Excel Tutorial

To make the most of this tutorial I suggest you follow through it while sitting in front of a computer with Microsoft Excel™ running. This will allow you to try things out as you follow along. This tutorial requires that you already have a basic working knowledge for using the computer. I wrote this tutorial with reference to the 2002 version of Microsoft Excel, however, most of what is covered here will work pretty much the same in all versions back to Excel 97. Additionally, while I am using Windows XP, you should find that most Excel commands are essentially the same on a Mac operating system.

I use the following conventions when referring to commands **Edit > Find** means select Find from the Edit menu. **Ctrl-C** means depress the control and c key at the same time. Similarly, **Alt-Ctrl-C** means press all three keys at once. Remember that there are usually several ways to accomplish any one command, personally I use the right click on my mouse and speed keys for most tasks. However, for this tutorial I will make extensive use of the menus as most beginners seem to prefer this method.

Introduction to the workbook and spreadsheet

A spread sheet looks a lot like a table you might see in any word processing package, but it has some very important features that most tables do not. The first is that it is designed to make repetitive and/or complicated calculations very easy to carry out. Secondly, most spreadsheet programs have advanced graphing capabilities that make producing graphs from the data on the spread sheet relatively simple.

While Excel is a very popular spreadsheet program, it is by no means the only one that will do the job. This document is designed to aid biology students with their first few spreadsheet applications. Excel and most other spreadsheet programs are very powerful applications with far too many features to learn all in one sitting. If you are interested in learning more advanced techniques I direct you to the help menu or to consider purchasing one of many how to books.

In Excel each document is referred to as a workbook. Within each workbook you can have any number of spread sheets, the default is three but you can add as many sheets as you find necessary. At any given time, only one sheet is active in your work book. It is important to note that most page formatting options apply only to the sheet you are working with (for example, margins, headers and footers etc.). Additionally, when you print, the default for Excel is to only print the sheet that is active.

The Excel window.

In Figure 1, a typical Excel window is pictured. Some of the toolbars shown may not be currently visible. You can change which toolbars are visible in the **View** menu. Toolbar views are toggle switches, if they are currently on and you select them they will turn off, and vice versa. If you can not currently see one of the toolbars pictured in Figure 1, turn it on now. Refer to Table 1 for brief descriptions of the toolbars displayed in Figure 1.

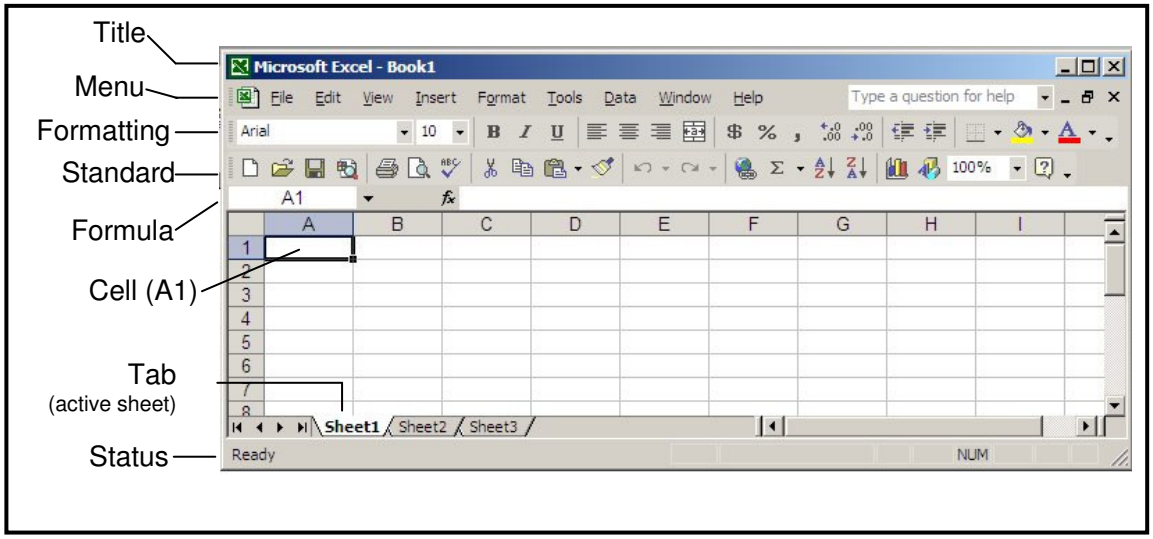


Figure 1. The Excel window.

