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Introduction to Formulas:

Just like a calculator, Excel has the ability to calculate numerical information using formulas. Excel can add, subtract, multiply, and divide. In this lesson, we'll show you how to use cell references to create simple formulas.

Note: All formulas start with the '=' equal sign. This is because the cell contains, or is equal to, the formula and the value it calculates.

Addition	+	**=10+5**
Substraction	-	**=10-5**
Multiplication	*	**=10*5**
Division	/	**=10/5**

Understanding Cell Reference:

As shown in the table above, you can simply create formulas manually by typing in fixed numbers to get calculation. However, most of the time, you will use cell addresses to create a formula. This is known as making a **cell reference**. **Cell reference** identify individual cells, rows, and/or columns in a worksheet. They tell Excel where to look for values to use in a formula. Using cell references will ensure that your formulas are always accurate because you can change the value of **referenced cells** without having to rewrite the formula.

To practice, open up a new workbook. Enter 10 in Cell A1 and 5 in Cell A2. Instead of typing in =10+5 to get the result in Cell A3, you can use Cell addresses to get the same result. See the formula entered into Cell A3 (Figure 1) displays the answer to the equation =A1+A2 in Figure 2. If any value in those referenced cells (A1 or A2) changes – such as changing the value in Cell A1 to 20, the result cell A3 will automatically recalculates for you as shown in Figure 3.
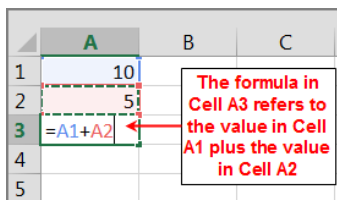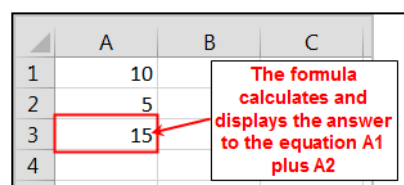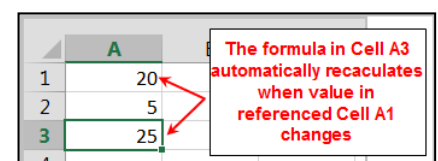

Figure 1

Figure 2

Figure 3

By combining a mathematical operator with cell references, you can create a variety of simple formulas in Excel. Formulas can also include a combination of cell references and numbers, as in the examples below:

=F2-1	Subtract 1 from Cell F2
=G2/F2	Divide Cell G2 by Cell F2
=F2*1.5	Multiply Cell F2 by 1.5

Other Examples on Cell References:

Cell references	Refer to values in
A10	the cell in column A and row 10
A10,A20	cell A10 and cell A20
A10:A20	the range of cells in column A and rows 10 through 20
B15:E15	the range of cells in row 15 and columns B through E
A10:E20	the range of cells in columns A through E and rows 10 through 20

To Create a Formula Using the Point-and-Click Method:

Rather than typing cell addresses manually, you can **point and click** on the cells you wish to include in your formula. This method can save a lot of time and effort when creating formulas.

Exercise: Use *FormulaSample* worksheet from *ExcelPart4.xlsx* workbook to follow the steps below. We are going to calculate the *Total Cost* for each line item by multiplying the *Units* and *Unit Cost*.

- Select Cell G2.
- Type in the equal sign "=".
- Click on Cell E2; the cell address will appear in the formula, and a dashed blue line will appear around the referenced cell.
- Type the mathematical operator you wish to use. In our example, we'll type the **multiplication sign** (*).
- Then click on Cell F2; the cell address will appear in the formula, and a dashed red line will appear around the referenced cell.

- Press Enter on your keyboard. The formula will be calculated, and the value will be displayed in the cell.

G3	⋮ ✕ ✓ *fx*

	A	B	C	D	E	F	G
1	**OrderDate**	**Region**	**Rep**	**Item**	**Units**	**Unit Cost**	**Total Cost**
2	1/6/13	East	Jones	Pencil	95	1.99	189.05
3	1/23/13	Central	Kivell	Binder	50	19.99	
4	2/9/13	Central	Jardine	Pencil	36	4.99	

Total Cost
189.05

Formulas can also be copied to adjacent cells with the fill handle [   ], which can save a lot of time and effort if you need to perform the same calculation multiple times in a worksheet. To utilize this useful feature, follow these steps.

- Click on Cell G2 where we entered our formula first.
- Click; hold and drag the **Fill Handle** to copy the functions to adjacent cells.

G2	⋮ ✕ ✓ *fx*	=E2*F2

	A	B	C	D	E	F	G
1	**OrderDate**	**Region**	**Rep**	**Item**	**Units**	**Unit Cost**	**Total Cost**
2	1/6/13	East	Jones	Pencil	95	1.99	189.05
3	1/23/13	Central	Kivell	Binder	50	19.99	999.50
4	2/9/13	Central	Jardine	Pencil	36	4.99	179.64
5	2/26/13	Central	Gill	Pen	27	19.99	
6	3/15/13	West	Sorvino	Pencil	56	0.00	

To Edit a Formula:

When you need to edit an existing formula, you can do so in a number of ways. Let's assume we are going to edit our formula in Cell G2 to include the markup of 10%. That would require to multiply the original formula =E2*G2 with 1.1 as =E2*G2*1.1. To do this, follow these steps.

