NUTSHELL EXCEL

*Excel review topics for MBA students preparing
to take the Decision Models course.*

Contents

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Excel Formulas

- **What:** An Excel formula performs a calculation or returns a value.

- **Format:** All Excel formulas begin with an equals sign. Then the arithmetic symbols used are +, -, /, *, and ^. Parentheses are used to control the order of operation.

- **Formulas & Functions:** While one can build one's own formulas for all operations, Excl includes a library of pre-built formulas called "functions". For example, the sum operation is used so often that Excel has made SUM into a function and has included a special button for it on the Standard Toolbar.

- **Making Formulas Useful:** One of Excel's primary strengths is its dynamic nature. In order to take advantage of this, one usually builds formulas using cell references instead of fixed values. For example:

| Recommended	=A1+A2	=sum(A1:B5)	=Total * TaxRate
Not Recommended	=50+100	=sum(1, 2, 3, 4, 5, 12, 14, 16, 18, 20)	= $100 * 0.05%

- **Relative Addressing:** When one uses cell references to refer to values in a formula, Excel's default is to adjust the references automatically if the values' location changes. In the illustrations below, Excel changes the formula in Cell A3 when the formula data is moved.
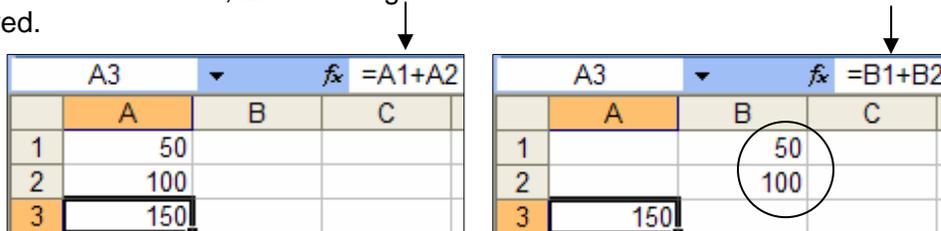
- **Absolute Addressing:** To keep Excel from changing a cell reference in a formula when the referenced cell value moves, make the reference absolute by using one or more dollar signs in the cell reference. For example: **A1** fixes both the column and row, **$A1** fixes the column but not the row, and **A$1** fixes the row but not the column. In the illustration above at left, this would be an absolute version of the formula: **=A1 + A2**. If the data in Cells A1 and A2 were moved to column B, the formula would return zero instead of 150 as it does now.

Excel Functions

- ▪ **What:** Excel functions are built-in formulas one can use in a model to save construction time and effort.

- ▪ **Where:** All Excel's functions are listed in Excel's "Insert Function" dialog (choose *Insert, Function* from Excel's menus).
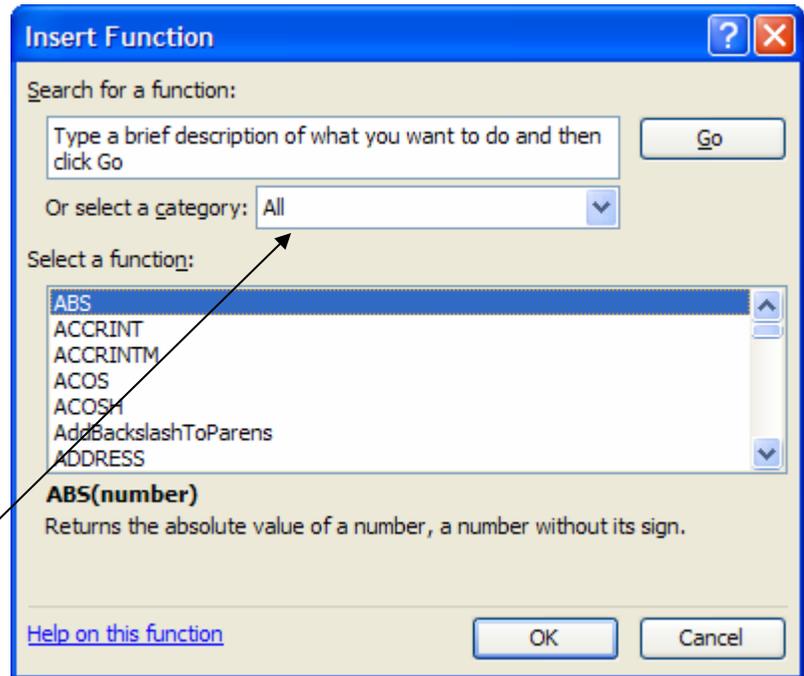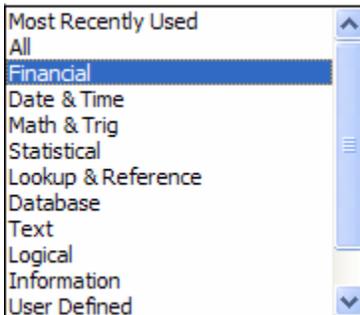
- ▪ **Find:** Look up a function by name or by category.