Table 1. Excel toolbars.

Toolbar Name	**Usage**
Title Bar	Displays the title of the workbook you are currently in.
Menu Bar	Menus, left click menu to see choices.
Formatting Toolbar	Various formatting shortcuts.
Standard Toolbar	Standard Tools, similar to other Microsoft products, and some special tools for Excel.
Formula Bar	Two important fields, the left field shows the cell address of the cell your cursor is currently located in. The right field displays the 'actual' contents of the cell, this field is especially important when you are entering formulas.
Tab Bar	Allows you to move through sheets. Note the active sheet is always highlighted.
Status Bar	Displays a description of what Excel is doing.

Cell addressing and entering data

The spread sheet itself is laid out as a table made up of columns and rows. Each column has a letter reference (A, B, C…) and each row has a number reference (1, 2, 3…). Each square in the spread sheet represents the intersection of 1 row and 1 column and is referred to as a **cell**. Cells are referenced according to the row and column intersection. For example: cell A1 is the cell in column A and row 1. This unique row and column reference of a cell is referred to as its 'address'. One of the beauties of spread sheets is that once a datum, label or formula is entered into a

unique cell in the spread sheet, the contents of the cell can then be used elsewhere in the program simply by referencing the cell address.

Entering data or labels into cells is simple, just move the cursor to the cell you wish to enter your datum, click to select the cell, enter your datum, and press enter. It's important to note that you must press 'enter'; otherwise the spread sheet does not recognize that you have entered data. If you wish to enter a series of numbers you can speed up the process by using the **auto fill** capability.

To use auto fill, enter the first two numbers in the series in adjoining cells. Now select both cells, grab the common **handle** (the little black box in the bottom right hand corner of the selected cells) and drag down as far as needed. You should now have a series of numbers, following the pattern of the first two you entered. This trick will work for letters and formulas as well as numbers, and works for columns as well as rows.

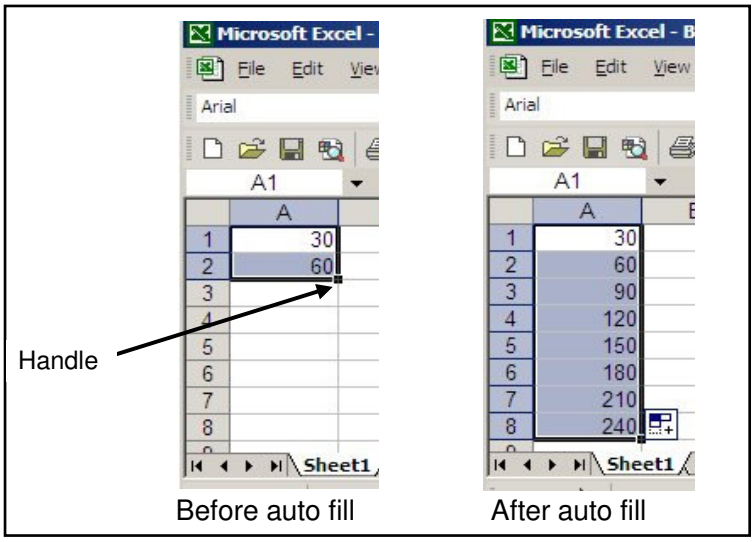


Figure 2. Using Excel's auto fill.
For example; if you sampled every 30 sec, enter 30 sec in A1 and 60 sec in A2. Select both cells, grab the handle and drag down to cell A8. You should now have a series of numbers, each 30 more than the one above it, as picture in the right hand screen shot.

Making your spread sheet look pretty.

To resize columns and rows, click in the header cell to select the column or row and drag the margin. Or, right click the header cell and select the **column width**, **row height** option.

Hundreds of options exist for formatting cells. Most of these are accessed by selecting the cells you wish to format, right clicking, and selecting the **format cells** option. Especially check out the options in the **Number** and **Alignment** tabs.

Box 1. Spread Sheet Basics.

You must press enter after typing your datum in a cell.
To format cells, select, right click, and click the 'format cells' option.
Auto fill is activated by selecting the cells 'handle'.
To alter page format for printing, use **File>PageSetup**,

Entering formulas

There are two ways to enter formulas in Excel, either use one of the functions already programmed in Excel, or enter your own from scratch.

