



## **Chapter 1:** ***Introduction to the Microsoft Excel Spreadsheet***

### **Objectives**

This chapter introduces you to the Microsoft Excel spreadsheet. You should gain an understanding of the following topics:

- The range of uses of a spreadsheet
- The basic elements of an Excel spreadsheet
- Manipulation of an existing spreadsheet
- Use of formulas to calculate values
- How to develop a simple spreadsheet of your own

### **Preparation**

In order to complete this chapter in 3 hours it is necessary for you to have a clear idea of your objectives. This chapter will introduce a number of different spreadsheet models that you will modify in some way. In each case you will need to understand certain principles demonstrated by the models. You will also be led step by step through the development of a new Excel spreadsheet. It will not be enough for you to just ‘follow the steps’. The ideas and techniques introduced here are building blocks for future exercises and you should make every effort to understand what you are doing and why you are doing it, rather than just following the steps.

- Read the whole of this lab carefully

### **Introduction**

This chapter has two parts. In the first part you will see some prepared spreadsheet models which illustrate the fundamental ideas of a spreadsheet and the range of uses to which it can be put. In the second part you will develop a simple spreadsheet model yourself.

### **Starting Microsoft Excel**

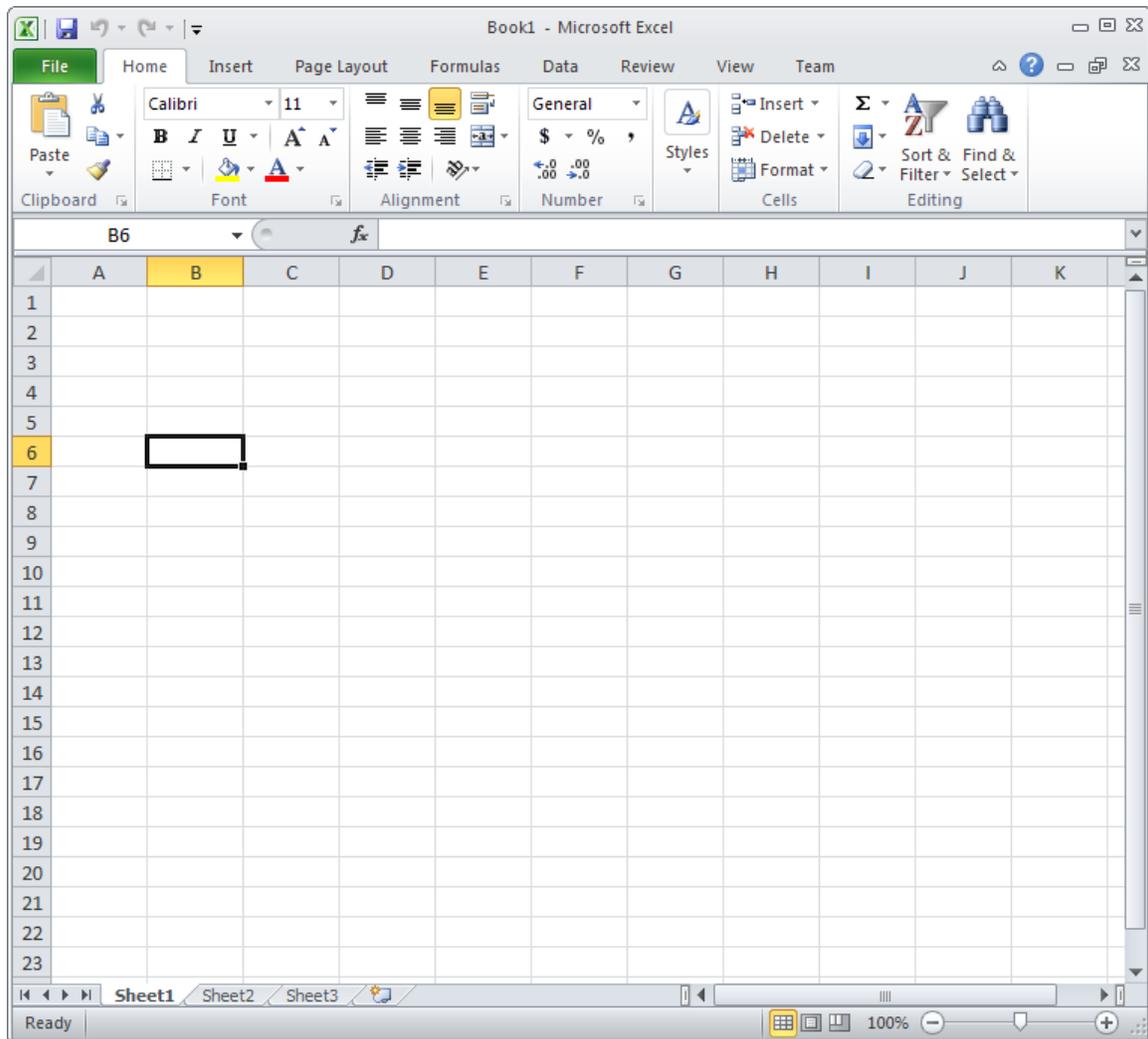
Refer to the section on launching applications in Chapter 0.

A window resembling Figure 1.1 should appear after Excel has launched. You won’t be using the new spreadsheet that appears but it is worthwhile examining some of the features of the Excel application before closing this new worksheet.



The most obvious feature is the array of rows and columns that constitute the worksheet. Notice that the columns are labeled with letters across the top of the worksheet (A through to K are visible) and that the rows are labeled with numbers down the left-hand side (1 through to 23 are visible). These column and row labels form a primitive method of naming each cell on the worksheet – B6 for example is the name of a cell in the B column six rows down. Such names can be used in formulas, although we'll see better ways to name cells later on in this chapter.

**Figure 1.1 the Excel 2010 window at launch**





## Entering Data into Cells

The second feature you should note is that one of the cells is highlighted with a black border. You can't see it in Fig. 1.1 but on your computer screen it should be cell B6. Point to any other cell with your mouse and click once. This changes the highlighted cell. Notice that the label in the area just above the worksheet on the left of the window contains the name of the selected cell:



Type anything you like (your name perhaps) into the cell that you selected – i.e. just start typing and you will see whatever you type appear in the cell. At the same time whatever you type will appear across the top of the worksheet – in an area that is called the formula bar:

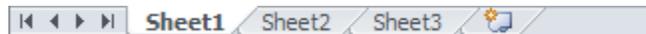


When you have finished typing press the **Enter** key and observe what happens to the cells on the worksheet. Do the characters you typed exceed the cell width? Experiment with entering large and small amounts of text in different cells.

Next select a different cell and this time type a number and press **Enter**. What do you observe about the placement of numbers as opposed to small amount of text in a cell?

## Other Worksheets in the Workbook

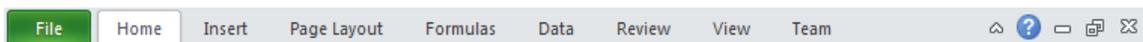
Next observe at the bottom of the screen that there are tabs labeled *Sheet1*, *Sheet2* etc. Currently *Sheet1* is highlighted but if you now click on one of the other sheets you will go to another worksheet of cells. This other worksheet is currently empty. Click on *Sheet1* to go back to the one on which you typed some data. There can be many worksheets in a spreadsheet model, with formulas linking them together.

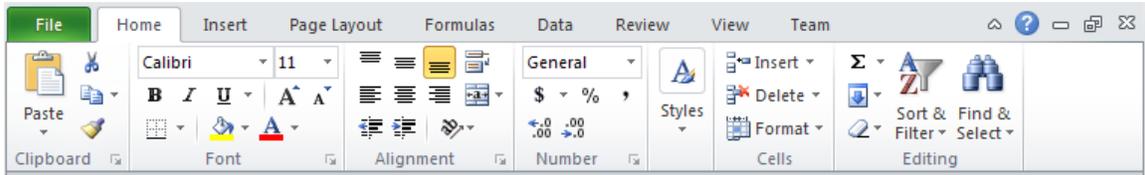


Notice too the arrows next to the sheet tabs, which allow you to move forwards or backwards through the various sheets.

## The Excel 2010 Ribbon Interface

With Excel 2007 Microsoft replaced the Command Menu and Toolbar with a "Ribbon" interface. Click on a tab on the top line (*Home* *Insert* *Page Layout* etc.), and a set of commands appears in the form of a ribbon below:



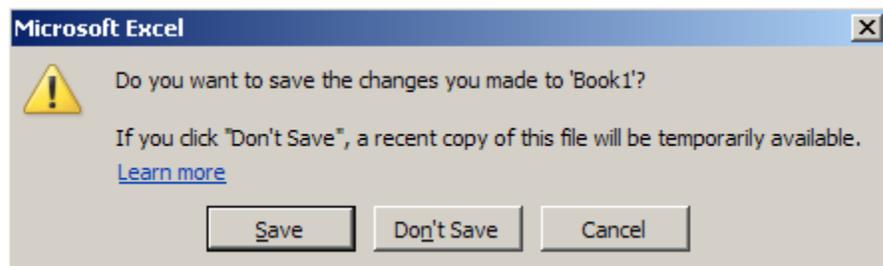


### Closing the Workbook

You don't want to use the workbook you have been playing around with. This has just been a brief tour of the Excel application interface. You should now close this workbook so that you can begin to examine the demonstration models. There are two ways to close a workbook – you can either choose the **Close** command in the **File** tab or you can click on the **X** button in the top right hand corner of the workbook window. If you chose the latter method be careful to click on the **X** in the workbook window, which is the lower set of window controls. Do one of these now.



