

Excel for Cost Engineers

Tips, Tricks & Techniques

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Index

• Errors	3	• Absolute Cell Ref	17
• Basics	5	• Reveal Formulas	18
• Tab Colors	6	• Formula Description	19
• Data Validation	7	• Rounding	20
– <i>Drop Down Lists</i>	8	• Automatic Rounding	21
– <i>Information Messages</i>	9	• Conditional Formatting	22
– <i>Error Messages</i>	10	• Exporting Data	23
– <i>Protect Formulas</i>	11	• Subtotal	24
• VLookup	12	• Autofilter	25
• Named Ranges	13	• Conversions	26
• Join Cell Values	14	• IF Functions	27
• Separate Values	15	• Custom Functions	28
• Go-To	16		

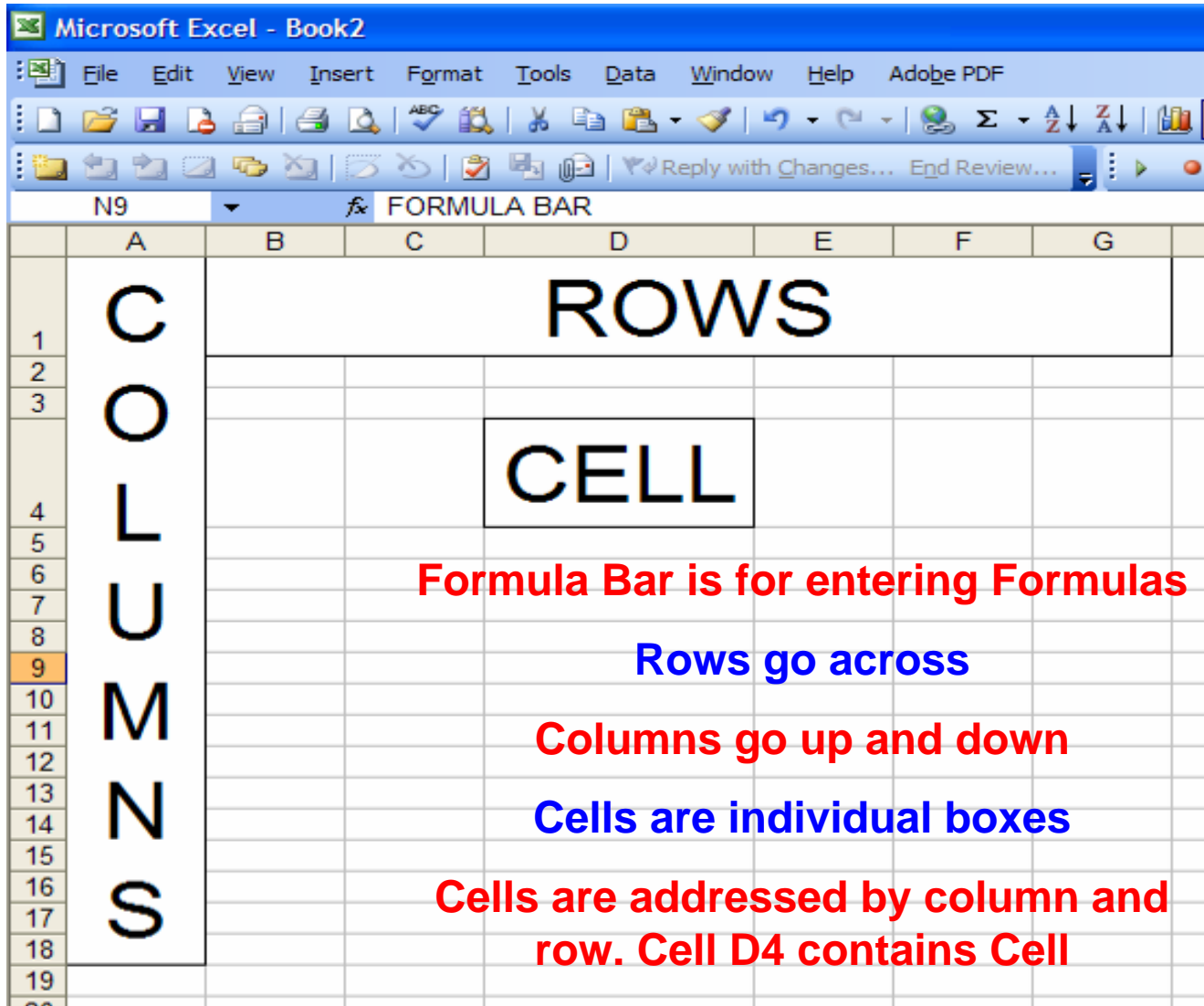
Spreadsheet Errors

- Spreadsheet formula cells containing errors
 - 2-5% experts
 - 6-15% novices
 - Comparable to software code errors @ 5% in thousands of inspections
 - Study included spreadsheets in use for some time
 - Individuals can find only 50-60% of them
 - Author finds less errors than others, immediately after creation
 - Finds more errors than others after reviewing a week after creation
 - Teams increases rate to ~80%
 - Error checking & testing requires ~ 1/3 of the development time
- According to expert audits
 - 94% of all spreadsheets inspected contain significant errors
 - Significant = affects final value by 5% or more

Spreadsheet Error Types

- Three primary types
 - Simple Mistakes
 - Spelling
 - Incorrect Cell Reference
 - Most likely when referencing data in both different columns and rows
 - Logic Errors
 - Incorrect formula as result of mistake in reasoning
 - Generally more logic errors than simple mistakes
 - Omissions
 - Items left out of spreadsheet, that should have been included
 - Most difficult to detect

The Basics



The screenshot shows the Microsoft Excel interface. The title bar reads "Microsoft Excel - Book2". The menu bar includes File, Edit, View, Insert, Format, Tools, Data, Window, Help, and Adobe PDF. The toolbar contains various icons for file operations and editing. The formula bar shows "N9" and "FORMULA BAR". The spreadsheet grid has columns labeled A through G and rows numbered 1 through 19. The word "COLUMNS" is written vertically in column A. The word "ROWS" is written horizontally across row 1. The word "CELL" is written inside a box in cell D4. Several text annotations are present in red and blue:

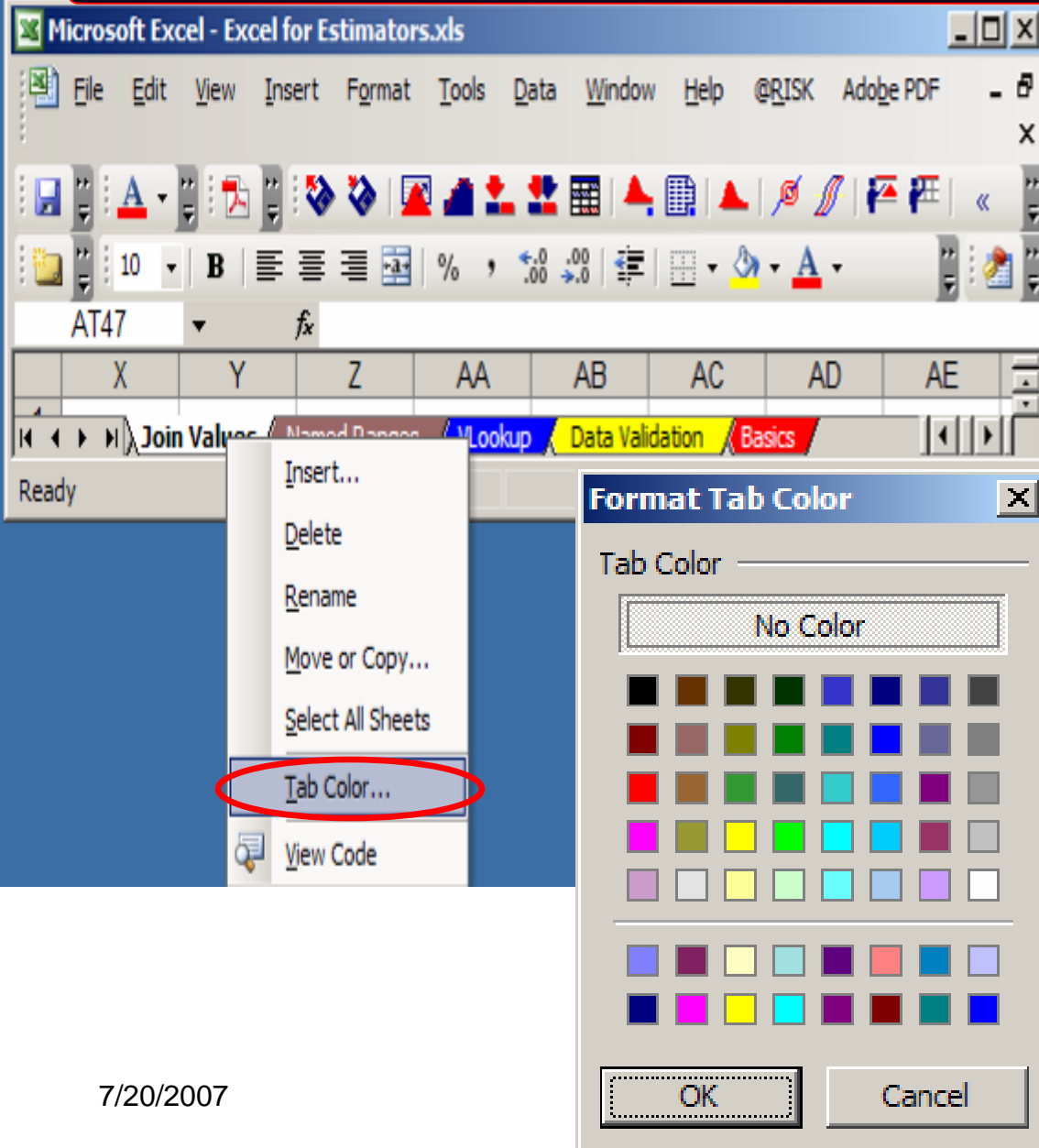
- Formula Bar is for entering Formulas** (red text)
- Rows go across** (blue text)
- Columns go up and down** (red text)
- Cells are individual boxes** (blue text)
- Cells are addressed by column and row. Cell D4 contains Cell** (red text)

