Graphing with Excel

Bar Graphs and Histograms

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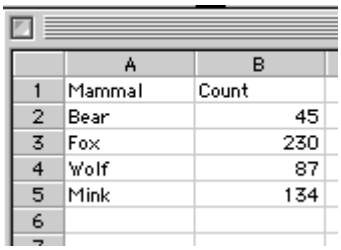
Introduction

Bar graphs are created in much the same way scatter plots and line graphs are. Histograms are a specialized type of bar graph used to summarize groups of data.

Creating a bar graph with one independent variable

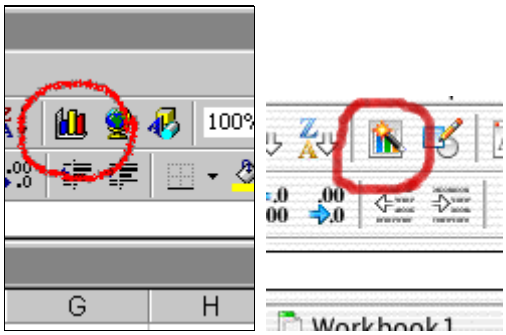
Data is entered into Excel much in the same way as it is with scatter plots and line graphs:



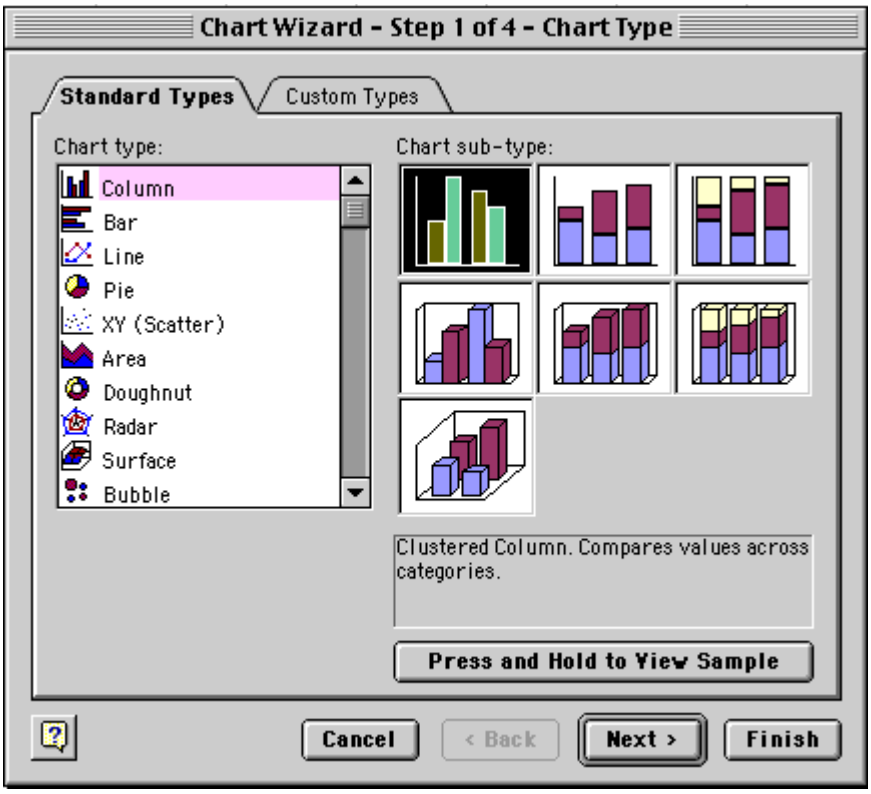
	A	B
1	Mammal	Count
2	Bear	45
3	Fox	230
4	Wolf	87
5	Mink	134
6		

Note that the *independent variable* is placed in the first column while the *dependent variable* is placed in the second column. The headers at the top of each column are not necessary, but they do help identify the variables.