- Double-click on Cell G2 where we entered our original formula. The cursor should be blinking at the end of the existing formula. (If not, move your cursor to the end of the existing formula.)
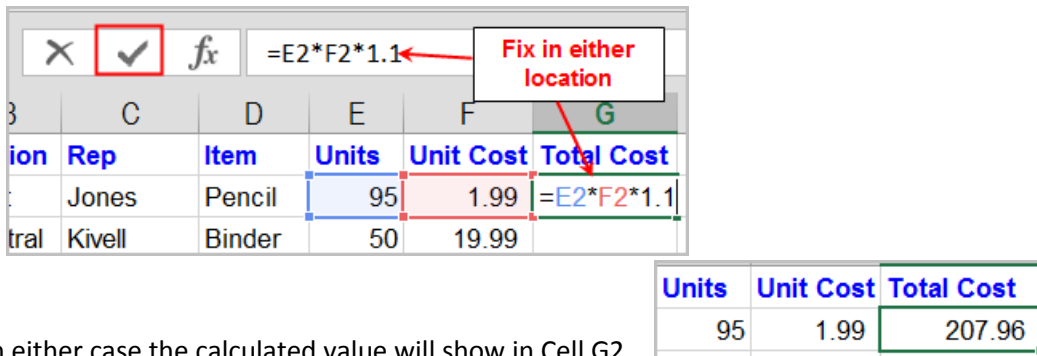
E	F	G
Units	**Unit Cost**	**Total Cost**
95	1.99	=E2*F2

Units	**Unit Cost**	**Total Cost**
95	1.99	=E2*F2*1.1

- Then type in the multiplication symbol "*" and "1.1" as shown.

OR

- You can also click directly in the formula bar area to fix the formula. When finished, hit **Enter** key on your keyboard or select the **Enter** command ☑ in the formula bar.

- In either case the calculated value will show in Cell G2.

  Use the Fill Handle feature to copy the new formula to the rows below. Keep this book opened.

  Note: To learn more about "order of operations" to use in complex formulas, please see *Appendix*.

Relative and Absolute Cell References:

There are two types of cell references: **relative** and **absolute**. Relative and absolute references behave differently when copied and filled to other cells. Relative references **change** when a formula is copied to another cell. Absolute references, on the other hand, remain **constant**, no matter where they are copied.

Relative Cell References: *By default*, all cell references are **relative references**. When copied across multiple cells, they change based on the *relative position of rows and columns*. For example, if you copy the formula =**A1+B1** from row 1 to row 2, the formula will become =**A2+B2**. Relative references are especially convenient whenever you need to repeat the same calculation across multiple rows or columns. Let's verify this by looking at our example *Formulasample.xlsx* we just practiced on page 10 above.

- The formula in Cell G2 is the product of Cell E2 and Cell F2. =E2*F2

- When we copied this formula to the lower Cell G3 by using the **Fill Handle**, the cell reference changed based on the *relative position of the row* – in this case, Row 3. So, the copied formula becomes =E3*F3

- If you check the remaining cell formulas in Cell G4 through G44, the cell references in these cells change to the *relative* position of their *row numbers*.

Absolute Cell Reference:

There may be times when you do not want a cell reference to change when filling cells. Unlike **relative references**, **absolute references** do not change when copied or filled. When you want to keep a row and/or column *constant,* use an **absolute reference**.

An absolute reference is designated in a formula by the addition of a dollar sign ($). It can precede the column reference, the row reference, or both. See the examples, below.

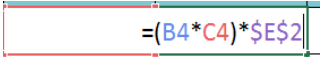| A2	the column and the row do not change when copied
$A2	The colum does not change when copied
A$2	The row does not change when copied

← Use generally more than other two formats.

When writing a formula, select the cell you want to change and 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. Let's do the exercise below.

Exercise: Open the *MenuOrder* worksheet in the same workbook. In this example, 8.0% sales tax rate in Cell E2 to calculate the sales tax for all items in column D. That requires us to use the **absolute cell reference E2** in our formula. Since each formula is using the same tax rate, we want that reference to remain constant when the formula is copied and filled to other cells in column D. Follow the steps below.

- Select the cell that will contain the formula. In our example, we'll select cell **D4**.
- Enter the formula to calculate the desired value. In our example, we'll type **=(B4*C4)* E2**

- After entering cell address E2, hit function key **F4** on your keyboard. The relative cell reference **E2** will change to an absolute cell reference as **E2**. =(B4*C4)*E2
- Press **Enter** on your keyboard. The formula will calculate, and the result will display in the cell.
- Locate the fill handle in the lower-right corner of the desired cell **D4**.

- Click, hold, and drag the fill handle over the cells you wish to fill: cells **D4:D14**.

D4			f_x	=(B4*C4)*E2		
	A	B	C	D		
1				Menu Order		
2			Sales Tax			Copy the formula using the fill handle from D4 thru D13
3	Menu Item	Price	Quantity	Sales Tax		
4	Empanadas: Beef Picadillo	$2.99	15	$3.59		
5	Empanadas: Chipotle Shrimp	$3.99	10			
6	Empanadas: Black Bean & Plantain	$2.49	20			
7	Tamales: Chicken Tinga	$2.29	20			
8	Tamales: Vegetable	$2.29	30			
9	Arepas: Carnitas	$2.89	10			
10	Arepas: Queso Blanco	$2.49	20			
11	Empanadas: Apple Cinnamon	$3.19	40			
12	Beverages: Horchata	$1.89	25			
13	Beverages: Lemonade	$1.89	35			
14	Beverages: Tamarindo	$1.89	10			
15				Total		

- Release the mouse. The formula will be copied to the selected cells with an absolute reference, and the values will be calculated in each cell. See below.

