbers, dates, or text representation of numbers are counted.
- Logical values and text representations of numbers that you type directly into the list of arguments are counted.
- Arguments that are error values or text that cannot be translated into numbers are ignored.
- If an argument is an array or reference, only numbers in that array or reference are counted. Empty cells, logical values, text, or error values in the array or reference are ignored.
- If you want to count logical values, text, or error values, use the COUNTA function.

Example

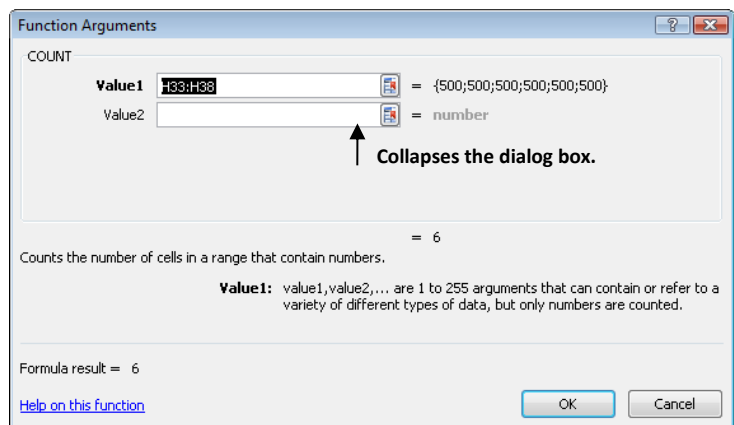
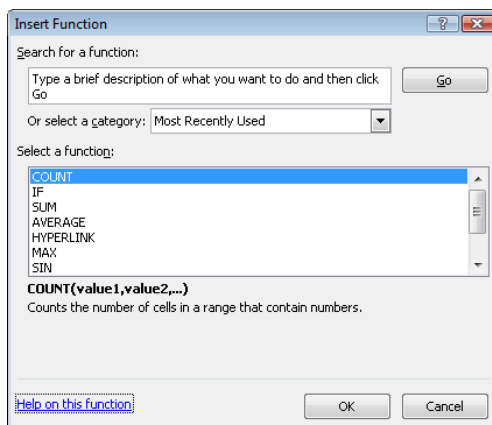
The example may be easier to understand if you copy it to a blank worksheet.

How to copy an example

	A	
1	Data	
2	Sales	
3	12/8/2008	
4		
5	19	
6	22.24	
7	TRUE	
8	#DIV/0!	

Formula	Description (Result)
=COUNT(A2:A8)	Counts the number of cells that contain numbers in the list above (3)
=COUNT(A5:A8)	Counts the number of cells that contain numbers in the last 4 rows of the list (2)
=COUNT(A2:A8,2)	Counts the number of cells that contain numbers in the list, and the value 2 (4)

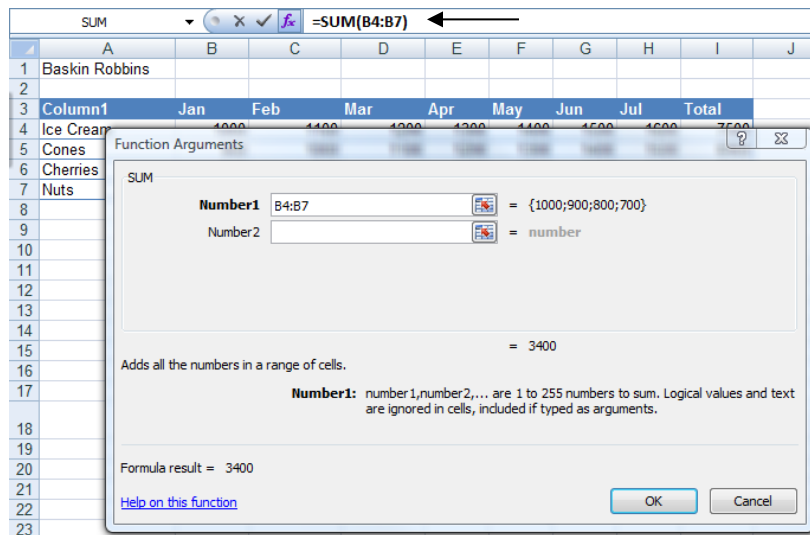
4. When you are done reading Help, you can click the "X" in the top right corner of the title bar. This brings you back to the Insert Function dialog box. If you then click OK, Excel will step you through inserting the Arguments as shown below. Click **OK** when done.