- ▪ **Syntax:** The basic syntax of every function is:
 **=FunctionName(parameter(s))**

  - ➢ A function with no parameters still requires parentheses (with nothing in them). For example: **=NOW()** or **TODAY()**
  - ➢ Optional parameters are presented in the function syntax as unbolded. For example, in the MATCH function "match_type" is optional:
    = MATCH(lookup_value, lookup_array, match_type)
  - ➢ In a function that can have one or more of the same kind of parameter, the syntax shows optional parameters in square brackets. For example:
    =SUMPRODUCT(array1, [array2], [array3], …)

- ▪ **Help:** Consult Excel's online help for a description of any function and examples of its use.

- ▪ **Array Functions:** Array functions are a special class (though not category) of functions in Excel. Some of them – like the FREQUENCY function – are array functions by nature and must always be entered that way. Others – like the simple SUM function – can in certain conditions be entered as an array function. The special key sequence for entering an Excel array function is CONTROL+SHIFT+ENTER.

Excel's Analysis Tools

- **What:** Excel has a set of built in financial and scientific analysis tools contained in its "Analysis Toolpak". The analysis tools are like functions in that they're built-in shortcuts. However, they involve more complex processing than do functions and are packaged differently.

- **Where:** The "Data Analysis" dialog is available by choosing *Tools, Data Analysis…* from Excel's menus. Although the Toolpak comes with Excel, it's an Excel add-in. It must be included in your Excel installation and then must be turned on as an add-in to appear as a menu option. If you do *not* see this option in your Excel menus, do the following:
  1) Choose *Tools, Add-Ins* from Excel's menus to open the "Add-Ins" dialog. If "Analysis ToolPak" appears as an option, turn it on.
  2) If "Analysis ToolPak" does *not* appear as an option, rerun the Excel installation program and make sure it's included as part of your installation.
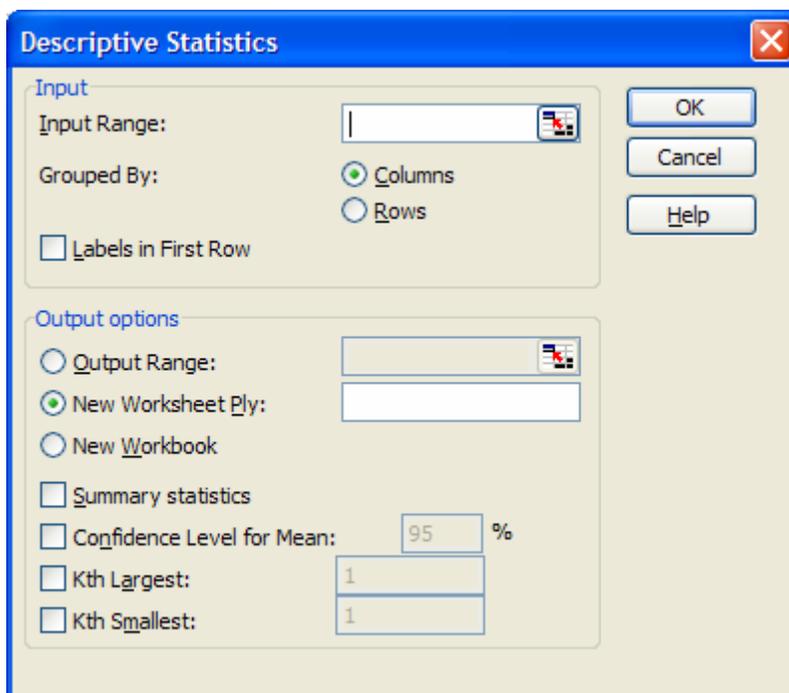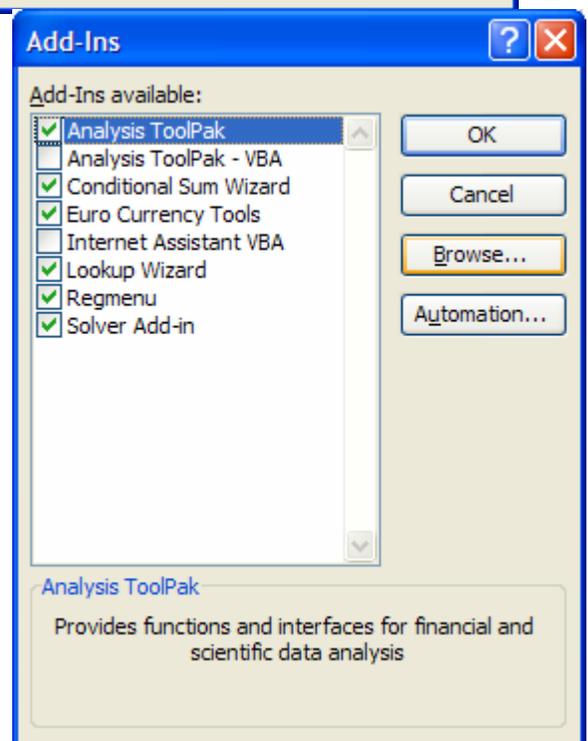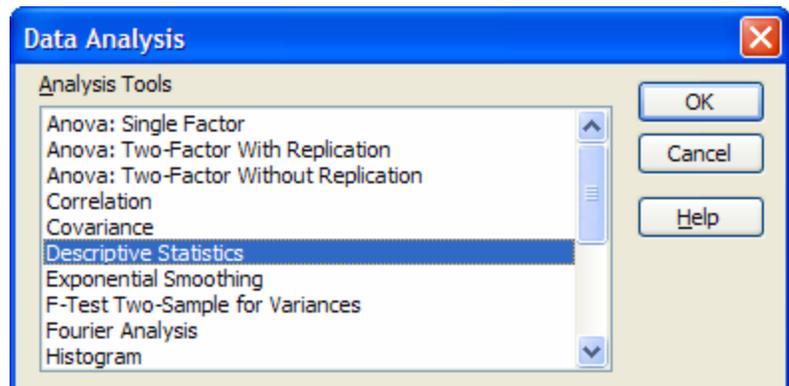
