

# Guide to Creating Graphs Using Excel

An essential part of science is communication of research results. In addition to written descriptions and interpretations, the data are presented in a figure that shows, in a visual format, the effect of the manipulations (independent variables) on the observed behavior (the dependent variable). This guide will teach you how to create two of the basic graph types used in psychology – the column graph (a.k.a. the bar graph) and the line graph.

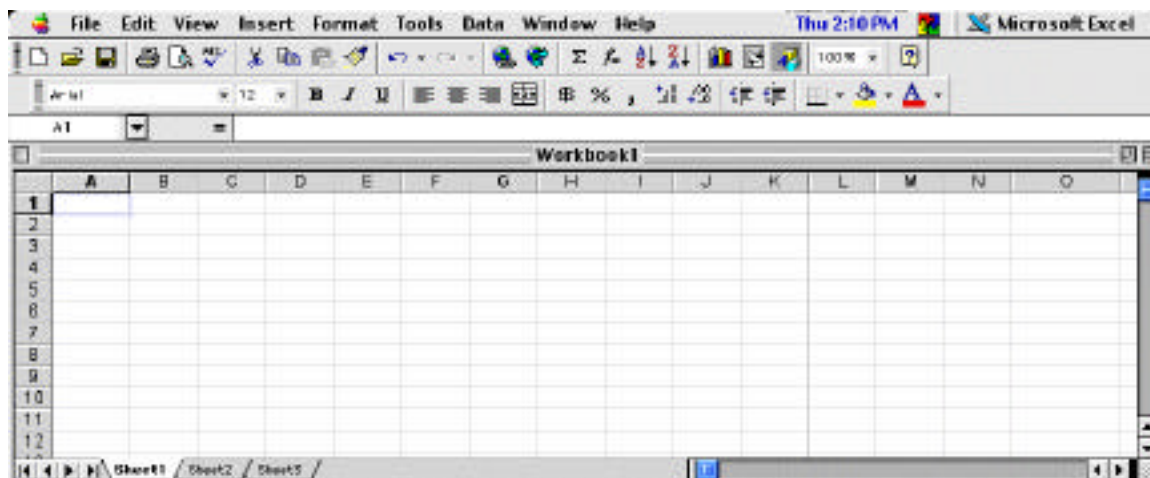
## Creating the Line Graph

### *Example experiment:*

*A new homeopathic drug has hit the market. The company claims that the drug will increase your speed of learning – what a great pill for students! As a student and a scientist, you have performed an experiment to test these claims. One group of students was given no pill, one group was given a fake pill (placebo) and one group was given the drug. Each participant had 10 trials to learn a list of 20 nonsense syllable pairs. The mean number of pairs each group learned on each trial is presented below:*

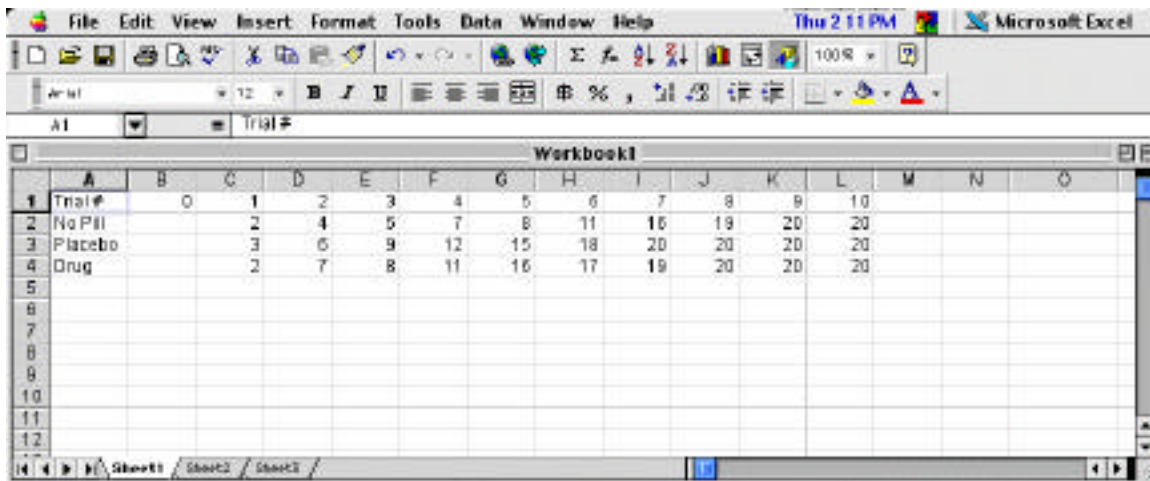
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10
No Pill	2	4	5	7	8	11	16	19	20	20
Placebo	3	6	9	12	15	18	20	20	20	20
Drug	2	7	8	11	16	17	19	20	20	20

We will use these results to demonstrate how to create a graph using Excel. This is the initial screen you will see when you open a new file in Excel. The vertical columns are labeled with letters, and the horizontal rows are labeled with numbers. Each cell represents an intersection of a row and a column. The white rectangle in the upper left corner is cell A1 (column A, row 1). Because the cursor was in this



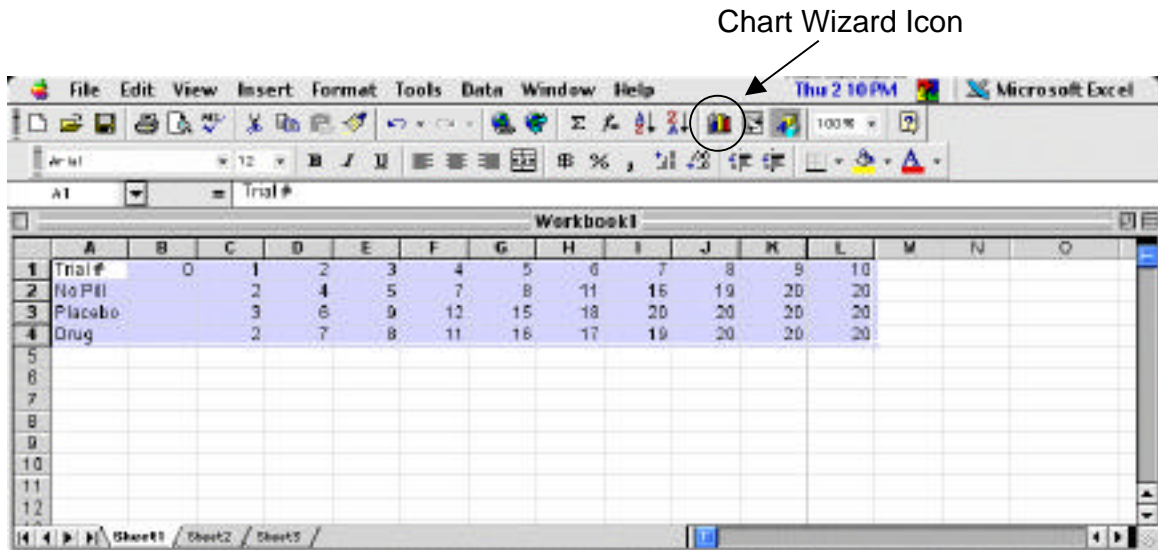
cell, it is outlined in black. You can enter many different types of information in a cell – words, numbers or equations. We will enter number values or word labels in the cells as we create graphs.