**Exercise:**

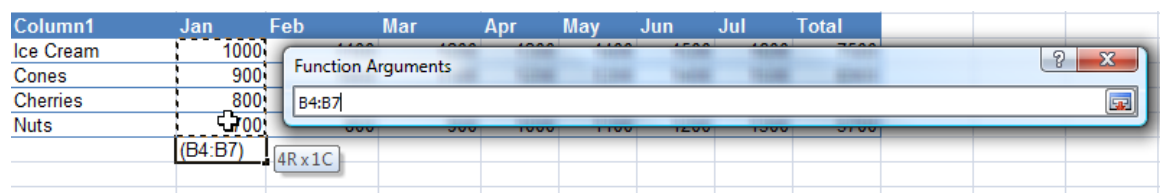
- Here is another example of using Insert Function to help with the Sum Function.

- Click in the cell where the sum is to appear.
- Click **the Insert Function tool** on the formula bar.
- Select **Sum** for the function and click **OK**. The following dialog box appears.



- The Function Name and the ( )s appear in the formula bar. **Either type in the desired range in the Number 1 text box; or**
- Make the dialog box collapse by clicking on the tool shown below and then drag across the range you want to select in the worksheet.**

Your screen should look like this:



- When done click **OK** or press **Enter**.

## More Functions

### Logical If Function

The IF statement is used to test if the contents of a cell meet certain requirements. Returns one value if a condition you specify evaluates to TRUE and another value if it evaluates to FALSE. The result of the test can be a calculation or a string. See examples below.

#### Syntax of If statement

= IF(logical\_test,value\_if\_true,value\_if\_false)

	A	B	C	D	E	F	G	H
3		Jan	Feb	Mar	Apr	Total	Accolades	Bonus
4	East	\$ 1,200	\$ 4,100	\$ 5,610	\$ 8,200	\$ 19,110	Great Job!	\$ 22,932
5	West	\$ 2,200	\$ 4,070	\$ 6,600	\$ 1,800	\$ 14,670	You're Fired!	\$ 14,670
6	North	\$ 3,200	\$ 3,340	\$ 6,800	\$ 3,800	\$ 17,140	Great Job!	\$ 20,568
7	South	\$ 4,200	\$ 2,400	\$ 5,260	\$ 4,800	\$ 16,660	Great Job!	\$ 19,992

Column G returns a text string  
Column H returns the value of an equation.

#### Sample IF Statements

Cell G3: =IF(F4>15000,"Great Job!","You're Fired")

**Important!** If you want to leave the cell blank, you must still type quotes

i.e. "".

Cell H3: =IF(F4>15000,F3\*1.2,F4)

### Logical AND Function combined with IF

Returns TRUE if all its arguments are TRUE; returns FALSE if one or more arguments is FALSE.

#### Syntax of IF combined with AND statement

= IF(AND(logical1,logical2, ...),true,false)

G4	:	X	✓	<i>f<sub>x</sub></i>	=IF(AND(D4>5000,E4>4000),"Great Job","Work Harder")			
	A	B	C	D	E	F	G	H
3		Jan	Feb	Mar	Apr	Total		
4	East	\$ 1,200	\$ 4,100	\$ 5,610	\$ 8,200	\$ 19,110	Great Job	
5	West	\$ 2,200	\$ 4,070	\$ 6,600	\$ 1,800	\$ 14,670	Work Harder	
6	North	\$ 3,200	\$ 3,340	\$ 5,800	\$ 3,800	\$ 16,140	Work Harder	
7	South	\$ 4,200	\$ 2,400	\$ 5,260	\$ 4,800	\$ 16,660	Great Job	

#### Sample IF AND Statements

Cell G3: =IF(AND(D4>5000,E4>4000),"Great Job","Work Harder")

**Important!** If you want to leave the cell blank, you must still type quotes

i.e. "".

### Logical OR Function combined with IF

Returns TRUE if any argument is TRUE; returns FALSE if all arguments are FALSE.

#### Syntax of IF combined with OR statement

= IF(OR(logical1,logical2, ...),true,false)

G4				=IF(OR(D4>6000,E4>4000),"Great Job","Work Harder")			
	A	B	C	D	E	F	G
3		Jan	Feb	Mar	Apr	Total	
4	East	\$ 1,200	\$ 4,100	\$ 5,610	\$ 8,200	\$ 19,110	Great Job
5	West	\$ 2,200	\$ 4,070	\$ 6,600	\$ 1,800	\$ 14,670	Great Job
6	North	\$ 3,200	\$ 3,340	\$ 5,800	\$ 3,800	\$ 16,140	Work Harder
7	South	\$ 4,200	\$ 2,400	\$ 5,260	\$ 4,800	\$ 16,660	Great Job

#### Sample IF OR Statements

Cell G3: =IF(OR(D4>6000,E4>4000),"Great Job","Work Harder")

### Concatenate Cells – Join Text Together

Joins several text strings into one text string.