You'll find that a dialogue window appears asking if you want to save the workbook - you should click on **Don't Save**:





## Exploring Some Spreadsheet Models

### Download files from the course website

To locate the following Demonstration Models, go to the course website and click on the "Resources" button, then select "Support Files" and then "1". Save the files to your computer for future use.

### Opening an Existing Spreadsheet

There are potentially two ways of opening an existing spreadsheet. One is to use the **Open** command from the **File** tab. Another is to locate the file and double-click on it. This time you will have to use the first way.

An **Open** dialogue window will appear and you should navigate through the file system to the folder containing the lab materials. Refer back to Chapter 0 if you have forgotten how to do this.

### Demonstration Model 1

The model you have just opened contains two worksheets. The names have been changed from **Sheet1** and **Sheet2** to **Comments** and **Summing**; and the **Comments** worksheet is the one displayed.

#### The Comments Worksheet

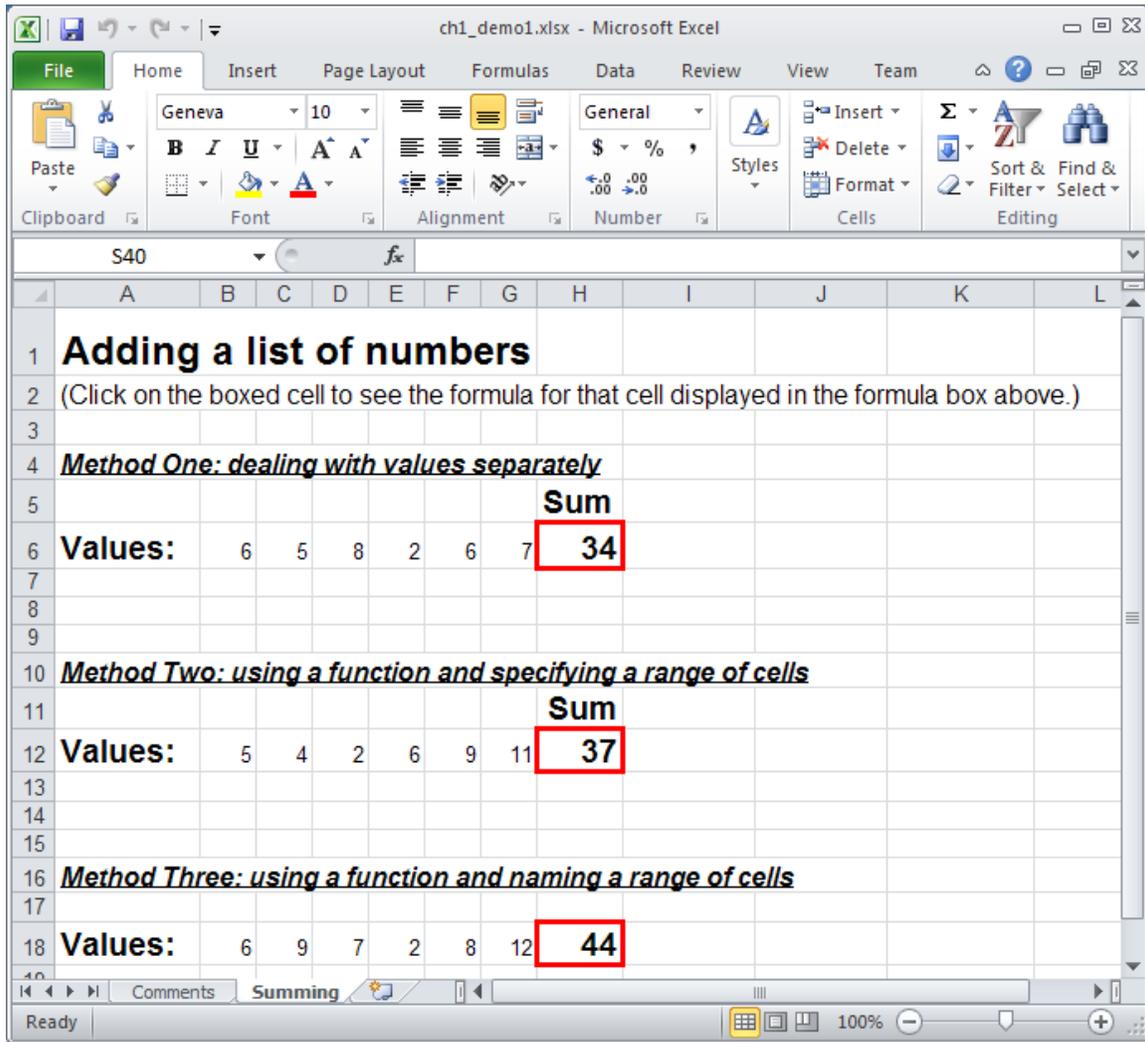
This worksheet contains a brief description of the purpose and features of the spreadsheet model. It illustrates a documentation principle that you should follow in all of the spreadsheet work you do. Documentation of your work is crucial – not only for other people who may need to understand or modify it, but also for yourself when you return to it after a few weeks or months and find that you have forgotten what you did.

#### The Summing Worksheet

This worksheet is shown in Fig. 1.2. It shows three methods of adding a row of numbers. The first thing you should do is examine the contents of the cells by selecting certain ones. For example, select the cell **B1**. It looks like it might have the characters “**a 1**” – i.e. part of “**a list**” in the cell. However, you can see from the formula bar that cell **B1** is actually empty. Select cell **A1** and you will see the entire first row displayed in the formula bar.



**Figure 1.2 the Summing worksheet in demonstration model 1**



Select cell B6 and you will see that it contains the number 6. Select cell H6, however, and you will see not the number 34 displayed in the formula bar but rather a formula, which has the value 34 as its result from adding the values in the row. Examine the formulas that calculate the other sum values and observe their differences.

### Changing Values on the Spreadsheet

Select one of the numbers in a row and type a new value, pressing Enter when you've done. Notice that the sum value is instantly changed to reflect the new value. This interactive feature of a spreadsheet is one of the reasons spreadsheet programs are such valuable tools in so many problem solving applications.



### Inserting a Column (or Row)

Add a new column to the spreadsheet so that a new number can be included in the row that is being summed. To do this, select one of the columns C, D, E, F, or G by clicking on the letter in the top row of the worksheet. Then from the **Home** tab, click on **Insert** within the **Cells** Group. A new empty column should appear to the left of whichever column you had selected. A row may be inserted in the same manner – that is, by selecting a whole row by clicking on its number on the far left (you’ll select the row below where you want the new one to appear) and from **Home**, click on **Insert** within **Cells**.

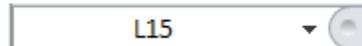
### The Generality of Formulas

Now select the new cell in one of the rows of numbers and type a new value that you would like to be included in the sum. Do this for each of the three rows of numbers observing in which cases the value for the sum also changes. One of the formulas gives the wrong answer when this new value is inserted, and hence you should draw the lesson that this type of formula should be avoided. Delete the new column you inserted once you have done this.

### Naming a Range of Cells

Click on the little downward pointing arrow to the right of the name bar (on the left of the window just above the column headings A, B, C etc:

The name bar:



You’ll see a single name, **Values**, appear. Click on that name and observe that the third row of numbers is highlighted. This row of numbers has been defined to have the name **Values** in this model. It is possible to name single cells or groups of cells like this. The aim is to define easily remembered names for data in your worksheets. These names can then be used in formulas so that they are easier to read, rather than having only cell references such as **B13** or whatever.

Click on the **Sum** value for this row and observe that the formula that calculates this value uses the name **Values**.

