Microsoft® Excel® What-If Features

Prepared by:
Dennis Taylor
Taylor Associates

WHAT-IF FEATURES
Goal Seek

Excel's Goal Seek feature allows you to work "backward" in re-calculating the result of formulas. Instead of trying to rework the formula (such as you might in an algebra problem when you attempt to solve for Y instead of X) Excel simply substitutes a series of values in one of the original formulas until it reaches the answer you want.
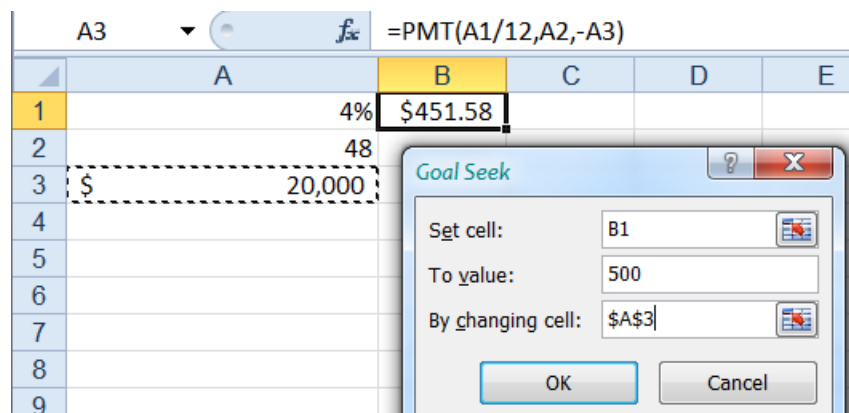
Goal Seek with the PMT function

Suppose you just used the **PMT** function to figure out the monthly payment on a car loan. After seeing the result, you feel as if you could comfortably pay more per month. Instead of reworking the function numbers many times to come up with the amount that you want to be the monthly payment, use the **Goal Seek** command to find the answer immediately. Imagine the following entries where the function in B1 calculates the monthly payment required to pay off a 4-year loan of $20,000 at 4% interest.

B1			f_x =PMT(A1/12,A2,-A3)	
	A		B	C
1		4%	$451.58	
2		48		
3	$	20,000		

1. Select   the cell containing the result you want to change (e.g. cell B1 above)
2. Click   The **What-If** Analysis button in the **Data Tools** group of the **Data** tab
3. Select   **Goal Seek**
4. Type   the result you want to see in the panel to the right of: **To value:**
5   Click   in the panel to the right of: **By changing cell:**
6. Select   the cell in the worksheet whose value you want to change (in the example above you could choose A3 to allow a higher principal, A2 to allow a different term, or A1 to allow a different rate.

A3			f_x =PMT(A1/12,A2,-A3)	
	A		B	C	D	E
1		4%	$451.58	
2		48		
3	$	20,000		
4				
5				
6				
7				
8				
9				

Goal Seek

Set cell: B1

To value: 500

By changing cell: $A$3

OK   Cancel

In the example to the left, Goal Seek is ready to calculate a monthly payment of $500 in cell B1 by changing the principal in cell A3.

7. Click   OK

At this point, the **Goal Seek Status** dialog box (see below) will indicate that a solution has been found; the solution will be displayed on the worksheet, but you may need to re-position the dialog box to see the answer.
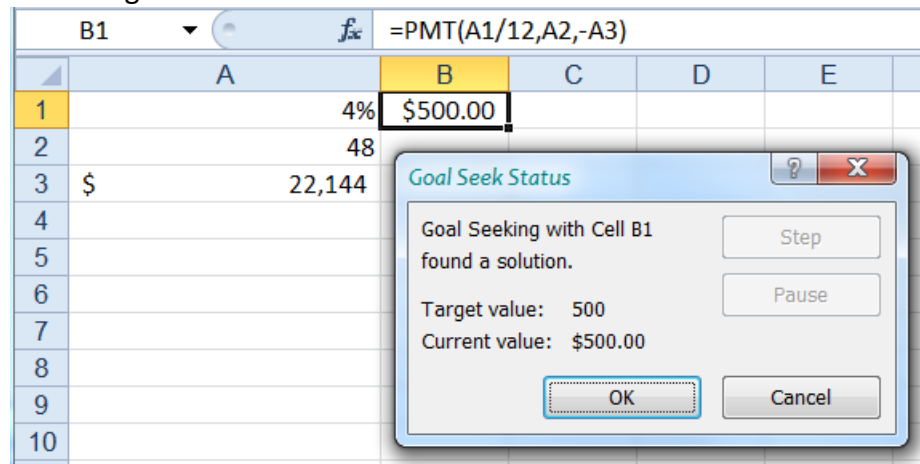
Sometimes, the dialog box will indicate that Goal Seek may not have found a solution - click **Cancel** and try different entries.

