

Formulas and Functions

Formulas

What is a formula? It is the performance of one or more of the basic mathematical operations to create a single answer.

Operators:

Addition (plus sign) +

Subtraction (minus sign/dash) -

Multiplication (asterisk) *

Division (common slash) /

Exponents (caret) ^

Examples:

$$3+2 = 5$$

$$3-2 = 1$$

$$3*2 = 6$$

$$3/2 = 1.5$$

$$3^2 = 9$$

When typing a formula into Excel, always begin with an equal (=) sign. This indicates to Excel that your intention is to create a formula, and not type numbers and symbols as plain text.

Cell References:

When doing math in Excel, it is considered a best practice to NOT type the value directly into the formula. Instead, refer to the cell in which the number resides.

1. It makes the number you are working with clear and obvious
2. Changes to the value become automatically updated in cells referring to said cell

	A	B	C	D	E	F
1		North	South	East	West	
2	Part A	12	5	7	20	
3	Part B	8	18	12	6	
4	Part C	10	12	20	15	
5						
6						
7						

In this example, to calculate the total number of parts sold for Part A, our formula would not be $=12+5+7+20$, instead it would be $=B2+C2+D2+E2$ (which equals 44)

Multiple Operations:

Sometimes, it is necessary to perform multiple operations within a worksheet. Using our sample worksheet, what if we wanted to multiply the result of adding all of those cells by a cost value?

	A	B	C	D	E	F
1		North	South	East	West	
2	Part A	12	5	7	20	
3	Part B	8	18	12	6	
4	Part C	10	12	20	15	
5						
6		Cost				
7	Part A	0.32				
8	Part B	1.25				
9	Part C	0.82				
10						
11						

Well, we would still want to create the formula $=B2+C2+D2+E2$ to get the sum, and we would want to multiply that result by 0.32 (cell B7). So is our formula $=B2+C2+D2+E2*B7$? That answer comes out to 30.4. However, if we think about the math here, that can't possibly be correct. We know the sum of the 4 numbers is 44. .32 is less than one-half. In fact, it's not a lot larger than one-tenth. The result of 30.4 is between 11 and 22, with the correct response being closer to 14.

Note that the formula appears here, in the formula bar. The 4 numbers is somewhere

	A	B	C	D	E	F	G	H	I
1		North	South	East	West				
2	Part A	12	5	7	20	44	14.08	30.4	
3	Part B	8	18	12	6				
4	Part C	10	12	20	15				
5									
6		Cost							
7	Part A	0.32							
8	Part B	1.25							
9	Part C	0.82							
10									
11									
12									

What happened?

Excel followed a mathematical principle known as the Order of Operations. When conducting multiple operations within a single formula, it's important to have a consistent set of rules regarding the order in which we do things. There is a mnemonic device for remembering the order of operations:

Please

Excuse

My

Dear

Aunt

Sally

With each word beginning with the same letter as the operation being referred to.

Please - Parentheses

Excuse - Exponents

My - Multiplication

Dear - Division

Aunt - Addition

Sally - Subtraction

So this formula:

$B2+C2+D2+E2*B7$ resulted in Excel multiplying E2 and B7 THEN adding that result to the remaining cells.

To force Excel to do the addition first, we add parentheses to the equation.

$(B2+C2+D2+E2)*B7$

It now does the addition first, and multiplies the sum of all those cells to the value in B7.

		G2						=(B2+C2+D2+E2)*B7	
	A	B	C	D	E	F	G	H	
1		North	South	East	West				
2	Part A	12	5	7	20	44	14.08	30.4	
3	Part B	8	18	12	6				
4	Part C	10	12	20	15				
5									
6		Cost							
7	Part A	0.32							
8	Part B	1.25							
9	Part C	0.82							
10									
11									

Relative vs Absolute References

When you type a cell reference into an Excel worksheet, the software uses a different method for determining which cells to use. While we as humans prefer to have static locations we can point to, Excel actually determines which cells to use based upon the relationship of the cell with the formula has with the source cells.

		F2						=B2+C2+D2+E2	
	A	B	C	D	E	F	G	H	
1		North	South	East	West				
2	Part A	12	5	7	20	44	14.08	30.4	
3	Part B	8	18	12	6				
4	Part C	10	12	20	15				
5									
6		Cost							
7	Part A	0.32							
8	Part B	1.25							
9	Part C	0.82							
10									
11	Anticipated Cost Increase								
12	10%								
13									
14									

So, in the sample above cell F2 is actually adding up the the 4 cells to its immediate left. What does this mean? Well, it means that we can copy and paste the formula to the cell directly beneath is (F3) and get the proper answer for that row.