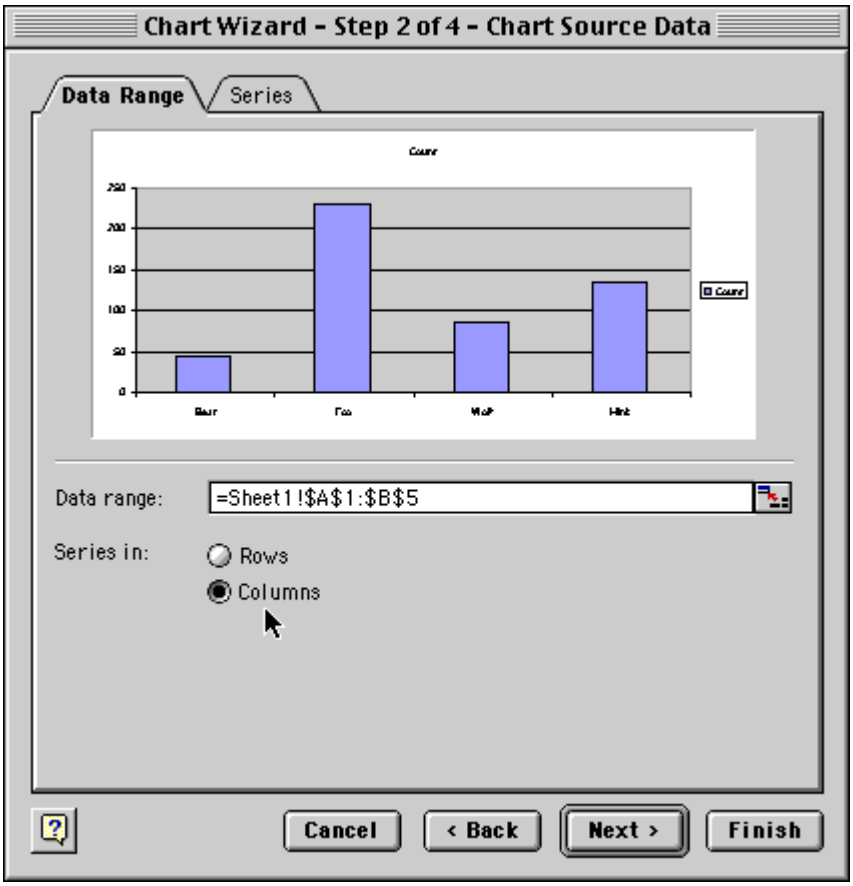
With the data shown above **highlighted**, start the **Chart Wizard** from the toolbar:



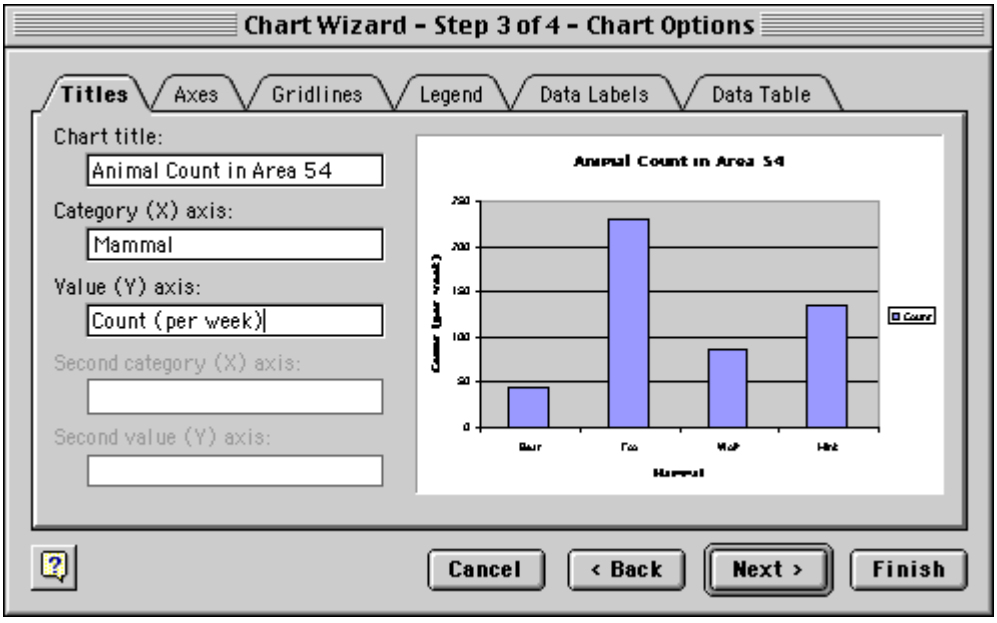
If the Chart Wizard is not visible on the toolbar, you can also choose **Insert > Chart...**