8. Click   **OK** to change the worksheet to include the goal and the altered cell.
    or
    Click   **Cancel** to leave the worksheet unchanged.

Another situation appropriate for Goal Seek is when a series of test scores are being averaged and you need to know what the next score in the ongoing series needs to be to reach a desired average.

PMT

Use the function **PMT** to calculate the monthly payment on a car or house loan.

PMT has the form: **=PMT(Rate, NPER, PV)**

Where:

Rate	Is the interest rate, expressed, for example, as 4.5%/12 to indicate the monthly rate on a 4.5% annual rate
NPER	Is the number of periods required to pay off the loan, say 4 years (48 months) for a car, 30 or 15 years (360 or 180 months) for a house. You can enter data as 360 or 30*12 to refer to a 30-year house loan
PV	Refers to Present Value – the amount you are borrowing

If used in the above manner, PMT returns the monthly payment (principal and interest included)

What is the monthly payment on a 4-year car loan of $25,000 at 4% annual interest?

=PMT(4%/12,48,20000) returns the amount -$564.48

To make the result of the PMT function positive, precede the **PV** argument with a minus sign.

SOLVER

If you want to have the result of a formula be a specific value, you can often rely on Excel's **Goal Seek** feature, which re-sets the value of another cell to an amount that adjusts a target cell. But if you'd like to set a target cell to a specific value while allowing changes to more than one cell (and at the same time keep their values within upper and lower limits), you need to use Excel's **Solver** utility.

To use Solver, you must first make sure that it is activated. You need only do this one time; thereafter, you can access Solver on the Data tab in the ribbon.

To activate **Solver:**

| 1. | Click | The **File** tab in the Ribbon |
2.	Click	**Options**
3.	Click	**Add-Ins**
4.	Click	Solver Add-in
5.	Click	The drop arrow in the box next to **Manage** and click **Excel Add-ins**
6.	Click	**Go**
7.	Check	The box next to **Solver Add-in** and click **OK**

To use **Solver** to recalculate a target value:

1.	Select	A target cell that contains a formula
2.	Click	**Solver** in the **Analysis** group on the **Data** tab
3.	Click	one of the radio buttons next to **Max**, **Min**, or **Value of**
4.	Enter	A value in the panel next to **Value of**
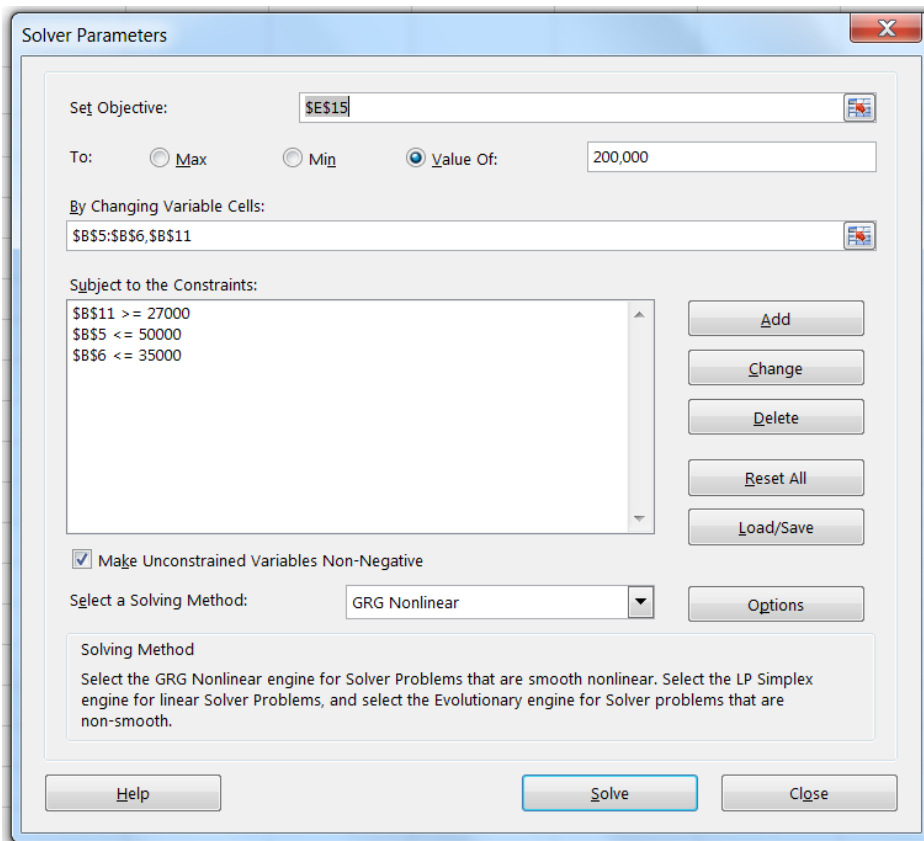
6.   Enter   A range of one or more cells in the panel next to **By Changing Cells**
7.   Click   **Add**
8.   Select   **Cell References** and type or select a cell reference;
                 select an operator; type a constraint in the Constraint panel.
9.   Click   **Add**

Repeat Steps 8 and 9 as many times as desired to list all constraints. Click **OK**
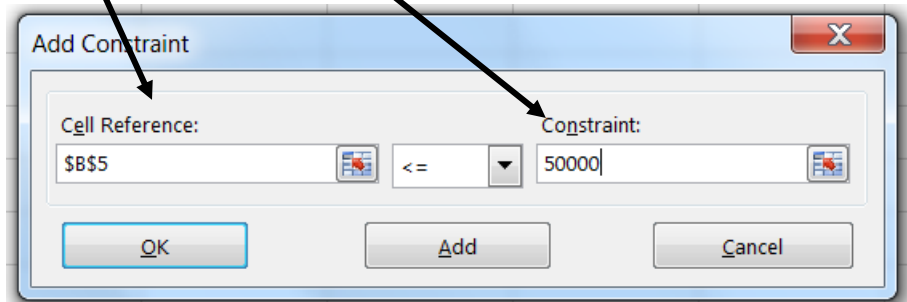
10. Click   **Solve**

When Solver finds a solution, it displays the changed worksheet and the Solver Results dialog box.
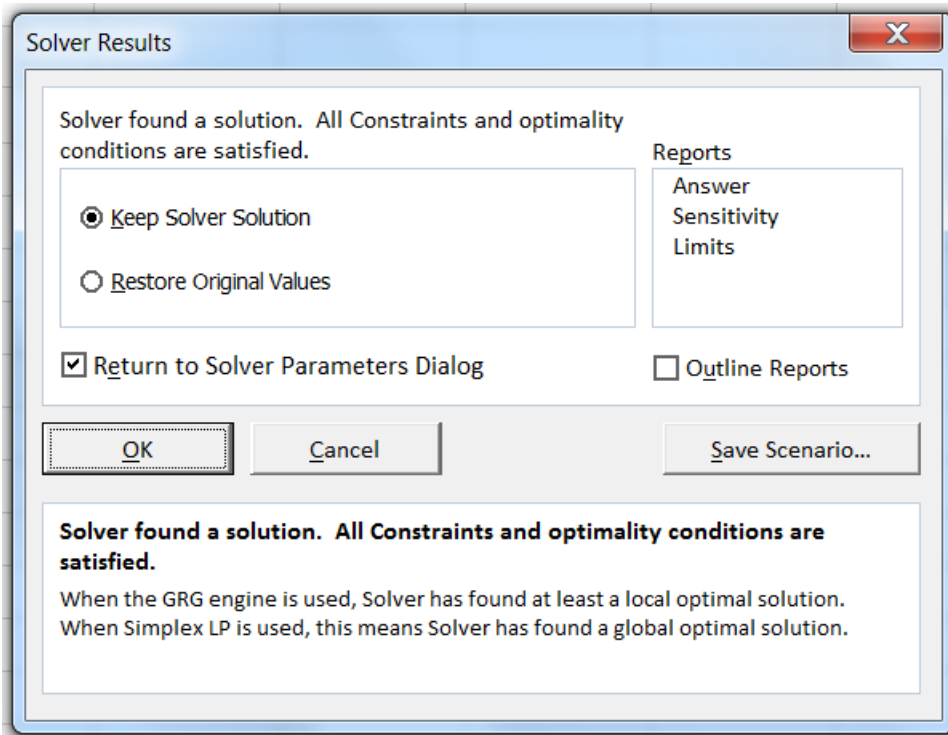
11. Select **Keep Solver Solution** or **Restore Original Values**
12. Click **Save Scenario**, if desired.
13. Click **OK**