This method of referring to a cell is known as relative referencing, and it is generally the way in which you want Excel to function.

Let's say that using the above sample, you wanted to create in Column C, rows 7-9, the projected cost increase for each part. Cell A12 has the value you want to use. Let's step through solving this:

1. The increase amount is the original value * the anticipated cost increase percentage
2. The new value is the original value PLUS the increase amount

Our formula, therefore, would be $=B7*A12+B7$ (or $B7+B7*A12$). The order of operations is in our favor here, and we don't need to add parentheses to ensure that the multiplication happens first.

	A	B	C	D	E	F	G	H
1		North	South	East	West			
2	Part A	12	5	7	20	44	14.08	30.4
3	Part B	8	18	12	6	44		
4	Part C	10	12	20	15	57		
5								
6		Cost						
7	Part A	0.32	0.352					
8	Part B	1.25						
9	Part C	0.82						
10								
11	Anticipated Cost Increase							
12	10%							
13								

However, if we copy and paste the formula to C8, we do not get the correct answer. Clicking on C8 and looking at the formula in the formula bar gives us our answer.

	A	B	C	D	E	F	G	H
1		North	South	East	West			
2	Part A	12	5	7	20	44	14.08	30.4
3	Part B	8	18	12	6	44		
4	Part C	10	12	20	15	57		
5								
6		Cost						
7	Part A	0.32	0.352					
8	Part B	1.25	1.25					
9	Part C	0.82	0.82					
10								
11	Anticipated Cost Increase							
12	10%							
13								

Due to relative referencing, when copying the formula one row down ALL cell references moved down one row. Since cells A13 and A14 are empty, the product of the original cost and the anticipated cost increase is zero. Add that to the original value, and it doesn't change.

So how does one make this work? We shift from relative referencing to absolute referencing.

Fill Tool

On our sample worksheet, we can see the need for repeating that formula for each row. What are our options?

1. We could completely rebuild the formula for each row. This would certainly work, but it would be time-consuming and could result in errors if there are many rows of data.
2. We could copy and paste the formula to each row. That's probably fine for smaller worksheets like the samples in this module, but it can become daunting on a large worksheet with hundreds or thousands of rows of data.
3. We can use the fill tool.

What is the fill tool?



By selecting a cell with the formula you wish to copy, then putting your mouse pointer over the fill tool, your mouse pointer changes to a black plus mark (thinner than the one below). You can then click your left mouse button, hold it down, and drag it down the column to copy the formula. On longer columns, you can choose to double-click the fill tool instead.

	A	B	C	D	E	F	G	H	I
1		North	South	East	West				
2	Part A	12	5	7	20	44	14.08	30.4	
3	Part B	8	18	12	6	44			
4	Part C	10	12	20	15	57			
5									
6		Cost							
7	Part A	0.32	0.352						
8	Part B	1.25	1.375						
9	Part C	0.82	0.902						
10									
11	Anticipated Cost Increase								
12	10%								

The fill tool isn't just for formulas. It can be used to fill in dates, days of the week, months of the year, and custom sequences of your making as well.

Functions

Excel extends the use of mathematical operators by using functions. Functions are specialized collections of operations that perform a specific task. Examples range from calculating a sum of a group of cells to calculating the amortization values for a loan.

Functions are structured in a very specific manner. It is important to have all parts in place for a function, or it may return an incorrect value, or simply not work at all.

Functions also begin with an equal (=) sign, followed by the name of the function, then the argument (the values needed for the function to perform its calculations) contained in parentheses.

When you begin to type a function, Excel returns a list of functions that match what you've typed. You can either choose to continue typing the function, or double click on the proper item from the list.

LARGE : *fx* =average

	A	B	C	D	E
1		North	South	East	West
2	Part A	12	5	7	20
3	Part B	8	18	12	6
4	Part C	10	12	20	15
5	Total				
6	Average	=average			
7		<i>fx</i> AVERAGE	Returns the average (arithmetic mea		
8		<i>fx</i> AVERAGEA			
9		<i>fx</i> AVERAGEIF			
10		<i>fx</i> AVERAGEIFS	Cost		
11	Part A	0.32	0.352		

After you either manually input the opening parenthesis or double-click on the function from the list, Excel will give you some guidance regarding the arguments required. Typically, the individual components of an argument are separated by commas. The item in bold is the active argument.

