Creating Complex Formulas

Excel is a spreadsheet application that can help you calculate and analyze numerical information for household budgets, company finances, inventory, and more. To do this, you need to understand **complex formulas**.

In this lesson, you will learn how to write complex formulas in Excel following the order of operations. You will also learn about **relative and absolute cell references** and how to **copy and fill formulas** containing cell references.

Complex Formulas

Simple formulas have one mathematical operation, such as 5**+**5. **Complex formulas** have *more than one* mathematical operation, such as 5**+**5-2. When there is more than one operation in a formula, the **order of operations** tells us which operation to calculate first. In order to use Excel to calculate complex formulas, you will need to understand the order of operations.

>>> Watch the video to learn about the order of operations in complex formulas.

Watch the video (4:56). Need help?
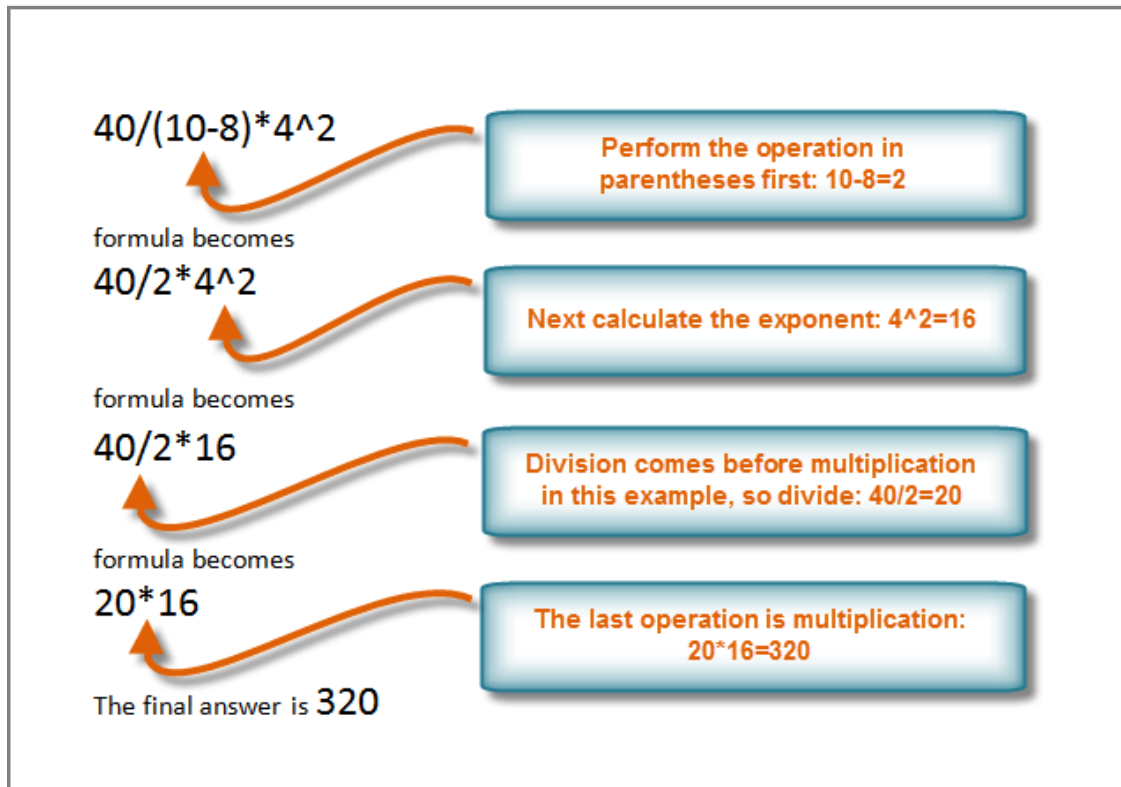
Order of Operations

Excel calculates formulas based on the following **order of operations**:

1. Operations enclosed in **parentheses**
2. **Exponential** calculations (to the power of)
3. **Multiplication** and **division**, whichever comes first
4. **Addition** and **subtraction**, whichever comes first

A mnemonic that can help you remember the order is **P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally.