Entering your own formula

To enter your own formula start by typing an equal sign (this tells Excel you are entering a formula) and then entering the formula using **operands** and **operators**. Standard arithmetic operators are listed in Table 1, but many others are available. Operands can either be numbers you enter, or can be cell references. To enter a cell reference into a formula either type it, or click the cell.

Table 2. Arithmetic operators.

Arithmetic operator	**Meaning (example)**
+ (plus sign)	Addition (3+3)
- (minus sign)	Subtraction (3-1)
*(asterisk)	Multiplication (3*3)
/ (forward slash)	Division (3/3)
% (percent sign)	Percent (20%)
^ (caret)	Exponentiation (3^2)

When using operators in your formulas, keep in mind that Excel follows an order of operation as summarized in Table 3. If a formula contains operators with the same precedence Excel evaluates the operators from left to right. To override operator precedence, use parenthesis. For more information on entering your own formulas check in; **Excel Help>Contents> creating and correcting formulas**.

Table 3. Operator precedence in Excel.

Precedence	Operator	Description
1	: (colon) (single space) , (comma)	Reference operators
2	–	Negation (as in –1)
3	%	Percent
4	^	Exponentiation
5	* and /	Multiplication and division
6	+ and –	Addition and subtraction
7	&	Connects two strings of text (concatenation)
8	= < > <= >= <>	Comparison

Using Excel's functions

The easiest way to understand the implementation of Excel functions is by following a step by step example. To access Excel's functions, click the down arrow next to the sum button. As shown in Figure 3, this gives you a popup menu showing the five most common Excel functions, and below these, a menu choice titled 'More Functions". Note that selecting one of the five functions in the pop up menu will work differently then selecting them from the "More Functions" menu.

In this first example we will calculate the sum of a series of numbers.

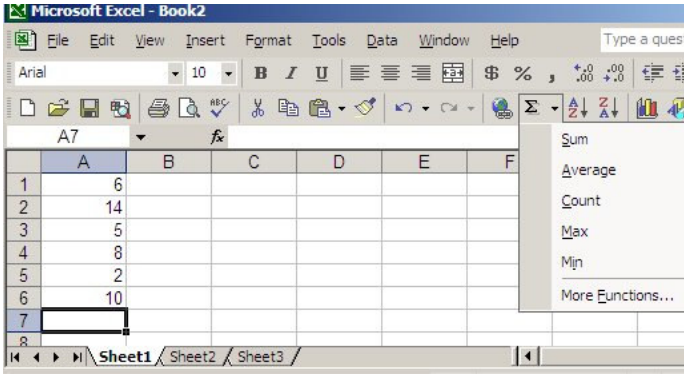


Figure 3. Excel's pop up function menu.

Step 1. Start by entering the series of numbers as pictured in Figure 3. Place your cursor in cell A7. Select sum from the list of functions that appears when you click the down arrow next to the sum button (or click the sum button). Excel tries to guess the cells you wish to sum up. Generally it will select all the cells containing numerical data immediately next to the cell you are inserting the function into.

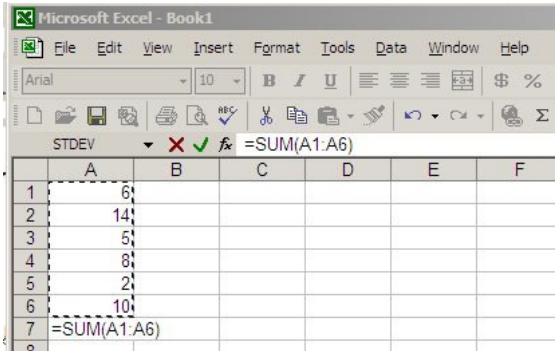


Figure 4. Excel's sum function.

Step 2. You can see what cells Excel has chosen in 2 ways. They will be enclosed in a marching dash box, and the range is displayed in the function window. In this case Excel has chosen the correct data. You can always override by selecting the cells yourself, or typing the correct range in the function window.

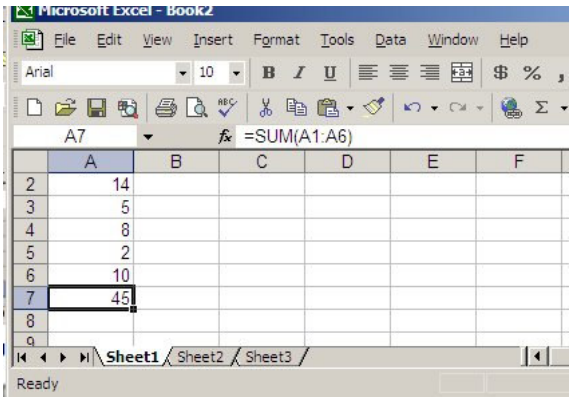


Figure 5. Result of using Excel's sum function.