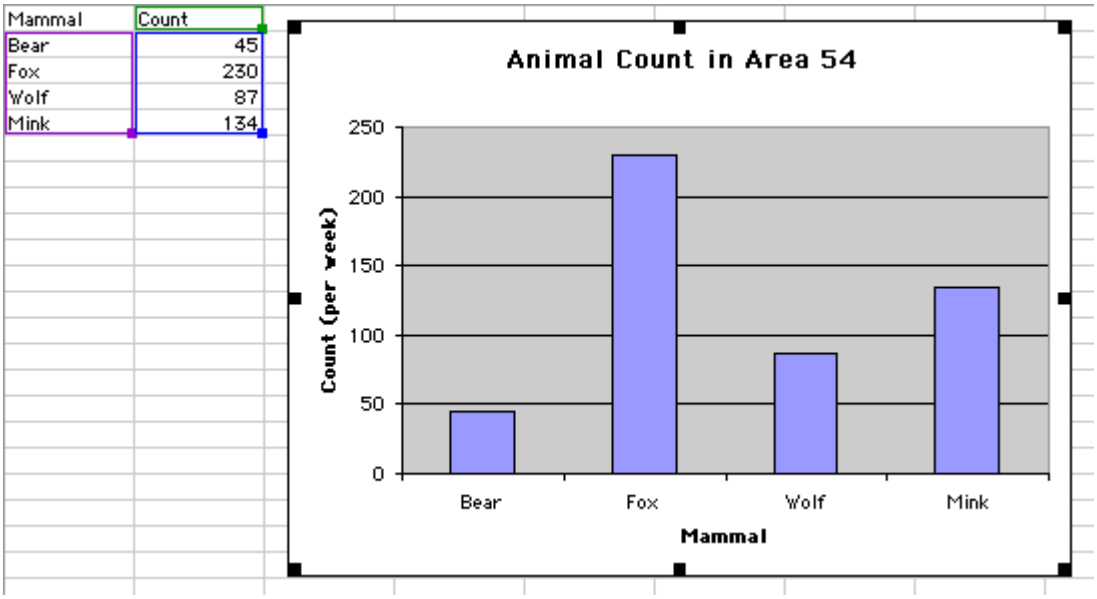
Choose the **Column Chart type** and the **Chart sub-type** in the **upper left corner** (basic bar graph). This chart type creates a vertical bar graph, which Excel refers to as a Column chart. If you want to create a horizontal bar graph, choose the Bar chart type. Click **Next** when you are done.



Confirm that your Data **Series** are in **Columns** in your spreadsheet. Your **Data range** should reflect your selection of the independent and dependent data (plus possibly your column headers) in absolute cell references. The **preview** should show a pretty good representation of what your chart will look like. Click **Next** when you are done.



Enter your titling. Also make sure to go to the **Legend** tab and **click off** the **Show Legend** option. You will not need a legend with only one independent variable. Click **Next** or **Finish** when you are done.



Your final graph should look something like the one above. Note that when the graph is selected, your independent and dependent variables are highlighted in purple and blue boxes, respectively.