First, we need to put the data into the spreadsheet. Each column will represent a different level of the independent variable of time (the trial number) and each row will represent the different levels of the independent variable of drug treatment. The value of the dependent variable at each level of the independent variables goes into each cell. See the example below:



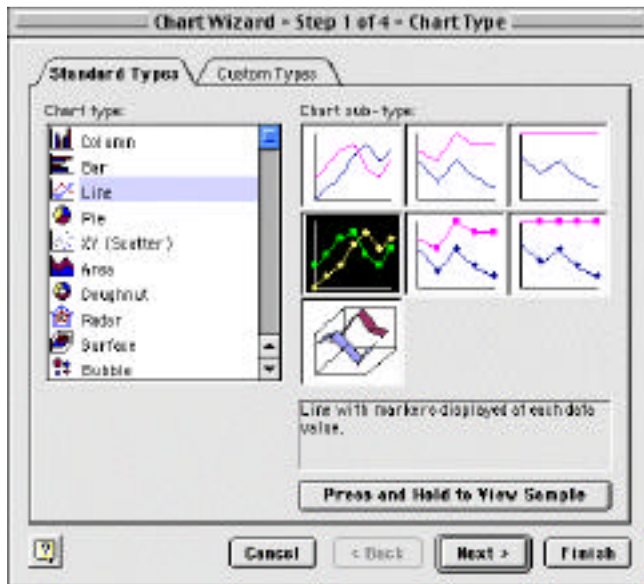
In this spreadsheet, Column A Row 1 gives the label for the values in that row (Trial #), and Column A, Rows 2, 3 and 4 have the labels for the drug variable, and Columns B through L in Row 1 have contain each trial number. The value for Cell B1 is 0, with no values underneath. (By setting up you spreadsheet this way, you will be able to specify how Excel should label your x-axis.) The mean correct pairs on each trial for each group are entered in the appropriate cell. Note that the labels are entered. This is an important step if you want the labels to appear in the finished graph. Once the data are in Excel, you can use the Chart Wizard to help you create the graph you want.

*To better understand the process, and learn a little about graphing, you should try to create this graph along with the handout. Take a moment now to enter the data on Excel and prepare to create a line graph.*



Excel will help you create a figure from the cells you highlight. Clicking in cell A1 and dragging to cell L4 highlighted the cells containing the labels and data in the figure above. To begin the graph, click on the small icon in the top toolbar that looks like a bar graph – the Chart Wizard icon. There are 4 steps to creating a graph that the Chart Wizard will help you to perform. We will go through the 4 steps in detail.

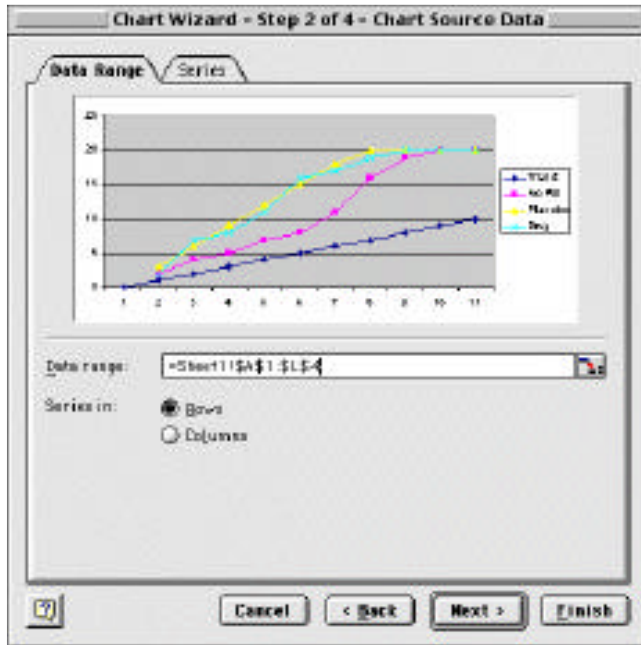
### *Step One – Selecting the chart type*



Click on the Chart Wizard icon to begin. (See the arrow in the figure above.) You can select the type of graph you wish to create. For the purposes of this lab, you will generally only use the column graph and the line graph. In this example, we will create a line graph. Begin by selecting the Chart Type in the left box of this window. The Chart sub-type box gives you some choices in the style of the graph. Excel will select the common format for the chart subtype, and you should probably stick with this default. In this example, click "Line" and then

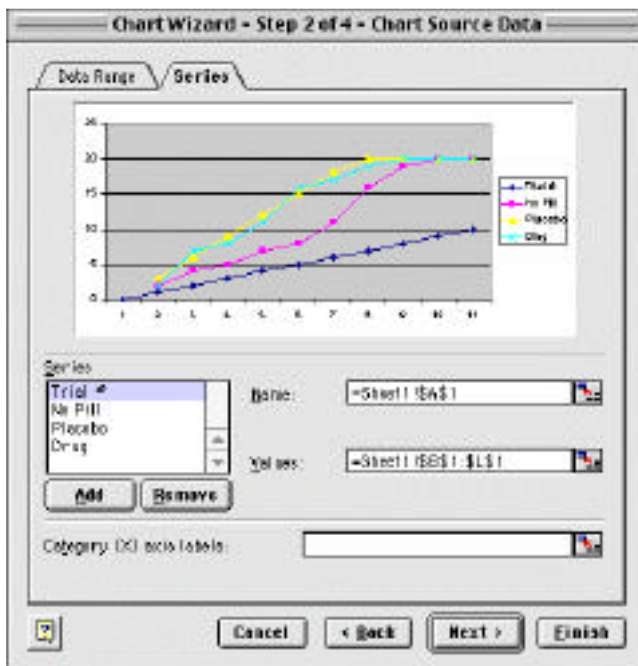
click the “Next >” button. If you can’t decide if you like the column graph or line graph for your figure, you can preview what the graph will look like by clicking and holding “Press and hold to view sample” above the “Next >” button.

## Step 2 – Chart Source Data



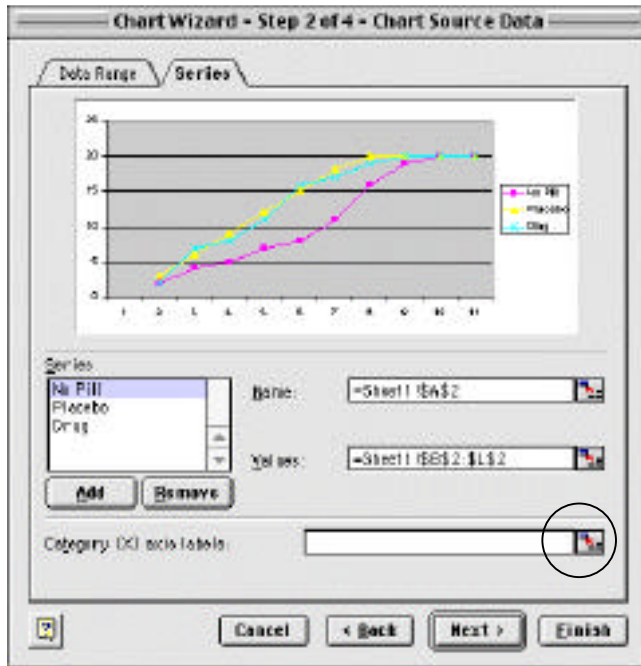
In this step you have the chance to specify what data should be included in the figure. At the top of the screen, there are 2 tabs “Data Range” and “Series”. The Data Range allows you to decide what set of values Excel will plot along the x axis (the horizontal axis) and which variable will be represented by different symbols. In this case, because each trial is in a different row, the trials will be plotted along the x-axis. You can change which variable is plotted along the x-axis by choosing the other option in the “Series in:” buttons and the bottom. In this case, it would make little sense to plot each of the different trials in a separate line, but some

data sets you may wish to switch what is plotted on the x-axis and what different lines and symbols in the figure represent.