Note: When Solver cannot find a result based on your constraints, it displays this dialog box.

Scenario Manager

Scenario Manager allows you to save the layout and conditions (including different cell contents) of different scenarios that you create.
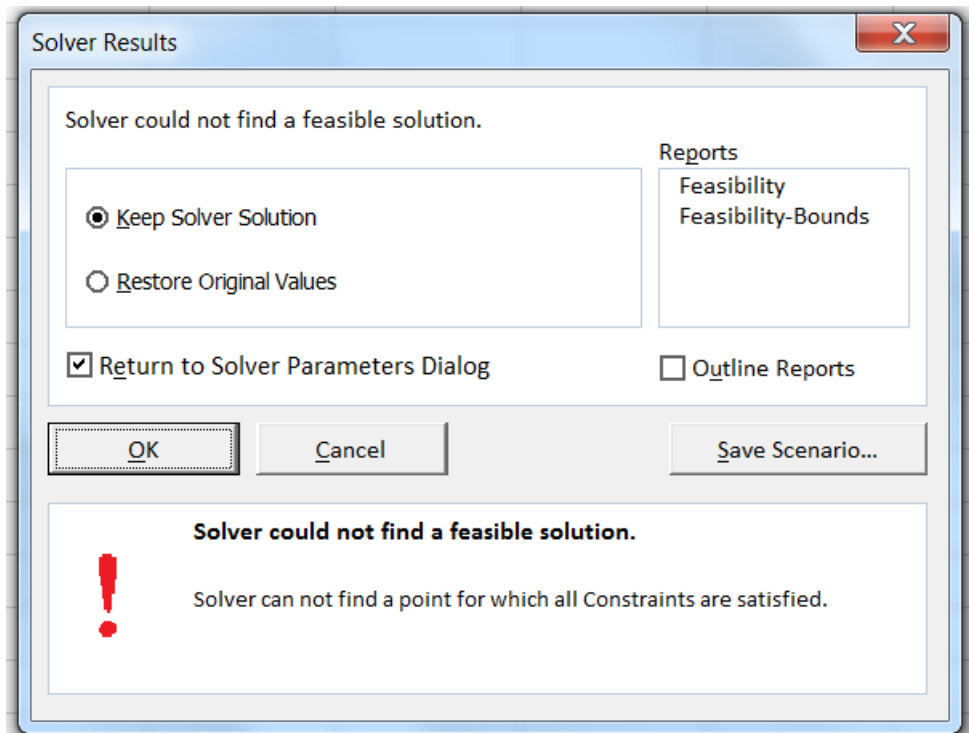
For example, you may want to have a spreadsheet model based on an optimistic set of sales figures for each of four quarters. You may also want to have two other scenarios, one using numbers based on low sales figures, another based on an average set. You would like to be able to activate any of these scenarios quickly rather than altering cell content each time you wanted to see a particular view.

Caution: if you want to be able to activate different scenarios and yet return to the state of your worksheet before you activated any of them, you should first set up a scenario with the values you want to return to.

Creating a Scenario

1. Click The **What-If** Analysis button in the **Data Tools** group of the **Data** tab
2. Click **Scenarios**
3. Type A name for the scenario in the panel next to **Scenario Name**
4. Enter An address of one or more cells where you want to set certain values.
5. Click OK

In the **Add Scenario** dialog box, you create a scenario name and identify cells to be assigned values.