The Basics

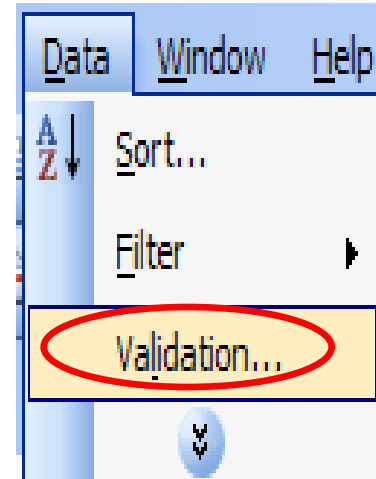
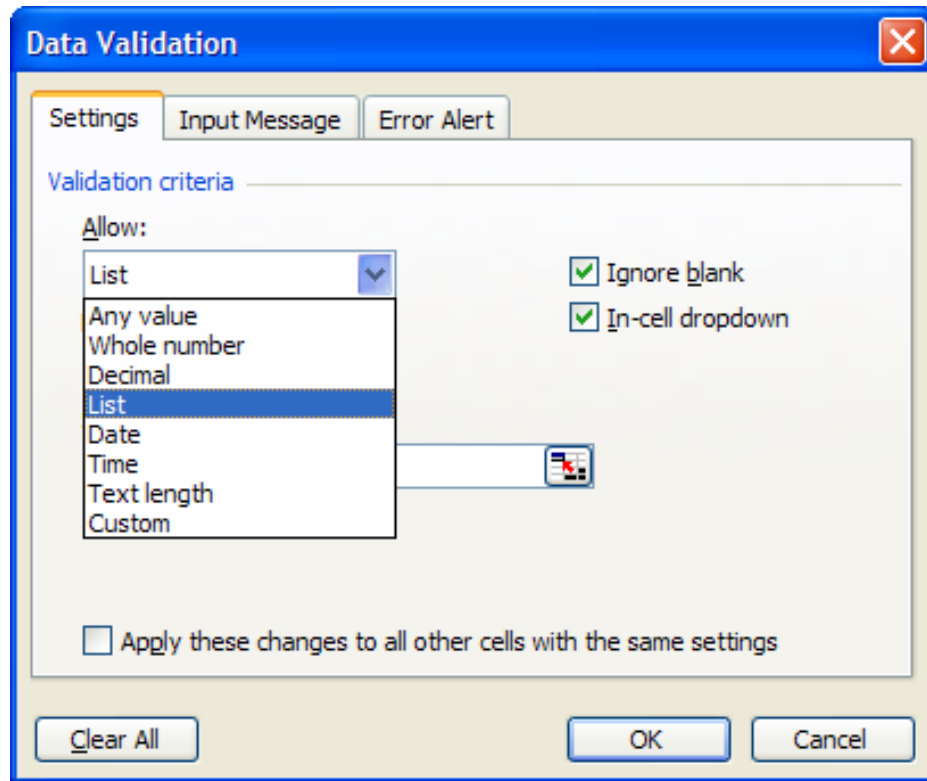
- Formulas declared with the = sign.
- Operators are
 - Plus +
 - Minus -
 - Times *
 - Divide /
 - Exponent ^
 - Brackets define order of operation ()
- Example =2*2 would show 4 in the cell

Tab Colors

- **Right Click on Tab**
 - Helps organize workbooks



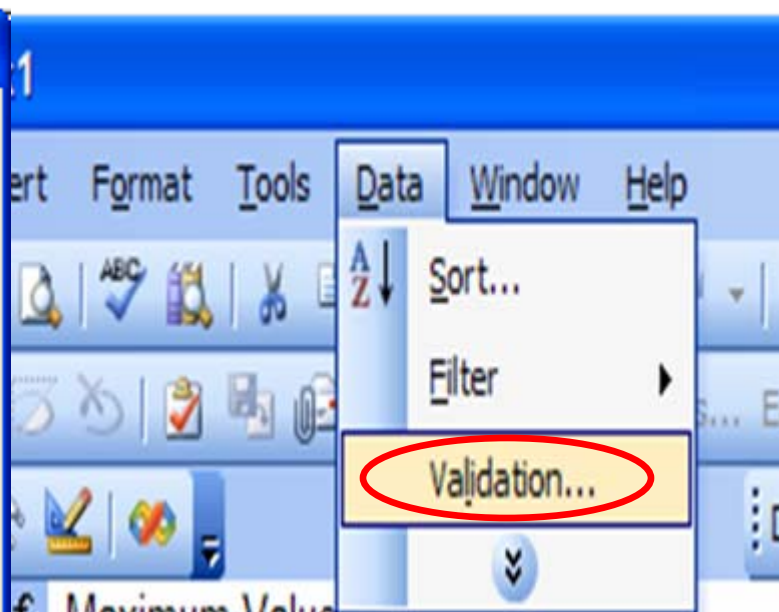
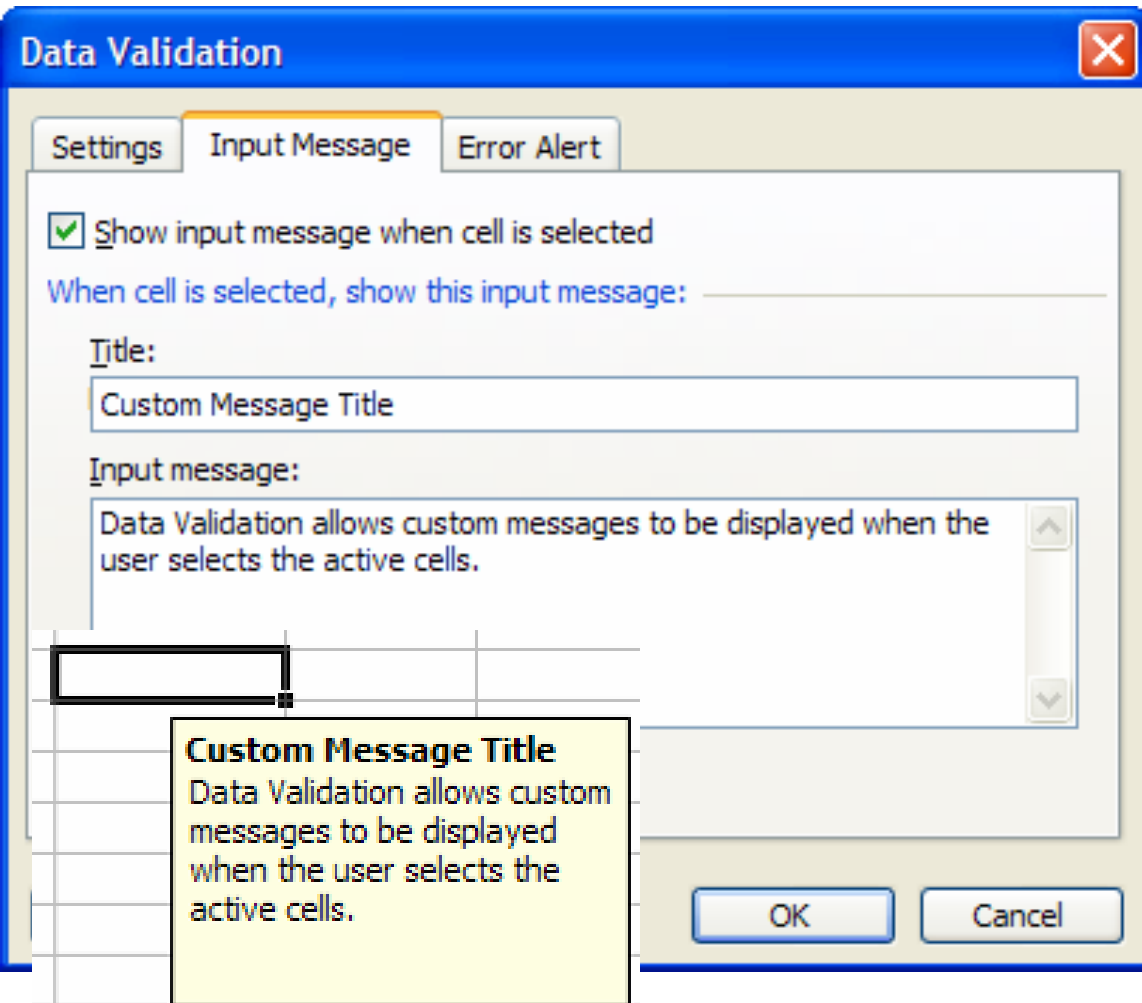
Data Validation – Drop Down Lists



