



NDUS Training and Documentation

Excel Formula and Function Basics

The real power behind Excel lies in creating effective formulas. It's important that you understand what a formula is and how to create one. In this session, we'll take a look at what goes into building an effective formula and using several of Excel's 200+ built-in functions to do some of the work of building complex formulas for you!

Using Named Ranges

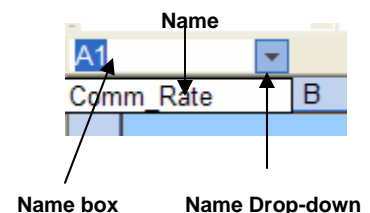
A *name* is a description you assign to a cell or a range of cells that you can use as an easier to read, understand, and edit alternative to cell references. Once you've defined a named range, you can use that name in formulas, you can use it to move quickly to a certain area of the workbook, or you can specify a particular print range easily using named ranges.

Name Guidelines

1. First character **must** be text or an underscore (_), not a number
2. Names **can't** contain spaces
3. Names can be up to 255 characters long
4. Names **can't** be the same as a cell reference
5. Excel doesn't distinguish between upper and lowercase characters in names

Viewing Existing Names

- Click the drop-down arrow in the Name box to see a list of all existing names in the workbook
- Click a name to quickly select the cell or cells within that named range

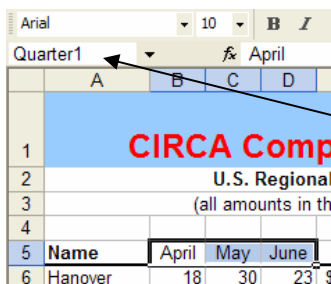


Two Ways To Create Named Ranges:

1. Select the cell or cells to be named
2. On the Menu Bar, select Insert, Name, Define...
3. In the Define Name dialog box, type a name for the range, then click OK

OR:

1. Select the cell or cells to be named
2. Click *inside* the Name box to select (highlight) the current cell address
3. Type a name for the range, then press the Enter key



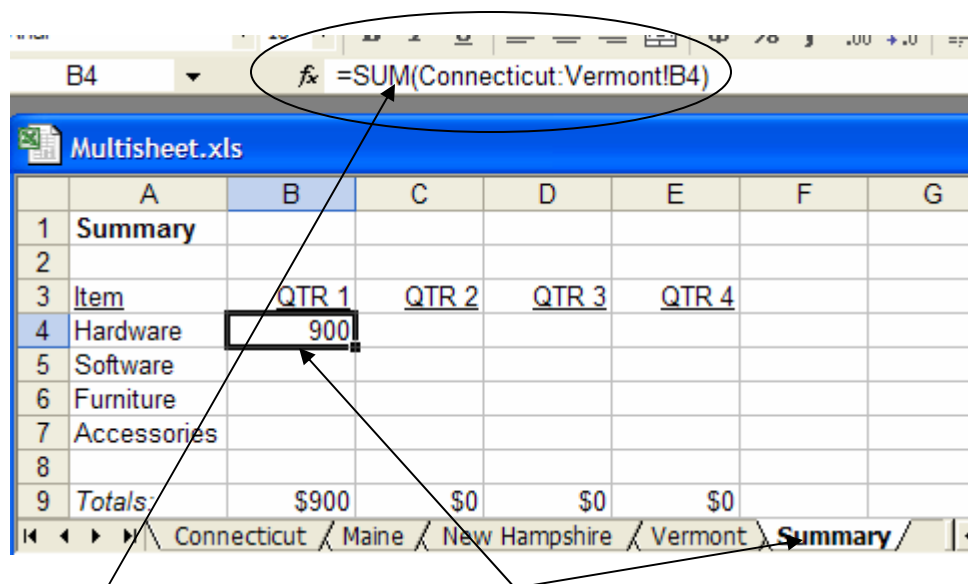
3-D References in Formulas

When you have workbooks that contain data on multiple worksheets, you may need to use a 3-D reference to link the data in different worksheets together in a formula so that changes to specific cells in one worksheet will be reflected in specific cells in another sheet. A *three-dimensional (3-D) reference* is a range that spans two or more worksheets in a workbook, linking the sheets together.