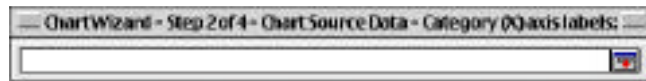
By clicking the “Series” tab at the top of the box, you have the chance to specify exactly where Excel should look for values to plot.

Excel needs to be coaxed into behaving like a true scientific graphing application. We want the x-axis to be labeled with the trials from 1 through 10. But, we also want to have a zero to start, and have the plotted lines begin at 1. Look at the box in the lower left labeled “Series”. There are four lines plotted, each line representing a series. Excel has

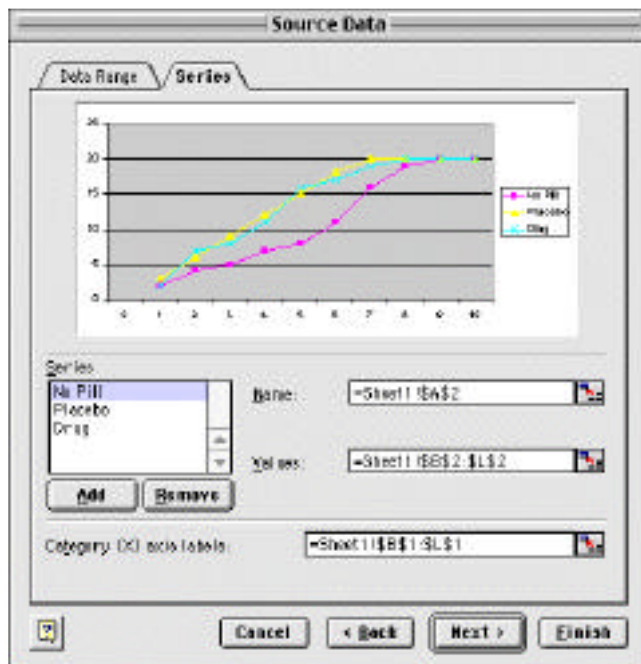
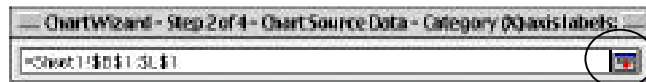


plotted the values in each of the rows in your spreadsheet, including Row 1 containing the labels for the trial number. (This is the straight line shown in the figure on the previous page). We need to remove it from the graph, and tell Excel to use these values as the labels along the x-axis. When the Trial # series is highlighted (as it is in the previous example) you can click the remove button to take that set of values off the graph. But, we want those values for the x-axis labels. At the bottom of the window, there is a white rectangle with an odd icon in the right corner. (Circled in this example) This is where you specify the

location in the spreadsheet to look for the values or labels for the x-axis. The heading on the left is "Category (X) axis labels". Click on the circled icon.



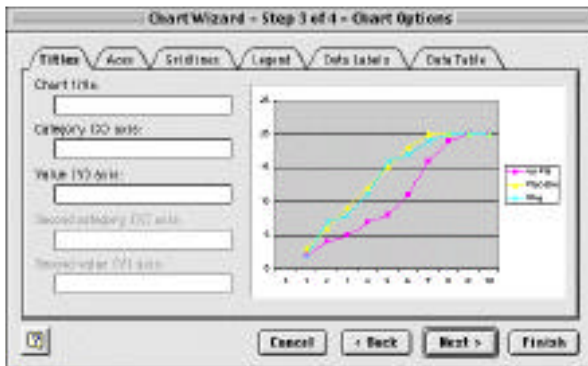
The top box will appear on the spreadsheet page. If it is not on the spreadsheet, you can click on the tabs at the bottom of the excel window to get to the correct spreadsheet.



Click and drag to highlight the cells on the spreadsheet that contain the labels for the x-axis. In this case, I will click on cell B1 and drag the mouse to cell L1. (Refer back to the figure of the spreadsheet.) Excel will enter the formula that means, "Look for the labels on Sheet 1 in cells B1 through L1. To return to the chart Wizard, click again on the icon on the right side of the white box (circled in the figure above).

Now, the line representing the trial number is off the example graph, and the values along the x-axis begin at 0. Click on the Next> button to continue.

## Step 3 – Formatting the Chart Options Titles for the Axes

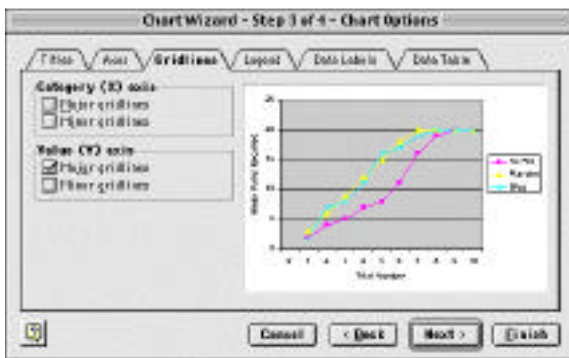
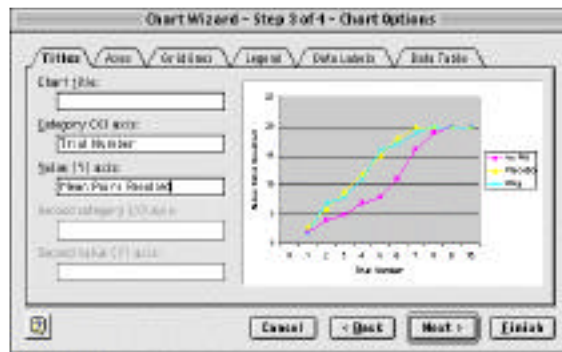


In this step, you will begin to specify the format and appearance of the final figure. In the first window of Step 3 – Chart Options, the “Titles” tab, you can enter a title for your graph, and titles for the x- and y-axes. Check with your Lab instructor about policies for titling the figures. Regardless, you do need to title the axes. In this experiment, the x-axis represents the trials, and the y-axis represents the mean number pairs

recalled (the dependent variable). Choose your titles and enter them in the white boxes. The titles will appear on the example of the graph, as shown in the figure on the right.

### Getting rid of Gridlines

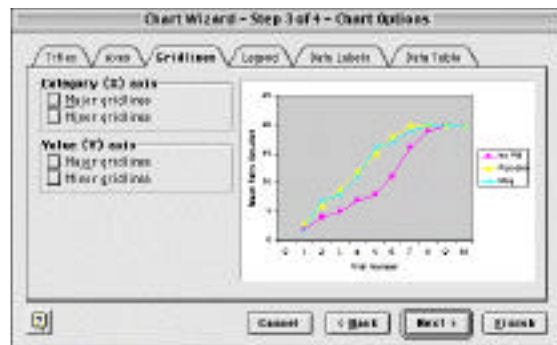
The figure should not have gridlines - the horizontal lines going through the graph at regular intervals. By clicking on the “Gridlines” tab, you can change the settings to specify gridlines. Uncheck the box “Major gridlines” to remove the lines.