- **Data validation uses**
 - Limit user inputs
 - Protect Formulas
 - Custom Messages
 - **Drop down lists**
 - Cell Range
 - Named Range

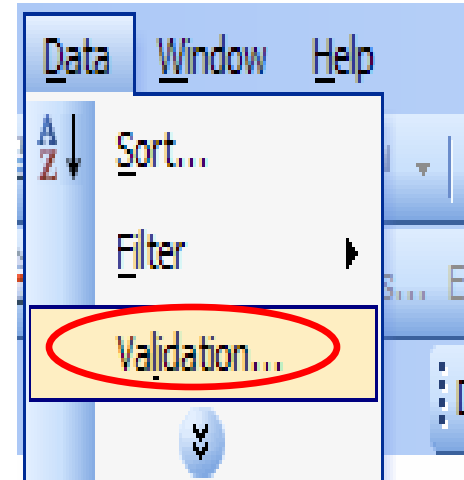
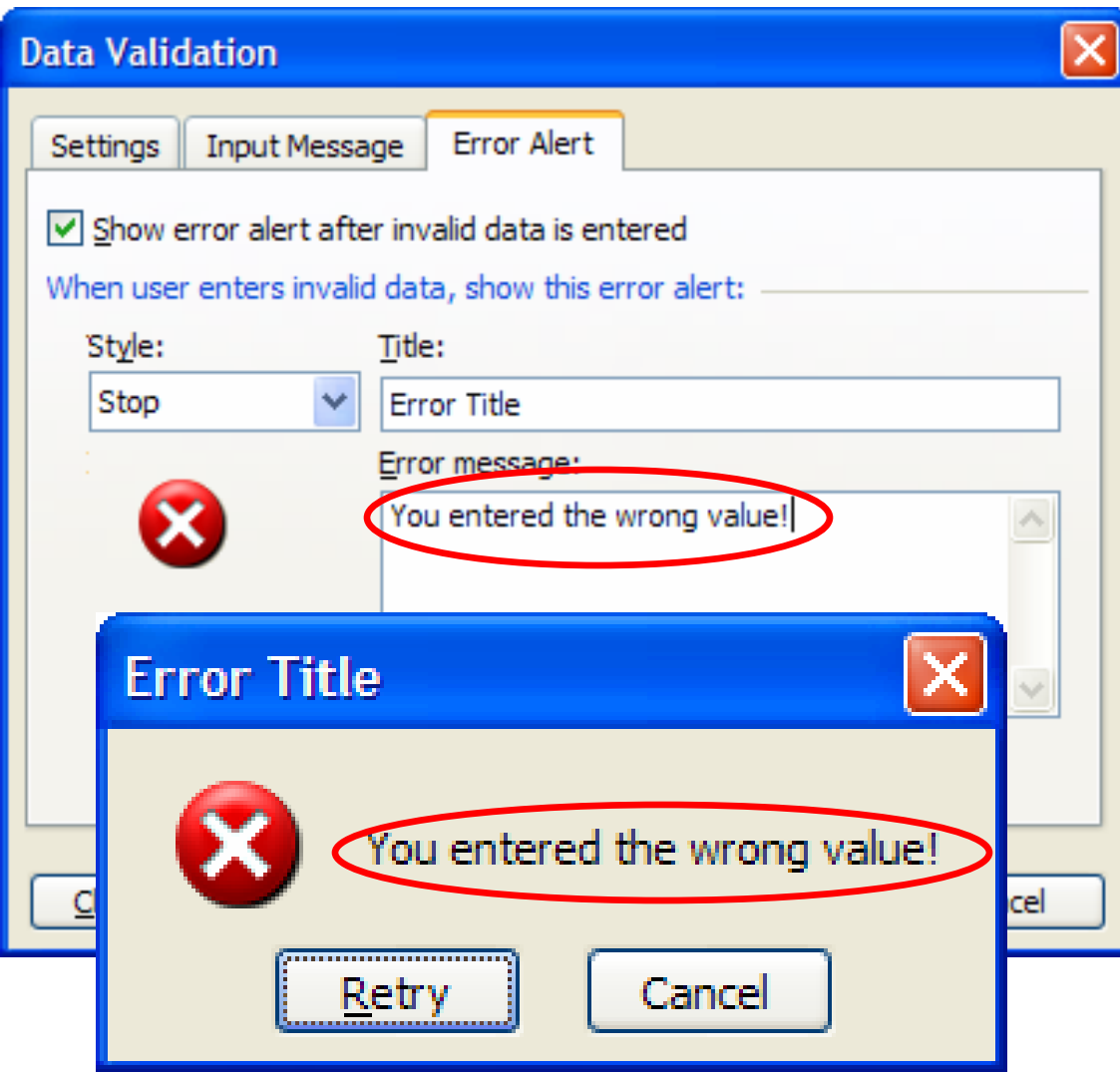
	A	B	C	D
1				
2	Site Development Required	Minimal		Minimal
3		Minimal		Average
4		Average		Above Avg
5		Above Avg		New Site
6		New Site		