D4			f_x	=(B4*C4)*E2	
	A	B	C	D	E
1				Menu Order	
2			Sales Tax		8.0%
3	Menu Item	Price	Quantity	Sales Tax	Total
4	Empanadas: Beef Picadillo	$2.99	15	$3.59	$48.44
5	Empanadas: Chipotle Shrimp	$3.99	10	$3.19	
6	Empanadas: Black Bean & Plantain	$2.49	20	$3.98	
7	Tamales: Chicken Tinga	$2.29	20	$3.66	
8	Tamales: Vegetable	$2.29	30	$5.50	
9	Arepas: Carnitas	$2.89	10	$2.31	
10	Arepas: Queso Blanco	$2.49	20	$3.98	
11	Empanadas: Apple Cinnamon	$3.19	40	$10.21	
12	Beverages: Horchata	$1.89	25	$3.78	
13	Beverages: Lemonade	$1.89	35	$5.29	
14	Beverages: Tamarindo	$1.89	10	$1.51	
15				Total	$48.44

- You can double-click the filled cells to check their formulas for accuracy. The absolute reference should be the same for each cell, while the other references are relative to the cell's row.

| COUNTIF | ▼ | : | × | ✓ | f_x | =(B7*C7)*E2 |

	A	B	C	D	E
1				**Menu Order**	
2		In this cell, the relative cell references in row 7 are relative to row 7 while the absolute cell refrence remains constant			8.0%
3	**Menu Item**	**Price**	**Quantity**	**Sales Tax**	**Total**
4	Empanadas: Beef Picadillo	$2.99	15	$3.59	$48.44
5	Empanadas: Chipotle Shrimp	$3.99	10	$3.19	
6	Empanadas: Black Bean & Plantain	$2.49	20	$3.98	
7	Tamales: Chicken Tinga	$2.29		=(B7*C7)*E2	

To reference cells across worksheets or Link Data across worksheets:

Excel allows you to refer to any cell on any worksheet, which can be especially helpful if you want to reference a specific value from one worksheet to another. To do this, you'll simply need to begin the cell reference **on the worksheet you want to see the result**. Let's use the same workbook above to practice.

- Since we have calculated sales tax for all the cells in column D, copy the formula in Cell E4 **=B4*C4+D4** onto Cell E5 through E14 by using the **Fill Handle**. See the result below.

| E4 | ▼ | : | × | ✓ | f_x | =B4*C4+D4 |

	A	B	C	D	E
1					**Menu Order**
2			**Sales Tax**		8.0%
3	**Menu Item**	**Price**	**Quantity**	**Sales Tax**	**Total**
4	Empanadas: Beef Picadillo	$2.99	15	$3.59	$48.44
5	Empanadas: Chipotle Shrimp	$3.99	10	$3.19	$43.09
6	Empanadas: Black Bean & Plantain	$2.49	20	$3.98	$53.78
7	Tamales: Chicken Tinga	$2.29	20	$3.66	$49.46
8	Tamales: Vegetable	$2.29	30	$5.50	$74.20
9	Arepas: Carnitas	$2.89	10	$2.31	$31.21
10	Arepas: Queso Blanco	$2.49	20	$3.98	$53.78
11	Empanadas: Apple Cinnamon	$3.19	40	$10.21	$137.81
12	Beverages: Horchata	$1.89	25	$3.78	$51.03
13	Beverages: Lemonade	$1.89	35	$5.29	$71.44
14	Beverages: Tamarindo	$1.89	10	$1.51	$20.41
15			**Total**		$634.66
16	Source: GCFLearnFree				

- Now, the total value shows in Cell E15 of this **Menu Order** worksheet. We will reference this cell to another worksheet **Catering Invoice** worksheet in the same workbook.
- Navigate to the **Catering Invoice** worksheet where we want to see the result appeared. Locate and select the cell **B3** where you want the value to appear.
- Type the equals sign (=); then click the worksheet where the reference cell exists. In our example, **Menu Order** worksheet; then select Cell **E15**.

- The formula appears as ='Menu Order'!E15 in the formula bar area.   See below.

- Press Enter on your keyboard. The value of the referenced cell will appear.

- If the value of cell **E15** changes on the **Menu Order** worksheet, it will be updated automatically on the **Catering Invoice** worksheet. To test this, change the quantity in Cell C14 from 10 to 20. The total in Cell E15 changed to $655.07.

14	Beverages: Tamarindo	$1.89	20	$3.02	$40.82
15			Total		$655.07

- The referenced cell in **Catering Invoice** worksheet ,cell **B3,** gets automatically updated.

Note: If you rename your worksheet at a later point, the cell reference will be updated automatically to reflect the new worksheet name. Try changing the *worksheet name* **Menu Order** into **Menu**. The cell reference is automatically to reflect the new worksheet name as **=Menu!E15**

To reference cells across workbooks or External Data Link across workbooks:

The same principal of creating cell reference across worksheets in the same workbook also applies to creating external references across different workbooks. External references are especially useful when it is not practical to keep large worksheet together in the same workbook. By doing so you can merge data from several workbooks and integrate them into a summary workbook.