	A	B	C	D	E	F
1	$ 467,728					
2		Jan	Feb	Mar	1st Q	Apr
3	**Gross Revenue**	1.0%				
4	**Sales**	$ 140,000				
5	**Shipping**	25,000				
6	Gross Revenue	165,000				
7						
8	**Cost of Goods Sold**					
9	**Goods**	$ 76,500				
10	**Freight**	1,300				
11	**Miscellaneous**	500				
12	Cost of Goods Total	78,300				
13	Gross Profit	86,700				
14						
15	**Expenses**					
16	**Advertising**	$ 18,400				
17	**Electricity**	175				
18	**Food**	200				
19	**Heat**	162				
20	**Insurance**	200				
21	**Interest**	3,800				

Scenario Manager

Scenarios:

Normal
HighSales
LowSales

Add...
Delete
Edit...
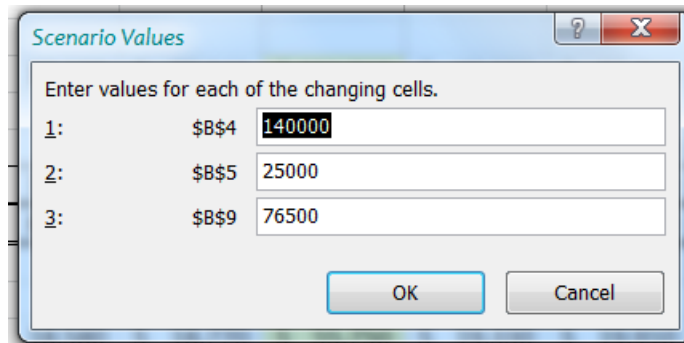Merge.
Summar

Changing cells: $B$4:$B$5,$B$9

Comment: Created by Dennis-2007 on 9/9/2013
Modified by Dennis-2007 on 9/9/2013

Show

6. Select The specific values to enter into each of the cells you selected in Step 4.

In the **Scenario Values** dialog box, enter desired values.

Scenario Values

Enter values for each of the changing cells.
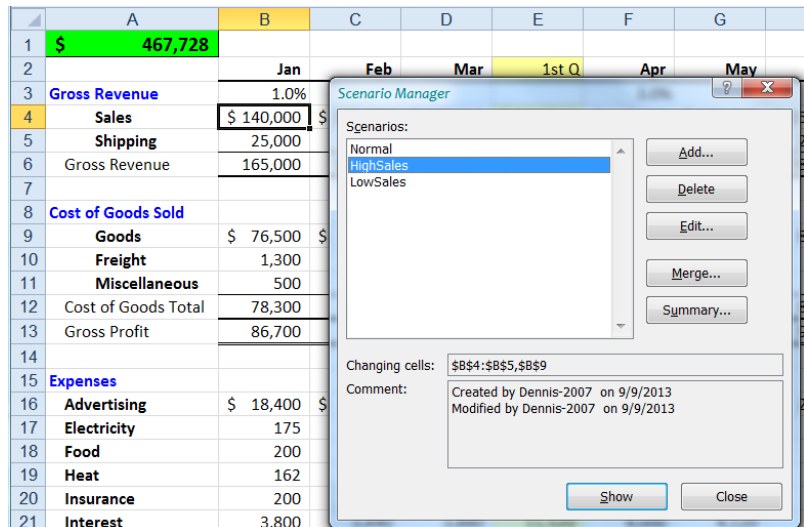
1: $B$4 `140000`

2: $B$5 `25000`

3: $B$9 `76500`

OK | Cancel

7. Click **OK**

8. Click the **Show** button to display a scenario.

In the image to the right, the **Show** button has been clicked to reveal the **High Sales** Scenario

	A	B	C	D	E	F	G
1	$	467,728					
2			Jan	Feb	Mar	1st Q	Apr	May
3	**Gross Revenue**	1.0%					
4	**Sales**	$ 140,000	$				
5	**Shipping**	25,000					
6	Gross Revenue	165,000					
7							
8	**Cost of Goods Sold**						
9	**Goods**	$ 76,500	$				
10	**Freight**	1,300					
11	**Miscellaneous**	500					
12	Cost of Goods Total	78,300					
13	Gross Profit	86,700					
14							
15	**Expenses**						
16	**Advertising**	$ 18,400	$				
17	**Electricity**	175					
18	**Food**	200					
19	**Heat**	162					
20	**Insurance**	200					
21	**Interest**	3,800					

Scenario Manager

Scenarios:

Normal
HighSales
LowSales

Add...
Delete
Edit...
Merge...
Summary...