### Functions

The formulas for the sum in methods two and three also use a function – the **SUM** function. Functions take the general form of

SomeFunctionName( someArgumentList )

You’ll use various functions extensively in later chapters. For now notice that the **SUM** function has as its argument list a single value expressed as either a range of cells

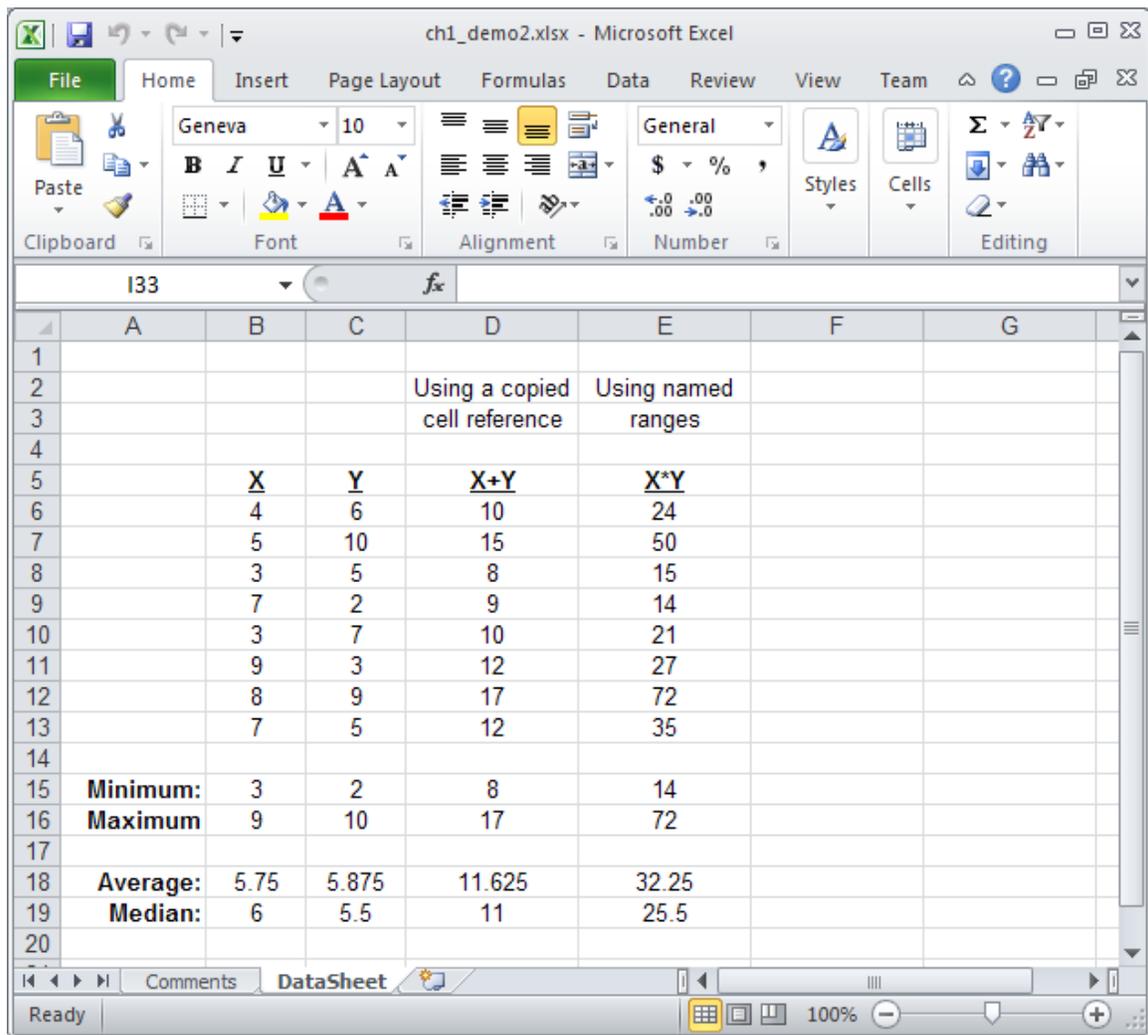


(B12:G12 for example) or the single name, list, representing a range of cells. This is the most common, although not the only way, of using the SUM function. Other functions might have more than one argument with the arguments separate by commas.

### Demonstration Model 2

Close the previous spreadsheet model (you don't need to save it) and open the one called Demonstration Model 2. Read the Comments worksheet carefully before you switch to the second worksheet called DataSheet. The DataSheet worksheet is shown in Fig. 1.3.

**Figure 1.3 – the DataSheet worksheet from demonstration model 2**





This worksheet demonstrates a number of new methods of making calculations, as well as a few new functions. The raw data on this worksheet – that is the data that is entered by hand and therefore not calculated by formulas – is contained in the columns labeled X and Y. Names have been created for these two columns. Click on the arrow in the Name Box and select first X and then Y to see what they refer to.

### **Copying Formulas – the Fill Command**

The data in the other columns labeled X+Y and X\*Y is created very easily, even though apparently a lot of formulas are involved. Select the cell D6 containing the value 10 and you'll see that it is calculated by the formula B6+C6. The other cells in this column are essentially calculated using the same formula except that the row numbers change. Examine a few of them. These formulas are created very easily by first typing the top formula, then selecting that cell and all of the others in the column (which are empty at this point) to which you want the formula to apply, and then choosing from Home tab the Fill/Down command within Editing group. This command copies the top formula into all of the selected cells, changing the row numbers as appropriate. The other columns of calculated data are created in essentially the same way – one formula was typed for the top cell, and then filled down the column.

### **Using Named Ranges in a Formula**

Examine the formulas for the first X\*Y column. The names X and Y refer to the whole columns (as you observed in a previous section) and here the same formula is filled down the X\*Y column to calculate all of these values. Although the names refer to the whole of the X and Y columns the formula “knows” to use just the two X and Y values on the same row in order to calculate any particular X\*Y value.

### **Some New Functions**

This worksheet also introduces some additional functions in order to familiarize you with their use. You've seen the SUM function before – and now you can see the MIN, MAX, AVERAGE and MEDIAN functions, all using a column of data as their argument. The column is either expressed as a range of cell references or as a named range. Close the worksheet before you move on to the next example (there's no need to save it).

### **Demonstration Model 3**

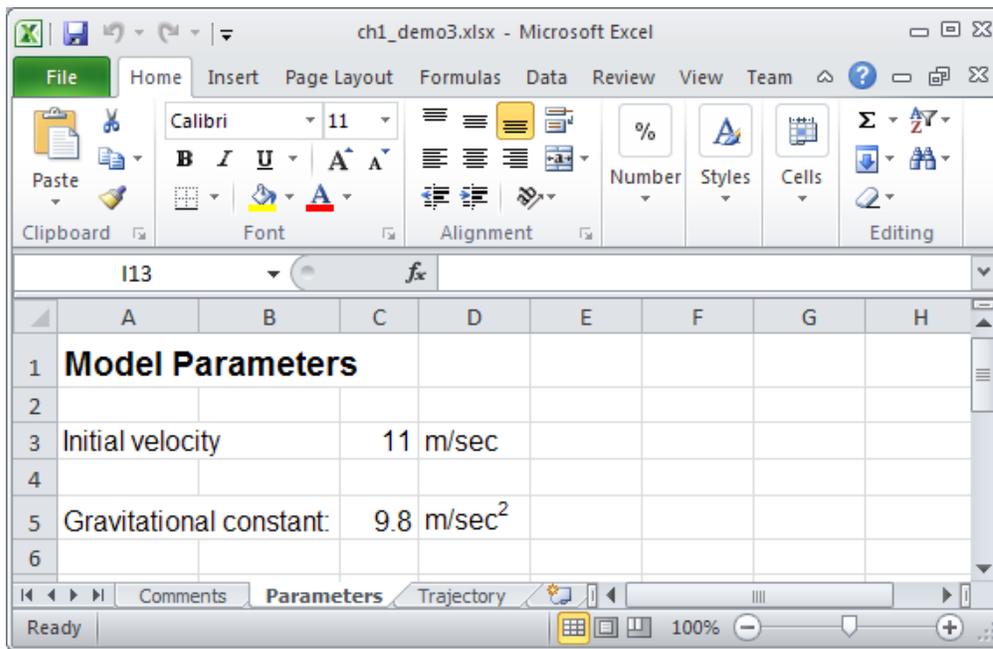
Open Demonstration Model 3. This model implements a slightly more complex formula than the previous examples, and also demonstrates the use of the graphing capabilities of a spreadsheet.

The model calculates the distance an arrow will travel if fired with an initial velocity and an initial angle, and assuming the ground is perfectly flat. The initial velocity is treated as a parameter – that is, it is held constant while the initial angle is varied and the distance is calculated for each angle.



The model has three worksheets – the Comments worksheet (read it carefully), the Parameters worksheet (Figure 1.4) and the Trajectory worksheet (Figure 1.5). Besides the initial velocity the Parameters worksheet also contains the other constant quantity – the gravitational constant. (Notice that the units are included in a cell adjacent to the value.)

**Figure 1.4 – the Parameters worksheet in the Flight of an Arrow model**



The Trajectory worksheet (Figure 1.5) contains a column of values for the initial angle and a column of values for the calculated distance the arrow travels, as well as a graph of the relationship.

### Nested Functions

The formula to calculate the distance the arrow will travel is:

$$\text{distance} = \text{velocity}^2 * \text{sine}( 2*\text{angle} ) / g$$

Click on one of the values in the Distance column in the Trajectory worksheet and observe the formula as it is expressed in Excel. In this formula two functions are used – but one of them is nested within the parentheses of the other. The formula is:

$$=V*V*SIN(2*angle*PI()/180)/g$$

Launch Angle is in degrees (you can see this in the worksheet) but the SIN function expects the angle to be in radians. Therefore, the angle is converted by multiplying by



$\pi/180$ . And  $\pi$  is represented by the second function -  $\text{PI}()$ . Notice that the function  $\text{PI}()$  does not have any arguments, as indicated by the empty parentheses – it simply produces the value of  $\pi$  as its result.