Creating a 3-D Reference:

1. Select the cell which will contain the formula
2. Enter a formula up to the opening parenthesis i.e. =SUM(
3. Click the worksheet tab of the first worksheet that will be included in the range
4. Click to select the appropriate cell in that worksheet
5. Press and hold down the SHIFT key and click the worksheet tab of the last worksheet in the range that will be included in the formula
6. Release the SHIFT key
7. Press the Enter key to enter the formula

Here's an example:



This 3-D reference, located in cell B4 of the Summary worksheet, adds cell B4 from each of four worksheets – Connecticut, Maine, New Hampshire, and Vermont and places the result in cell B4 in the Summary worksheet.

You can also type 3-D references manually in the cell, but it's simpler to use the SHIFT, Click method to select the cells and worksheet tabs to include in the reference.

Linking Cells in Different Workbooks

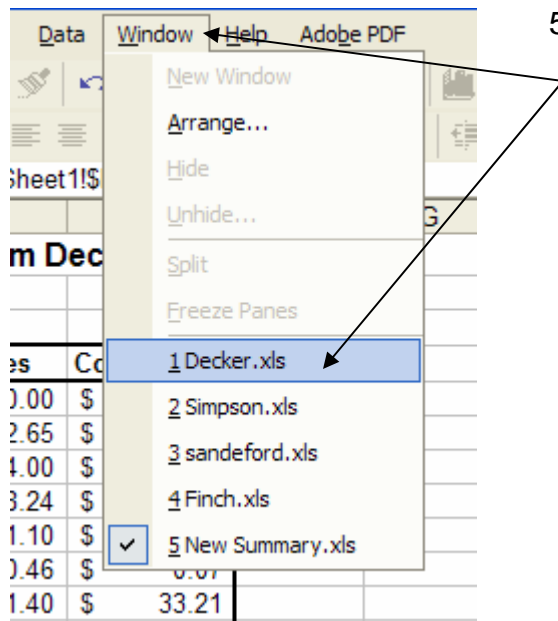
When you want one workbook to use data from another workbook you create a *link*. You can link workbooks together by writing a formula in one workbook, called the

dependent workbook, that refers to a value in another workbook (or multiple workbooks), called the **source workbook**. The formula containing a reference to another workbook is called an **external reference**.

Linking Two Workbooks Together

1. Open the workbook that you want to contain the link (the dependent workbook that contains the external reference formula)
2. Open the workbook(s) that you want to link to (the source workbooks)
3. Select the cell that you want to place the linking formula in (in the dependent workbook)
4. Type the = symbol to begin entering a formula

	A	B
1	Monthly Sales Totals	
2	January, 1999	
3		
4	Total Sales	Total Commissions
5	=	
6		



5. Use the Window menu to activate each workbook you wish to link to, then click to select the cell(s) to link to, and type any mathematical operators or functions necessary to build the formula

	A	B	C	D	E
1	Sales Report for: William Decker				
2	January, 1999				
3					
4	Item Code	Item Price	Qty.	Sales	Commission
5	1	10	2	\$ 20.00	\$ 3.00
6	2	6.53	5	\$ 32.65	\$ 4.90
7	3	98	8	\$ 784.00	\$ 117.60
8	4	79.32	32	\$ 2,538.24	\$ 380.74
9	5	76.22	5	\$ 381.10	\$ 57.17
10	6	0.23	2	\$ 0.46	\$ 0.07
11	7	55.35	4	\$ 221.40	\$ 33.21
12	8	10.2	5	\$ 51.00	\$ 7.65
13	9	11.32	12	\$ 135.84	\$ 20.38
14	10	14.67	6	\$ 88.02	\$ 13.20
15	Totals:				\$ 4,252.71 \$ 637.91

6. Press the Enter key to enter the formula into the dependent workbook

Here's an example of an external reference that links three workbooks:

	B	C	D	E	F	G	H	I
Formula Bar	=[Decker.xls]Sheet1!\$E\$15+[Simpson.xls]Sheet1!\$E\$15+[sandeford.xls]Sheet1!\$E\$15							

This formula adds the values in cell E15 of the Decker.xls, Simpson.xls, and sandeford.xls workbooks and places the result in a cell in the dependent workbook. You can also type these kind of linking formulas manually, but if you use the mouse to

activate the appropriate workbooks, and select the appropriate cells, you have less chance of making an error in the formula's syntax.

Once you've built one 3-D reference formula, or one external reference linking formula in a workbook, you can copy those formulas to other cells, just as you would copy any other formula, making the job of creating multiple formulas much easier!