Step 3. When the correct cells have been chosen, press enter. The sum will appear in cell A7. Note that when you select cell A7, the function appears in the function window, but the result will still appear in the cell on the spread sheet

In this second example, we will calculate the standard deviation for the same numbers used in the sum example.

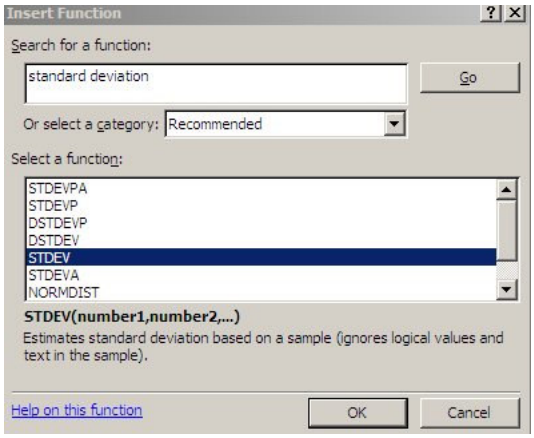


Figure 6. Excel's insert function window.

Step 1. Place your cursor in cell A8. From the function pop up menu choose more functions.

Step 2. When you select 'More Functions', you will get a new window where you can either search for the function by name, or select a category, and then scroll down looking for the function. Notice the description of the selected function appears near the bottom of the window. Enter 'standard deviation' in the search window and click 'Go'. Select the function STDEV.

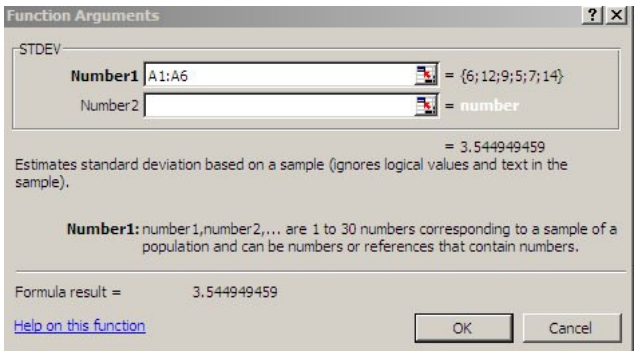
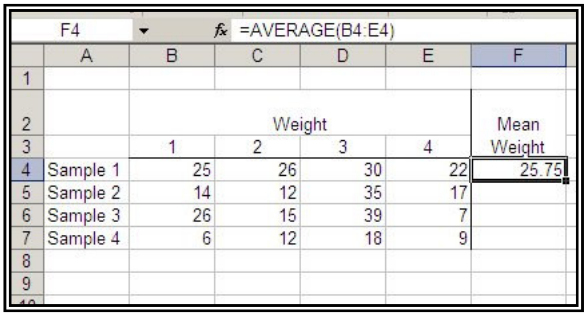


Figure 7. Excel's Function Arguments window.

Step 3. Once you have selected the function you want, you will get yet a new window called 'Function Arguments '. Here the program is looking for the address, or actual numbers, you want the function to use. You can either enter the cells addresses manually, or select the cells, using click and drag. Go back to the spread sheet and select the cells A1 through A6. Your Function Arguments window should now look like the one in Figure 7. Select OK. Cell A8 will now show the standard deviation (4.1833) for cells A1 through A6.

Using auto fill to copy a formula.

Often, you will want to apply the same formula to a series of cell. Enter the weight data as shown in Figure 8 (don't enter the mean weight). Use Excel's average function to calculate the average for sample 1. Now, grab the cell handle for Sample 1 mean weight and drag down four cells. Go back and click in the cell for the mean weight of sample 2. Notice that the formula bar, the function is still AVERAGE, but the cell reference has moved down one row (in my example it would now read B5:E5). This is referred to as **relative addressing** and it is the default method Excel applies to copying formulas.