### **Inter-Worksheet Formulas**

The formula that calculates the **Distance** values in the **Trajectory** worksheet uses the named values **V**, **angle**, and **g**. However, **V** and **g** refer to values that are in a different worksheet, the **Parameters** worksheet, and hence the formula is actually what we will call an inter-worksheet formula.

Use **Formulas/Name Manager** to open the **Name Manager** window to see the list of names. You'll see that the cell reference is prefixed by the worksheet name – **Parameters!** in this case. This method of specifying a cell or range as coming from a particular worksheet is part of the syntax of Excel formulas. Take careful note of this syntax because you'll meet it frequently and sometimes you might want to be able to type it out yourself. Close the **Name Manager** window again.

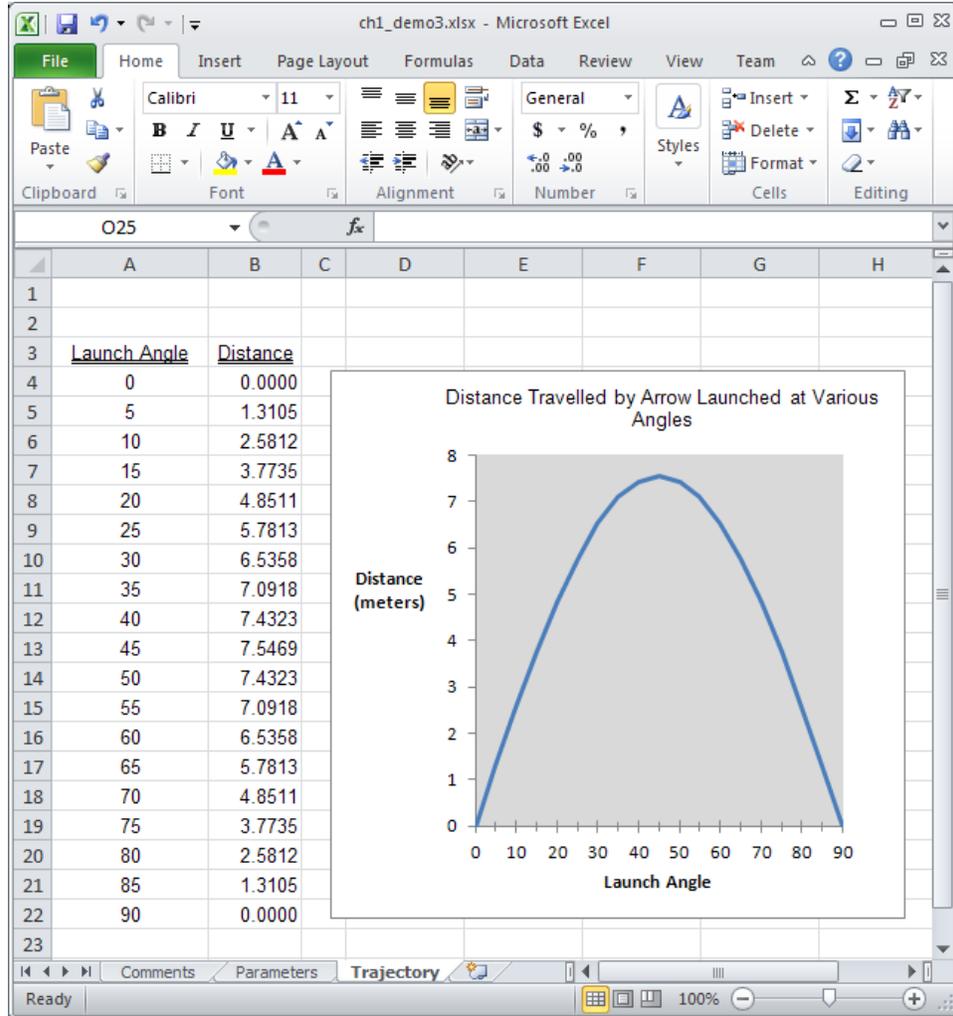
### **A Graph**

Graphs of many different types can be created by a spreadsheet program – and either placed next to data on a worksheet (as in this example) or placed on a separate worksheet of their own. One interesting feature is that the graph is interactive in the sense that it is redrawn immediately if you change any of the data from which it is derived.

Observe the maximum distance that the arrow can travel (it is about 7.5m for an initial angle of 45 degrees) and then switch to the **Parameters** worksheet where you can change the value of the **Initial Velocity**. Type a new value and return to the **Trajectory** worksheet. You should see that the graph has changed to reflect the new data.



**Figure 1.5 – the Trajectory worksheet in the Flight of an Arrow model.**

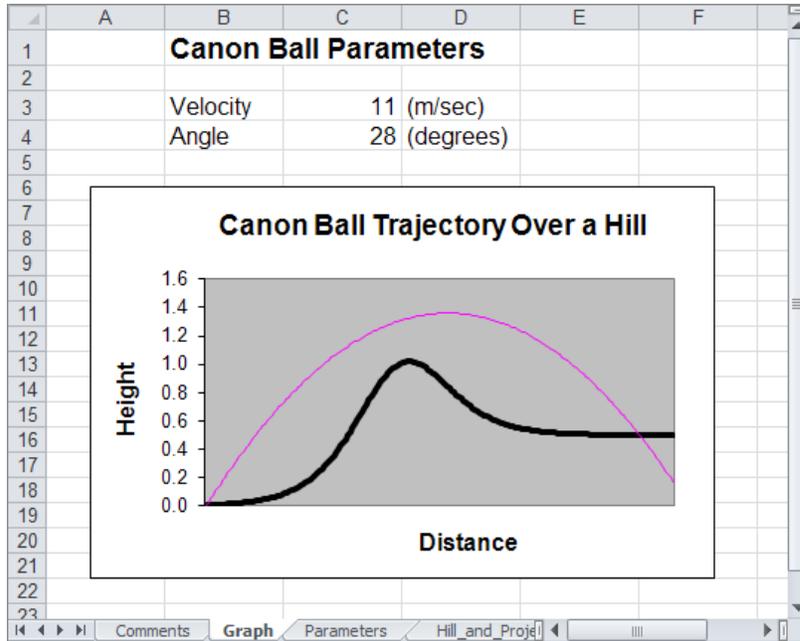


### Demonstration Model 4

Open Demonstration Model 4. This model contains 4 worksheets – the **Comments** worksheet; a worksheet containing a graph and values for the initial velocity and angle of a canon ball fired over a hill; a **Parameters** worksheet containing values which define the shape of the hill (and the gravitational constant); and a **Hill\_and\_Projectile** worksheet containing the data that is to be graphed. The graph is shown in Figure 1.6.



**Figure 1.6 – the Canon Ball Trajectory**



The main new feature of this model is the ease with which the model parameters can be adjusted in order to achieve some objective. The objective in this case might simply be to have the canon ball hit the far right corner of the land (i.e. where the black line reaches the edge of the graph). One approach is simply to change the velocity and/or angle parameters hoping by trial and error to hit the corner. Try this now.

### New Functions and Operators

Besides this goal seeking demonstration the model also provides examples of the use of yet more functions. Examine the formula for the Z column and you'll see the use of the EXP function (which calculates the value of  $e^x$ , where x is the argument of the function). The formula that calculates the Hill Height column demonstrates the use of the exponentiation operator, ^, and the Projectile Height formula shows the use of further trigonometric functions, TAN and COS, in a fairly complex expression.

### Demonstration Model 5

Open Demonstration Model 5. This model demonstrates the capability of a spreadsheet to analyze (in this case statistically) a large set of data, and to present the results visually. The model simulates the rolling of two dice and presents simple statistics (frequency counts) of the sum of the numbers on the two dice.



There are three worksheets in the model – a **Comments** worksheet, the **dieValues** worksheet which contains the values on the two dice and their sum, and a **Countif** worksheet which demonstrates one possible way of calculating the frequency counts.

### The RAND Function

Select the **dieValues** worksheet and examine the formula that calculates a die value. It uses nested functions again. The **RAND()** function produces a random number between 0 and (less than) 1, which must then be multiplied by 6 and converted to an integer in order to obtain a value between 0 and 5 inclusive. The **INT** function does the conversion to an integer. Add one to produce the values on the dice.

### The COUNTIF Function

To count the frequency of each possible roll of the dice, we list the possible values first (i.e. the values 2 to 12) and use them as a criterion by which to decide whether to count a particular value. The **COUNTIF** function uses the possible value of the sum of the dice in order to decide whether to include a value from the long list of dice “throws” in the frequency count for that possible sum value.

Select the first value in the **Frequency** column and examine the formula. It should be

```
=COUNTIF(dieValues!$C$2:$C$701,Countif!A3)
```

Looking at the last argument first, namely **Countif!A3**, observe that this refers to the first value in the **Sum** column, i.e. 2. The first argument refers to the large column called **Sum** in the **dieValues** worksheet. Thus this function arrives at this first value in the **Frequency** column by counting those values from the **dieValues!Sum** column which equal 2.