Let's use the same workbook above to practice further on this concept. Assume you have two more cells in the *Catering Invoice* worksheet for *Paper Items* and *Rental Equipment*. And you have two separate workbooks for each item called *PaperItems.xlsx* and *RentalEquipments.xlsx.*

- Open those two workbooks (*PaperItems.xlsx* and *RentalEquipments.xlsx*) and leave them open.
- Let's start referencing for Paper Items Cell – Cell B4. In your *ExcelPart4.xlsx* workbook, click in Cell B4 on *Catering Invoice* worksheet. Type in equal "=" sign.
- Then navigate to *PaperItems.xlsx* workbook and click on Cell E8 where the total figure for Paper Items is. You can see that the external reference includes the workbook name in square brackets ([ ]), followed by the worksheet name, an exclamation point (!), and the cells that the formula depends on. Notice the cell address is an absolute.
- Hit Enter button and you will be navigated to the *ExcelPart4.xlsx* workbook where cell referencing begins.
- Do the same to fill in Rental Equipment cost line in cell B5. Make sure to reference to cell E7 in *RentalEquipments.xlsx*.

Formula bar: `=[PaperItems.xlsx]Paper!$E$8`

|	A	B	C	D	E
1					Paper Items
2		Sales Tax			8.0%
3	Menu Item	Price/box	Quantity	Sales Tax	Total
4	Plates	$4.99	15	$5.99	$80.84
5	Silverwares	$12.99	5	$5.20	$70.15
6	Cups	$7.99	15	$9.59	$129.44
7	Napkins	$2.29	20	$3.66	$49.46
8				Total	$329.89

Note: If any of the data changes in either source workbooks - *Paperitems.xlsx* or *RentalEquipments.xlsx*, the referenced cells in the destination workbook – *ExcelPart4.xlsx* will be automatically updated. If all these workbooks are open simultaneously, the updates will happen instantly without any notification. In reality, the updates on the source workbooks could and would have been carried out without the destination workbook opened. If that is the situation, when the destination workbook – *ExelPart4.xlsx* is open **by itself**, you will see the Security Warning above the formula bar area as shown below.

SECURITY WARNING Automatic update of links has been disabled   Enable Content

B6   `=B3*0.18`
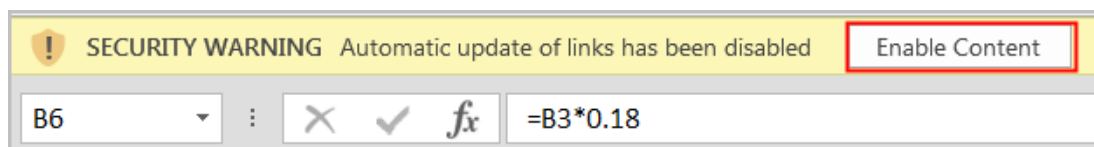
Click on *Enable Content* button. The Security Warning dialog box will appear to give you option whether you want to mark the linked source workbook(s) as Trusted Document(s) or not. If you say "No", you will have to click on the Enable Content button every time you open the destination workbook – *ExcelPart4.xlsx* by itself. Say "Yes" if you want to skip that step and the warning will not be there anymore.
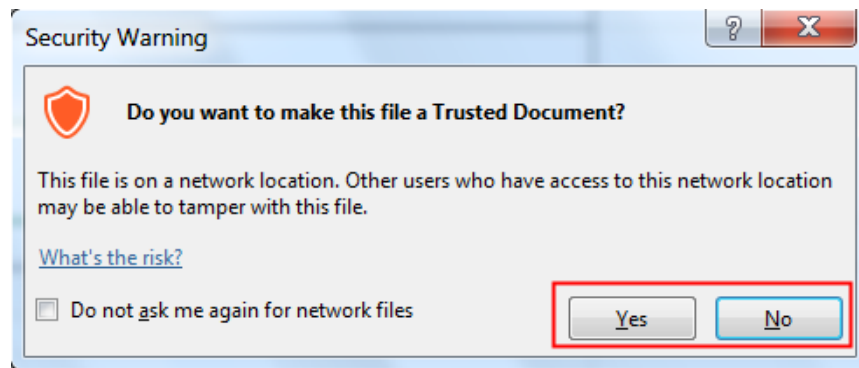
When you open the destination next time, you will receive the dialog box below. Click on Update if you want to open the workbook with updated data; otherwise, click on Don't Update button.
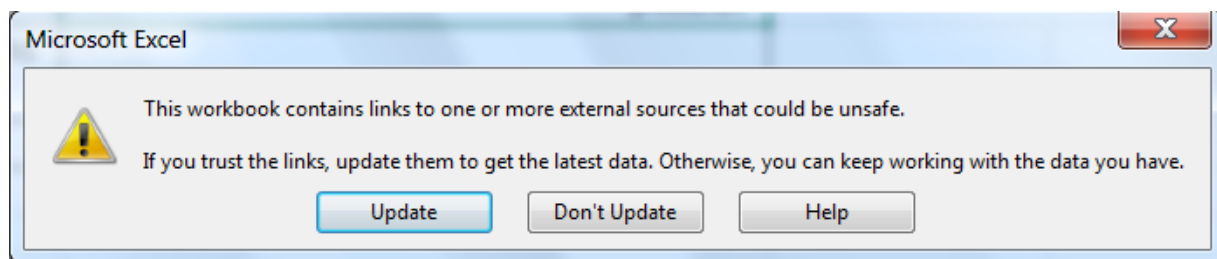

Introduction to Functions:

A **Function** is a predefined formula that performs calculations using specific values in a particular order. Excel includes many common functions under the **Home** tab that can be useful for quickly finding the **sum**, **average**, **count, maximum value**, and **minimum value** for a range of cells. Let's examine the different parts of a **sum function** and how to create arguments to calculate values and cell references.