Editing Links

You may need to edit the links to the source workbooks when you've created an external reference formula for many reasons. For example, you may no longer have access to a source workbook, or you need to link to a different source workbook.

To Change Source Workbooks

1. Open the dependent workbook (the workbook that contains the linking formula)
2. On the Menu Bar, select Edit, Links
3. In the Links dialog box, select the link you wish to change, then click the Change Source button
4. Select the workbook you want to redirect the link to in the Change Source dialog box, then click OK to return to the Edit Links dialog box
5. Click Close to close the Edit Links dialog box

To Break A Link (Excel 2002 – XP)

1. Open the dependent workbook
2. On the Menu Bar, select Edit, Links
3. In the Links dialog box, select the link you wish to break, then click the Break Link button
4. Click Break Links in the message box that appears
5. Click Close to close the Edit Links dialog box

To Break A Link (Excel 2000)

1. Open the dependent workbook
2. Select the cell containing the linking formula
3. On the Formula Bar, remove the reference to the source workbook by manually editing the linking formula reference, then press Enter to accept the change

Excel's Functions

Excel ships with over 200 built-in functions that can help you create more complex formulas. You may never use most of Excel's functions, but you will want to be familiar with the basic functions we'll cover in this session.

Function Syntax

Each function has a particular syntax you must follow when using that function to create a formula:

=FunctionName(Argument1, Argument2, ArgumentN...)

Since functions are formulas, the first thing you need is the equal symbol (=), then you need the function name. Enclosed within the parentheses () are the function's *arguments*. Arguments are the values that a function uses to perform operations or calculations. The type and the number of arguments a function uses are specific to that function.

Each argument is separated by a comma – if you see a function that has two commas in it, that function has three arguments!

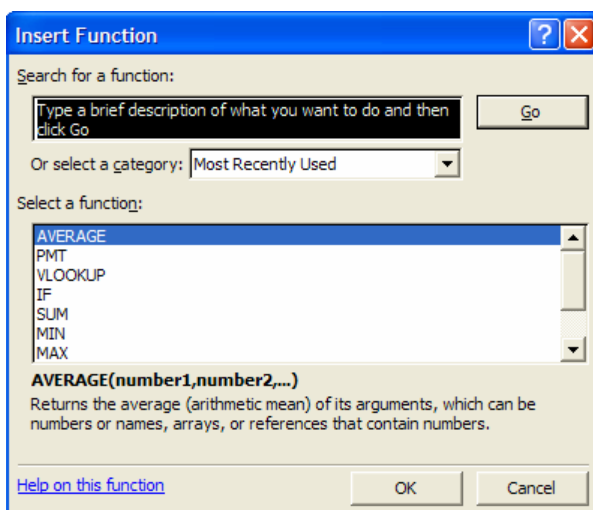
Functions can be entered in a number of ways – for simple functions like the SUM, AVERAGE, and ROUND functions, it may be easiest to type the function manually as you would type any other formula.

For more complex functions like the IF and VLOOKUP functions it will be easier to use the Paste Function (Excel 2000) or Insert Function (Excel 2002 - XP) dialog box to help you create the formula.

Insert Function (Paste Function)

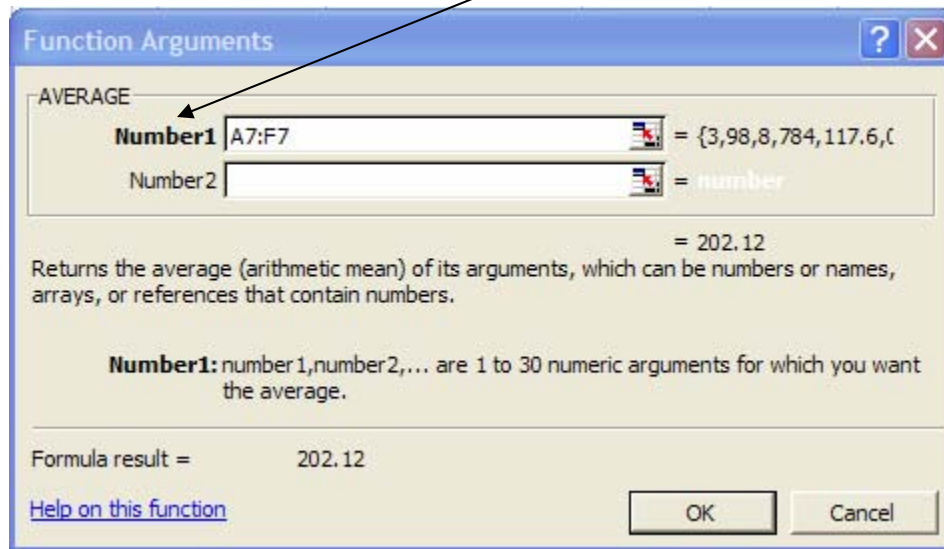
Use the Insert Function (or Paste Function) dialog box to easily create formulas containing functions – you'll be able to see the required syntax and learn more about each function in this dialog box:

- Click the Insert Function button (Excel 2002 – XP) to the left of the Formula Bar, or
- Click the Paste Function button (Excel 2000) located on the Standard Toolbar



- Search for a particular function by typing the function name in the Search box
- Select a function category from the category: list box
- Click a function to select it under Select a function:
- The syntax for the selected function and a description of what it does appears at the bottom of the dialog box
- To learn more about each function, select it from the list, then click “Help on this function”

After selecting the function you want to use, click OK to create the formula in the Function Arguments dialog box – arguments listed in **bold** are required arguments; unbolded arguments are optional and may be left empty if you don't need them:



SUM

=SUM(Num1:NumN) [Num1:NumN indicates a range of cells to be summed]

Replaces =A1+B1+B2, etc.

Example: =SUM(A1:B26) sums all of the values in cells A1 to A26 and B1 to B26

AVERAGE

=AVERAGE(Num1,Num2,...)

Replaces =A1+A2+A3+A4/4

Example: =AVERAGE(B5:B8,D5:D7) produces the average of all the values from B5 to B8 (argument 1) and from D5 to D7 (argument 2) – you can use as many arguments as necessary in the Average function

Date and Time Functions

=**NOW()** inserts the current system date and time into the cell – updates whenever the worksheet is recalculated (no arguments are required – but you still need to include the parentheses)

=**TODAY()** inserts the current date without the time – updates whenever the worksheet recalculates

Example: =TODAY()+30 calculates a date 30 days from the current date

ROUND

=ROUND(Num, NumOfDigits)

Rounds the value specified in the first argument to the number of digits specified in the second argument

Example: =ROUND(A6,2) A6 is the value to be rounded (1st argument), 2 is the number of digits to round to (2nd argument).

6.555313 entered in cell A6 becomes 6.56 in the cell containing the Round function

Decision Making Functions

The IF Function

If you learn and understand how to use only one function in Excel, it should be the IF function. The IF function is a very powerful decision-making function that is often the solution to many problems in Excel.

IF allows a formula to return one result if a certain condition you specify is true, and a different result if the condition is false. The IF function has three required arguments in this syntax:

=IF(Logical_Test, TrueValue, FalseValue)

- The first argument – Logical_Test – is the value you are testing. This value can be an expression (i.e. A6=6, A2+B6>B26, etc.), or it can be another function nested inside the IF function (AVERAGE(B6:B30)>100). The test value must meet a condition that can be evaluated to either True or False.
- The second argument – TrueValue – is the result you want the formula to “return” to the cell if the evaluation of the first argument (Logical_Test) is TRUE – this value can be an expression, a constant value, text, or another function nested inside the first function.
- The third argument – FalseValue – is the result you want the formula to “return” to the cell if the evaluation of the first argument (Logical_Test) is FALSE – this value can also be an expression, a constant value, text, or another function nested inside the first function.

In this example, the formula in cell F6 calculates a commission for the salesperson by multiplying the Total Sales in cell E6 by the 18% Commission Rate in cell J3, even if they didn't meet the Quota in cell J4

CIRCA Company, Inc.							U.S. Regional Sales (all amounts in thousands)		Commission Rate: 18% Quota: \$ 60	
Name	April	May	June	Total	Comm.	Bonus	Total	Bonus		
Hanover	18	30	23	\$ 71	\$ 13	\$ 8	0	0		
Monder	20	12	20	\$ 52	\$ 9	\$ 2	50	2		
Jaen	15	22	25	\$ 62	\$ 11	\$ 2	68	8		
Simmonds	8	10	21	\$ 39	\$ 7	\$ -				
Peruzzi	15	20	21	\$ 56	\$ 10	\$ 2				
Totals	76	94	110	\$ 280	\$ 50	\$ 14				

(Comm_Rate is a named range referring to cell J3, Quota refers to cell J4). The named ranges make the formulas easier to understand and to update.