Changing cells: $B$4:$B$5,$B$9

Comment: Created by Dennis-2007 on 9/9/2013
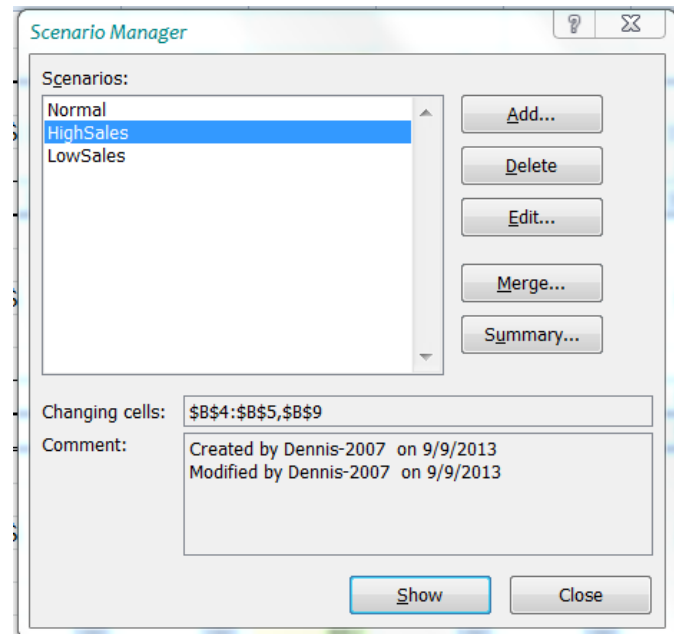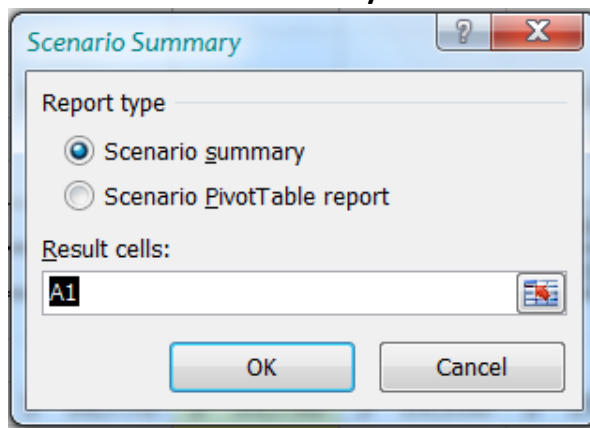Modified by Dennis-2007 on 9/9/2013

Show | Close

or

9. Click the **Close** button to return to the worksheet without switching to a different scenario.

Scenario Summary

When you have multiple summaries defined, it may be of value to see the details of the various scenarios summarized on a separate worksheet.

Creating a Scenario Summary

1. Click   The **What-If** Analysis button in the **Data Tools** group of the **Data** tab
2. Click   **Scenarios**
3. Click   The **Summary** button

4. Click   OK

The Scenario Summary (on a new worksheet named **Scenario Summary**) shows all values of changing cells for various scenarios in the current workbook.

Scenario Summary		Current Values:	Normal	HighSales	LowSales
Changing Cells:					
$B$4	$ 140,000	$ 130,000	$ 140,000	$ 120,000
$B$5	25,000	22,000	25,000	20,000
$B$9	$ 76,500	$ 76,500	$ 76,500	$ 76,500
Result Cells:					
$A$1	$ 467,728	$ 291,858	$ 467,728	$ 129,618

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

Data Tables

Data Tables allow you to set up tables containing variable in rows and columns with a master formula. They come in two forms – those with one variable and those with two variables.