Data Validation – Information Messages



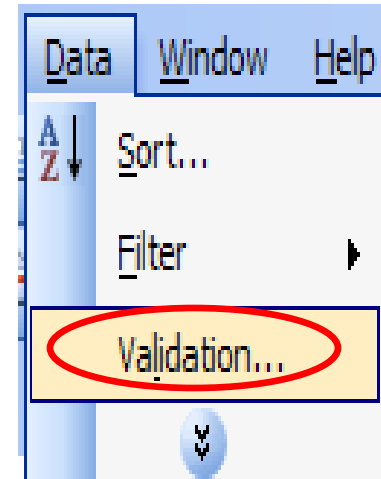
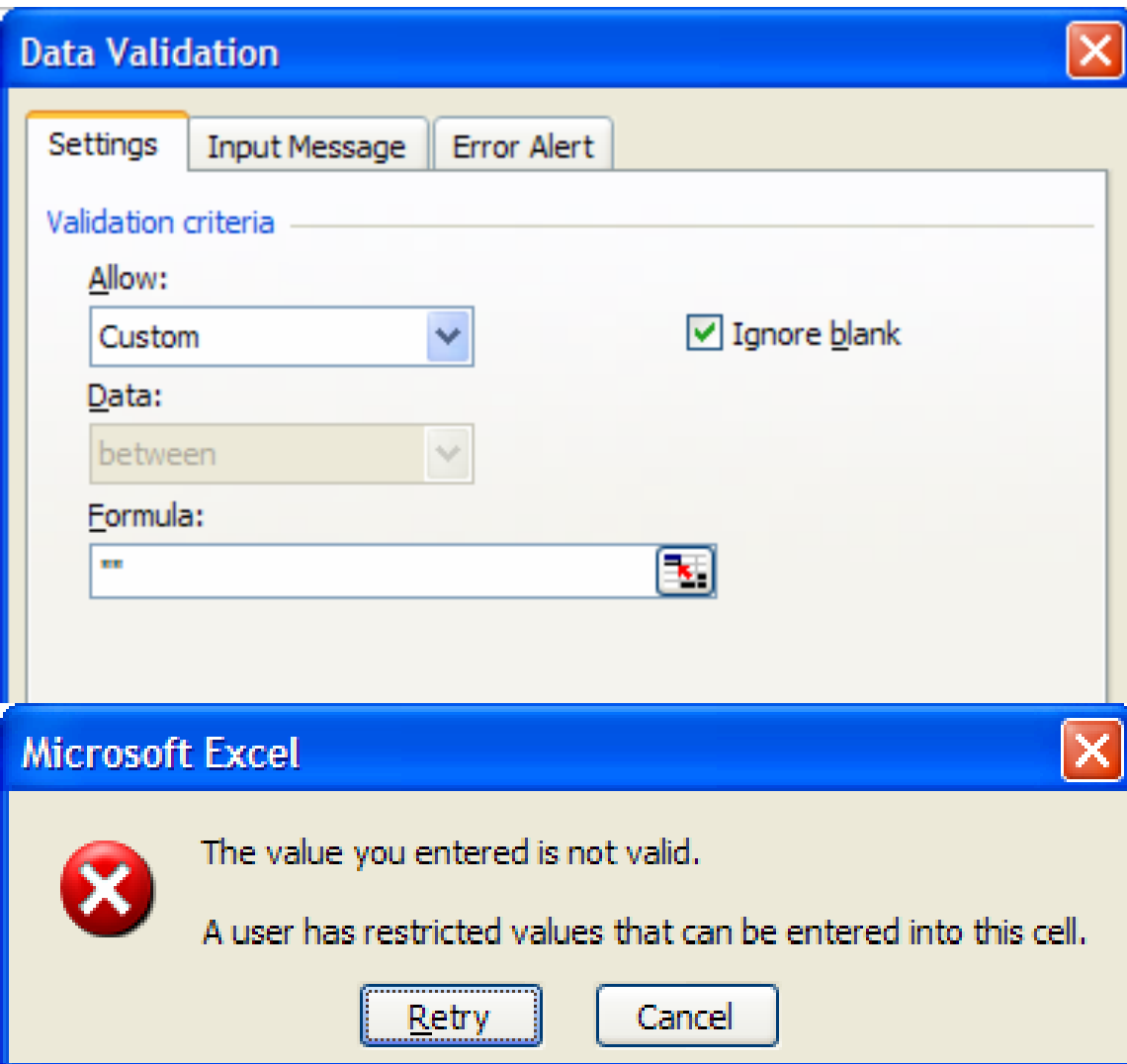
- **Data validation uses**
 - Limit user inputs
 - Protect Formulas
 - **Custom Messages**
 - Drop down lists
 - Cell Range
 - Named Range

Data Validation – Error Messages



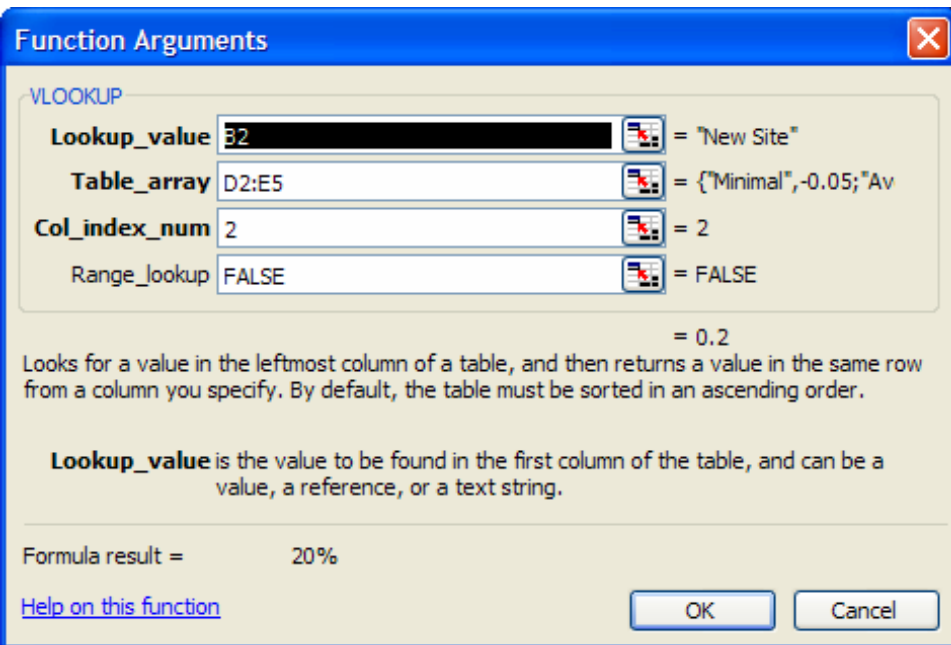
- **Data validation uses**
 - Limit user inputs
 - Protect Formulas
 - **Custom Messages**
 - Drop down lists
 - Cell Range
 - Named Range

Data Validation – Protect Formulas



- **Data validation uses**
 - Limit user inputs
 - Protect Formulas
 - Custom Messages
 - Drop down lists
 - Cell Range
 - Named Range

VLookup (Vertical Lookup)



Great for automating spreadsheets, automatically applying cost escalation indexes, cost factors, etc.

- Lookup_value, is the cell value that you want to lookup from your list
- Table_array, is the address of the list that you want to look in
- Col_index_num, is the column number that the answer will come from.
- Range_lookup, is optional, and True requires an Exact match, False does not require an exact match.

	A	B	C	D	E
1				Item to be Looked Up	Lookup Value
2	Site Development Required	New Site	20%	Minimal	-5%
3		Minimal		Average	0%
4		Average		Above Avg	10%
5		Above Avg		New Site	20%
6		New Site			

**HLookup (Horizontal Lookup)
Comparable Function**

Named Ranges

- Named Ranges Can Be
 - Individual Cell
 - Group (Cell Range)
- Select cells - name in Name Box
 - Spaces not allowed
 - Can be referenced in formulas
=Sum(SF_Costs)
 - Found by setting zoom to any percentage lower than 40%.

Name Box

	A	B	C	D
1				
2				
3				
4	SF Costs			
5	202			
6	190			
7	150			
8	170			
9	195			
10	210			

Named Range

Joining Cell Values

- **Concatenate (Joining Cell Values)**

- Cells values can be jointed together with

- =A1&A2

- If space needed between cell values

- =A1&" "&A2

	A	B
1	New	NewOffice
2	Office	New Office

- **Or** Concatenate function can be used

- =CONCATENATE(B6," ",C6," ",," ",A6," ",D6," ",E6," ",F6)

	A	B	C	D	E	F
6	Office	New	Concrete	Bldg	26000	SF
7	New Concrete Office Bldg 26000 SF					

Separating Cell Values

- Values can be separated with formulas.
- Remove the first value from a cell.

Mary	Mary had a little lamb
=LEFT(B3,FIND(" ",B3)-1)	Mary had a little lamb

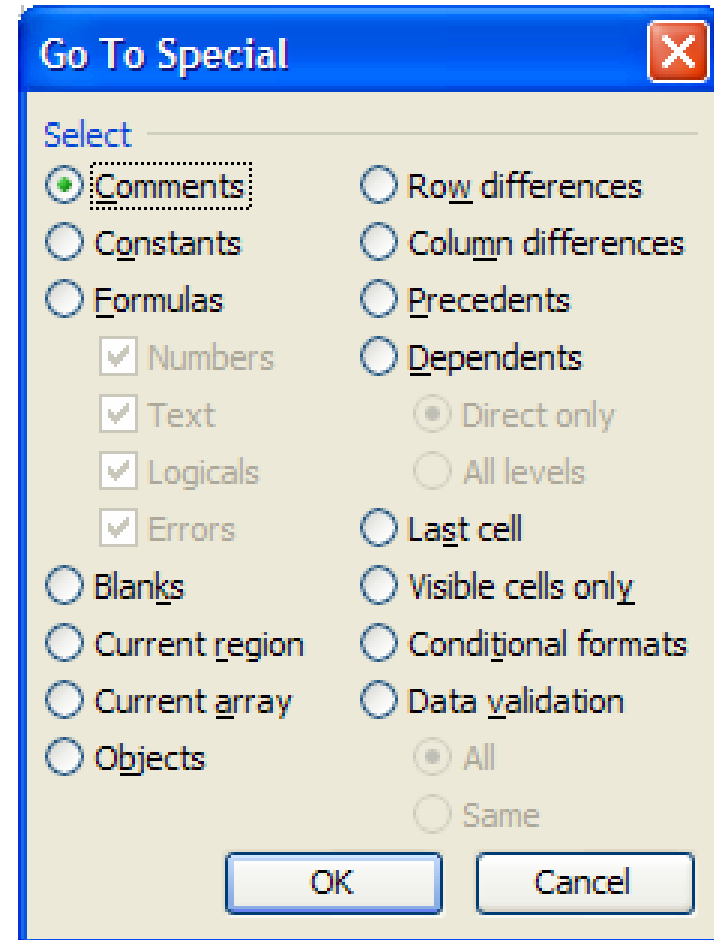
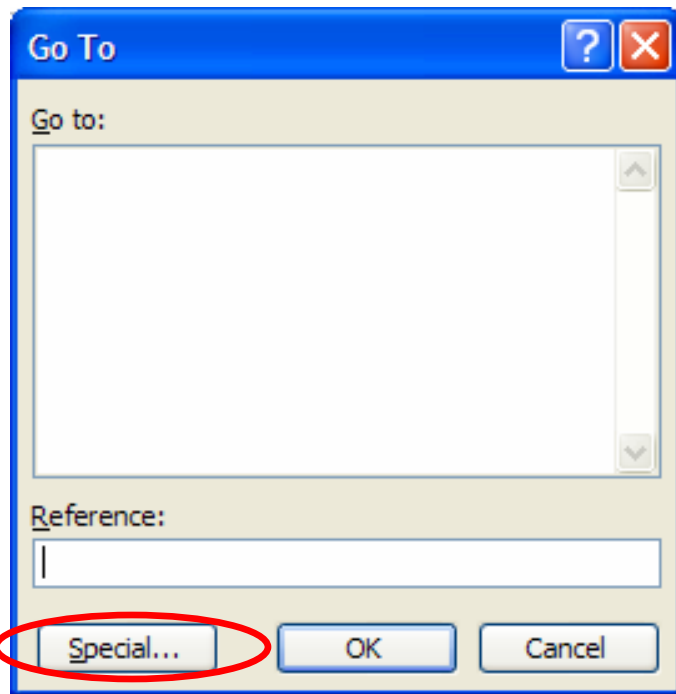
- Remove last value.