- **Basic Format:** The basic format of every analysis tool in the Analysis ToolPak is like the illustration shown at left. That is, the tool asks you to supply input data and asks you to choose output options.

Excel Logic

- **What:** There are a few key logical functions in Excel that are important to know and understand. Knowing them will help you express the relationships between values that may be required to construct an effective Excel model.

- **The IF Function:** The IF function is the most commonly-used logical function in Excel. A simple IF function returns one of two parameter values. The syntax of the IF function is:

    =IF(condition-to-test, value-if-true, value-if false)

    Where Condition-to-test returns either TRUE or FALSE,
    Value-if-true is the value returned if the condition returns TRUE, and
    Value-if-false is the value returned if the condition returns FALSE.

    Examples: **=IF(10+10=20, A1-A2, B1-B2)**
    =IF(A1>A2, "Late", "Not Late")

    In Excel 2003, IF functions can be nested seven levels deep (although this isn't recommended!). For example:
    =IF(A1>A2, IF(B1>B2, A10-A11, B10*B11), 100)

- **The AND Function:** Returns TRUE if all its arguments are true and FALSE if one or more of its arguments are false. For example: **=AND(2+2=4, 3+2=5)** returns TRUE. AND can be used as part of an IF function. For example: **=IF(AND(A1>A2, B1>B2), "Yes", "No")**

- **The OR Function:** Returns TRUE if at least one argument is true. For example: =OR(2+2=4, 3+2=10) returns TRUE. OR can be used as part of an IF function. For example: **=IF(OR(2+2=4, 3+2=10), "Yes", "No")**

- **The MIN and MAX Functions:** Return the minimum and the maximum value from a list of values, respectively. Often used in conjunction with other functions. For example:
    =MAX(IF(A1>(A2*A3), B15-B16, C15-C16, 0)
    =IF(A1>A2, MIN(A15, B15, C15, 12), 1)

- **The COUNT functions:** Include COUNT, COUNTA, and COUNTIF. COUNT counts the number of numbers or dates in a range. COUNTA counts the number of cells in a range that contain data, whether text, dates, or numbers. COUNTIF counts the number of cells in a range that meet a specified criterion.