## Exercise 1 - Making a New Spreadsheet

This exercise will walk you through the development of a simple budget spreadsheet. Any similarity to your real budget is purely coincidental!

Assuming you have Excel running, close any open workbooks. To open a new, blank, workbook, click on the **File** tab, then click **New** and under **Available Templates**, double-click **Blank Workbook**. (Or exit Excel entirely and restart it.) You should see a window similar to Figure 1.1.

First, change the names of the worksheets. Double click on the **Sheet1** tab to highlight the word **Sheet1** and then type the new name – **Comments** in this case. Do the same with **Sheet2** renaming it **MonthlyBudget**. You should delete the third worksheet by first selecting it and then clicking on the **Home** tab, followed by clicking on **Delete** in the **Cells** group and then finally clicking on **Delete Sheet**.



## The Comments Worksheet

A Comments sheet is **essential to any well designed Excel model**. It should include a brief description of the model you are about to create. You will probably want to revise the comments worksheet after you have written the monthly budget worksheet – but it is important to be able to write part of the comments worksheet first so that it serves as a plan that you can follow in writing the rest of the model.

The aim of this model is to list your sources of income and subtotal them, to list your expenses and subtotal them, and finally to calculate the surplus (or deficit). This is to be done for the months May to August. The end result, without actual dollar amounts entered, is shown in Figure 1.8.

## The Monthly Budget Worksheet

**Figure 1.8 – the Monthly Budget worksheet**

	A	B	C	D	E	F
1			May	June	July	August
2						
3		<b>Income:</b>				
4		Pay				
5		Student Allowance				
6		Other Income 1				
7		Other Income 2				
8		<b>Total Income:</b>	0	0	0	0
9						
10		<b>Expenses:</b>				
11		Tuition				
12		Room and Board				
13		Clothing				
14		Car				
15		Insurance				
16		Books				
17		Recreation				
18		Credit Cards				
19		<b>Total Expenses:</b>	0	0	0	0
20						
21						
22		<b>Monthly Surplus (Deficit):</b>	0	0	0	0
23						

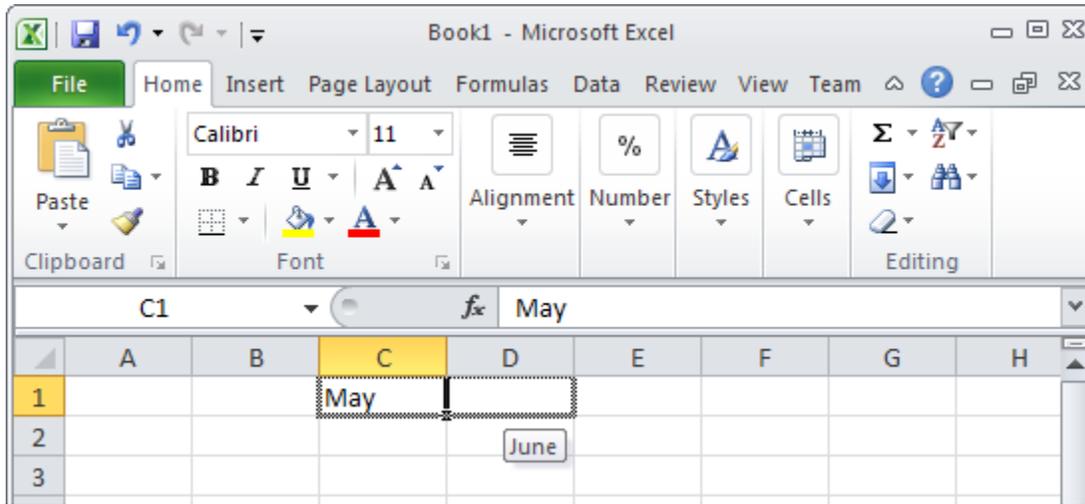
### Entering and Formatting the Month Names

Enter the month names in the first row of the MonthlyBudget worksheet. A simple way to do this is to type just the first month in the appropriate cell (C1). Then click on the lower right corner of the cell border and drag it to the right across the other 3 cells. You must carefully point to the corner of the cell containing May. You'll see the cursor change



shape to a cross (+) when it's in the right position. You should see the other month names appear as you drag. Figure 1.9 shows how this should look as you start.

**Figure 1.9 – dragging the fill handle**



Now you should format the month names – select the four cells (by dragging across them) and then use the **Font**, **Alignment** and **Number** groups in the **Home** tab to change the font size and/or type, and to make the text bold or italicized, etc. The font type is currently Calibri. Click on the arrow to the right of the font name and select a different font if you want to. The size, currently 11, can be changed in the same way. Clicking on the other icons once will cause the formatting changes indicated.

You might also need to change the width of the columns if the words exceed the default. To do this, carefully position the cursor over the boundary between two columns (the cursor will change shape to a vertical line intersected by a horizontal line with double arrows:  $\leftarrow \rightarrow$ ) and drag the column boundary to make it wider. If you select all four columns containing the month names their widths can be changed at the same time.

**Income and Expense Items**

Type all the Income and Expense headings as indicated in Figure 1.8. You can include other types of income and expense if you want. Format the data to enhance its clarity and readability and also adjust the column widths appropriately.

**Creating the Formulas**

The three rows Total Income:, Total Expenses:, and Monthly Surplus (Deficit): are the only ones, which contain calculated data. You must enter the rest of the data – it being the “raw data” of the model.

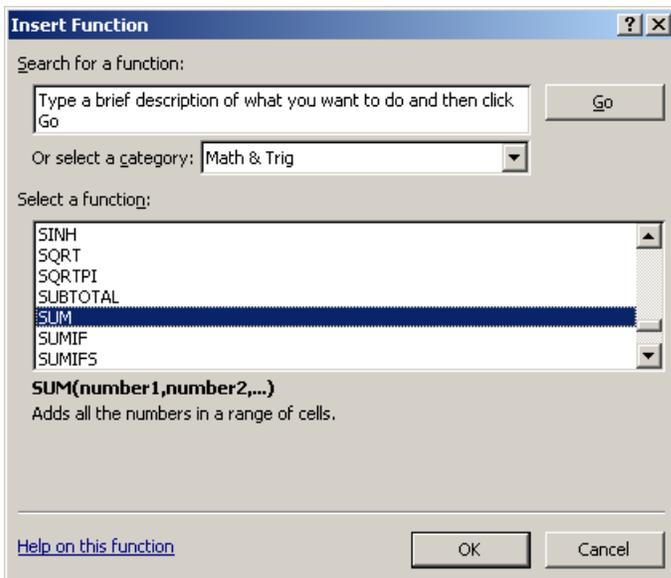


The total income for each month is just the sum of the income amounts for that month. You should use the **SUM** function with the argument being the range of cells in the column above. To do this, select the cell for total income for May and then click on the function icon in the formula bar.

The function icon: 

A window displaying the list of functions available in Excel appears and you should select the **Math & Trig** collection of functions amongst which you'll find the **SUM** function (see Figure 1.10).

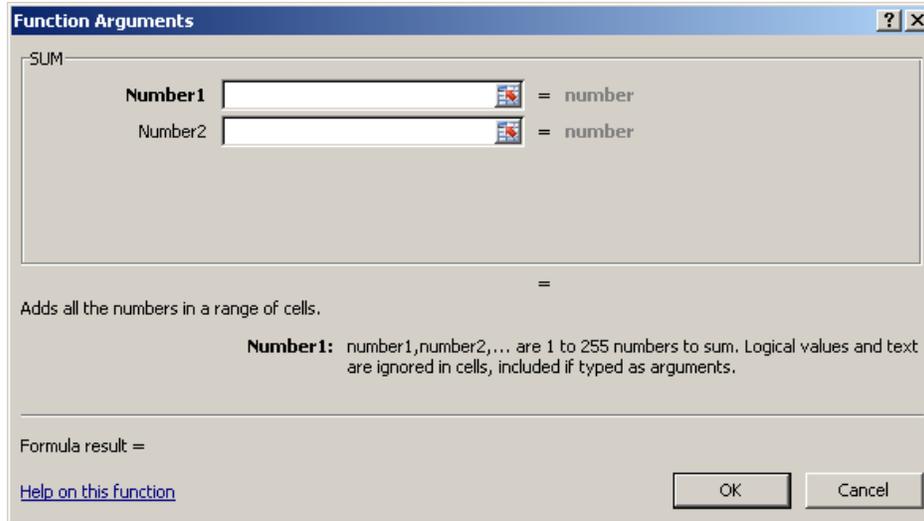
**Figure 1.10 – the Insert Function window**



Click on the **OK** button and the function is entered in the formula bar and a panel appears that helps you fill in the argument (Figure 1.11). In this panel the text box labeled **Number1** should have the cursor in it indicating that this is where text will appear. The argument (i.e. the cell range representing the values you want to sum) should be the column of income amounts for May. Drag the panel out of the way if you have to so that you can select the cells containing income amounts for May (by dragging over the cells). Notice that the range you select appears in the **Number1** text box. Click **OK** once you have done this.