$$= \text{ Sum } (A10{:}A20)$$

Equation   Function Argument
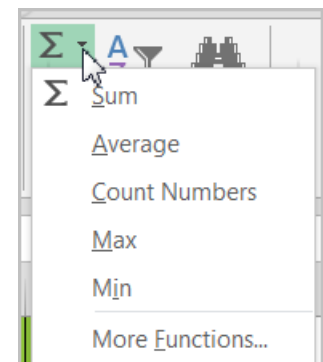
Equation: is required at beginning of every formula.
Function: is a predefined formula; in this example, to sum or add what is stated in the argument.
Argument: contains the information you want to calculate and it must be enclosed within a **parenthesis.** It can refer to both **individual cells** and **cell ranges**, in this example, referring to cell range A10 through A20. You can include one argument or multiple arguments, depending on the syntax required for the function**.**

| Basic Mathematical Functions		
AVERAGE	Finds the average within a range of cells.	=AVERAGE(A10:A20)
COUNT	Finds the number of cells within a range of cells that contain values (**numbers**) in them.	=COUNT(A10:A20)
COUNTA	The COUNTA function counts cells containing **any type of information**, including error values and empty text (""). For example, if the range contains a formula that returns an empty string, the COUNTA function counts that value. The **COUNTA function does not count empty cells.**	=COUNTA(A3:A15)
COUNTBLANK	Counts **empty** cells in a specified range of cells.	=COUNTBLANK(B3:B15)
MAXIMUM	Finds the **largest** number within a range of cells.	=MAX(D3:D15)
MINIMUM	Finds the **smallest** number within a range of cells.	=MIN(D3:D15)
SUM	Finds the total or sum within a range of cells.	=SUM(A10:A20)
Basic Date Functions		
NOW()	Displays the computer's current date and time. The formula will update the date and time next time the workbook is opened.	=NOW()
TODAY()	Displays the computer's current date. The formula will update the date next time the workbook is opened.	=TODAY()

Creating Basic Functions:

Single Argument Exercise: Open *ExcelFunctions.xlsx* to practice creating arguments.

Average Function:

- In Cell **C17** we want to calculate the average price per unit. Select Cell **C17.**
- Click on the drop-down arrow next to the **Sum** function in the **Editing Group** under the **Home** tab. Select **Average.**
-
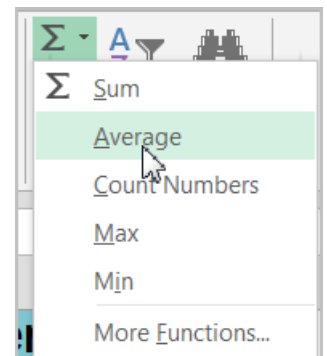
- The selected function will appear in the cell. If logically placed, the **Average** command will automatically select a cell range for the argument. In our example, cells **C3:C16** were selected automatically. In our case, there is no data in **C16**. You can manually fix the argument directly in the formula bar area by using the backspace button on your keyboard and change the cell address from **C16** to **C15**.

fx | =AVERAGE(C3:C16)
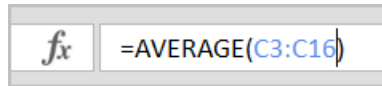
(OR you can use your mouse; click and drag to include the desired cell range into the argument as well.)

- Press Enter on your keyboard. The function will be calculated, and the result will appear in the cell. In our example, the average of **C3:C15** is $13.72.

- Find the "Average Shipping Time (Days)" in Cell **B24** by using the same **Average** function for the cell range **G3:G15.** OR you can use your mouse; click and drag to include the desired cell range into the argument. The result: 3.7692308. Adjust the decimal point to show only 2. The result should be 3.77.

C17 | fx =AVERAGE(C3:C15)

	A	B AVERAGE(**number1**, [number2], ...)
1		Food
2	**Item**	**Quantity** **Price Per Unit** **To**
3	Tomatoes (case of 12)	3	$17.44
4	Black Beans (case of 10)	5	$20.14
5	All Purpose Flour (50 lb.)	5	$14.05
6	Corn Meal/Maza (25 lb.)	5	$18.69
7	Brown Rice (25 lb.)	5	$10.99
8	Lime Juice (1 gallon)	5	$11.99
9	Tomato Juice (case of 10)	3	$19.49
10	Bottled Water (case of 24)	15	$2.49
11	Hot Sauce (1 gallon)	8	$7.35
12	Salsa, Medium (1 gallon)	12	$8.47
13	Salsa, Hot (1 gallon)	6	$9.59
14	Olive Oil (2.5 gallon)	4	$28.69
15	Vegetable Wash (1 gallon)	2	$8.99
16	**Quantity of Items Ordered**		
17	**Average Price Per Unit**	=AVERAGE(C3:C15)

Sum Function:
- Click on Cell **D18**.
- Select the **Sum** function from the list.
- Fix the cell range by using the mouse (start from cell **D3** and drag your mouse to **D15** to include the cell range **D3:D15.**
- Hit **Enter**. The sum of **Total Cost** in our example is: $878.16.
- Use the same **Sum** function to get total "quantity of items ordered" (cell **B3:B15)** in cell **B16.** Result: 78.

Maximum Function: Find out the most expensive item in column **C (Price Per Unit)** in cell **B23** by using the =MAX(C3:C15). The result should be: $28.69.