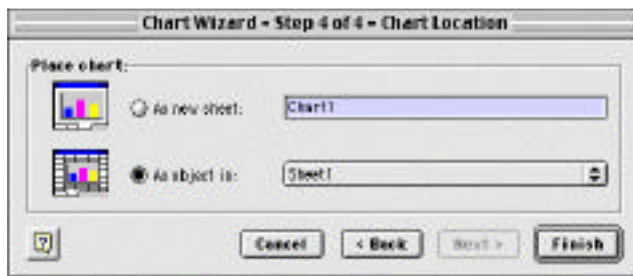
the settings to specify gridlines. Uncheck the box “Major gridlines” to remove the lines.

The other tabbed pages in this step will have very little application to the graphs we are making in this lab. One exception: if you have only one line on your graph, you should click on the

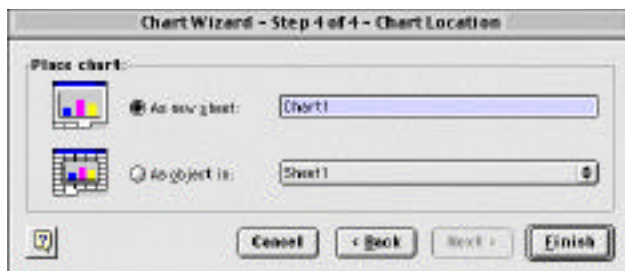
Legend tab, and uncheck the box labeled “show legend” to remove the legend box (Do this only if there is a single line plotted on your figure - this only happens rarely) You can go through them to see what kinds of changes you can make to the graph, then click the “Next >” button to get to Step 4.



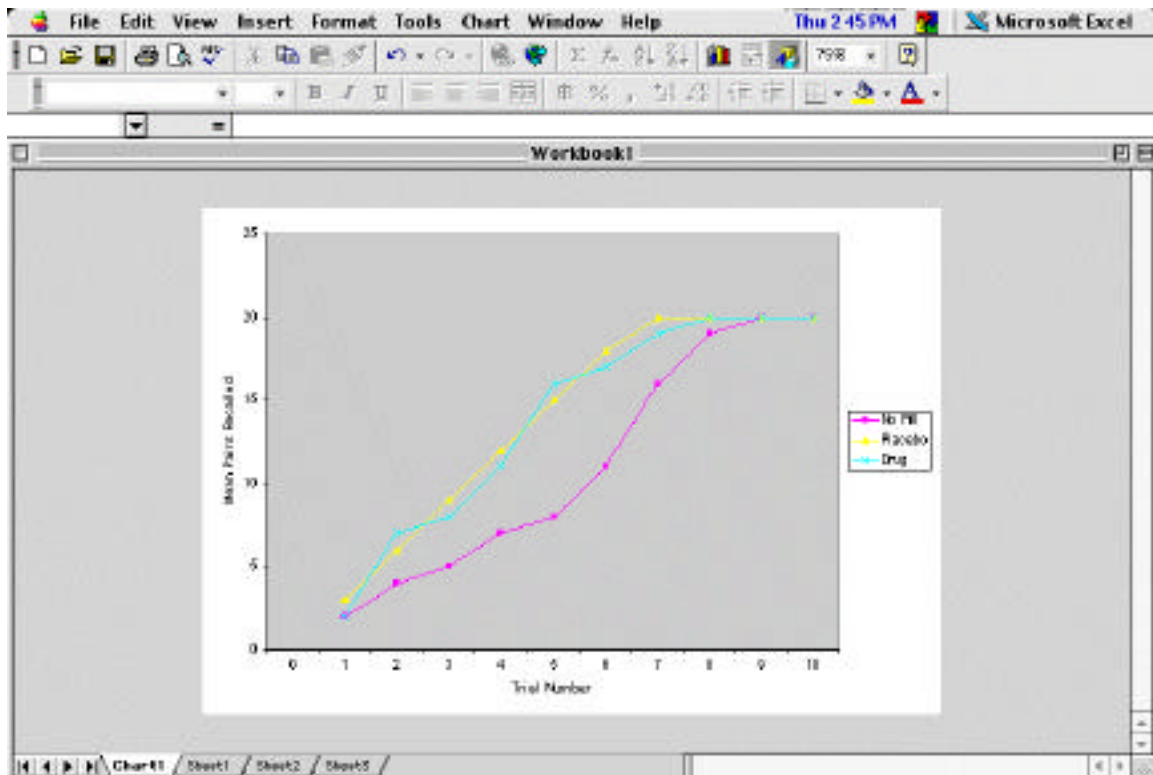
## Step 4 – Finishing the Chart



The final step in the Chart wizard allows you to save your graph in the Excel workbook. The default setting in Excel will store your graph on the spreadsheet – DON'T DO THIS!!. In order to make the final formatting changes, and to print the final graph, you should always choose to save the graph as a new sheet in your Excel workbook. If you want to choose a name, you can enter it here, or Excel will call the new sheet Chart 1.

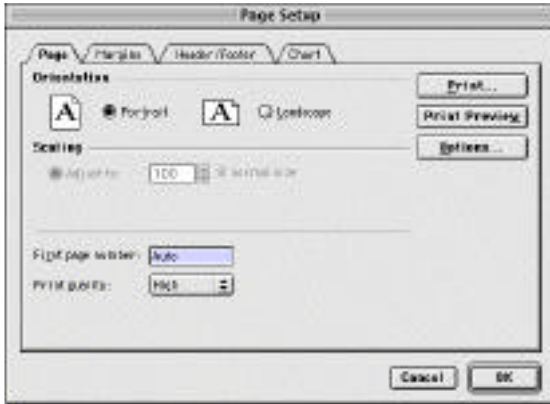


Here is what the figure looks like so far: Notice that there are several tabs at the bottom of the spreadsheet, including Sheet 1, which contains the data, and Graph 1, which contains the figure.



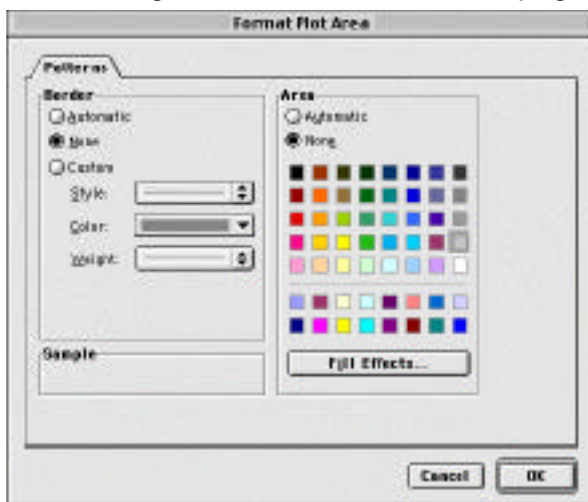
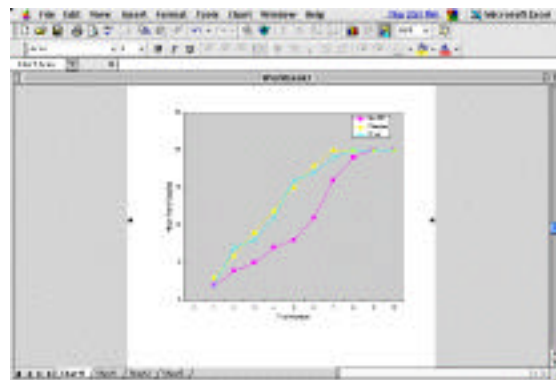
## Final Formatting

There are several fine formatting details to finish before you print the figure for a report.