**Figure 1.11 – the SUM function argument window**



The next step is to replicate this formula for the other months. This is easily done by dragging the fill handle across the three rows just as you did when entering the month names. This time, however, as the formula is filled across the row it is changed to specify the correct column letter for each column.

The formula for the Total Expenses: row is created in the same way.

To create the formula for the Monthly Surplus (Deficit) row you should first select the cell for the May column, type an = symbol, then click on the total income cell for May, type a – (subtraction) symbol and then click on the total expenses cell for May. As you do these various operations observe that the cell references are entered into the formula. Pointing and clicking is probably the easiest way of specifying the formula although you could also type it yourself if you were familiar enough with the syntax of Excel.

**Note: Point-and-Click is the definitely the best way to go.**

### Entering and Formatting Data

At the moment there are no amounts entered for any income or expenses. The values calculated by formulas will therefore be zeroes. You should now enter any sensible values for income and expense amounts and perform any remaining formatting to make your worksheet resemble Figure 1.8. You'll have to explore the various possibilities represented by the icons in the formatting tool bar (Home tab and Font, Alignment and Number cells within it) – but you have the basis for discovering these possibilities for yourself now. Remember that the numbers in this worksheet are all dollar amounts and should therefore be formatted as such. **Make sure you do this.** Close the workbook making sure that you save it - you might first want to create a folder called Ch1, say, in which to save the work you do in this lab.



## Exercise 2

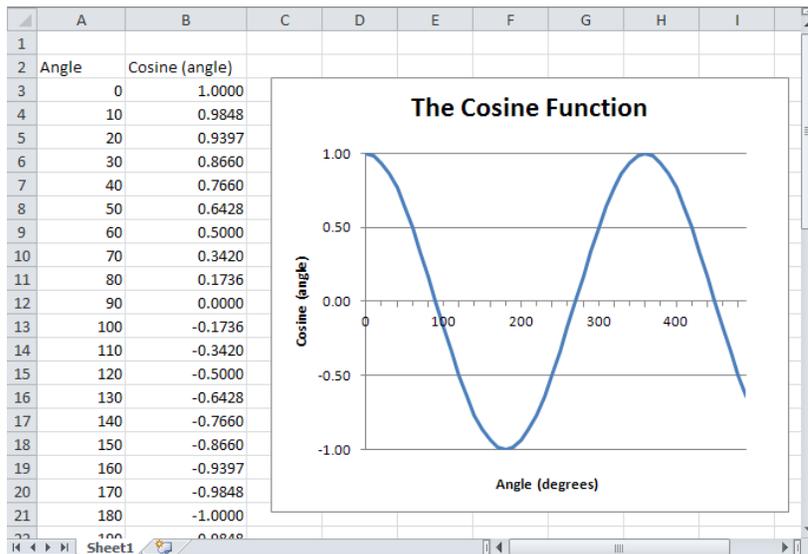
Create the following spreadsheet in which the values of the **Sum** and **Product** columns are calculated by formulas. The first value in the **Sum** column is the sum of 4, 7 and 8 for example. Make sure you do it in such a way that if you were to add a fourth or fifth column of numbers the formulas still calculate the correct values. Can you figure out how to center the title **Test Values** across the columns?

	A	B	C	D	E
1	Test Values				
2	Test1	Test2	Test3	Sum	Product
3	4	7	8	19	224
4	3	2	4	9	24
5					
6					

## Exercise 3

Create the spreadsheet shown in Figure 1.12. This spreadsheet calculates the graph of the cosine function. There is a column of at least 50 values for the angle (in degrees) and a column for the value of the cosine of the angle.

**Figure 1.12 – the cosine function model**

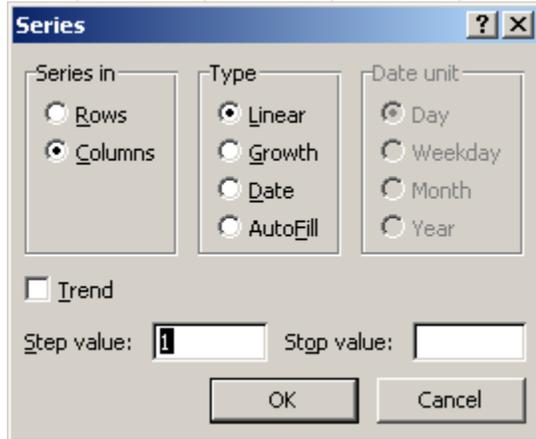




**Filling with a Series**

There are at least 50 values for the angle and you should not enter them by hand. Neither can you enter them using the fill handle as you did for the month names and the formulas in the budget model. In this case you must enter the first value and then select the column range, including the first value you just entered, that you want to fill with the other values for the angle – making sure it is at least 50 cells. Select the **Home** tab, and then click on the arrow (triangle) next to the **Fill** command, which is located in the **Editing** group at the right end of the command ribbon, and select the **Series...** option. Examine the choices you can make in this window carefully. Except for the **Step value:** box you don't need to change any of the choices, but you should at least try to remember what options the series fill provides. Change the step value to 10 and click **OK**. Observe how the column of values for the angle is filled.

**Figure 1.13 - the Series fill dialogue panel**



**Calculating the Cosine**

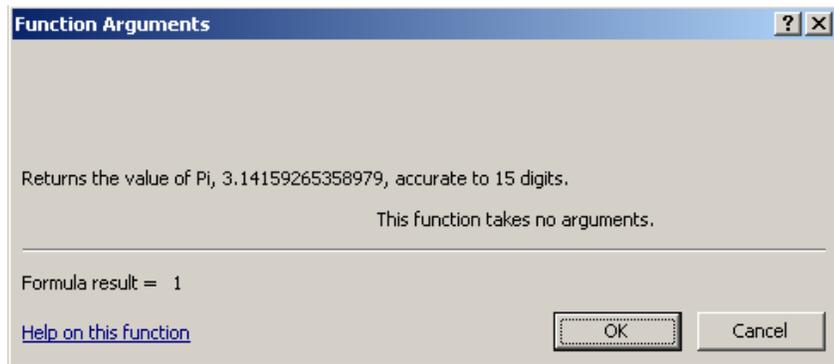
This can be done by writing the formula for the first cell and then filling down the column by dragging the fill handle (that little square in the bottom right corner of the border around the cell that is selected). Select the first cell and use the function icon to activate the Insert Function window (Figure 1.10). You'll find the **COS** function amongst the **Math & Trig** functions and you can specify the argument by clicking on the adjacent cell containing the angle value. The angle values are in degrees but the **COS** function expects radians so you must convert the angle value to radians by multiplying by  $\pi$  (pi) and dividing by 180. To do this simply type the multiplication symbol (the asterisk) and then click on the pull-down menu arrow in the name box. The name box currently displays the **COS** function name but a short list of other functions should appear and if you choose

The name box displaying the **COS** function:





More Functions... you'll open the Insert Function window (Figure 1.10) and be able to select the PI function from the Math and Trig group of functions. The PI function simply represents an accurate value for  $\pi$  (pi). You'll see this next panel:

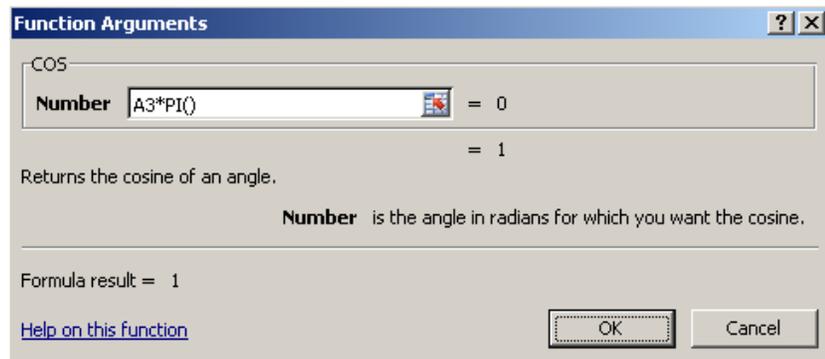


Your inclination now is to click the OK button. Do **not** click the OK button! At this point you have a function (PI) inside another function (COS). What should happen when you click OK is a return to COS so you can complete that function. That does not happen. Clicking OK in PI closes not only PI but also COS, which is still incomplete. Rather than clicking OK in PI move the cursor back up to the formula bar and position it anywhere within the name COS in the expression in the formula bar and click the left mouse button.