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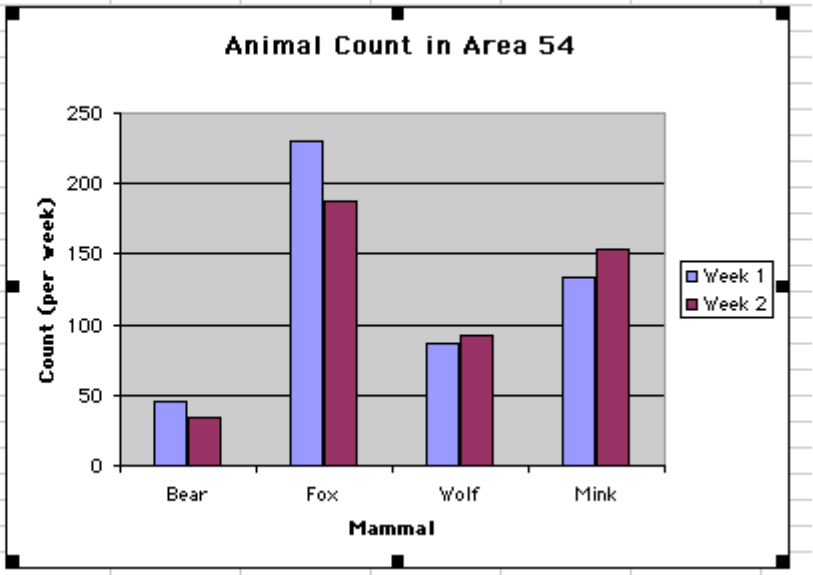
Creating a bar graph with two independent variables

A multiple bar graph depicting data using two independent variables is created in the same way as a simple bar graph:

Mammal	Count	
	Week 1	Week 2
Bear	45	34
Fox	230	187
Wolf	87	92
Mink	134	154



Some things to note when creating this multiple bar graph:

- The first independent variable, *Mammal*, is still in the first column, with the dependent variable values (*Count*) in columns two and three. The second and third columns represent dependent variable values at two different levels of the second independent variable, *Week*.
- Make sure to select all of the data when creating the graph. The Chart wizard will automatically recognize you have a second independent variable.
- When you get to the last step of the Chart wizard, keep the legend turned **on**, since it shows the coding for the two levels of the second independent variable.

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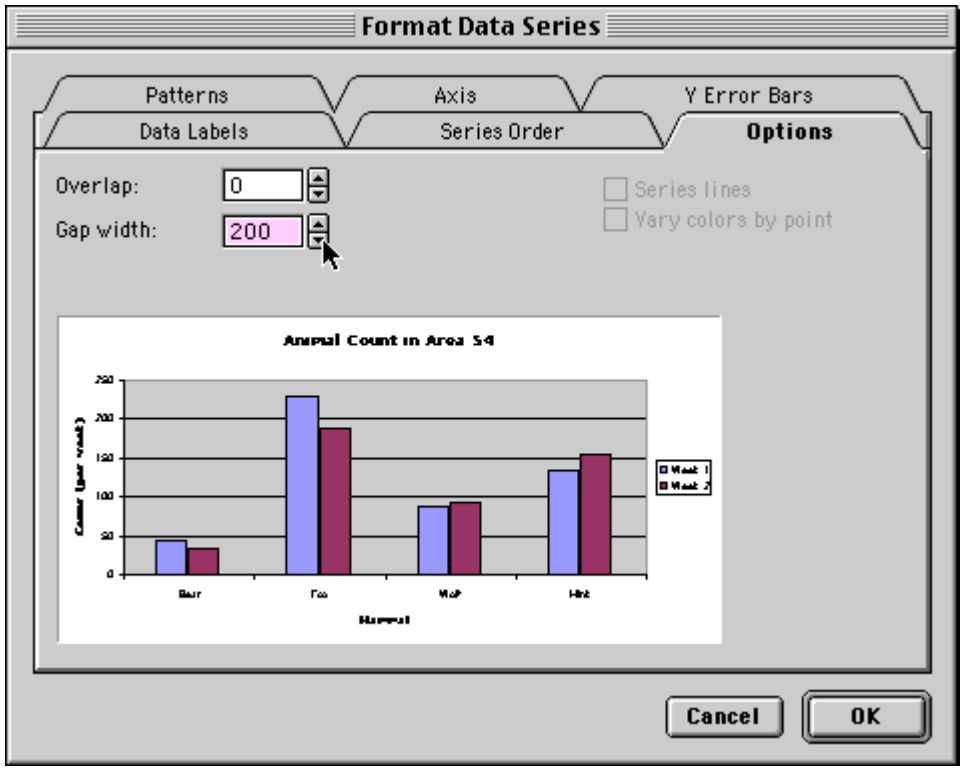
Adjusting bar spacing