#### Syntax of Concatenate statement

= CONCATENATE (text1,text2,...)

#### Sample CONCATENATE Statements

Cell D1: =CONCATENATE(A2," ",B2," ",C2)

D17				=CONCATENATE(A17," ",B17," ",C17)		
	A	B	C	D	E	F
16	First	Middle	Last	Full Name		
17	Sandy	Eileen	Rylander	Sandy Eileen Rylander		
18	Nicholas	Jacob	Fielding	Nicholas Jacob Fielding		
19	Alex	Hayden	Smith	Alex Hayden Smith		
20	Tori	Jane	Jacobs	Tori Jane Jacobs		

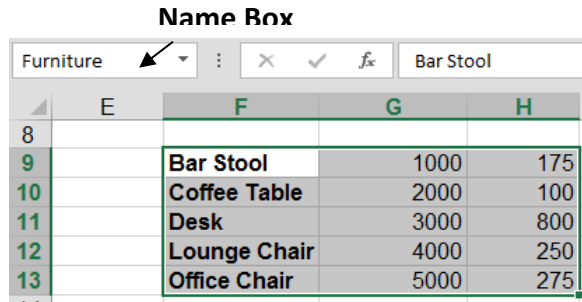
## Named Ranges

Worksheets often have labels at the top of each column and to the left of each row that describe the data within the worksheet. You can use these labels within formulas when you want to refer to the related data. You can also create descriptive names that are not labels on the worksheet to represent cells, ranges of cells, formulas, or constants.

### Create a Range Name Individually

7. Select the cell, range of cells, or nonadjacent selections that you want to name.

**Name Box**

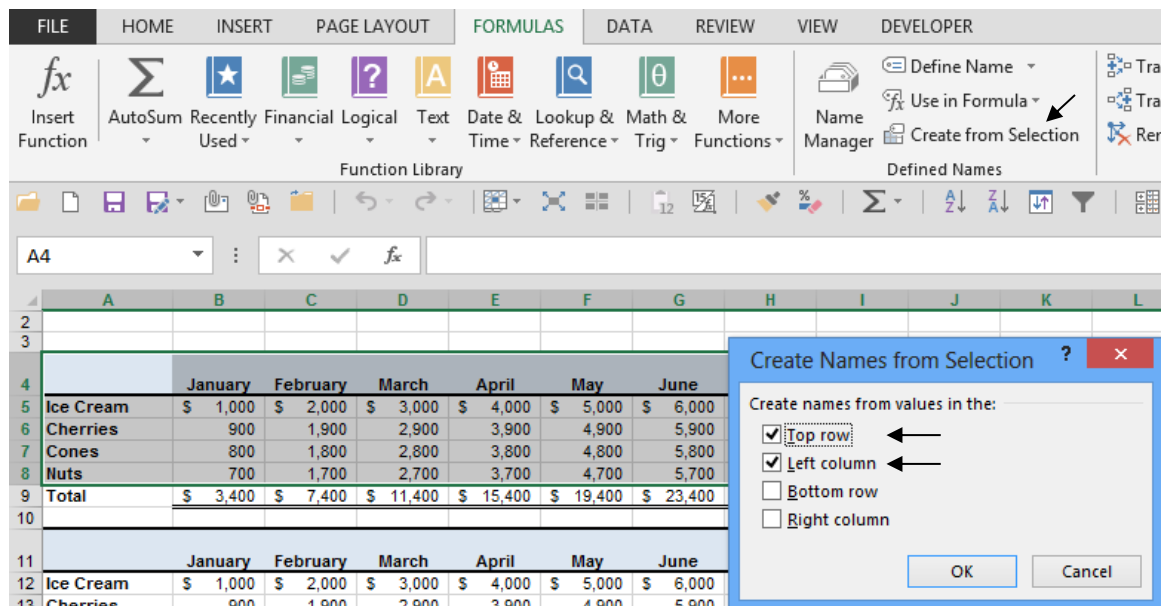


	E	F	G	H
8				
9		Bar Stool	1000	175
10		Coffee Table	2000	100
11		Desk	3000	800
12		Lounge Chair	4000	250
13		Office Chair	5000	275

8. Click in the **Name box** at the left end of the **formula bar**.
9. Type the desired range name (i.e. Furniture) and press **Enter**.