Multiple Argument Example: A function can contain multiple arguments. Each argument has to be separated by the "comma". For example, the function =SUM(A1:A3, C1:C2, E2) will add the values of all the cells in the three arguments. (Example: GCFLearnFree.org)

COUNTA | fx =SUM(A1:A3,C1:C2,E1)

	A	B	C	D	E	F
1	7		5		15	
2	4		12			
3	23					
4						
5	=SUM(A1:A3,C1:C2,E1)					
6						

Complex Function/Formula:

There are hundreds of functions in Excel and you can search them by category, such as Financial, Logical, Text, Date & Time, and more from the **Function Library** on the **Formulas** tab. The ones you use most frequently will depend on the type of data your workbooks contains. To access the **Function Library**, select the **Formulas** tab on the **Ribbon**. The **Function Library** will appear. Click on each category to explore some of the different types of functions that will be helpful as you create new projects.
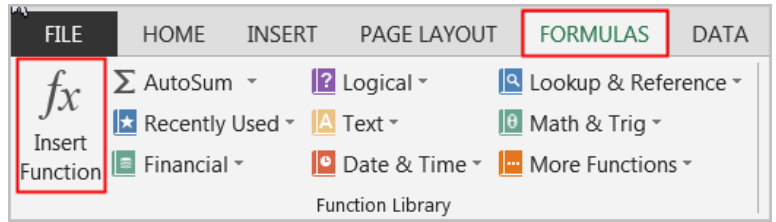
For complex formulas, it's not easy to remember which function and which arguments to use for each task. Fortunately, the **Insert Function** feature in Excel helps you with this. We will use the same example above to count the number of cells to get the answer "how many items are ordered in column **A**". Since the items in column **A** are in text, we cannot use the basic **COUNT** function because it will only count cells with numerical information. We will have to use the **COUNTA** function. We will enter the answer in cell **C22.** Follow the steps below.

- Select a cell **C22**.
- Click on **Insert Function** command in the formula bar area   OR
  select **Formulas** tab and click on **Insert Function** command in the **Function Library** group.

- **Insert Function** dialog box will open; type "count cells" in the **Search for a function** box and click on **Go** button. Recommended functions will appear in the "**Select a function**" box. By clicking on each, the explanation of that function will appear in the lower part of the box.

-
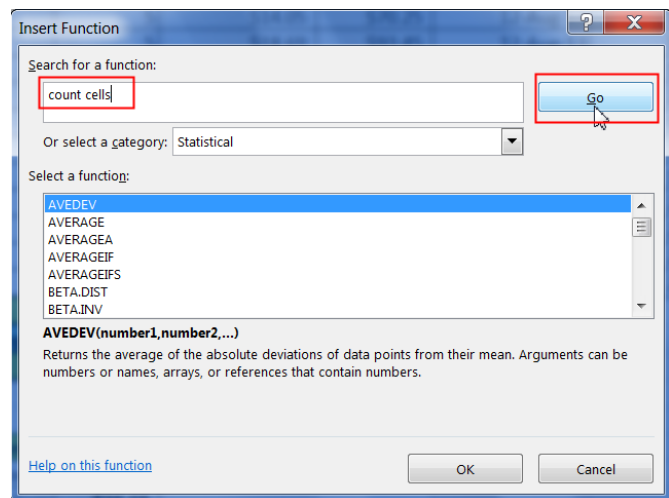
- When **COUNTA** shows up in the **Selection a function** box, click on it. Click on **OK** button.

- **Function Arguments** dialog box will come up. Change the **Value1** to include cell range **A3:A15.** You may continue to add arguments in the **Value2**: field if you have more cells to count, but in this case we only want to count the number of cells in the cell range A3:A15.

- Click on **OK**. The result should be 13.

Change the cell range to read A3:A15
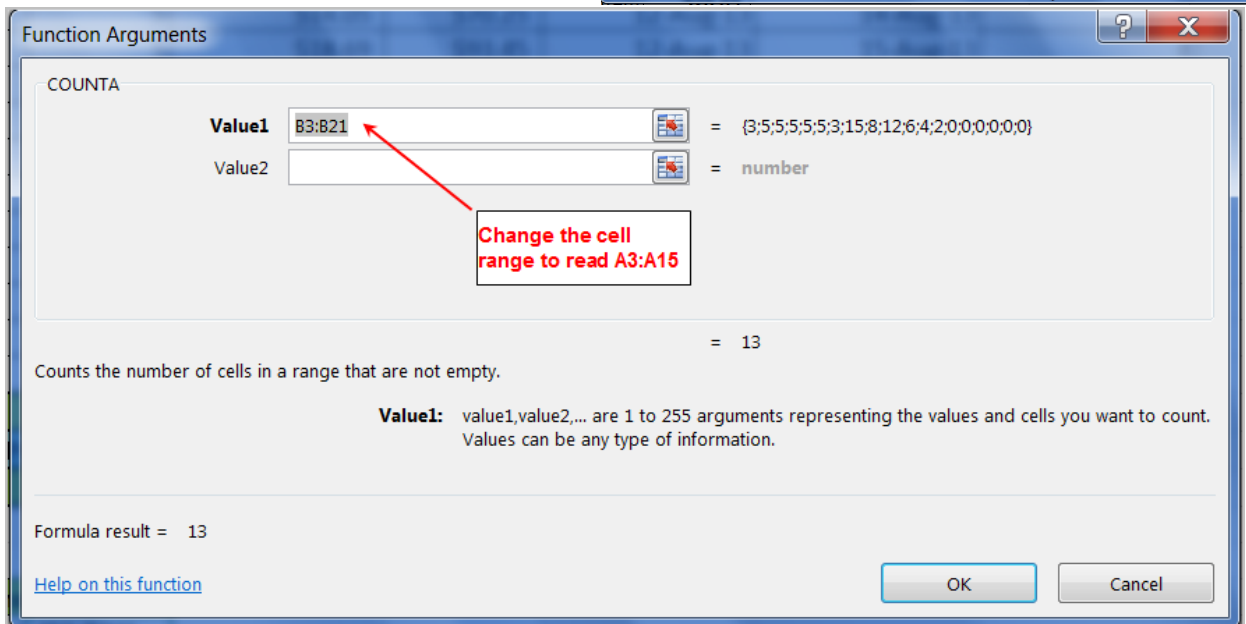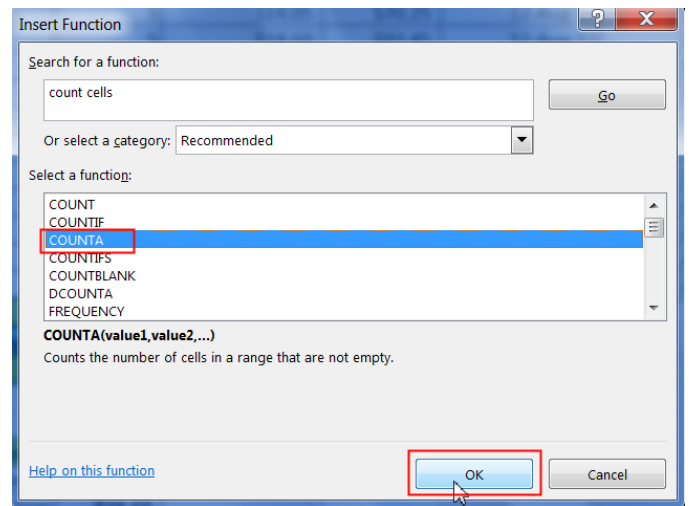
Note: You can type in any search term in the **Search for a Function** box and the recommended function will be provided. These dialog boxes include explanation on what each function does such as in our example,