Mary had a little lamb	lamb
Mary had a little lamb	=RIGHT(B3,LEN(B3)-FIND(" ",SUBSTITUTE(B3," ","*",LEN(B3)-LEN(SUBSTITUTE(B3," ","*")))))

- Many other combinations possible.

Go To Special

- **Go To Special can be with F5 Key**
 - Little known, occasionally very useful
 - Selects all worksheet cells that contain the selected criteria, when selected they can be color coded for easy identification, or selected on a one by one basis.



Absolute Cell References

- Cell references are typically defined as =A1*A2.
- Works fine unless formula is copied to another location. If this happens the cell references will change unless **Absolute Cell References** are used.
 - =\$A\$1 will always refer to cell A1 regardless where the reference is copied
 - =\$A1 will always refer to Column A, but row is allowed to shift
 - =A\$1 will always refer to Row 1 but column is allowed to shift

1	=A1	=\$A\$1	=\$A1
2	=A2	=\$A\$1	=\$A2
3	=A3	=\$A\$1	=\$A3
4	=A4	=\$A\$1	=\$A4
5	=A5	=\$A\$1	=\$A5

Reveal Formulas

- Formulas on a worksheet revealed by depressing **Ctrl `**
- Will revert back by depressing **Ctrl `** again.

\$ 186	Average Value
\$ 210	Maximum Value
\$ 150	Minimum Value
SF Costs	
\$ 202	
\$ 190	
\$ 150	
\$ 170	
\$ 195	
\$ 210	

=SUBTOTAL(1,\$A\$4:\$A\$17)	Average Value
=SUBTOTAL(4,\$A\$4:\$A\$17)	Maximum Value
=SUBTOTAL(5,\$A\$4:\$A\$17)	Minimum Value
SF Costs	
202	
190	
150	
170	
195	
210	

Formula Descriptions

- Typical Excel formula would be
=Average(A10:A100)*A1
- Gives no indication of what formula does.
- Descriptions can be added **if** proper format is used.
- N function returns value of 0 for any values.
 - Will not interfere with this calculation.

186.17

=AVERAGE(A6:A12)+N("Square Foot Costs")*5000+N("New Project Size")

Rounding

- Estimates can be rounded with the formulas
 - =Round(A1,-1)

9,555,455	9,555,460	=ROUND(B1,-1)
9,555,455	9,555,500	=ROUND(B2,-2)
9,555,455	9,560,000	=ROUND(B3,-4)
9,555,455	9,600,000	=ROUND(B4,-5)
9,555,455	10,000,000	=ROUND(B5,-6)

- = INT rounds number down to the nearest integer
- = EVEN rounds a positive number up & negative numbers down
- = Roundup rounds number up away from zero
- = Rounddown rounds number down, toward zero

Automatic Rounding

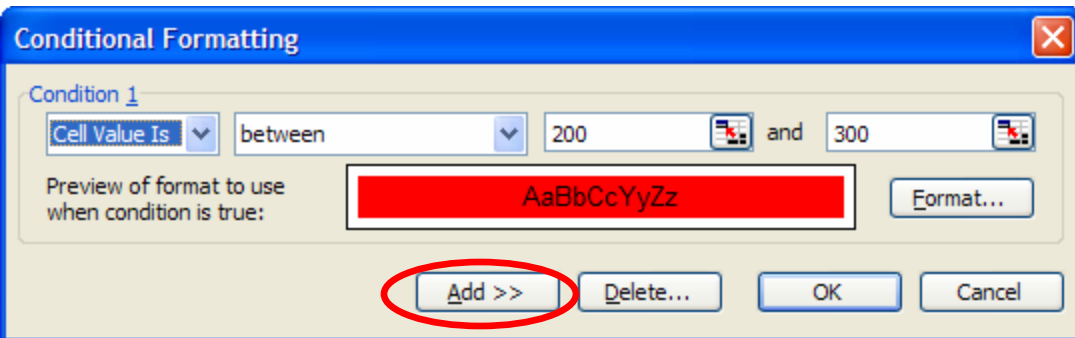
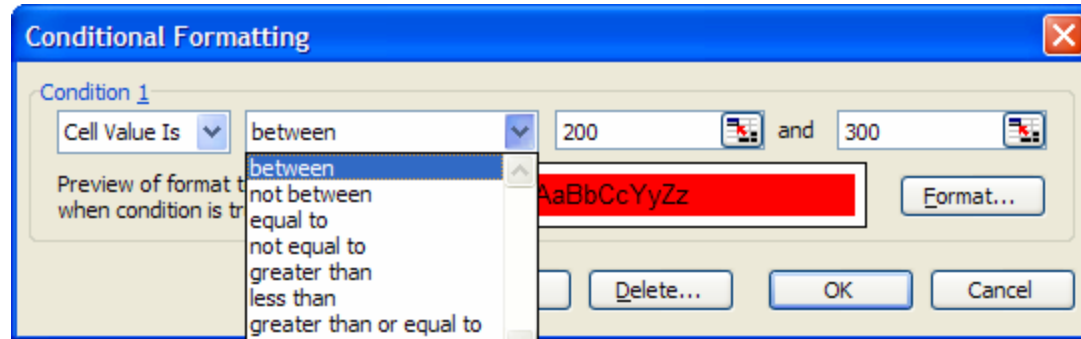
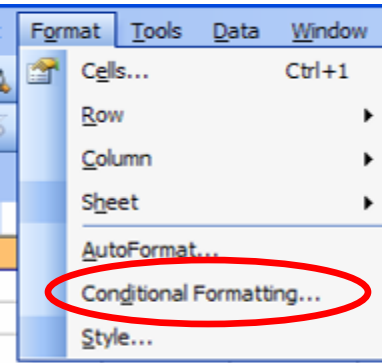
- Estimates can be rounded with the formula
- Or automatically rounded using
 $=1.5-\text{Log}(A2)$

Great for
Templates

Original Value	Log Formula $=1.5-\text{LOG}(A2)$	Rounding Formula $=\text{ROUND}(A2,B2)$
97	-0.487	97
978	-1.490	980
9,778	-2.490	9,800
97,778	-3.490	98,000
977,778	-4.490	980,000
9,777,778	-5.490	9,800,000
97,777,778	-6.490	98,000,000
977,777,778	-7.490	980,000,000
9,777,777,778	-8.490	9,800,000,000
97,777,777,778	-9.490	98,000,000,000
977,777,777,778	-10.490	980,000,000,000

Conditional Formatting

- Many choices, & up to three conditions can be entered.
- Can be copied with format painter.