Example 1

The following example demonstrates how to use the order of operations to calculate a formula:

$40/(10-8)*4^2$
Perform the operation in parentheses first: 10-8=2

formula becomes

$40/2*4^2$
Next calculate the exponent: 4^2=16

formula becomes

$40/2*16$
Division comes before multiplication in this example, so divide: 40/2=20

formula becomes

$20*16$
The last operation is multiplication: 20*16=320

The final answer is 320

Order of Operations example

Example 2

In this example, we will review how Excel will calculate a complex formula using the order of operations. The selected cell will display the percent of total Pete Lily seeds sold that were white.

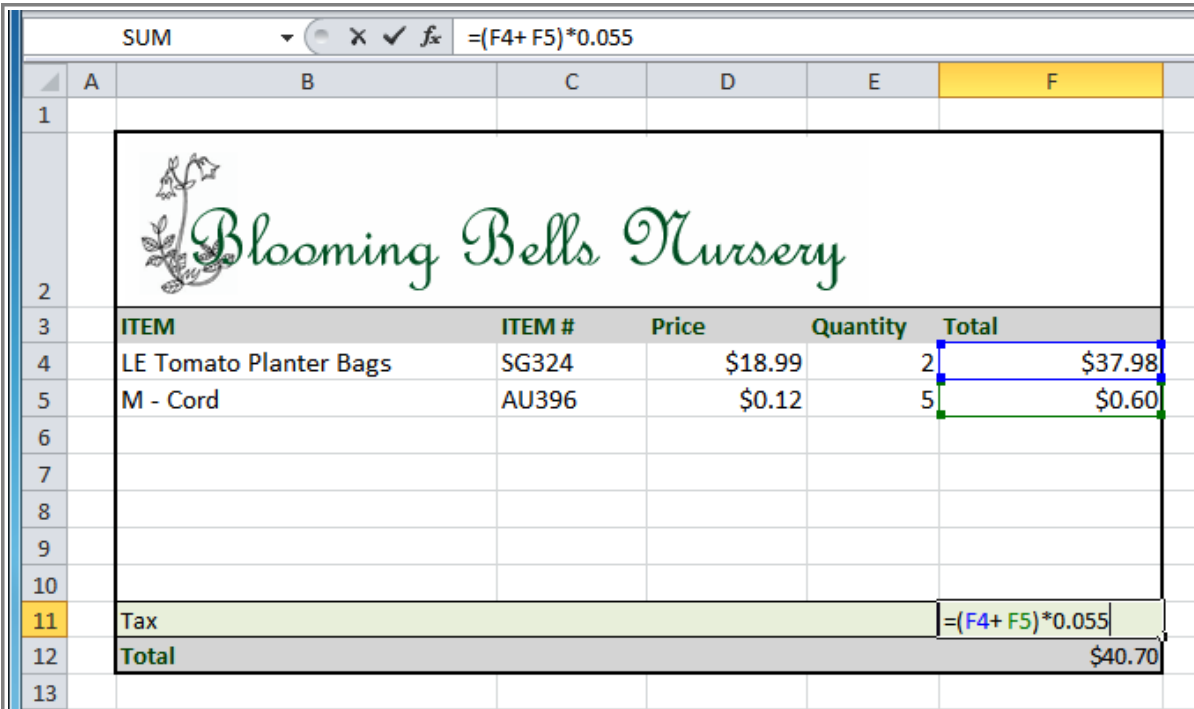| Seed Inventory	Packets Sold	Price	Percent of Total Sold
Pete Lily - Blue	14	$1.99	42.42
Pete Lily - White	19	$1.99	=(19*1.99)/(33*1.99)*100
Total Pete Lily	33	$1.99	

Order of Operations Excel example

1. First, Excel will calculate the amount sold in parentheses: **(19*1.99)=37.81** White Lily seeds and **(33*1.99) =65.67** Total Lily seeds.

2. Second, it will divide the White Lily seeds amount by the Total Lily seeds amount: **37.81/65.67=.5758**.

3. Last, it will multiply the result by 100 to obtain the value as a percent: **.5758*100=57.58**.

Based on this complex formula, the result will show that **57.58%** of the total Pete Lily seeds sold were white. You can see from this example, that it is important to enter complex formulas with the correct order of operations. Otherwise, Excel will not calculate the results accurately.

To Create a Complex Formula Using the Order of Operations:

In this example, we will use **cell references** in addition to actual values, to create a complex formula that will add tax to the nursery order.