A good example of a Data Table is one in which you want to evaluate varying terms and interest rates on a house or auto loan.

Data Table formulas refer to empty cells. These empty cells are then referenced as Input Cells (one for row entries, the other for column entries) when you activate the Data Table command.

To set up a two-variable Data Table to calculate monthly payments on a car loan

1. Enter   A series of interest rates in a column or row
2. Enter   A series of terms (36 mo, 48 mo, etc.) perpendicular to the column or row where you entered the interest rates.

A1		f_x	25000		
▲	A	B	C	D	E
1	$25,000.00				
2			36	48	60
3		3.500%			
4		3.625%			
5		3.750%			
6		3.875%			
7		4.000%			
8		4.125%			
9		4.250%			
10		4.375%			
11		4.500%			
12		4.625%			
13		4.750%			
14		4.875%			
15		5.000%			

3. Type   The master function or formula at the intersection of the column and row.
             For the Row entries (Row 2 above) refer to a nearby empty cell, such as C1.
             For the Column entries (Column B above) refer to a nearby empty cell, such as A2.
             In the example above, click in cell B2 and type **=PMT(A3/12,C1,-A1)**
             Cell **C1** serves as the **Row Input** cell
             Cell **A3** serves as the **Column Input** cell
             Cell **A1** contains the principal – the amount borrowed
             Note: the formula may result in an error or a blank
4. Select   The rectangular range that includes the master formula and all of the variables – B2:E15 below
5. Click   The **Data** menu
6. Click   **Table**
7. Enter   A value for the Row Input Cell – C1 below

8. Enter — A value for the Column Input Cell – A3 below

	C1	▾	fx	=PMT(A3/12,C1,-$A$1)

	A	B	C	D	E
1	$25,000.00				
2		#NUM!	36	48	60
3		3.500%			
4		3.625%			
5		3			
6		3			
7		4			
8		4			
9		4			
10		4			
11		4			
12		4.625%			
13		4.750%			
14		4.875%			
15		5.000%			

Data Table

Row input cell: $C$1

Column input cell: $A$3

OK   Cancel

9. Click — OK to see the results as shown below

	B2	▾	fx	=PMT(A3/12,C1,-$A$1)

	A	B	C	D	E
1	$25,000.00				
2		#NUM!	36	48	60
3		3.500%	732.55	558.90	454.79
4		3.625%	733.94	560.29	456.19
5		3.750%	735.32	561.68	457.60
6		3.875%	736.71	563.08	459.00
7		4.000%	738.10	564.48	460.41
8		4.125%	739.49	565.88	461.82
9		4.250%	740.88	567.28	463.24
10		4.375%	742.28	568.68	464.66
11		4.500%	743.67	570.09	466.08
12		4.625%	745.07	571.50	467.50
13		4.750%	746.47	572.91	468.92
14		4.875%	747.87	574.32	470.35
15		5.000%	749.27	575.73	471.78

Using the IF function & relational operators

The **IF** function provides alternate answers, depending upon the results of a condition.

The generic form of the function is: **=IF(condition,true,false)**

In the simplest form of this function, there are three arguments:

1. A condition to be tested
2. The result if the tested condition is true
3. The result if the tested condition is false

The condition is a logical expression, indicating some kind of comparison. Comparisons between the following kinds of data are possible:

Comparison Type	Example
Cells and values	**B2>10**
Cells and formulas	**B2<(C3*7)**
Cells and functions	**B2=SUM(P2:P6)**
Cells and text strings	**B2="Sell "**
Formulas and Values	**B2/6>=100**
Functions and Values	**SUM(H6:H12)<50**
Functions and formulas	**AVERAGE(G3:H8)>(Q6*R5)**

The true or false portions of the statement can be values, cell locations, formulas, functions, or any combination of these types of entries; the true or false result might also be a text string enclosed in quotes.

Type **IF** functions in the worksheet cells where you want the results to appear.