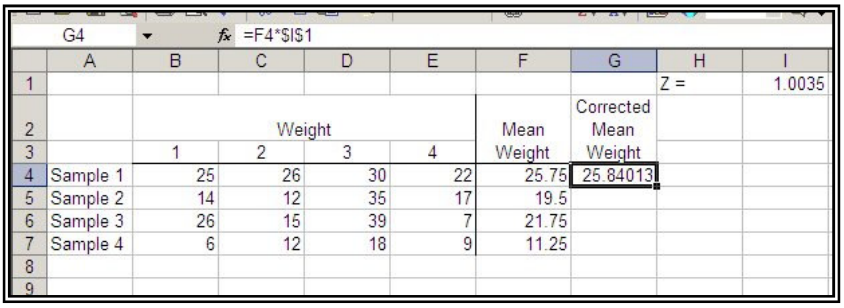


F4 =AVERAGE(B4:E4)

	A	B	C	D	E	F
1						
2		Weight				Mean
3		1	2	3	4	Weight
4	Sample 1	25	26	30	22	25.75
5	Sample 2	14	12	35	17	
6	Sample 3	26	15	39	7	
7	Sample 4	6	12	18	9	
8						
9						

Figure 8. Auto filling a formula in Excel.

Occasionally you will need to make an **absolute reference** to a cell. To do this, add dollar signs to the cell reference. In my example I need to correct the mean weight of all the samples by multiplying it by the Z factor of 1.0035, which is entered in cell 1I. To do this, I enter a formula, as shown in the formula bar of Figure 9, using I1 to reference the Z factor. Now, when I auto fill, all mean values are multiplied by the value 1.0035. Give it a try, and see what happens when you don't use the absolute reference.



G4 =F4*I1

	A	B	C	D	E	F	G	H	I
1								Z =	1.0035
2		Weight				Mean	Corrected Mean		
3		1	2	3	4	Weight	Weight		
4	Sample 1	25	26	30	22	25.75	25.84013		
5	Sample 2	14	12	35	17	19.5			
6	Sample 3	26	15	39	7	21.75			
7	Sample 4	6	12	18	9	11.25			
8									
9									

Figure 9. Using an absolute reference in Excel.

Box 2. Entering formulas.

- All formulas start with an = sign.
- Case is not important when entering the formula.
- Cells containing non numerical entrees will be ignored in calculations.
- Excel functions are listed in; Excel Help>Contents>Function Reference
- The default for auto filling formulas is to use relative addressing.

Graphing

Excel has the capability of making many different styles of graphs. The following example will show you how to make a scatter plot, add a linear regression trend line, and how to fine tune the graphs appearance.

Making a scatter plot.

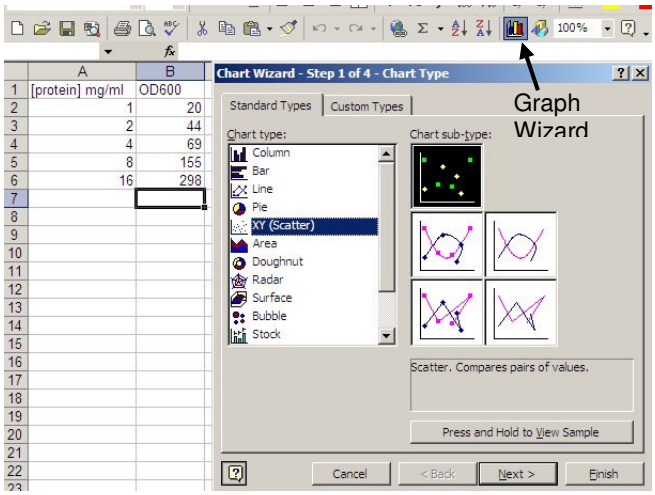


Figure 10. Excel's chart wizard, step 1, selecting the chart type.

Step 1. Let's start with a typical set of data for establishing a standard curve. Enter the data into Excel as picture in Figure 10. Now click the **chart wizard** button.

Click the XY scatter plot button. Do not use line graph, this will not give us what we want.

Select the first option for graph sub-type (the one with just dots, no line drawn), and click next.