Results

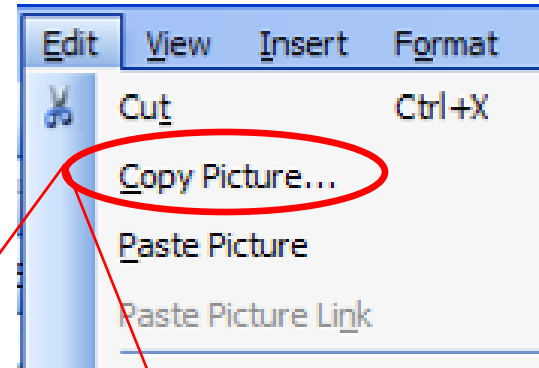
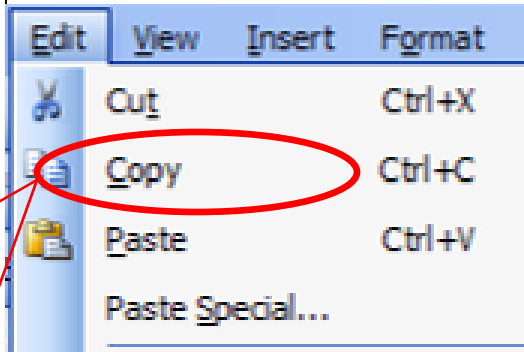
\$	202
\$	190
\$	150
\$	170
\$	195
\$	210

Exporting Data

- Data sometimes does not copy well from Excel.
- Press Shift button before selecting Edit menu, options change.

\$ 186	Average Value
\$ 210	Maximum Value
\$ 150	Minimum Value
SF Costs	
\$ 202	
\$ 190	
\$ 150	
\$ 170	
\$ 195	
\$ 210	

Copy Results



\$ 186	Average Value
\$ 210	Maximum Value
\$ 150	Minimum Value
SF Costs	
\$ 202	
\$ 190	
\$ 150	
\$ 170	
\$ 195	
\$ 210	

Copy Picture Results

\$ 186	Average Value
\$ 210	Maximum Value
\$ 150	Minimum Value
SF Costs	
\$ 202	
\$ 190	
\$ 150	
\$ 170	
\$ 195	
\$ 210	

Subtotal Function

- Subtotal functions very useful.
- Multiple Subtotals ignored by other Subtotals.

SF Cost	
Office	\$ 200
Office	\$ 200
Subtotal	\$ 200
Warehouse	\$ 100
Warehouse	\$ 100
Total	\$ 600

Function_num

- 1 AVERAGE
- 2 COUNT
- 3 COUNTA
- 4 MAX
- 5 MIN
- 6 PRODUCT
- 7 STDEV
- 8 STDEVP
- 9 SUM
- 10 VAR
- 11 VARP

Function Arguments

SUBTOTAL

Function_num = 4

Ref1 \$A\$4:\$A\$17 = {"Price";200;50;500;}

= 900

Returns a subtotal in a list or database.

Function_num: is the number 1 to 11 that specifies the summary function for the subtotal.

Formula result = 900

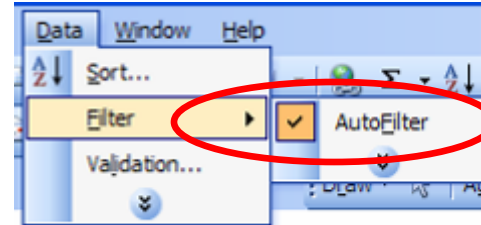
[Help on this function](#)

OK Cancel

SF Cost	
Office	200
Office	200
Subtotal	=SUBTOTAL(9,B22:B23)
Warehouse	100
Warehouse	100
Total	=SUBTOTAL(9,B19:B23)

AutoFilter

- Great for
 - Finding Info
 - Quick Calculations



	A	B
1	\$ 186	Average Value
2	\$ 210	Maximum Value
3	\$ 150	Minimum Value
4	\$ 23	Standard Deviation
5		
6	SF Cost	Description
7	\$ 202	Sort Ascending
8	\$ 190	Sort Descending
9	\$ 150	(All)
10	\$ 170	(Top 10...)
11	\$ 195	(Custom...)
12	\$ 210	Office
13		Office/Warehouse
		Warehouse

\$ 206	Average Value
\$ 210	Maximum Value
\$ 202	Minimum Value
\$ 6	Standard Deviation
SF Cost	Description
\$ 202	Office
\$ 210	Office

Space Needed

Unit Conversion

• Excel “Add In” Function

• Weight

• Mass

• Distance

• Time

• Pressure

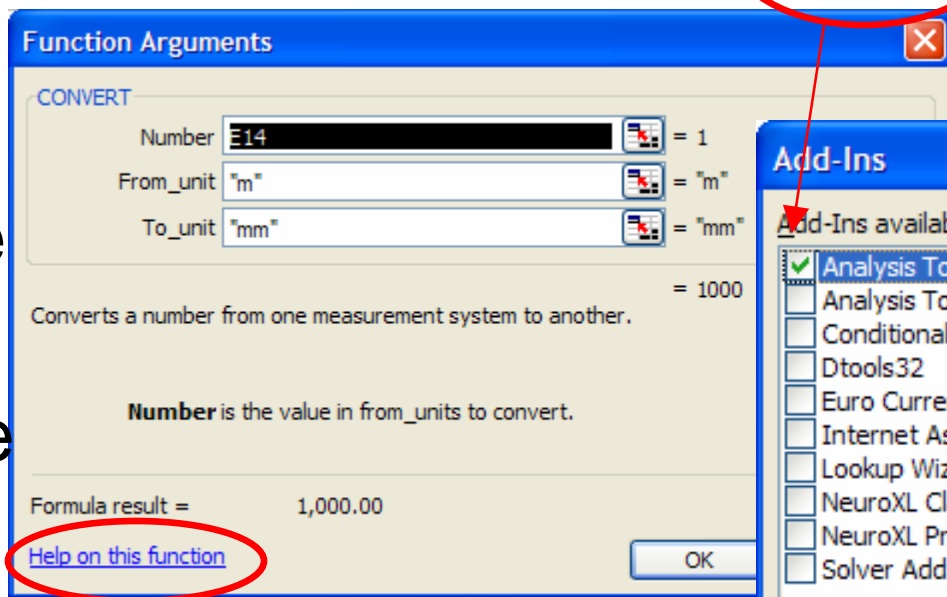
• Force

• Energy

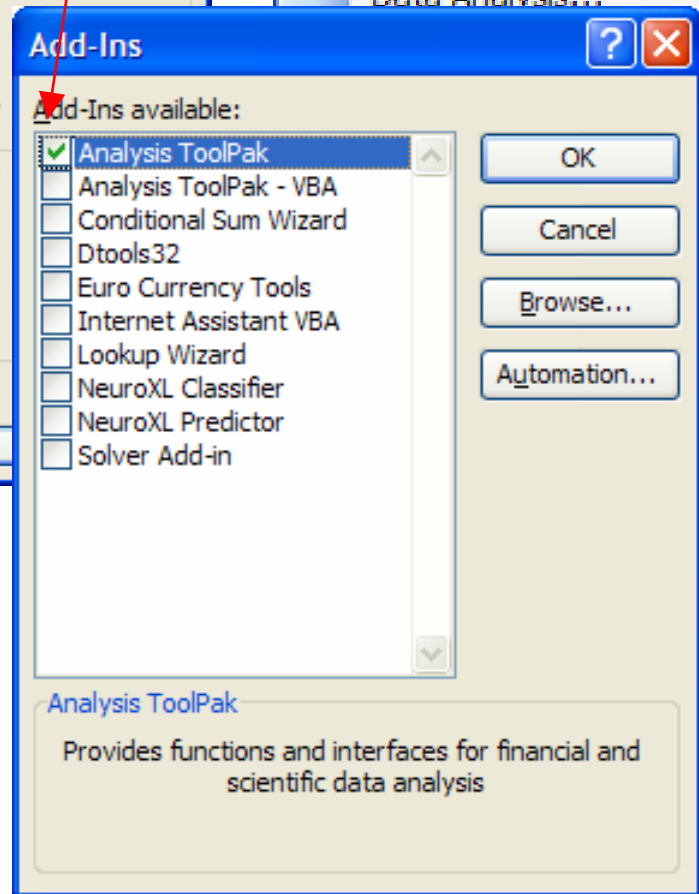
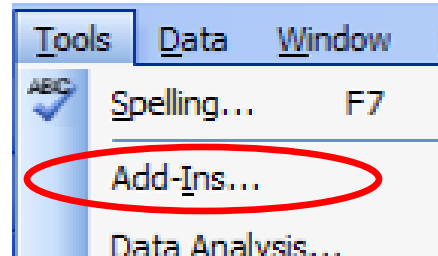
• Power