COUNTA(value1,value2,...)
Counts the number of cells in a range that are not empty.

.

If you need any additional explanation on any function, you may click the link on "**Help on this function**" in these dialog boxes. **Excel Help** window will open to provide you with the detailed help with examples.

Display Formulas on your worksheet:

You can display the formulas in your worksheet by using the **Show Formulas** command in the **Formula Auditing** group under the **Formulas** tab.
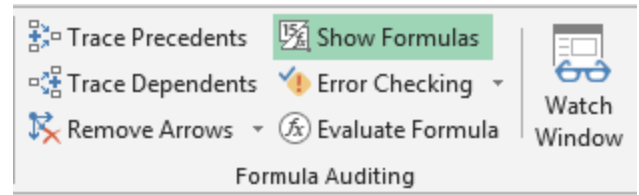
|	A	B	C	D
1				
2	**Item**	**Quantity**	**Price Per Unit**	**Total Cost**
3	Tomatoes (case of 12)	3	17.44	=B3*C3
4	Black Beans (case of 10)	5	20.14	=B4*C4
5	All Purpose Flour (50 lb.)	5	14.05	=B5*C5
6	Corn Meal/Maza (25 lb.)	5	18.69	=B6*C6
7	Brown Rice (25 lb.)	5	10.99	=B7*C7
8	Lime Juice (1 gallon)	5	11.99	=B8*C8
9	Tomato Juice (case of 10)	3	19.49	=B9*C9
10	Bottled Water (case of 24)	15	2.49	=B10*C10
11	Hot Sauce (1 gallon)	8	7.35	=B11*C11
12	Salsa, Medium (1 gallon)	12	8.47	=B12*C12
13	Salsa, Hot (1 gallon)	6	9.59	=B13*C13
14	Olive Oil (2.5 gallon)	4	28.69	=B14*C14
15	Vegetable Wash (1 gallon)	2	8.99	=B15*C15
16	**Quantity of Items Ordered**	**=SUM(B3:B15)**		
17		**Average Price Per Unit**	**=AVERAGE(C3:C15)**	
18			**Total Cost**	**=SUM(D3:D15)**

If you want to have the row numbers (1,2,3..) and column headings (A,B,C..) in your print out, go to **Page Layout>Page Setup>Click on Sheet tab>Check on Row and column headings box.** Keep this workbook open for next topic.
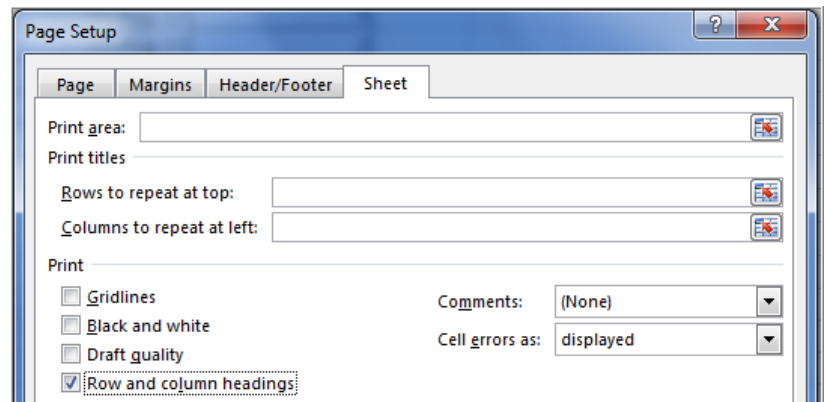
Trace Precedents and Dependents:

Sometimes, checking **formulas** for accuracy or finding the source of an error can be difficult when the formula uses precedent or dependent cells. For practice, let's use the same workbook.
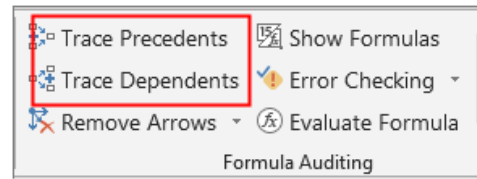
Trace Precedents shows arrows that indicate which cells affect the value of the currently selected cell. In our example, if you want to check which are the values that affect the value in cell "**D3**". This is where "**Trace Precedents**" help. Select **D3**. Go to the **Formula** tab and select **Trace Precedents**.