### Convert existing row and column labels to names.

10. Select the range that you want to name, including the row or column labels.
11. On the **Formulas** tab, in the **Defined Names** group, click **Create from Selection**.



The screenshot shows the Excel ribbon with the **FORMULAS** tab selected. In the **Defined Names** group, the **Create from Selection** button is highlighted. A dialog box titled "Create Names from Selection" is open, showing the following options:

- ☒ Top row
- ☒ Left column
- ☐ Bottom row
- ☐ Right column

The background shows a worksheet with a table of data. The table has columns for months (January to June) and rows for items (Ice Cream, Cherries, Cones, Nuts, Total). The first row of data (row 5) is highlighted.

12. In the **Create Names from Selection** dialog box, designate the location that contains the labels by selecting the **Top row**, **Left column**, **Bottom row**, or **Right column** check box.



**Tip!** A name created by using this procedure refers only to the cells that contain values and does not include the existing row and column labels.

**Tip!** If a column or row heading has a space in the name it will be replaced with an underline.

13. Click the drop down arrow on the Name box to see the names created.



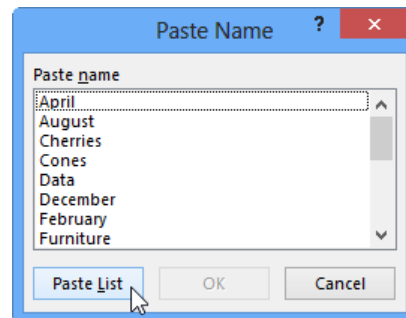
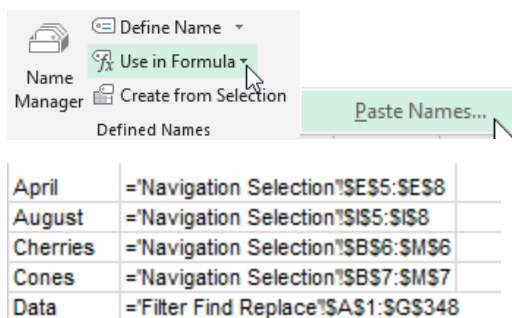
### Paste Names

14. Select an empty cell in a worksheet.

**IMPORTANT!** Leave room in several rows below selected cell to paste the list of range names.

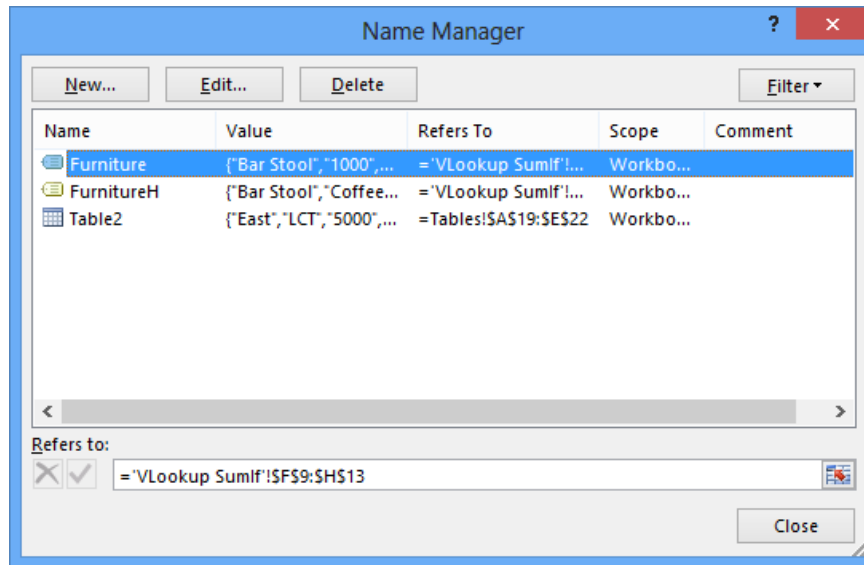
15. Select **Formulas, Use in Formula, Paste Names** and then click **Paste List**.

*A list of all names, and what they represent, appears.*



### Delete or Add or Modify Range Names

16. Select **Formulas, Name Manager** to Add or Delete or Modify Names.



## VLOOKUP

In Microsoft Excel, the **VLOOKUP function** searches for value in the left-most column of *table\_array* and returns the value in the same row based on the *index\_number*.

### Syntax of VLOOKUP

VLOOKUP( value, table\_array, index\_number, [not\_exact\_match] )

*value* is the value to search for in the first column of the *table\_array*.

*table\_array* is two or more columns of data that is sorted in ascending order.

*index\_number* is the column number in *table\_array* from which the matching value must be returned. The first column is 1.