Excel's Data Table

A Data Table is a range of cells that record how changing certain values used in a spreadsheet model's formula(s) affect the results of the formula(s). Data Tables are a shortcut for calculating multiple model outcomes in a single operation and a way to view and compare the results of all of the different outcomes together in a condensed space on a single worksheet. The Data Table comes in two varieties: One-Input and Two-Input

The One-Input Data Table is a range of cells that record how changing certain values used in a spreadsheet model's formula affect the results of the formula. The Data Table is a shortcut for calculating multiple model outcomes in a single operation.

	A	B	C
1	One-Input Data Table		
2			
3			
4	Interest Rate		0%
5	Term in Years		30
6	Loan Amount	$100,000	
7	Monthly Payment	$277.78	
8			

In this example, the model is the simple one shown at left. Monthly payment is calculated using Excel's PMT function. The PMT function uses interest rate, term, and loan amount as input values.

A One-Input Data Table is created by listing down a column in an empty part of a worksheet the input values the Data Table should substitute into the model. Here, a variety of interest rate values ranging from 5% to 13.5% is shown.

	D
10	
11	5.00%
12	5.50%
13	6.00%
14	6.50%
15	7.00%
16	7.50%
17	8.00%
18	8.50%
19	9.00%
20	9.50%
21	10.00%
22	10.50%
23	11.00%
24	11.50%
25	12.00%
26	12.50%
27	13.00%
28	13.50%

The next step in constructing a One-Input Data Table is to locate a copy of the model formula you want to track in the Data Table structure. In a One-Input Data Table, the formula *must be located one column to the right of the input values and one row above the input values*.

	C	D	E	F
4				
5	Interest Rate	0%		
6	Term in Years	15		
7	Loan Amount	$300,000		
8	Monthly Payment	$1,666.67		
9				
10			$1,666.67	
11		5.00%		
12		5.50%		
13		6.00%		
14		6.50%		
15		7.00%		
16		7.50%		
17		8.00%		
18		8.50%		
19		9.00%		
20		9.50%		
21		10.00%		
22		10.50%		
23		11.00%		
24		11.50%		
25		12.00%		
26		12.50%		
27		13.00%		
28		13.50%		

The location of the One-Input Data Table formula.

There are two ways to add a formula to a One-Input Data Table structure.
1) Copy the formula from the model; that is, copy the PMT function in Cell D8.
2) Simply reference the cell in the model that holds the formula. To do that, enter the formula =D8 in the Data Table's formula cell (E10).

At this point, Data Table construction is complete. Now the Data Table must be run.

	C	D	E
4			
5	Interest Rate	0%	
6	Term in Years	30	
7	Loan Amount	$100,000	
8	Monthly Payment	$277.78	
9			
10			$277.78
11		5.00%	$536.82
12		5.50%	$567.79
13		6.00%	$599.55
14		6.50%	$632.07
15		7.00%	$665.30
16		7.50%	$699.21
17		8.00%	$733.76
18		8.50%	$768.91
19		9.00%	$804.62
20		9.50%	$840.85
21		10.00%	$877.57
22		10.50%	$914.74
23		11.00%	$952.32
24		11.50%	$990.29
25		12.00%	$1,028.61
26		12.50%	$1,067.26
27		13.00%	$1,106.20
28		13.50%	$1,145.41
29			

To run a One-Input Data Table:

Select the range that includes all the input values, the blank cell above the input values, the formula, and the blank cells below the formula to the right of the input values (as illustrated at left).

From Excel's menus choose *Data, Table* to open the "Table" dialog.

In the "Table" dialog indicate the cell that holds the model value into which the Data Table input values should be substituted. In this example, the input values are a range of interest rates, so the "Column input cell" prompt in the "Table" dialog holds a reference to the model cell D5.