You can add the IF function to this formula to make it calculate a commission for each salesperson only when they meet or exceed the quota.

The modified formula using the IF function works like this:

CIRCA Company, Inc.						
U.S. Regional Sales						
(all amounts in thousands)						
Name	April	May	June	Total	Comm.	Bonus
Hanover	18	30	23	\$ 71	\$12.78	\$ 8
Monder	20	12	20	\$ 52	\$0.00	\$ 2
Jaen	15	22	25	\$ 62	\$11.16	\$ 2
Simmonds	8	10	21	\$ 39	\$0.00	\$ -
Peruzzi	15	20	21	\$ 56	\$0.00	\$ 2
Totals	76	94	110	\$ 280	\$23.94	\$ 14

E6>=Quota is the logical test argument – if E6 is greater than or equal to the Quota (60,000), then the test is TRUE and the result of the calculation or value in the second argument – E6*Comm_Rate (18%) – is returned. The third argument is ignored.

If E6 is NOT greater than or equal to the Quota (60,000), then the test in the first argument is FALSE and the result of the calculation or value in the third argument – 0 in this case – is returned to the cell. The second argument is ignored.

Notice the \$0.00 values returned to cells F7, F9, and F10 – a commission was not calculated for these salespeople, since they did not meet the \$60,000 quota.

If you want a formula or function to return a string of text (characters) to a cell, enclose the text in the formula within quote marks, like this: "No Commission". If you wish to have a function return a blank value (not zero) to the cell, use quote marks without a space between them. Here's an example:

=IF(E6>=Quota,E6*Comm_Rate,"") This formula example calculates, or returns, a commission value to the cell containing the formula if the test is true. If the test is false, it returns an empty string (a blank value) to that cell.

The VLOOKUP Function

The IF function allows a formula to return only two different results – the logical test evaluates to either TRUE or FALSE. There are many circumstances where you need your formula to make more than one decision. This is where the VLOOKUP function comes in handy.

The VLOOKUP function finds and returns a value located in a certain row and column of a lookup table that you create in another part of your worksheet or workbook. This lookup table contains an orderly arrangement of information – values in the lookup table

should be sorted in ascending order from top to bottom and the lookup table should be placed in another part of the worksheet away from the main body of your worksheet, or in a separate worksheet within the workbook.

Here's the syntax of the VLOOKUP function:

=VLOOKUP(Lookup_Value,Table_Array,Col_Index_num,Range_Lookup) – only the first three arguments are required, the 4th argument is optional.

- Lookup_Value is the value that Excel looks up in the first column of your lookup table. It can be a value, a cell reference, an expression, or a text string.
- Table_Array is a reference to (or the name of a reference to) the location of your lookup table (i.e. H6:I10, or Grades).
- Col_Index_num is the column number in the lookup table of the column you want the value returned from (index numbers are 1, 2, etc. from left to right rather than column references – A, C, etc.).
- Range_Lookup is an optional argument that specifies whether you require an exact match to the value you're looking up, or an approximate match. If you omit this optional argument, the VLOOKUP function uses an approximate match which is the most appropriate in most cases.

If you've allowed VLOOKUP to use approximate matches, when the function can't find an exact match for the Lookup_Value argument in the lookup table, it uses the largest value in the table's first column that is still less than Lookup_Value.

Here's an example:

	A	B	C	D	E	F	G	H	I
1	Name	Test 1	Test 2	Average	Final Grade				
2	Doe, John	95	90	92.5	A				
3	Smith, Jill	72	82	77	C				
4	Anderson, Kate	56	74	65	D				
5	Johnson, Ole	100	82	91	A				
6								Score	Grade
7								0	F
8								65	D
9								70	C
10								80	B
								90	A

The VLOOKUP function in this example returns a letter grade for each student by looking up the Average value computed in cell D2 in column 1 of the lookup table and returning the correct letter grade for the value that is less than or equal to that value from the second column of the lookup table.