1. Click the cell where you want the formula result to appear (for example, F11).
2. Type the **equal sign (=)**.
3. Type an **open parenthesis**, then click on the cell that contains the first **value** you want in the formula (for example, F4).
4. Type the first **mathematical operator** (for example, the addition sign).
5. Click on the cell that contains the second **value** you want in the formula (for example, F5), and then type a **closed parenthesis**.
6. Type the next **mathematical operator** (for example, the multiplication sign).
7. Type the next **value** in the formula (for example, 0.055 for 5.5% tax).

SUM					=(F4+ F5)*0.055
A	B	C	D	E	F
1					
2	Blooming Bells Nursery				
3	ITEM	ITEM #	Price	Quantity	Total
4	LE Tomato Planter Bags	SG324	$18.99	2	$37.98
5	M - Cord	AU396	$0.12	5	$0.60
6					
7					
8					
9					
10					
11	Tax				=(F4+ F5)*0.055
12	Total				$40.70
13					

Row 4, Column D

8. Click **Enter** to calculate your formula. The results show that $2.12 is the tax for the nursery order.
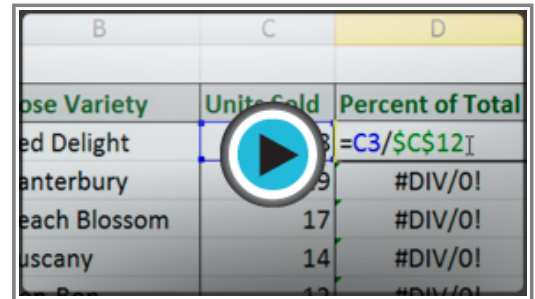
$2.12

Result in F11

Working with Cell References

In order to maintain accurate formulas, it is necessary to understand how cell references respond when you copy or fill them to new cells in the worksheet.

Excel will interpret cell references as either **relative** or **absolute**. By default, cell references are **relative references**. When copied or filled, they change based on the relative position of rows and columns. If you copy a formula (=A1+B1) into row 2, the formula will change to become (=A2+B2).

Absolute references, on the other hand, do not change when they are copied or filled and are used when you want the values to stay the same.

Watch the video (4:38). Need help?

>>> Watch the video to learn how to copy and fill relative and absolute references.
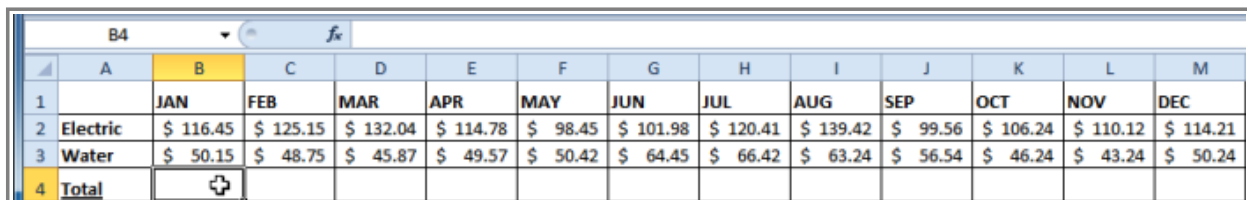
Relative References

Relative references can save you time when you are repeating the same kind of calculation across multiple rows or columns.

In the following example, we are creating a formula with cell references in row 4 to calculate the total cost of the electric bill and water bill for each month (B4=B2+B3). For the upcoming months we want to use the same formula with relative references (C2+C3, D2+D3, E2+E3, etc.) For convenience, we can copy the formula in B4 into the rest of row 4 and Excel will calculate the value of the bills for those months using relative references.

To Create and Copy a Formula Using Relative References:

1. Select the first cell where you want to enter the formula (for example, B4).

	A	B	C	D	E	F	G	H	I	J	K	L	M
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1													
2	Electric	$ 116.45	$ 125.15	$ 132.04	$ 114.78	$ 98.45	$ 101.98	$ 120.41	$ 139.42	$ 99.56	$ 106.24	$ 110.12	$ 114.21
3	Water	$ 50.15	$ 48.75	$ 45.87	$ 49.57	$ 50.42	$ 64.45	$ 66.42	$ 63.24	$ 56.54	$ 46.24	$ 43.24	$ 50.24
4	Total												

Selecting cell B4

1. Enter the formula to calculate the value you want (for example, add B2+B3).

Entering formula into B4

1. Press **Enter**. The formula will be calculated.

Result in B4

1. Select the cell you want to copy (for example, B4) and click on the **Copy** command from the **Home** tab.
2. Select the cells where you want to paste the formula and click on the **Paste** command from the **Home** tab. (You may also drag the fill handle to fill cells.)