The name box and formula bar after inserting the PI function:

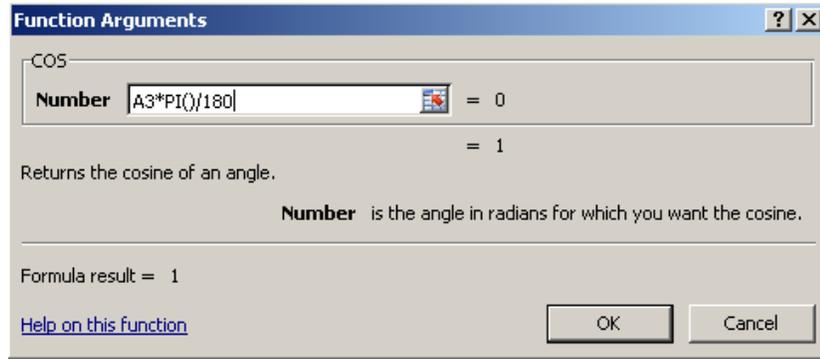


The Function Arguments window for COS now reappears:





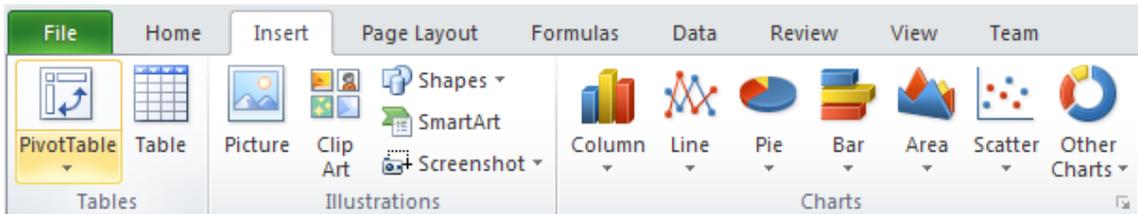
You can now finish the formula by including the division by 180. The Function Arguments window now looks like this:



The formula is now finished so click OK and fill the formula down the column. You should get the results shown in Figure 1.12. Format the Cosine column to display only 4 decimal positions.

### Creating a Graph

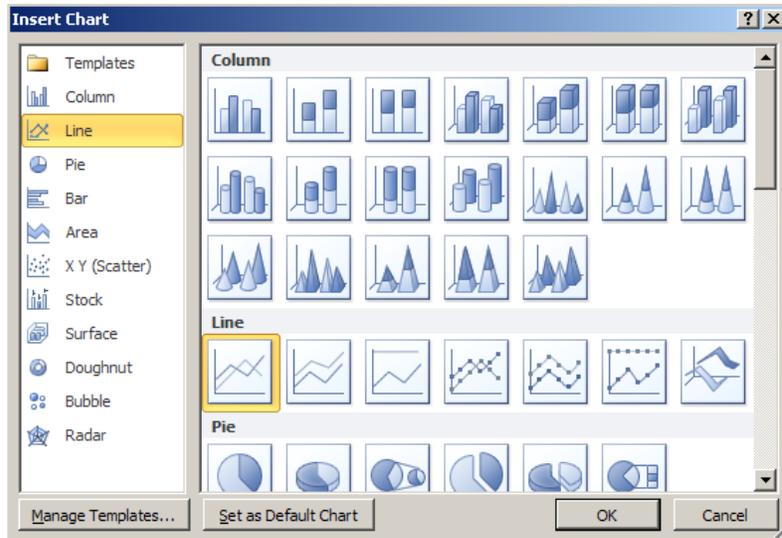
Click on the Insert tab and select the Line command from the Charts cell and then select “All Chart types...”.



The Insert Chart window shown in Figure 1.14 should appear. Observe the possible chart types carefully (select each of them to see all of the possibilities) but then make the selection shown in the figure – i.e. the first entry in the Line row – before clicking OK.

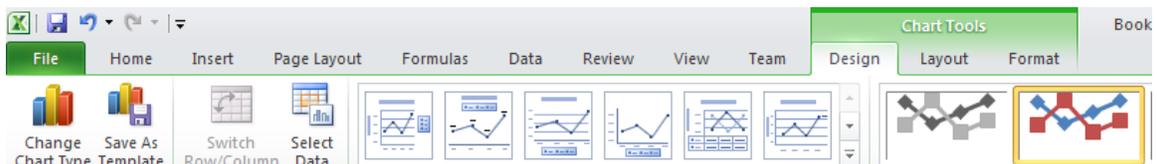


**Figure 1.14 – the Insert Chart window**

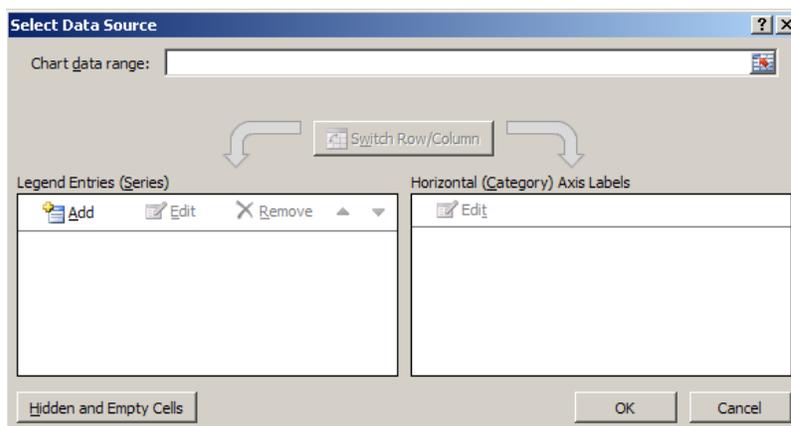


An object in the form of an empty rectangle is placed on the current worksheet. When complete the graph will appear in this space, as shown in Figure 1.12.

The next step in the chart creation is to select the data. Notice that the Design tab in Chart Tools is now showing.



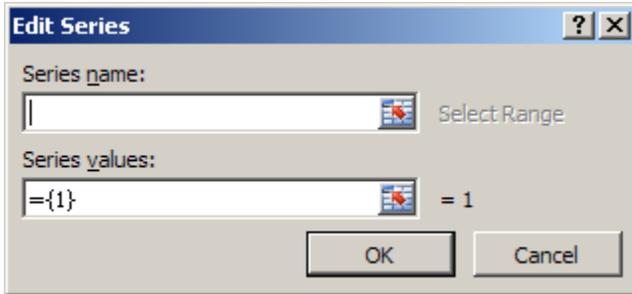
When you click on Select Data the Select Data Source window appears:



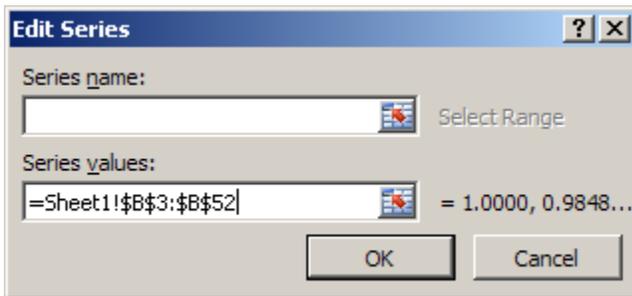


In the language of Excel **Legend Entries (Series)** are the values on the Y-axis, i.e. the curve in our case, and the **Horizontal (Category) Axis** is the X-axis.

To create the cosine curve, select **Add** under **Legend Entries** and click **OK**. The following window appears:

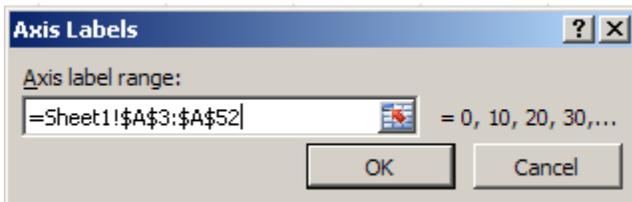


You can give the curve a name, but that is not necessary. Erase the phrase `= {1}` in Series values and highlight cells B3 to B52 (or to the last cell containing a value) on the worksheet and click **OK**.



Notice that the horizontal axis seems to bear no relation to the angles from which you calculated the cosine function value. In fact the horizontal axis seems to simply count how many values there are in the data. The next step allows you to specify which data to use on the horizontal axis of the graph.

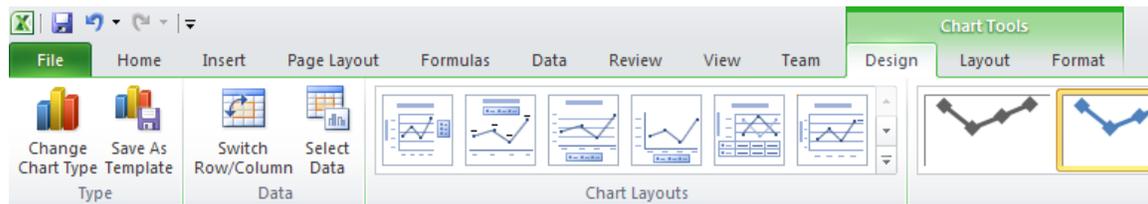
Click on the **Edit** button below **Horizontal (Category) Axis Labels** and select the angle data on your worksheet.





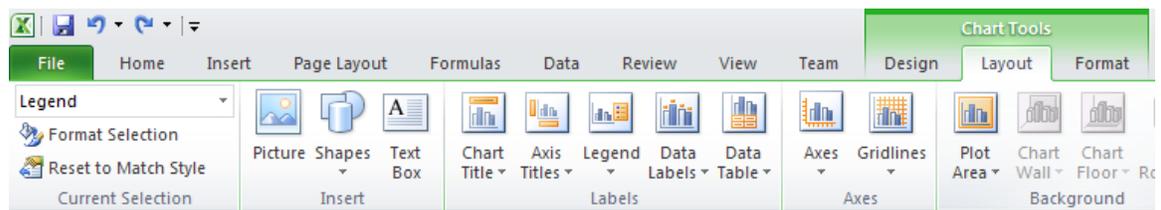
The next step is to specify a chart title, labels for the axes, and the legend, amongst other possibilities. A legend is useful if more than one line (series) is being plotted since the legend would identify the lines.