The relative widths of bars to the gap between the bars can be adjusted by **double-clicking** on one of the bars in the graph:



- **Gap width** represents the spacing between bars as a percentage of the width of one bar
- **Overlap** will overlap bars in group as a percentage of bar width. Negative values creates a gap between the bars within a group.

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Introduction to histograms

In some investigations, you may find yourself collecting a large number of data points for a single level of an independent variable. That is, you take the same measurement over and over again. You

would do this because a lack of perfect precision in your measuring process would not let you get a good estimate of the true value with only a single measurement. In this example, the fracture stress of a certain type of glass bar is measured 24 times:

M	N
Tempered Rods	
Stress (psi)	
106	
99	
102	
90	
98	
151	
115	
118	
133	
70	
85	
112	
100	
55	
169	
155	
144	
80	
101	
93	
71	
111	
90	
79	

Clearly, the measured stress is not the same for each sample. In fact, the measurements range from a low of 55 to a high of 169. How can you summarize the results of these measurements? One way might be to simply calculate the average (mean) of all these measurements. This would not, however, give you a good feel for how the data is *distributed.* A distribution graph, or **histogram**, allows you to see how many measurements fall within set ranges, or **bins**, of the dependent variable. A histogram is usually depicted as a bar chart, with one bar representing the count of how many measurements fall with a single bin.