1. Page Setup – in the File pull-down menu (at the top left of your computer screen), select Page Setup, and choose the Portrait orientation for your figure. It will print in the orientation appropriate for your report. If you have a figure with many values on the x-axis, you may need to keep the figure in the landscape orientation, but portrait is preferable if possible. Click the OK button when you are finished.

2. Set the Graph Size – Click to highlight the whole graph. Put the cursor into the corner until a diagonal arrow appears. Click and drag to make the figure about a 3:4 y:x size ratio. Adjust as necessary to accommodate the length necessary for your x-axis. You do not want to use the whole page (a favorite Excel default) so size the figure to be centered on the page.

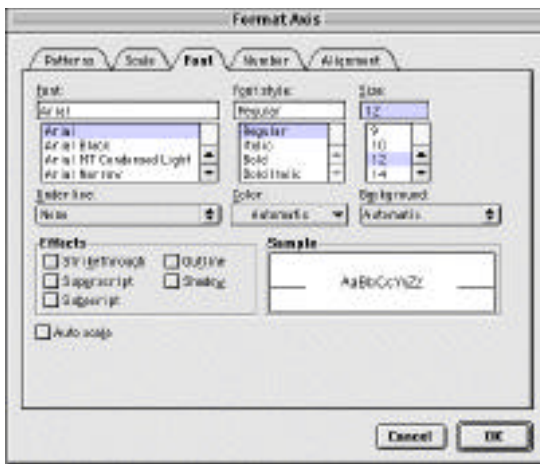
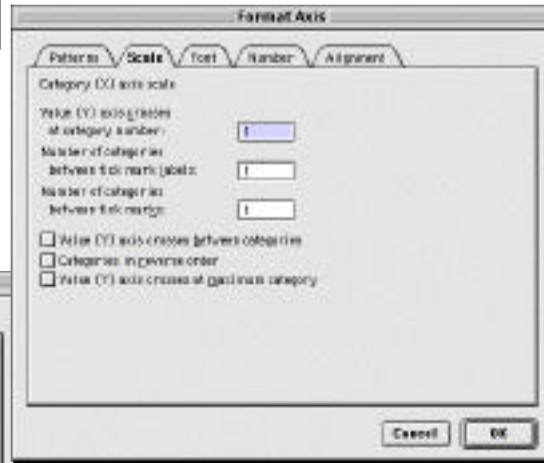


3. Get rid of the gray shading in the background of the graph. Double click on the interior of the graph, where you see the gray shading behind the plotted lines of data. When you see the window like this example (see figure on the right) select “None” for the Border, and “None” for the Area, and click OK.



4. Format the axes. Beginning with the x-axis, position the arrow cursor exactly on the line of the axis, and double click. When you get to the Format Axis screen, click on the arrow next to the “Weight” box to make sure the line for the axis is dark enough to be easily seen. Excel sometimes defaults to the faint line that appears in this box as a dotted line, resulting in a very faint axis - change it to the solid line just under the lighter line.

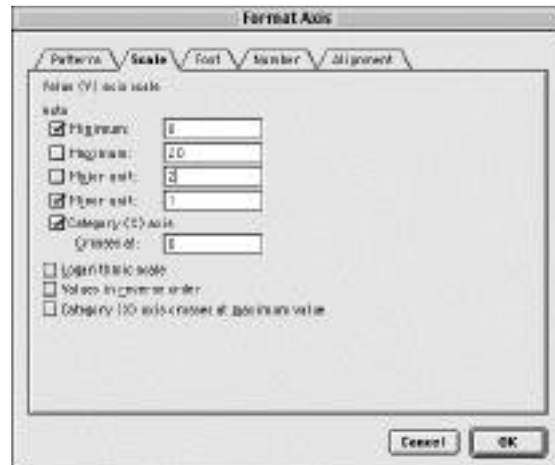
5. Click on the “Scale” tab at the top. By unchecking the box “Value (Y) axis crosses between categories” the numbers on the x-axis will line up under the tick marks.



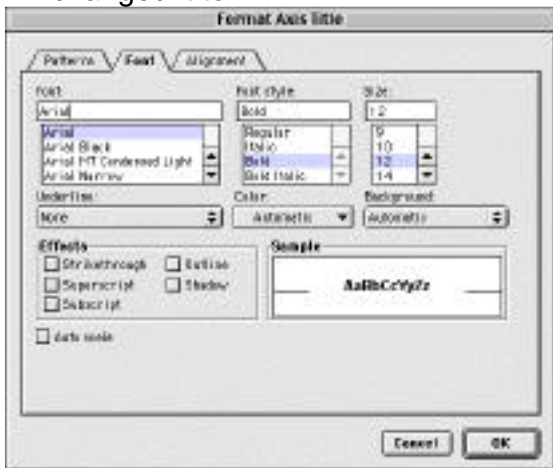
6. Click on the “Font” tab to can change the font and the font size to your favorite. Make the font size at least 10 or 12 point. If you also uncheck the box labeled “Auto scale” in the lower left

corner, the font size will not change if you alter the size of the figure. (This is important!)

7. Make the editing changes to the y-axis in the same manner as for the x-axis. Change all the same stuff. On the Scale window, you can make alterations to the numbers on the y-axis. If your dependent variable has a maximum value, use that value. For example, this experiment had a total of 20 trials, so use that for a maximum. You can also specify the unit of

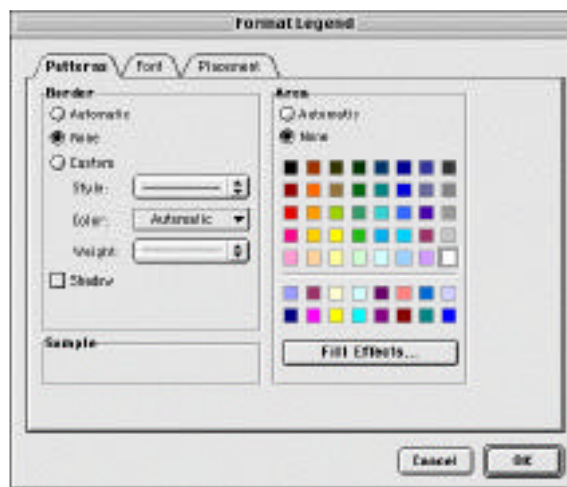


measure by changing the default value for the “Major unit”. In this case, I changed it to 2.



8. Double click on the axis titles to increase the font size to at least 10 point, or some easily readable size. Uncheck the auto scale.