• Temperature

• Liquid Measure



Must Be Checked



IF Function

- IF Functions have many uses

- Can Be Nested

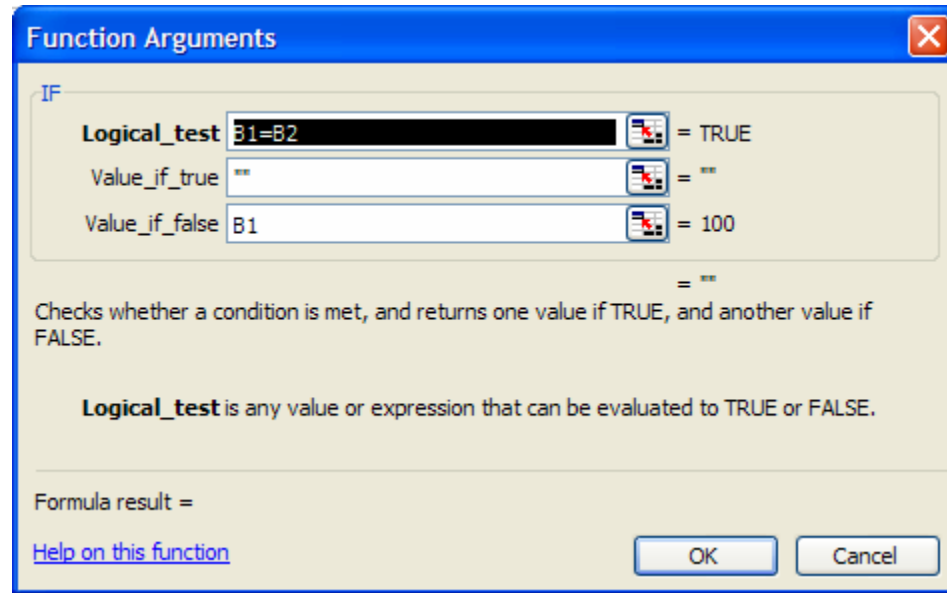
- Works on Text or Numbers

- Can be used to Eliminate #Ref, #Value, or #Div/0

```
0  
#DIV/0!  
=IF(F3>1, F3/G3,0)
```

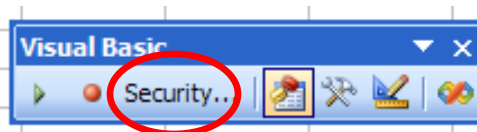
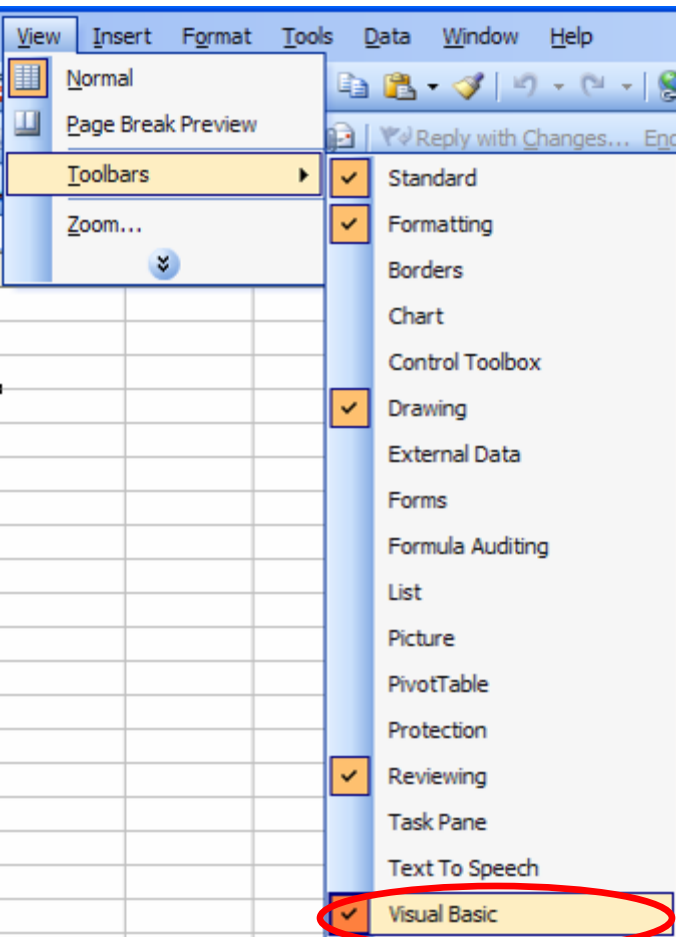
	100
	100
	100
100	100
200	200
	100
100	100
	ABC
	ABC
	ABC
ABC	ABC
DEF	DEF
	ABC
ABC	ABC

=IF(B16=B17,"",B16)

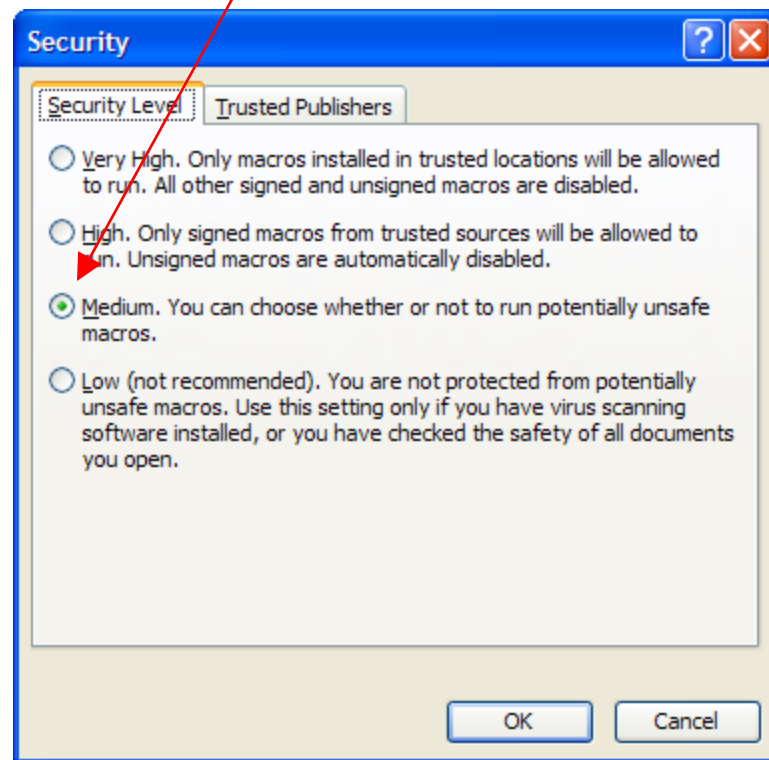


Custom Functions

- Almost Unlimited Capabilities

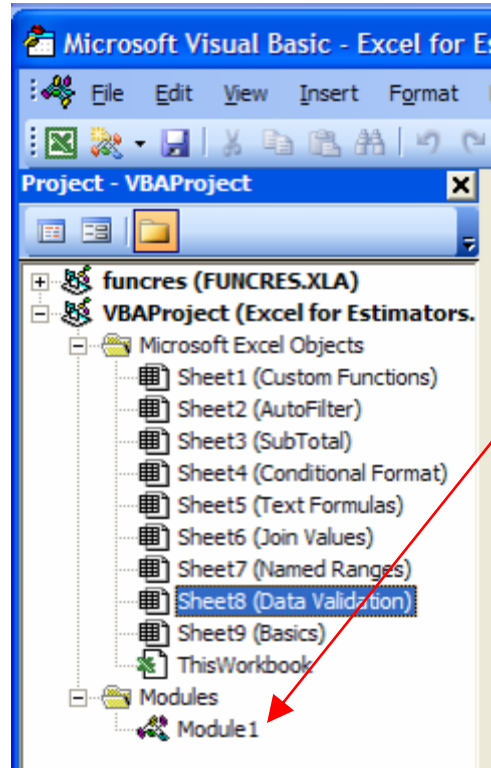
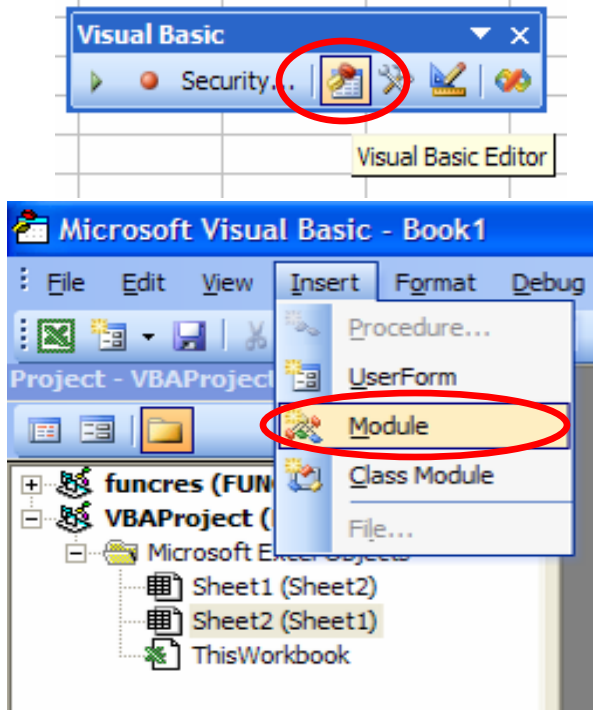