LARGE : *fx* =average(

	A	B	C	D	E	F	G
1		North	South	East	West	Total	Inventory Cost
2	Part A	12	5	7	20	44	14.08
3	Part B	8	18	12	6	44	55
4	Part C	10	12	20	15	57	46.74
5	Total						
6	Average	=average(
7		AVERAGE(number1, [number2], ...)					
8							

B6 : *fx* =AVERAGE(B2,B3,B4)

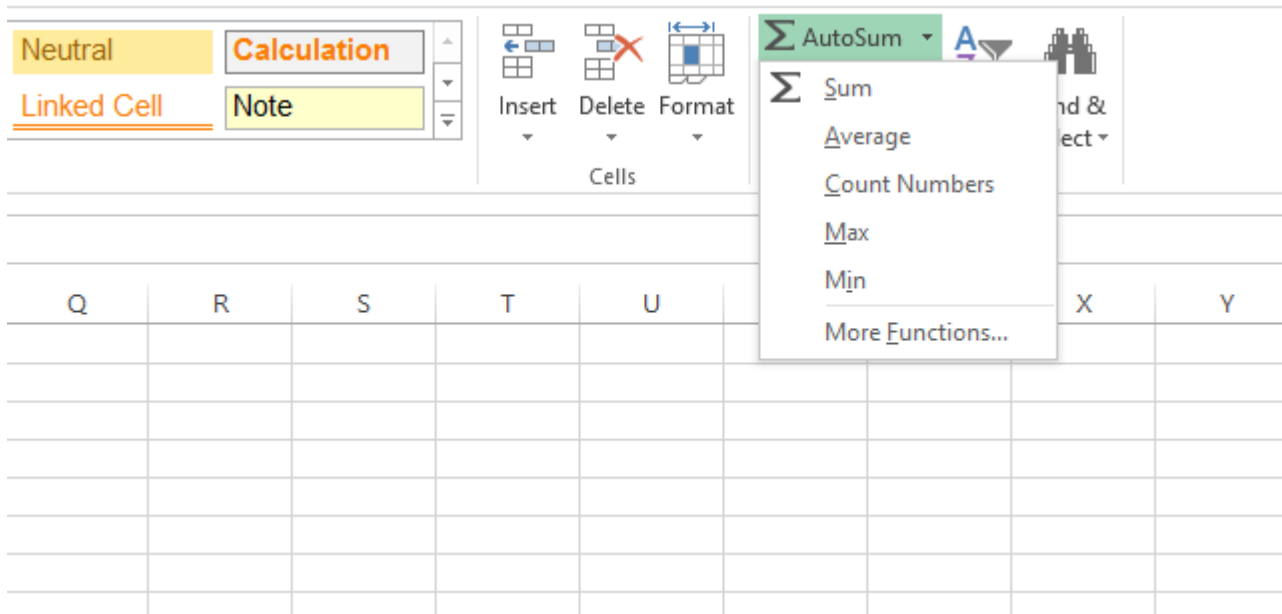
	A	B	C	D	E	F
1		North	South	East	West	Total
2	Part A	12	5	7	20	44
3	Part B	8	18	12	6	44
4	Part C	10	12	20	15	57
5	Total					
6	Average	10				
7						

When calculating a value based on cells that are next to one another, you can choose to select the group of cells instead of entering them individually. This selection of cells is known as a range. Ranges are indicated this way:

Top Leftmost cell referenced : Bottom Rightmost cell referenced.

	A	B	C	D	E
1		North	South	East	West
2	Part A	12	5	7	20
3	Part B	8	18	12	6
4	Part C	10	12	20	15
5	Total				
6	Average	10	11.66667		
7					
8					

Another way of inserting a function is by using the AutoSum button. Using the drop menu next to the Auto Sum button, you can insert several of the most commonly used functions.



Clicking on a function results in Excel inserting the function into the active cell, and selecting what its best guess is for the range you wish to use in the function. It typically does a good job, but if it doesn't select properly, just select the cells you wish to use instead of the ones it has highlighted.