Values calculated in C4:M4

1. Your formula is copied to the selected cells as a relative reference (C4=C2+C3, D4=D2+D3, E4=E2+E3, etc.) and the values are calculated.

Absolute References

There may be times when you do not want a cell reference to change when copying or filling cells. You can use an **absolute reference** to keep a row and/or column constant in the formula.
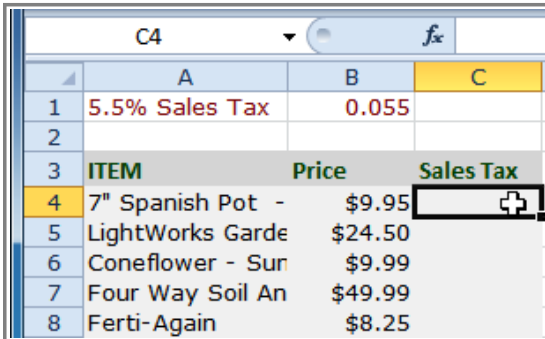
An absolute reference is designated in the formula by the addition of a **dollar sign ($)**. It can precede the column reference, the row reference, or both.

A2:	The column and the row do not change when copied.
A$2:	The row does not change when copied.
$A2:	The column does not change when copied.

In the below example, we want to calculate the sales tax for a list of products with varying prices. We will use an absolute reference for the sales tax (B1) because we do not want it to change as we are copying the formula down the column of varying prices.
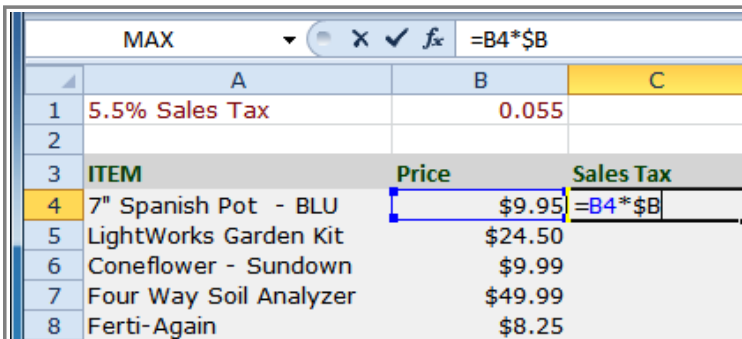
To Create and Copy a Formula Using an Absolute Reference:

1. Select the first cell where you want to enter the formula (for example, C4)

Selecting cell C4

2. Click on the cell that contains the first **value** you want in the formula (for example, B4).

3. Type the first **mathematical operator** (for example, the multiplication sign).

4. Type the **dollar sign ($)** and enter the **column letter** of the cell you are making an absolute reference to (for example, B).

Entering formula

5. Type the **dollar sign ($)** and enter the **row number** of the same cell you are making an absolute reference to (for example, 1).

Entering formula

6. Press **Enter** to calculate the formula.

Result in C4

7. Select the cell you want to copy (for example, C4) and click on the **Copy** command from the **Home** tab.

8. Select the cells where you want to paste the formula and click on the **Paste** command from the **Home** tab. (You may also drag the fill handle to fill cells.)

Values calculated in C5:C8

9. Your formula is copied to the selected cells using the absolute reference (C5=B5*B1, C6=B6*B1, etc.) and your values are calculated.

Challenge!

1. Open an existing Excel 2010 workbook. If you want, you can use this example.

2. Create a complex formula that uses the addition and subtraction operations.
3. Create a complex formula that uses the multiplication and division operations.
4. Create a formula that uses an absolute reference. If you are using the example, calculate the sales tax in E4:E20. Use cell C23 as your absolute reference to the price of sales tax.
5. Create a formula that uses a relative reference. If you are using the example, create a formula that adds the price of each item (in column D) and the sales tax for each item (in column E), and then multiplies the result by the quantity of each item (in column F). Enter your results in the totals column (column G).