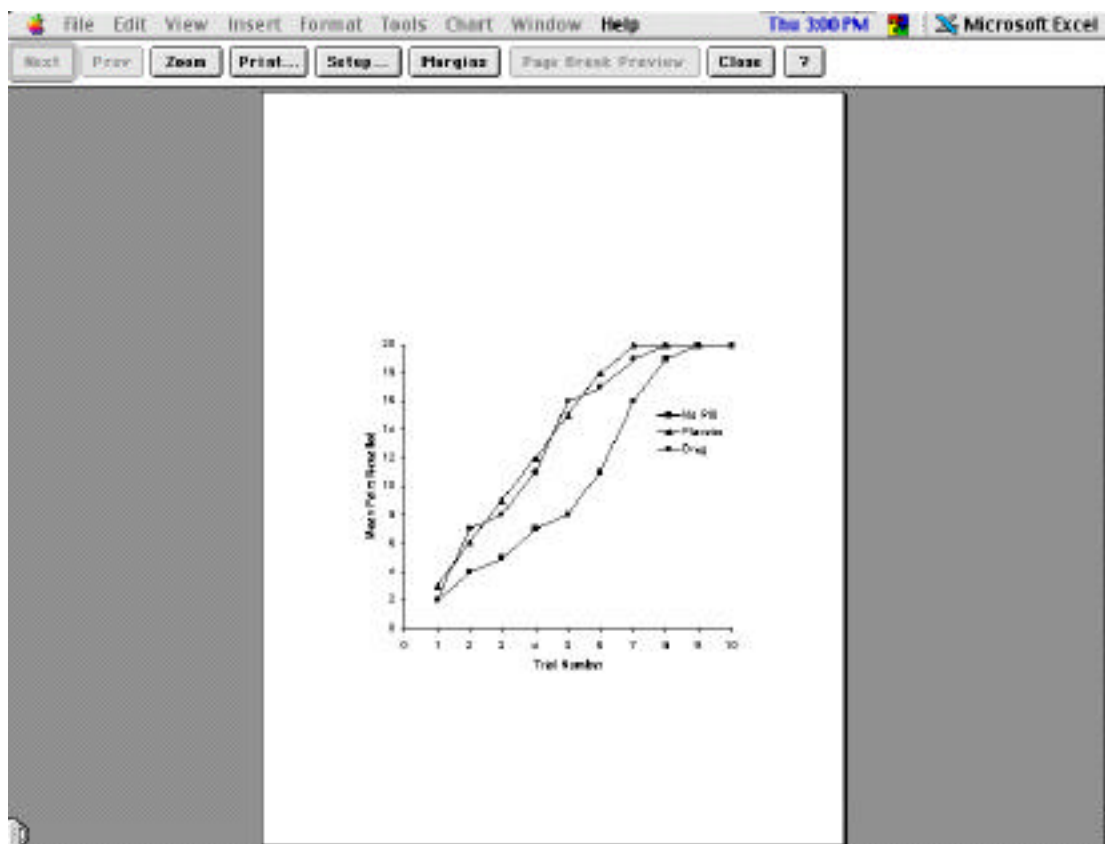
9. Double click on the legend to change the font size and remove the border. To remove the border, select “None” on the “Patterns” tabbed window. Change the font on the “Font” window. Uncheck the auto scale.



10. Excel will give you colored symbols and lines for the plotted data. You need to change the color of the lines and symbols to black. Click on the line for each of the variables to get to the “Format Data Series” window. Be sure you click on a line that is connecting two of the plotted points. If you click on a point, it will only format that one point. If you click on the plotted line, it will format all of the data points in that series. For the line, click on the arrow to the right of the “Color” box and select black. For the marker, change the Foreground and Background to black. This is the window you would use if you wanted to choose another symbol. The symbols in the figure should be simple, primary shapes – circles, squares, triangles, etc. Symbols should be filled, not hollow. Do this for each line on your graph.

11. Once you have completed the formatting, you are ready to print the graph to check the results. You can use the Print Preview to see how your graph will

look. An example is below. Graphs turned in for credit should be formatted like this.



## Creating a Bar Graph

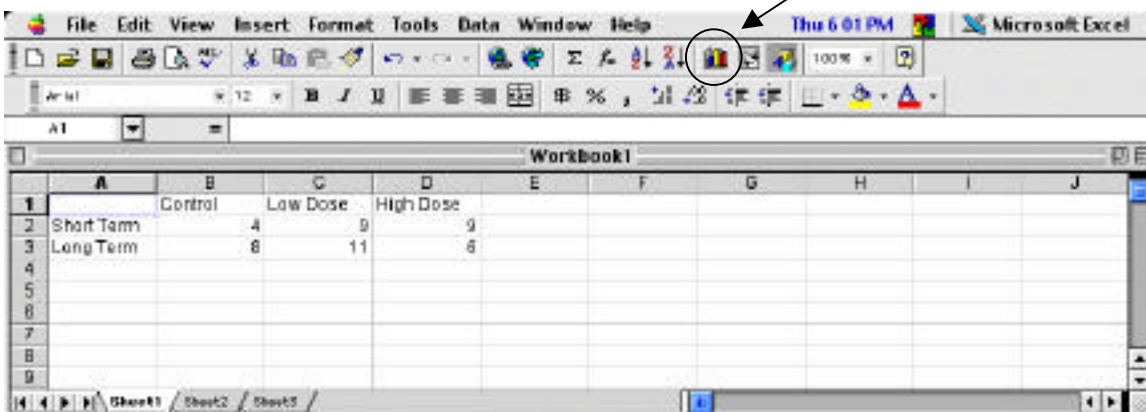
The idea of the bar graph follows the same basic formatting as the line graph. An example is presented below. You can practice by trying to graph the data below on your computer as you read through the directions.

*A researcher believes she has developed a new drug to increase long-term memory in college students. To test this drug, three groups of college students were randomly chosen to receive a placebo control, or a low dose of the drug, or a high dose of the drug. Each subject studied a list of nouns, and was tested for recall either 15 minutes later (short term) or 48 hours later (long term). The results are summarized below:*

	Control	Low Dose	High Dose
Short Term	4	9	9
Long Term	8	11	6

First, we need to put the data into the spreadsheet. We will use the columns for the different levels of one independent variable, and rows for the levels of the other independent variable. Then, the dependent variable values go into the cells. See the example below:

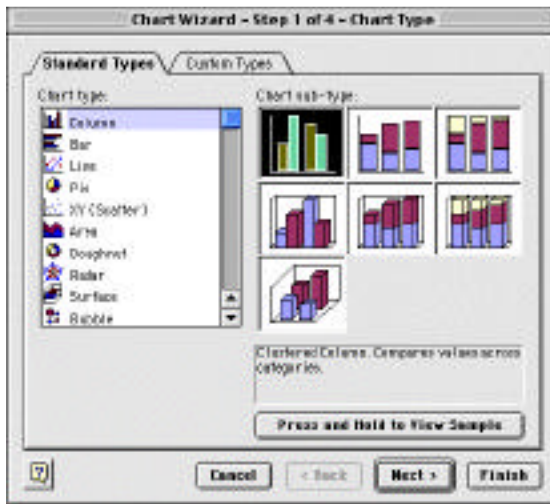
Chart Wizard Icon



In this spreadsheet, Row 1 gives the labels for the different drug conditions, and, and column A has the labels for the duration conditions before the memory test. You must have the labels on the spreadsheet to get the bars labeled on your figure.

The mean number of errors for each group is entered in the appropriate cell. Once the data is in Excel, you can use the chart wizard to help you create the graph you want.