*not\_exact\_match* is optional. It determines if you are looking for an exact match based on *value*. Enter FALSE to find an exact match. Enter TRUE to find an approximate match, which means that if an exact match is not found, then the VLOOKUP function will look for the next largest value that is less than *value*. If this parameter is omitted, the VLOOKUP function returns an approximate match.

**IMP!** If you enter FALSE for the *not\_exact\_match* parameter and no exact match is found, then the **VLOOKUP function** will return #N/A.

### Worksheet Function Example

#### Invoice Example on Left, Lookup Table Array on Right

A4		=VLOOKUP(B4,Furniture,2,FALSE)						
	A	B	C	D	E	F	G	H
3	Item #	Description	Price					
4	1000	Bar Stool	175	4000				
5	5000	Office Chair	275					
6	2000	Coffee Table	100					
7	3000	Desk	800			Bar Stool	1000	175
8	4000	Lounge Chair	250			Coffee Table	2000	100
9	5000	Office Chair	275			Desk	3000	800
10	2000	Coffee Table	100			Lounge Chair	4000	250
11			800			Office Chair	5000	275

## ISNA

The VLOOKUP function will return an **NA** if a value is not found. To capture that error and return the value you desire, use a combination of the If and an ISNA functions as shown below.

A4		fx		=IF(ISNA(VLOOKUP(B4,Furniture,2)), "", VLOOKUP(B4,Furniture,2))				
	A	B	C	D	E	F	G	H
1	Order							
2								
3	Item #	Description	Price					
4	1000	Bar Stool	175					
5	5000	Office Chair	275					
6	2000	Coffee Table	100					
7	3000	Desk	800					
8	4000	Lounge Chair	250					

## IFNA

This is a new function in Excel 2016 and works the same as the =If(ISNA) function above only it dramatically shortens the function! See the new function below.

C6		fx		=IFNA(VLOOKUP(B6,Furniture,3),"")				
	A	B	C	D	E	F	G	H
1	VLookup with ISNA							
2								
3	Order							
4								
5	Item #	Description	Price					
6	1000	Bar Stool	175					
7	5000	Office Chair	275					
8	2000	Coffee Table	100					
9	3000	Desk	800			Bar Stool	1000	175
10	4000	Lounge Chair	250			Coffee Table	2000	100
11	5000	Office Chair	275			Desk	3000	800
12	2000	Coffee Table	100			Lounge Chair	4000	250
13						Office Chair	5000	275

## SUMIF

In Microsoft Excel, the **SUMIF function** adds all numbers in a range of cells, based on a given criteria.

### Syntax of SUMIF

SUMIF( range, criteria, [sum\_range] )

*range* is the range of cells that you want to apply the *criteria* against.

*criteria* is used to determine which cells to add.

*sum\_range* is optional. It is the cells to sum. If this parameter is omitted, the **SUMIF function** uses *range* as the *sum\_range*.

### Worksheet Function Example

C11		fx		=SUMIF(A4:A10,D4,C4:C10)	
	A	B	C	D	E
1	Order				
2					
3	Item #	Description	Price		
4	1000	Bar Stool	175	5000	
5	5000	Office Chair	275		
6	2000	Coffee Table	100		
7	3000	Desk	800		
8	4000	Lounge Chair	250		
9	5000	Office Chair	275		
10	2000	Coffee Table	100		
11			550		

### Worksheet Function Example #2

Using a static number in the formula and greater than or equal to operators.

C11		fx		=SUMIF(A4:A10,">=4000",C4:C10)	
	A	B	C	D	E
1	Order				
2					
3	Item #	Description	Price		
4	1000	Bar Stool	175		
5	5000	Office Chair	275		
6	2000	Coffee Table	100		
7	3000	Desk	800		
8	4000	Lounge Chair	250		
9	5000	Office Chair	275		
10	2000	Coffee Table	100		
11			800		

**Worksheet Function Example #3**

Using a cell address in the formula and greater than or equal to operators.

C11		fx		=SUMIF(A4:A10,">=" & D4,C4:C10)		
	A	B	C	D	E	F
1	Order					
2						
3	<b>Item #</b>	<b>Description</b>	<b>Price</b>			
4	1000	Bar Stool	175	4000		
5	5000	Office Chair	275			
6	2000	Coffee Table	100			
7	3000	Desk	800			
8	4000	Lounge Chair	250			
9	5000	Office Chair	275			
10	2000	Coffee Table	100			
11			800			

Source: <https://www.lsntap.org/sites/lsntap.org/files/Excel%202016%20Formulas%20Functions%20Training.pdf>