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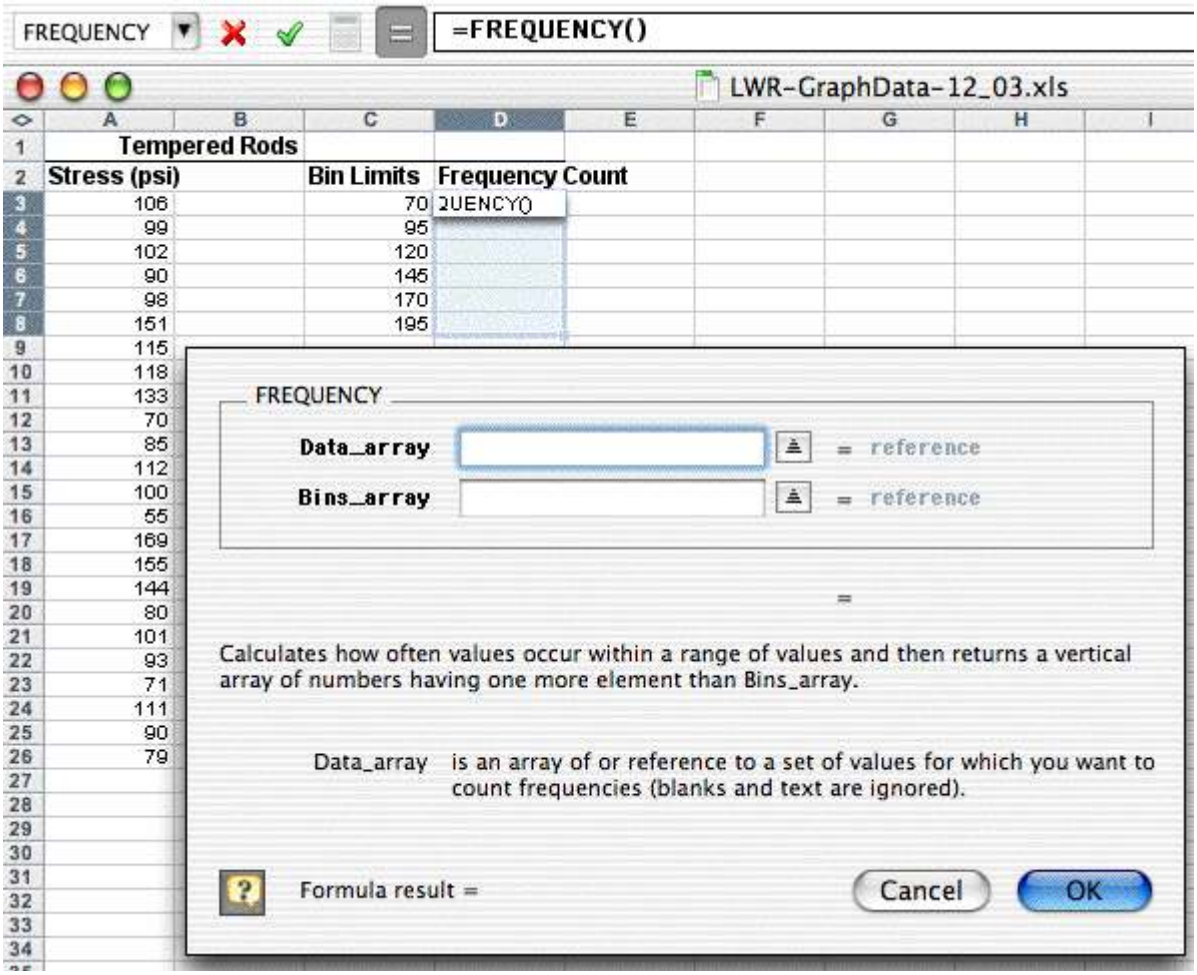
Histograms - using the FREQUENCY function

To start with, it is usually a good idea to scan your data and get a feel for its overall range. For the data above, the range is from 55 to 169. Next you will want to decide how fine you want the increment of your bins. The finer the increment, the more bins, and thus the more bars on your chart. For this example we will choose a bin increment of 15 starting with 70. Depending on what you want to depict, you may want to show an empty bin above and/or below the extreme values of your samples to show the viewer that you are at the extremes of your data set. Type in these bin increments in a column next to your raw data:

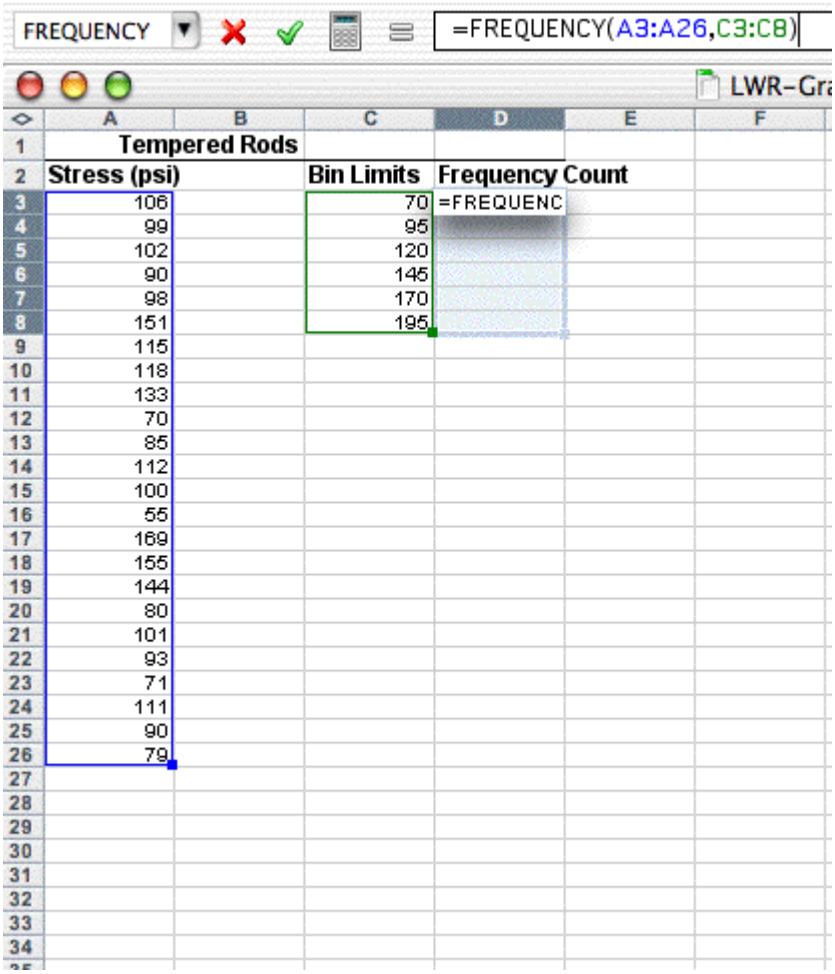
Tempered Rods			
Stress (psi)		Bin Limits	Frequency Count
106		70	
99		95	
102		120	
90		145	
98		170	
151		195	
115			
118			
133			
70			
85			
112			
100			
55			
169			
155			
144			
80			
101			
93			
71			
111			
90			
79			