Click *OK.*

Table

Row input cell: [ ]

Column input cell: [D5]

[OK]   [Cancel]
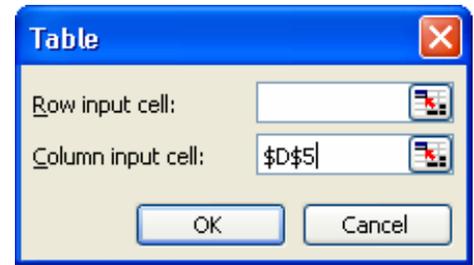
Excel fills the empty cells to the right of the column inputs with monthly payment values. Each monthly payment value in the completed One-Input Data Table corresponds to the value monthly payment would take on were the interest rate to its left entered into the interest rate cell in the model.

The Two-Input Data Table can contain only one formula. However, as its name implies, the Two-Input Data Table supports two sets of input variables instead of just one. The layout of the Two-Input Data Table must, of course, differ from that of the one-input. The Two-Input table has one set of input values down the left-hand column, another set of input values across the top row, and its single formula in the upper left-hand cell of the table. The single formula *must* be located in the cell that's the intersection of the left-most column and the top-most row. The formula must reference both the column and row inputs to the Data Table. The inputs represent the model values that are sequentially replaced by Data Table values. A Two-Input Data Table structure would look like this illustration:

Another set of inputs across the top row.

Model formula that uses both inputs. →

One set of inputs down the left-hand column.

	Loan Amounts				
$843.86	$100,000	$150,000	$200,000	$250,000	$300,000
6.00%					
6.25%					
6.50%					
6.75%					
7.00%					
7.25%					
7.50%		Area where the Data			
7.75%		Table results will			
8.00%		appear.			
8.25%					
8.50%					
8.75%					
9.00%					
9.25%					
9.50%					
9.75%					
10.00%					
10.25%					

(Left column label: Interest Rates)

As required by the Two-Input Data Table, the formula in the table references both the vertical Data Table input (Interest Rate) and the horizontal Data Table input (Loan Amount).

Note: An alternative to entering the PMT function in the table is to enter a reference to the worksheet cell in the model that holds the function.

Partial view of the Two-Input Data Table structure. The single formula (or reference to a model formula cell) is in the top left-hand cell.

$843.86	$100,000	$150,000	$200,000
6.00%			
6.25%			
6.50%			
6.75%			
7.00%			
7.25%			
7.50%			
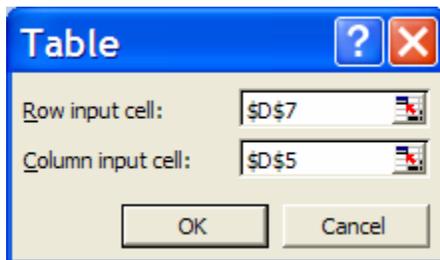
Execute the Two-Input Data Table. When prompted, identify the loan amount as the row input cell and the interest rate as the column input cell.

Format the Data Table results with dollar signs (currency or accounting format) with two decimal places.

Common to Both the One-Input and the Two-Input Data Table
Certain characteristics are common to both the One-Input and the Two-Input Data Table.

1) Change input values and the Data Table automatically recalculates itself.
2) Extend (or contract) the number of input values and then rerun the Data Table specifying the new range.
3) Each result cell in a Data Table is one element of an array that cannot be individually changed or erased. It can, however, be individually formatted.
4) To erase any Data Table result cell, erase all the result cells in a Data Table. Then rerun the Data Table, if desired.
5) Odd or unexpected results are often caused by:
    a. Incorrectly structuring the Data Table, whether One- or Two-Input. Excel is unforgiving in its structural requirements for the Data Table.
    b. Inadvertently switching row input and column input cell references in the "Table" dialog at run time or – for a One-Input Data Table – specifying a row input cell instead of a column input cell. (Note: A One-Input Data Table *can* be constructed with its input values across the top row, in which case specifying a row input cell would be correct.)
    c. Misidentifying the cell or cells in the model for which a Data Table's values will substitute.

Excel's XY Chart

The relationship between data points is best plotted with an XY or Scatter plot for certain kinds of data.

For example, the data shown at right is population data, with one column of "Year" values and one column of "Population" values, in billions. Should one be inclined to chart this data with a simple line chart, the result would look like the illustration below.