In the **Design** tab, select the appropriate layout of titles (Chart Title across the top and Axis title along both the X- and Y- axis) from the **Chart Layouts** cell.



You won't find exactly what you are looking for, so choose one that has more than you need. You can later delete the unwanted parts. Click on each of these and change them to the titles shown in Figure 1.12.

To delete an unwanted part, such as **Legend**, select the desired entry in the **Labels** cell in **Layout** within **Chart Tools**:



Rather than use the pre-defined Chart Layouts you can also build the Labels one-by-one, if you prefer.

### Further Adjustments to the Chart

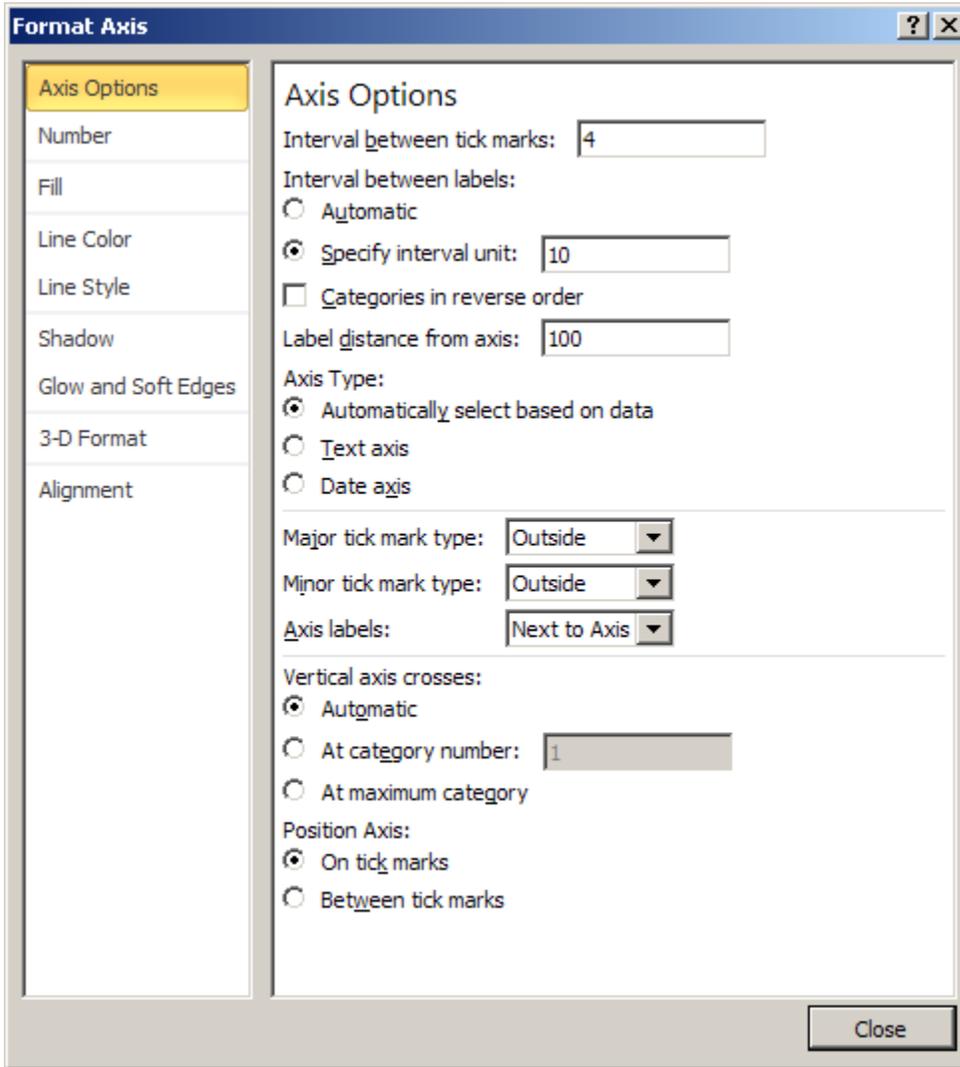
The chart now needs some tidying up. For example, the numbers on the horizontal axis would be better if they were oriented normally, and there are too many of them. In addition, there are too many values on the vertical axis and those values certainly do not need to have such decimal figure precision.

To further fine-tune the presentation of the plot you can select various features of it in order to make adjustments. For example, select a component in the chart by clicking once within its border ("handles" should appear on its border). You can resize it or move it.



Double-click on any of the values along the horizontal axis and the Format Axis window appears:

**Figure 1.15 – the format Axis window for the X-axis**

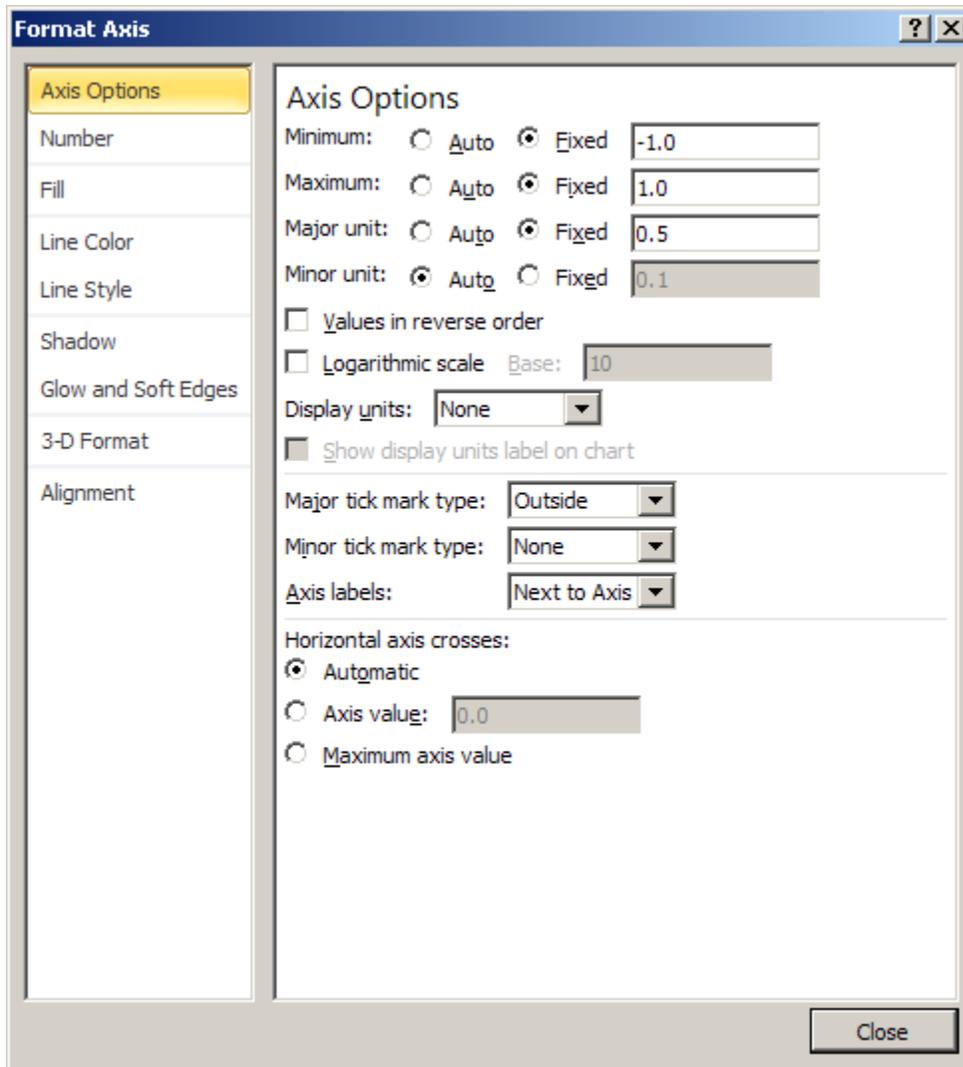


Type in the values shown in the figure and change other settings whenever they differ from the initial values and settings. Make sure you understand why these values were chosen. In fact, you would be well advised to experiment with different values to see the effects and make the changes one at a time and examine the graph after each one.



Next, double-click on any value on the vertical axis of the graph and adjust the parameters displayed in the Format Axis window, see if you can make your graph look like that shown in Figure 1.12.

**Figure 1.16 – the Format Axis window for the Y-axis**



## Summary

This chapter has given you an introduction to Excel spreadsheets. The techniques for creating a spreadsheet model and building formulas are fundamental to your future work with spreadsheets of any type. You must take the opportunity now to ensure that you are totally familiar with the principles discussed in this chapter, so please review the work and experiment with the many capabilities of the spreadsheet that have been introduced.