	A	B	C	D
1				Food Supply Inv
2	**Item**	**Quantity**	**Price Per Unit**	**Total Cost**
3	Tomatoes (case of 12)	3	$17.44	$52.32
4	Black Beans (case of 10)	5	$20.14	$100.70
5	All Purpose Flour (50 lb.)	5	$14.05	$70.25
6	Corn Meal/Maza (25 lb.)	5	$18.69	$93.45

You will now magically see arrows (as above) which means the value in **D3** is dependent on values coming from multiple cells "**B3**" and "**C3**" in our example, i.e. **Total Cost=Quantity*Price Per Unit**.

Trace Dependents does exactly the opposite. This option shows which are the cells affected by values from this cell. In our example let's take a look at cell "**C3**".

- Click cell **C3** and then on **Trace Dependents.** You will see multiple arrows to indicate cells **D3, B23** and **C17** are depending on the value in cell **C3.**
- Click **Trace Dependents** again since it runs the dependency in recursion, and another arrow pointing to cell **D18** to indicate the value in cell **D18** is also depending on the value in cell **C3.**

So if the value in cell C3 changes, all of these cells will be affected. To remove the arrows, use the "**Remove Arrows**" button from "**Formulas**" toolbar.

	A	B	C	D	
1				Food Supply Invent	
2	**Item**	**Quantity**	**Price Per Unit**	**Total Cost**	**Dat**
3	Tomatoes (case of 12)	3	$17.44	$52.32	
4	Black Beans (case of 10)	5	$20.14	$100.70	
5	All Purpose Flour (50 lb.)	5	$14.05	$70.25	
6	Corn Meal/Maza (25 lb.)	5	$18.69	$93.45	
7	Brown Rice (25 lb.)	5	$10.99	$54.95	
8	Lime Juice (1 gallon)	5	$11.99	$59.95	
9	Tomato Juice (case of 10)	3	$19.49	$58.47	
10	Bottled Water (case of 24)	15	$2.49	$37.35	
11	Hot Sauce (1 gallon)	8	$7.35	$58.80	
12	Salsa, Medium (1 gallon)	12	$8.47	$101.64	
13	Salsa, Hot (1 gallon)	6	$9.59	$57.54	
14	Olive Oil (2.5 gallon)	4	$28.69	$114.76	
15	Vegetable Wash (1 gallon)	2	$8.99	$17.98	
16	**Quantity of Items Ordered**	76			
17	**Average Price Per Unit**		$13.72		
18	**Total Cost**			$878.16	
19					
20					
21	**Inventory Order Summary**				
22	Total Items Ordered	13			
23	Most Expensive Item	$28.69			
24	Average Shipping Time (Days)	3.76923077			

Appendix:

"Order of Operations" to more complex mathematical expressions:

A complex mathematical expression has more than one mathematical operator, such as 5+2*8. When there is more than one operation in a formula, the order of operations tells **Excel** which operation to calculate first. In order to use **Excel** to calculate complex formulas, you will need to understand the order of operations as follows:

Excel calculates formulas based on the following order of operations:

1. Operations enclosed in **parentheses**
2. **Exponential** calculations (3^2, for example)
3. **Multiplication** and **division**, whichever comes first
4. **Addition** and **subtraction**, whichever comes first

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

So in this following example to solve - **10+(6-3)/2^2*4-1**, the order of operations will be carried out according to the order stated above. See the steps below.

Step 1)

Using the Order of Operations

Parentheses   **10+(6-3)/2^2*4-1**
E
M
D
A
S

Step 2)

Using the Order of Operations

P   **10+(6-3)/2^2*4-1**
Exponents   **10+3/2^2*4-1**
M
D
A
S

Step 3)

Using the Order of Operations

P   **10+(6-3)/2^2*4-1**
E   **10+3/2^2*4-1**
Multiplication   **10+3/4*4-1**
Division Whichever comes first!
A
S

Step 4)

Using the Order of Operations

P   10+(6-3)/2^2*4-1
E   10+3/2^2*4-1
Multiplication   10+3/4*4-1
Division *Whichever comes first!*   10+**0.75*4**-1
A
S

Step 5)

Using the Order of Operations

P   10+(6-3)/2^2*4-1
E   10+3/2^2*4-1
M   10+3/4*4-1
D   10+0.75*4-1
Addition *Whichever comes first!*   **10+3**-1
Subtraction

Step 6)

Using the Order of Operations

P   10+(6-3)/2^2*4-1
E   10+3/2^2*4-1
M   10+3/4*4-1
D   10+0.75*4-1
Addition *Whichever comes first!*   10+3-1
Subtraction   **13-1**

Step 7)

Using the Order of Operations

P   10+(6-3)/2^2*4-1
E   10+3/2^2*4-1
M   10+3/4*4-1
D   10+0.75*4-1
A   10+3-1
S   **13-1 =12**

Exercise: Open the *CateringInvoice.xlsx* workbook and calculate 7.5% Tax in Cell D6.
- **Steps: Add** Cell D3, D4, and D5 in the **Parenthesis; Multiply** the result with .075 such as =(D3+D4+D5)*.075.
- Then calculate the total in Cell D7 by **adding** Cells D3 through D6 by using point and click method.