

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'll learn how to write complex formulas in Excel following the order of operations. You will also learn about **relative** and **absolute cell references**, as well as 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. To use Excel to calculate complex formulas, you'll need to understand the order of operations.

You can download Excel2010_ComplexForm_Practice file from moodle for extra practice.

The order of operations

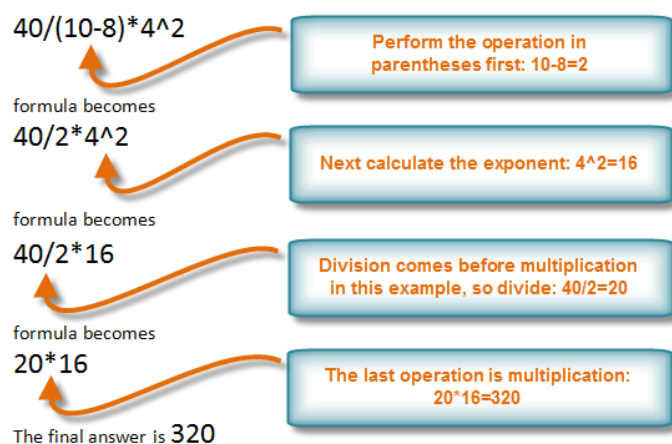
Excel calculates formulas based on the following **order of operations**:

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 **Please Excuse My Dear Aunt Sally**.

Example 1

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



Example 2

In this example, we'll 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	


1. First, Excel will calculate the amount sold in parentheses: **$(19*1.99)=37.81$** White Pete Lily seeds and **$(33*1.99)=65.67$** Total Pete Lily seeds.
2. Second, it will divide the White Pete Lily seeds amount by the Total Pete 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'll 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 (**F11**, for example).
2. Type the **equals sign (=)**.
3. Type an **open parenthesis**, then click the cell that contains the first **value** you want in the formula (**F4**, for example).
4. Type the first **mathematical operator** (the addition sign, for example).
5. Click the cell that contains the second **value** you want in the formula (**F5**, for example), then type a **closed parenthesis**.
6. Type the next **mathematical operator** (the multiplication sign, for example).
7. Type the next **value** in the formula (**0.055** for **5.5% tax**, for example).

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						

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

\$2.12

Excel **will not always tell you** if your formula contains an error, so it's up to you to check all of your formulas.

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.

Relative references

Relative references can save you time when you're repeating the same type of calculation across multiple rows or columns.

In the following example, we're 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 these 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 (**B4**, for example).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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												

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

	A	B	C
1		JAN	FEB
2	Electric	\$ 116.45	\$ 125.15
3	Water	\$ 50.15	\$ 48.75
4	Total	=B2+B3	

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

\$ 166.60

4. Select the cell you want to copy (**B4**, for example), then click the **Copy** command from the **Home** tab.
5. Select the cells where you want to paste the formula, then click the **Paste** command from the **Home** tab. You can also drag the fill handle to fill cells.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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	\$ 166.60	\$ 173.90	\$ 177.91	\$ 164.35	\$ 148.87	\$ 166.43	\$ 186.83	\$ 202.66	\$ 156.10	\$ 152.48	\$ 153.36	\$ 164.45

6. 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.

\$A\$2:	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'll use an absolute reference for the sales tax (\$B\$1) 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 (**C4**, for example).

	A	B	C
1	5.5% Sales Tax	0.055	
2			
3	ITEM	Price	Sales Tax
4	7" Spanish Pot -	\$9.95	
5	LightWorks Garde	\$24.50	
6	Coneflower - Sur	\$9.99	
7	Four Way Soil An	\$49.99	
8	Ferti-Again	\$8.25	

2. Type an equals sign, and then click the cell that contains the first **value** you want in the formula (**B4**, for example).
3. Type the first **mathematical operator** (the multiplication sign, for example).
4. Type the **dollar sign (\$)**, then enter the **column letter** of the cell you are making an absolute reference to (**B**, for example).

	A	B	C
1	5.5% Sales Tax	0.055	
2			
3	ITEM	Price	Sales Tax
4	7" Spanish Pot - BLU	\$9.95	=B4*\$B
5	LightWorks Garden Kit	\$24.50	
6	Coneflower - Sundown	\$9.99	
7	Four Way Soil Analyzer	\$49.99	
8	Ferti-Again	\$8.25	

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

MAX			=B4*\$B\$1
	A	B	C
1	5.5% Sales Tax	0.055	
2			
3	ITEM	Price	Sales Tax
4	7" Spanish Pot - BLU	\$9.95	=B4*\$B\$1
5	LightWorks Garden Kit	\$24.50	
6	Coneflower - Sundown	\$9.99	
7	Four Way Soil Analyzer	\$49.99	
8	Ferti-Again	\$8.25	

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

\$0.55

- Select the cell you want to copy (**C4**, for example), then click the **Copy** command from the **Home** tab.
- Select the cells where you want to paste the formula, then click the **Paste** command from the **Home** tab. You can also drag the fill handle to fill cells.

C5			=B5*\$B\$1
	A	B	C
1	5.5% Sales Tax	0.055	
2			
3	ITEM	Price	Sales Tax
4	7" Spanish Pot - BLU	\$9.95	\$0.55
5	LightWorks Garden Kit	\$24.50	\$1.35
6	Coneflower - Sundown	\$9.99	\$0.55
7	Four Way Soil Analyzer	\$49.99	\$2.75
8	Ferti-Again	\$8.25	\$0.45

- Your formula is copied to the selected cells using the absolute reference (C5=B5*\$B\$1, C6=B6*\$B\$1, etc.), and your values are calculated.

When writing a formula, you can press the **F4** key on your keyboard to switch between relative and absolute cell references. This is an easy way to quickly insert an absolute reference.

Challenge!

- Open an **existing Excel 2010 workbook**. If you want, you can use Excel2010_ComplexForm_Practice file from moodle.
- 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.
- 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, then multiplies the result by the quantity of each item in column F. Enter your results in the totals column (column G). **Hint:** You'll need to think about the order of operations for this to work correctly.