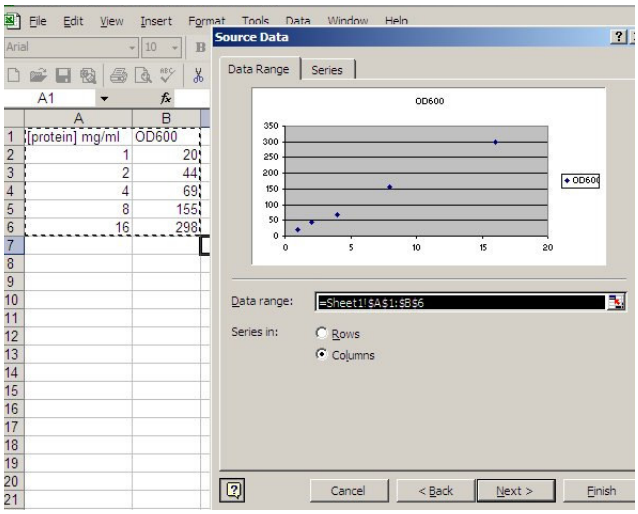


Figure 11. Excel's Chart Wizard, step 2, selecting the source data.

Step 2. Excel will guess what data you wish to use. It may or may not guess correctly. To check what data has been selected, click the series tab.

The series window is also where you would go to add more data. Don't worry about the series name for now.

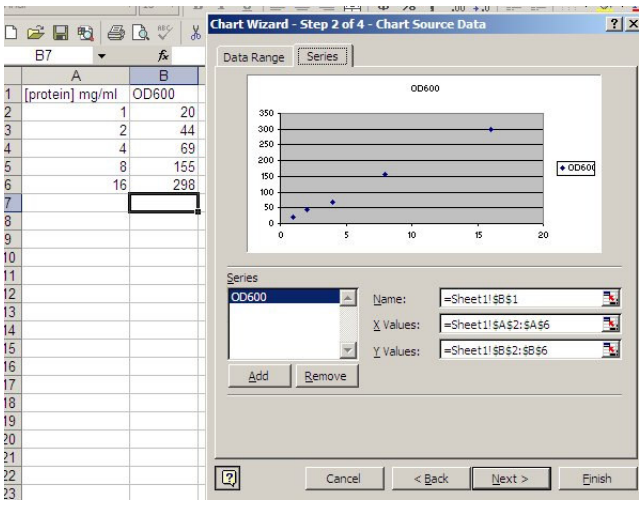


Figure 12. Excel's Chart Wizard, step 2, selecting the source data.

Click the small box containing the red arrow next to the X value window. This button takes you back to the spreadsheet. The data being used as X values will be in a marching dash box. If you need to change the data being used, just select it. Similarly, check the Y data.

Remember, your X axis is always the controlled variable (in this case the protein concentration).


This button appears in many Excel source data windows, clicking it will always take you back to the spread sheet, allowing you to select cells for input.


Clicking this button will take you back to source data window you started from.

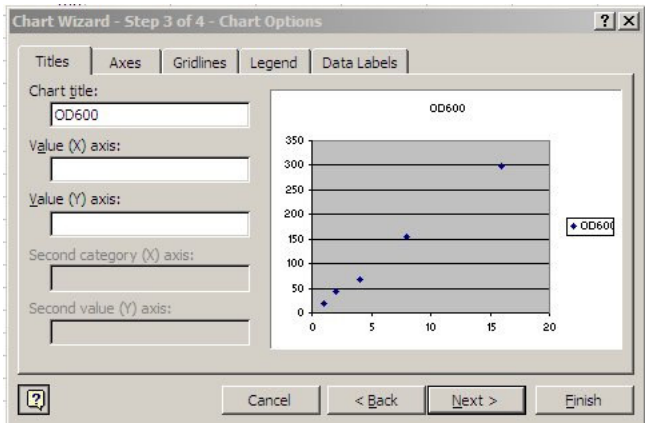


Figure 13. Excel's Chart Wizard, step 3.

Step 3. When you are satisfied with the data being used, click next. This takes you to the Chart Options window. Notice the multiple tabs for formatting your graph.

Enter titles for the X and Y axis, and a chart title.
In the Gridlines tab, remove the major gridlines.
Since there is only one series, go to the legend tab and remove the legend.

Click next.

Step4. Choose where to place your chart in the work book. It's usually best to use the default, object in sheet, as the graph appears next to your data.