**Must Be
Medium**



Custom Functions

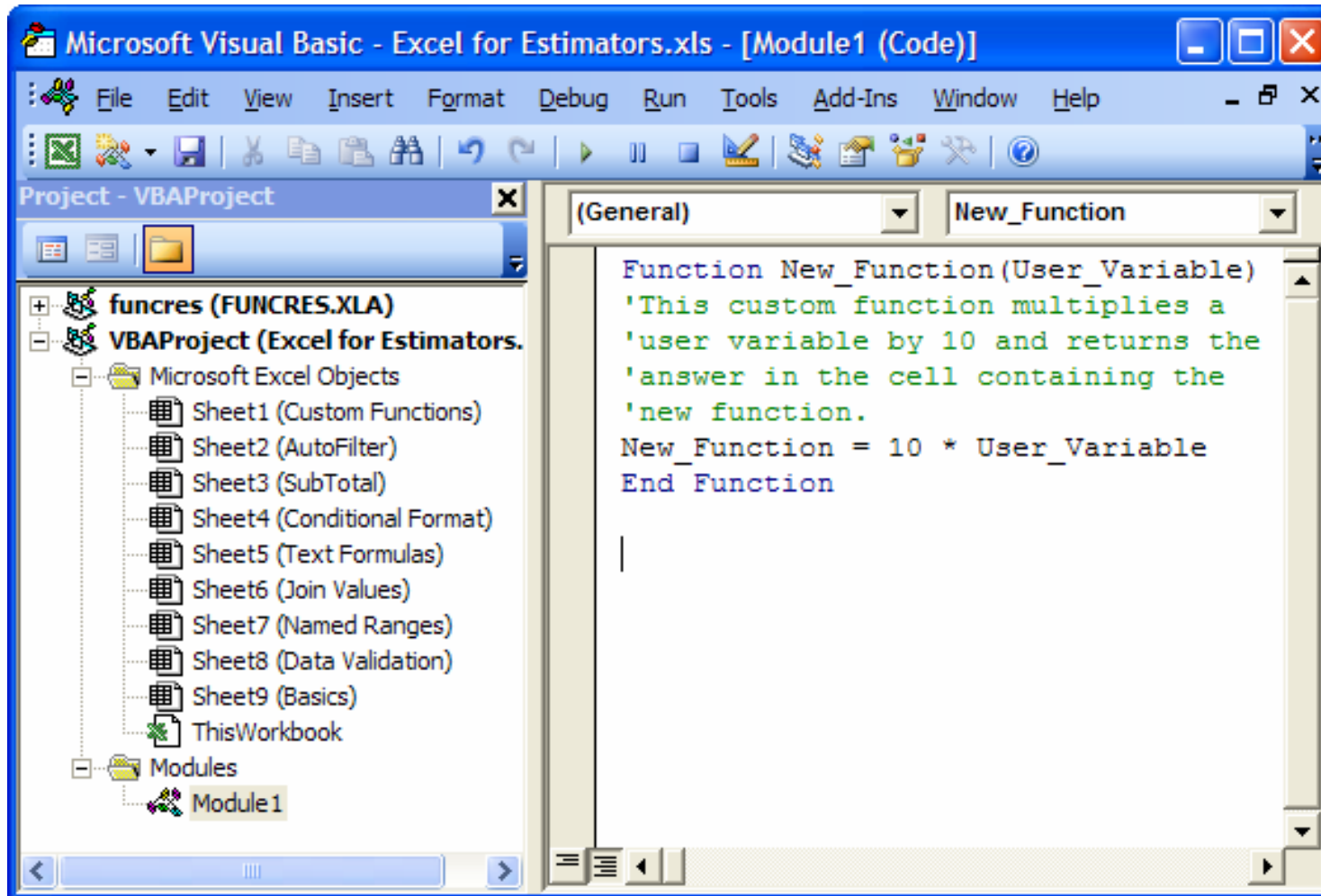
- Insert Module



Double
Click
Module

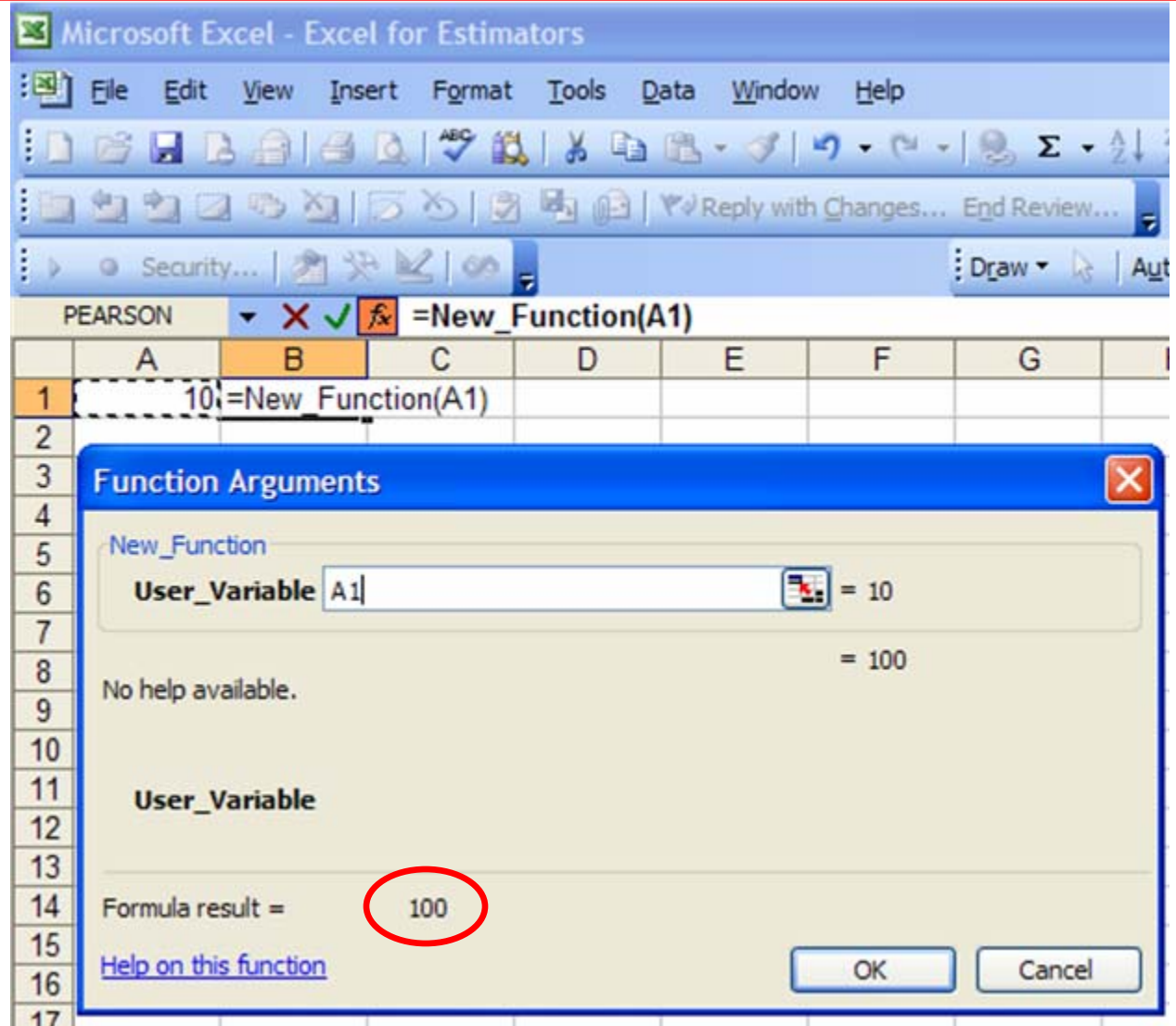
Custom Functions

- Write Code



Custom Functions

- Results



Custom Functions

- **Economies of Scale = GBSize**

Function GBSize(Historical_Size, New_Size) As Double

GBSize = 1.010001 * (New_Size / Historical_Size) ^ -0.101

End Function

Functional Example

Economies of Scale		
\$	175	Cost Per SF
	30,000	Historical SF
	4,000	New Project SF
	123.8%	Economies of Scale Factor
\$	216.64	Adjusted SF Cost