Though you can manually count the number of measurements that fall within each of these bins, an easier way is to use the Excel function **FREQUENCY**. This function is a bit more complex than

functions such as MEAN. The FREQUENCY function is an *array functio***n**, returning values to a range of cells. Look at the figure below and follow the steps to enter this function:



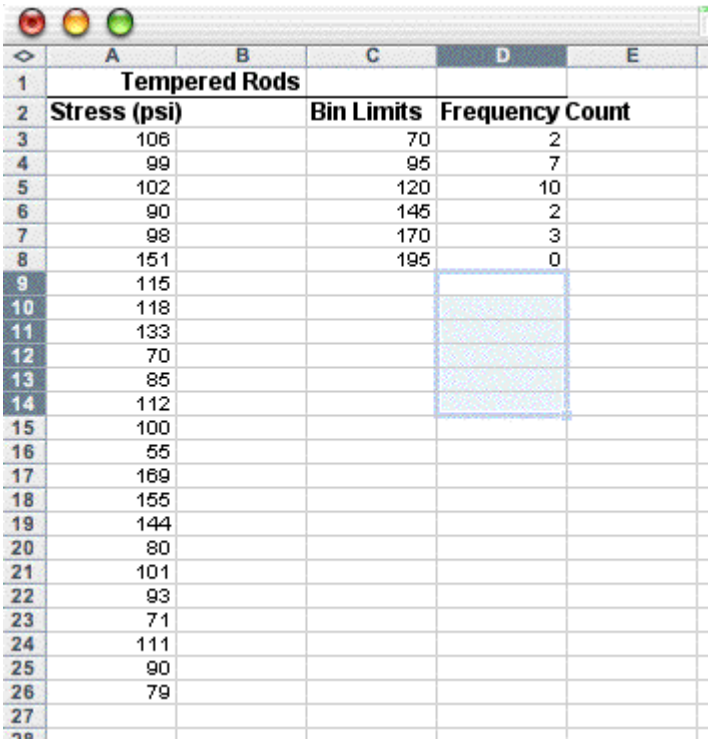
- **Highlight** the **range of cells** which will hold the frequency counts **(D3:D8)**. These will be all of the Frequency Count cells next to the bin increments.
- Choose **Insert>Function...**, pick the **Statistical** Function category and scroll down in the box on the right and choose **FREQUENCY** as the Function name.
- Use the dialogue box to enter the function. With the **Data_array** box selected, go to the spreadsheet page and **highlight** the data values **(A3:A26)**. The dialogue box with "roll up" while you highlight these values and then "roll down" when you are done.
- Repeat this process by selecting the **Bins_array** box and then go out the spreadsheet and **highlight** the bin limits cells **(C3:C8)**.
- Click OK. The completed formula is seen in the formula bar and the correct count value is seen in the Bin Limit 70 count cell (D3):