Relational Operators

Use these relational operators in building an **IF** statement condition:

=	Equal to
>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
<>	Not equal to

> When using operators consisting of two symbols, (such as >= or <>) you must use the symbols in the same left to right order as seen in the list shown to the left.
>
> i.e.   use **B2>=7**
>   not **B2=>7**

Examples:
=IF(A2<=9,10%,20%)   or   =IF(A2<=9,.1,.2)
If A2 is less than or equal to 9, the result is **10%**, otherwise, the result is **20%**

=IF(A2>100,150,75%)

If A2 is greater than 100, the result is **150** otherwise, it is **75%**

=IF(A2>10,B3*2,B6*2)

If A2 greater than 10, result is **B3*2**, otherwise, it is **B6*2**

Note: this function does not alter cells B3 or B6

=IF(A2=10,10%,20%)*B4

If A2 is equal to 10, the result is **10%*B4**, otherwise, the result is **20%*B4**

Note: this function does not alter the content of cell B4

=IF(A2<>1, "Match", "Fail")

If A2 is not equal to 1, the result is the text string **<u>Match</u>**, otherwise, the result is the text string **<u>Fail</u>**

Notice that when you use text strings (like the words **Match** and **Fail** above), they must be embedded in double quotes.

If you want one of the results in an IF statement to appear blank, use the double quotes twice, with no space between them;   ""   This is referred to as a null string.

Logical Functions and the IF function

You can use logical functions (actually functions in their own right) nested in **IF** functions:

=AND   Check to see if **all** of two or more conditions are true:
AND(A4="B",B7>10)
AND(J7=1,K3=5,M3>0)
The conditions are true only if **<u>all</u>** arguments are true.

=OR   Check to see if **any** of two or more conditions are true:
OR(B3="Q",B4= 6)
OR(J7>5,K3>5,L3>5)

The condition is true when **<u>any</u>** of the arguments is true.

=NOT   Used to negate a condition; the result is true when the condition is false. Use this operator carefully to avoid unwieldy or unclear construction.
NOT(J7>B5)

Examples: **=IF(OR(A3=7,D3=5)), 100, 50)**
If A3 equals 7 **or** D3 equals 5, the result is 100, otherwise the result is 50

=IF(AND(B6= "A", B7 = "B"), 100, 50)
If B6 equals A **and** B7 equals B, the result is 100, otherwise the result is 50

You can use **AND** and **OR** in the same **IF** statement, but it may be difficult to write and test the statement. *Can another person figure out what you have written?*

=IF(OR(A3=7,AND(B3=5,D3=5)),"Bonus", "Nothing")
If A3 equals 7 or both B3 and D3 equal 5, the result is the string **Bonus**, otherwise the result is the string **Nothing**).

=IF(AND(A3=7,OR(B3=5,D3=5)),"Bonus", "Nothing")
If A3 equals 7 and either B3 or D3 equals 5, the result is the string **Bonus**, otherwise the result is the string **Nothing**).

Nested IF Statements

You sometimes need to have more than two possible results in an **IF** statement. You can do this by making either the true or the false result itself be another **IF** statement.

> **=IF(condition1,true,if(condition2,true,false))**
> **=IF(condition1,if(condition2,true,false),false)**

When you attempt to handle more than three results in an **IF** statement, it may be more efficient to use the **VLOOKUP**, or **CHOOSE** function, as explained in the next sections.

Examples:
=IF(B3>7,"HIGH",IF(B3>4,"MIDDLE","LOW"))
If B3 is greater than 7, the result is the string **HIGH,**
if B3 is greater than 4 (but less than or equal to 7) the result is **MIDDLE**,
otherwise the result is **LOW**.

=IF(D4>=40000,30%,IF(D4>=25000,20%,10%)
If D4 is greater than or equal to 40000, then the result is 30%;
if D4 is greater than or equal to 25000 (but less than 40000) the result is 20%, otherwise the result is 10%.

Observe these general guidelines that apply to the **IF** function as well as to other functions:
- Spaces may follow commas or equal signs
- Type any characters you want between the set of double quotes in text strings.
- Capitalization of function names and cell references is not required.
- A closing paren) is not required when there is a single set of parentheses and a closing paren would terminate the function. For example, when you type:

    =IF(A1>100,1,2   or   **=AVERAGE(D3:D12**

    and press enter, the functions will be entered correctly.

- When multiple sets of parentheses are used, you must type all open and close parentheses.