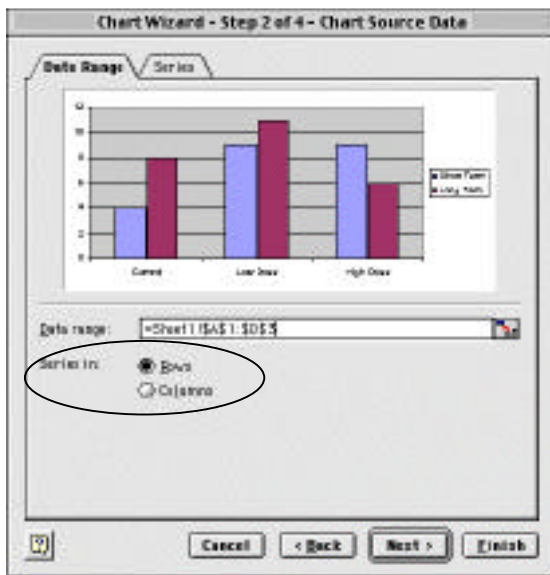
## Step One – Selecting the chart type



Click on the Chart Wizard icon to begin. (See the arrow in the figure above.) You can select the type of graph you wish to create. For the purposes of this lab, you will usually only use the column graph and the line graph. In this example, we will create a bar, or column graph. The “Chart sub-type” gives you some choices in the style of the graph. Excel will select the common format for the chart subtype. In this example, click “Column” and then click the “Next >” button. If you can’t decide if you like the column graph or line graph for your figure, you can preview what the graph will look like by clicking

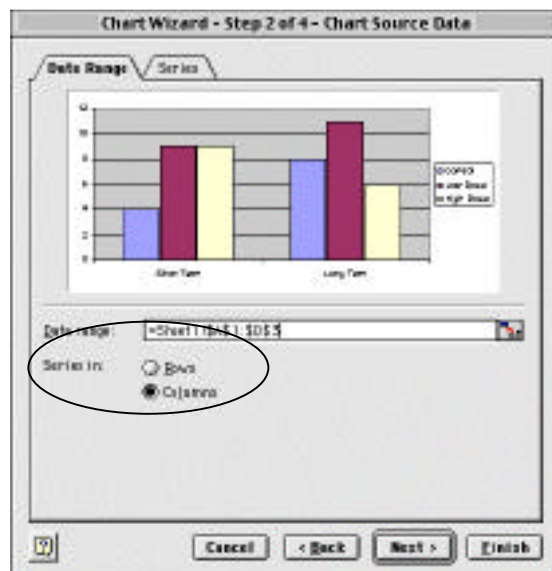
and holding “Press and hold to view sample” above the “Next >” button.

## Step 2 – Chart Source Data

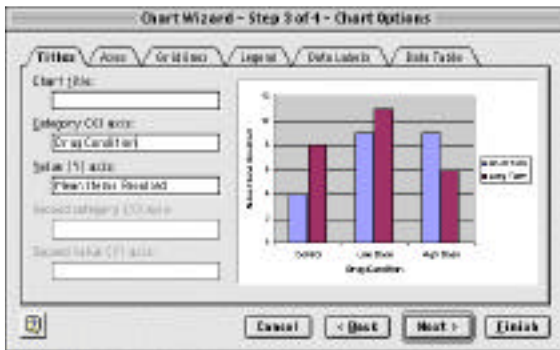


rows along the axis, or from the columns. You can click back and forth to decide which you prefer.

In this step you have the chance to specify what the look of your graph. You have the choice of plotting one variable on the x-axis, and representing the other with different shadings in the bars. You can choose the variable to plot on the axis. Choose the configuration that makes sense to you when you look at the figure. At the bottom of the window, you can choose the button have the data from the



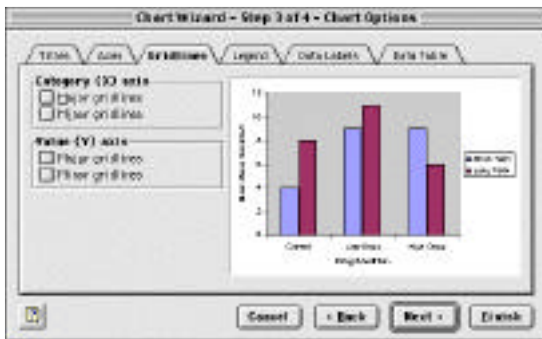
## Step 3 – Formatting the Chart Options Titles for the Axes



In this step you will add the final touches to bring the figure into its final form. In the first window of Step 3, the “Titles” tab, you can enter a title for your graph, and titles for the x and y-axes. For the APA report, you do not include a Chart Title on the page with the figure. But, you do need to title the axes. In this experiment, the x-axis represents the drug condition, and the y-axis represents the mean

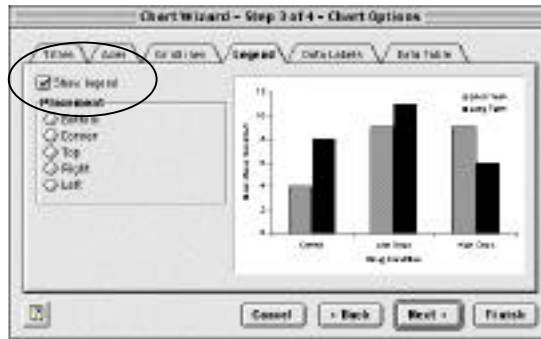
number of errors. Choose your titles and enter them in the white boxes. The titles will appear on the example of the graph, as shown in the figure on the right.

## Getting rid of Gridlines

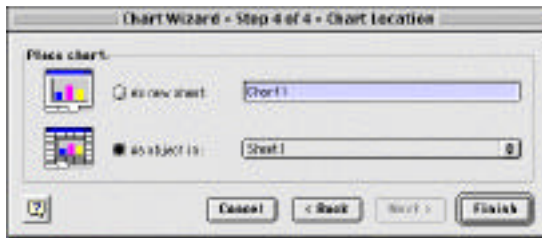


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The other tabbed pages in this step will have very little application to the graphs we are making in this lab. One exception: if you have only one variable on your graph, you should click on the legend tab, and uncheck the box labeled “show legend” (Circled in this example) to remove the legend box. Do this only if there is only one independent variable being plotted (only one set of bars) Click the “Next >” button to get to Step 4.