What has not been done yet is to copy the array function down to the other Frequency Count cells. This is a bit different that typical cell copying:

- With the Frequency Count cells **still highlighted (D3:D8)**, **click** on the **FREQUENCY function** into the formula bar (i.e., =FREQUENCY(A3:A26,C3:C8))
- **Propagate** the function by typing **Control-Shift-Enter** on a PC (type **Command-Return** on the Mac).

The frequency values should now fill the cells next to the bin increments. Note that your first bin increment, 70, holds all the measurements at 70 and below. The next bin, 95, holds measurements from 71-95, and so on. The result should look like this:



If only the top cell is filled with a frequency value, then you probably either didn't highlight the range of cells next to the bin increments, or you didn't use the special key combination to enter the function. Note that in the next figure, the last bin value, **195**, was changed to **More** to indicate in the graph that it represents the count for everything above 170.

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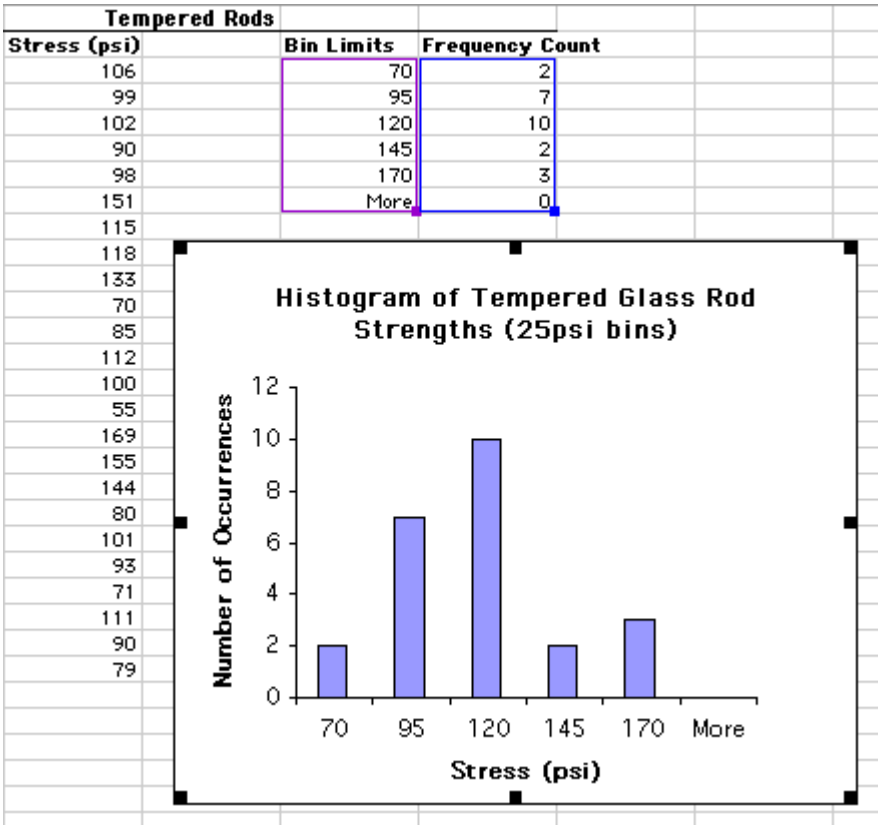
Creating a histogram

You can now create a bar graph as you did above using the histogram summary data rather than the raw data:



Note again that this histogram is made from the summary data (highlighted in purple and blue boxes), not the raw data. Optionally you can leave the More category from the graph.

Just as you can with other data, you can create a multiple bar histogram. You can either do this as was shown above or by superimposing two histograms (see the Advanced module on superimposing graphs).

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