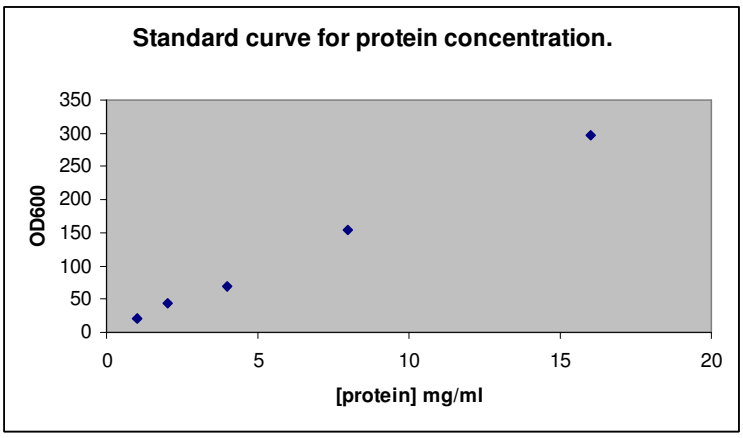


Figure 14. Excel graph before fine tuning.

Fine tuning your graph.

Pretty much anything you like can be modified in your graph, such as; changing the coloured background, change the default tick marks position and intervals, change the symbols used etc. To make changes, usually you can just double click the region of the graph you want to change. For example, to get rid of the ugly grey background seen in Figure 14, double click the background and change area to none. Click a variety of positions on the chart and see what happens. Select the chart and right click to get some other options including, reselecting the source data, chart type and chart options. Also, with the chart selected, note that a new menu called **Chart**, appears in the menu bar. We will use this menu to add a trendline.

Adding a trendline to a graph.

Select the chart (make sure the chart is selected, not just the graph) and the **Chart** menu appears. Select **Chart>Add Trendline**. The window pictured in Figure 15 will now appear. Select the **Linear** regression type and then switch to the **Options** Tab. Select '**Display equation on chart**', and '**Display R-squared value on chart**'. Figure 16 pictures the same graph as seen in Figure 15, but after cleaning it up and adding the trendline.

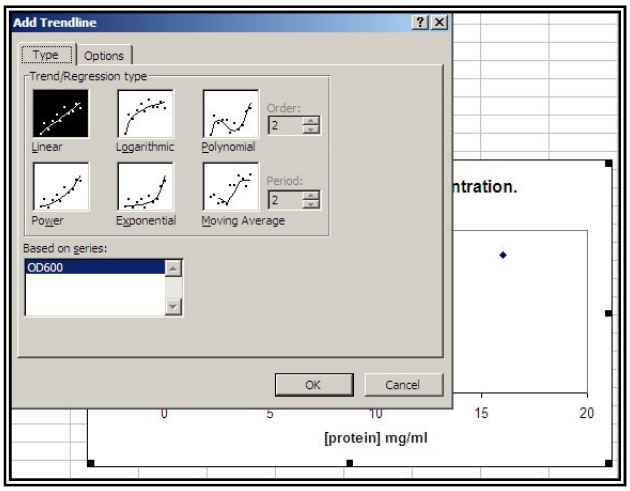


Figure 15. Excel's Add Trendline window.

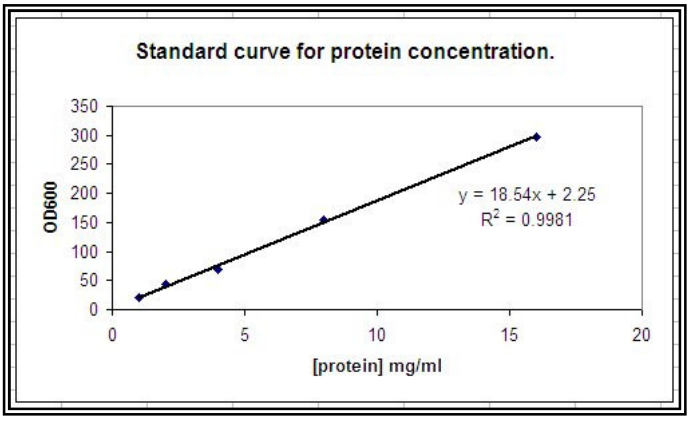


Figure 16. Excel graph after adding trendline.

Adding error bars to a chart.

Select the data series to which you want to add error bars. To do this, click on of the points on the graph belonging to the data series. On the **Format** menu, click **Selected Data Series**. On the **X Error Bars** tab or the **Y Error Bars** tab, select the options you want.

Box 3. Graphing basics.

- Once your graph is made it will automatically be updated to reflect any changes you make to the data used to create the graph.
- To modify most things on your graph either right click the chart, or double click the element you wish to change.
- To access chart specific menus, the chart must be selected.