- The first argument – D2 (Lookup_Value) tells Excel to lookup the value in cell D2 in the lookup table.
- The second argument - \$H\$6:\$I\$10 (Table_Array) tells the VLOOKUP function where the lookup table is stored, the function looks in the first column of this lookup table for an approximate match to Lookup_Value.
- The third argument – 2 (Col_Index_num) tells the VLOOKUP function to return the value from the 2nd column of the lookup table to the cell from the row that matches the approximate Lookup_Value.
- The optional fourth argument – Range_Lookup was not used in this example.

If you change any of the values that result in the Lookup_Value used in the VLOOKUP function being changed, the value returned by the VLOOKUP function in the formula will also change.

Protecting Your Worksheets

When you've spent considerable time and effort creating complex formulas in your worksheets, you certainly don't want to accidentally change the formula!

If you don't protect portions of your worksheets, it's very easy to accidentally overwrite a formula with a value simply by selecting the cell containing the formula, typing in a value, then saving the workbook – your formula is gone!

By default, all cells in an Excel worksheet are locked (locks are installed), but you can still change any of those locked cells until you turn on Worksheet Protection (lock the locks).

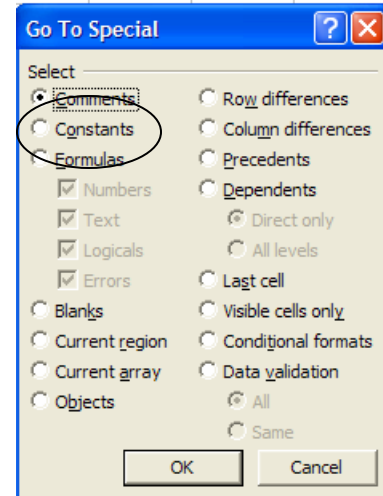
To see cell locks:

1. Select a cell (or cells) to view
2. On the Menu Bar, select Format, Cells
3. At the top of the Format Cells dialog box, click the Protection tab, if necessary
4. You should see a check mark next to Locked

Once you've protected your worksheet, any locked cell can no longer be changed. To protect only certain cells in your worksheet, you'll need to first remove the locks from those cells, then protect the worksheet.

Since you want to protect only those cells that contain formulas from accidental change, you want to **leave those cells locked**. You'll need to remove the locks from those cells that **don't** contain formulas. There's a great trick in Excel to select all of those cells quickly:

1. On the Menu Bar, select Edit, Go To...
2. In the Go To dialog box, click the Special...
3. In the Go To Special dialog box, click Constants, then click OK
4. All of the cells that **don't** contain formulas should be selected



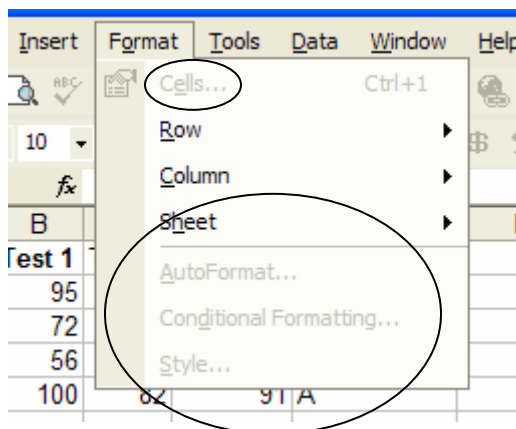
To Unlock Cells:

1. With the appropriate cells selected, click Format, Cells on the Menu Bar
2. Click the Protection tab, if necessary
3. Remove the check mark next to Locked, then click OK

To Protect the Worksheet:

1. After unlocking the desired cells, select Tools, Protection, Protect Sheet from the Menu Bar
2. In the Protect Sheet dialog box, type a password (not recommended) if you wish to require users to type a password before they can remove worksheet protection, then click OK

Once you've protected the worksheet in this manner, you can't make any changes to any locked cells. Unlocked cells can be changed in the normal manner. If you need to make later changes to the formulas inside locked cells you'll need to remove worksheet protection, make the changes, then reapply worksheet protection again.



When your worksheets are protected some of your Menu Bar choices and Toolbar buttons will not be available and will appear "grayed out". In order to reactivate those unavailable options, you'll also need to unprotect the worksheet before you can make those changes.

To Unprotect the Worksheet:

Select Tools, Protection, Unprotect Sheet from the Menu Bar

Now that you've learned how to create formulas, and how to use some of Excel's built-in functions, you'll be able to use Excel to produce the kinds of results you need!