Year	Population
0	0.01
1000	0.20
1250	0.40
1500	0.65
1750	0.78
1800	0.90
1850	1.20
1900	1.65
1910	1.75
1920	1.85
1930	1.95
1940	2.05
1950	2.59
1960	2.70
1970	3.10
1980	3.80
1990	4.30
1999	4.85
2000	5.40
2010	5.95
2020	6.50
2030	8.11
2040	8.58
2050	8.91
2100	9.46
2150	9.75
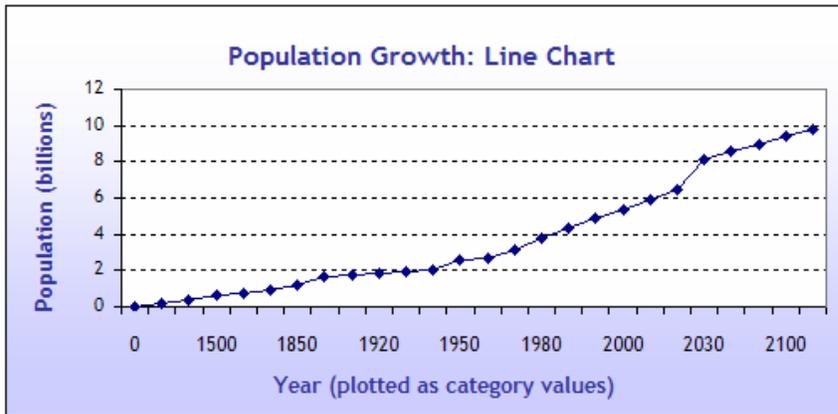
Although the chart above is an accurate line chart, it gives a misleading idea of the rate of population growth. The same data plotted with an XY Chart (also known as a Scatter Plot) looks like this:
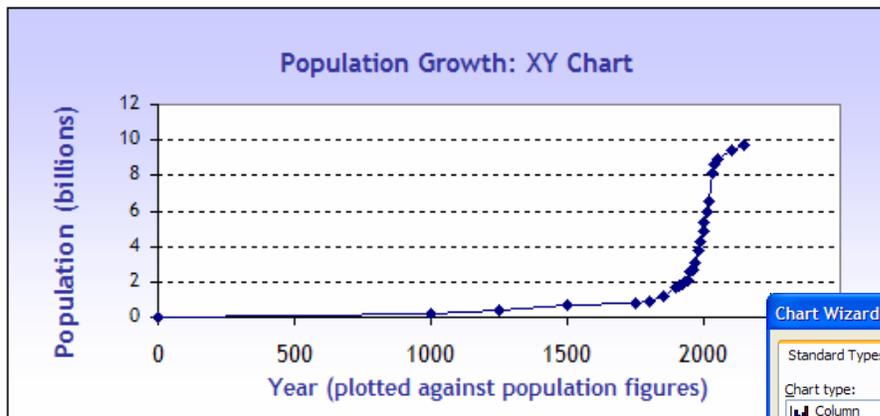
This chart type provides a much more accurate representation of the growth rate of population over time.
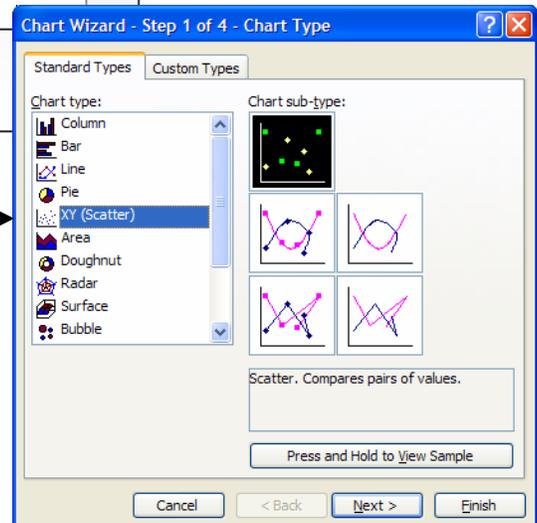
The XY (Scatter) chart is a standard chart in Excel's Charting Wizard Step 1.

Supporting Excel Files

LogicPractice.xls

DataTableBasics.xls

Charting Primer I.xls and Charting Primer II.xls

FormulaReview.xls