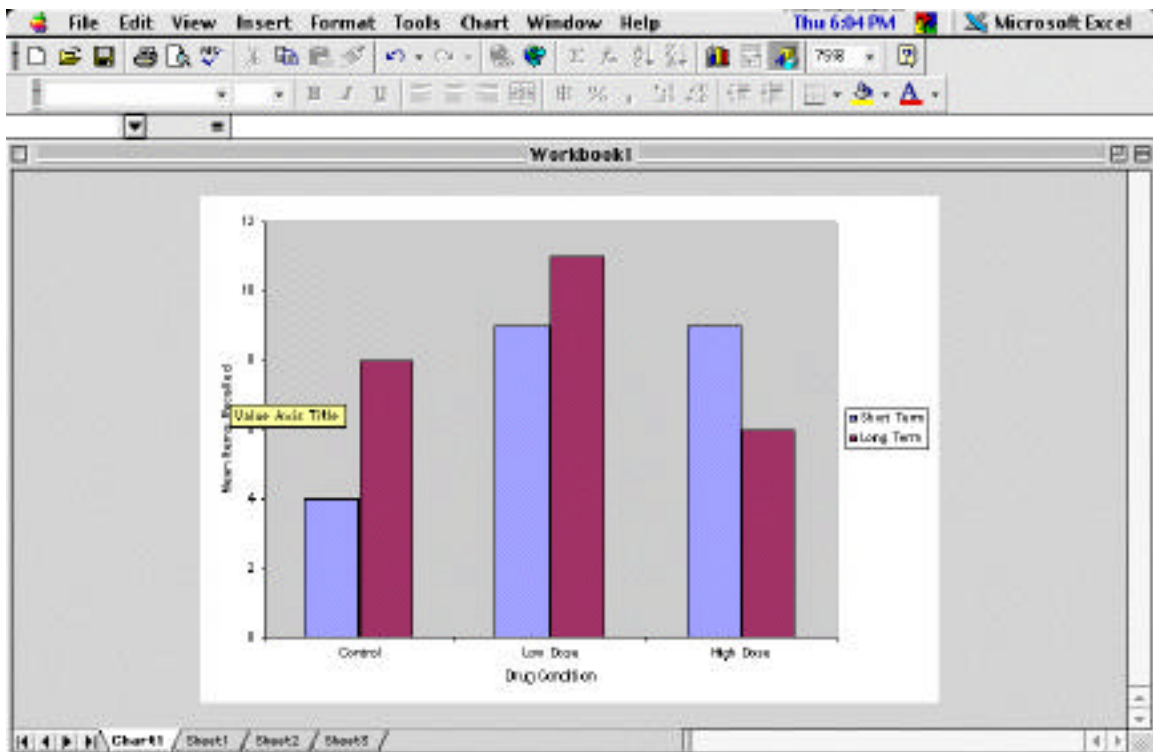
## Step 4 – Finishing the Chart

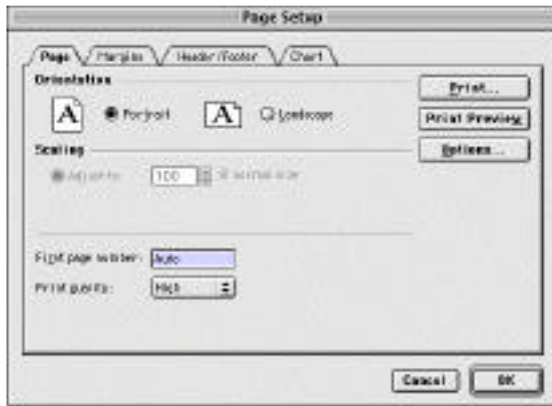


The final step in the Chart wizard allows you to save your graph in a final form. The default setting in Excel will store your graph on the spreadsheet, but this isn't the best option. In order to make the final formatting changes, and to print the final graph, you should always choose to save

the graph as a new sheet in your Excel workbook. If you want to choose a name, you can enter it here, or Excel will call the new sheet Chart 1.

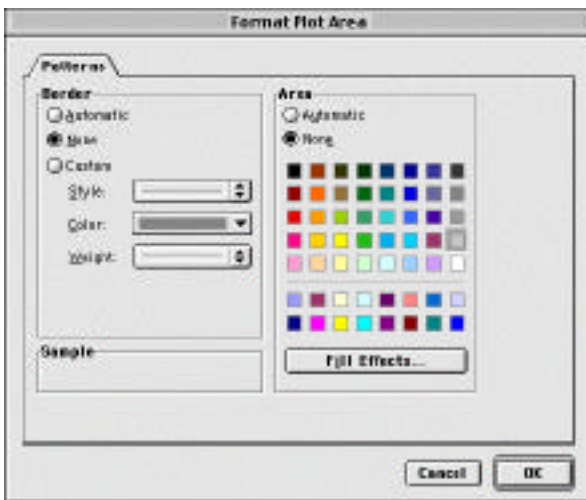
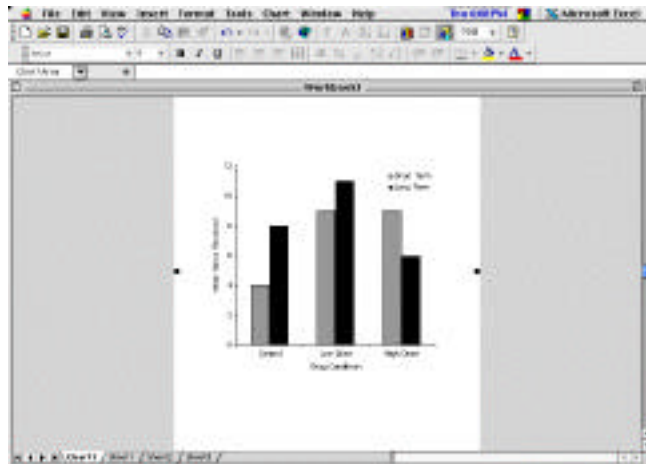
Here is what the figure looks like so far: Notice that there are several tabs at the bottom of the spreadsheet, including Sheet 1, which contains the data, and Graph 1, which contains the figure.





1. Page Setup – in the file pull-down menu, select Page Setup, and choose the Portrait orientation for your figure. It will print in the orientation appropriate for your report. If you have a figure with many values on the x-axis, you may need to keep the figure in the landscape orientation, but portrait is preferable if possible. Click the OK button when you are finished.

2. Set the Graph Size – Click to highlight the whole graph. Put the cursor into the corner until a diagonal arrow appears. Click and drag to make the figure about a 3:4 y:x size ratio. Adjust as necessary to accommodate the length necessary for your x-axis.

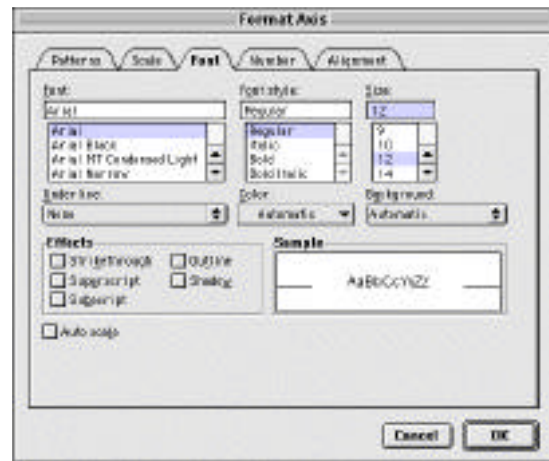


3. Get rid of the gray shading in the background of the graph. Double click on the interior of the graph, where you see the gray shading behind the plotted lines of data. On the screen like that to the right, select “None” for the Border, and “None” for the Area, and click OK.

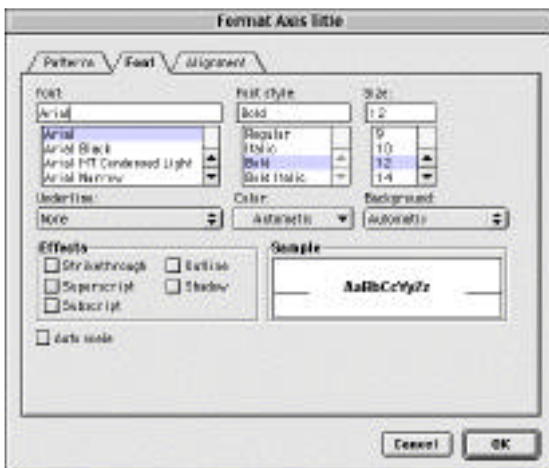


4. Format the axes. Beginning with the x-axis, position the arrow cursor exactly on the line of the axis, and double click. When you get to the Format Axis screen, click on the arrow next to the “Weight” box to make sure the line for the axis is dark enough to be easily seen. Excel sometimes defaults to the dashed line, which results in a very faint axis - change it to the solid line just under the lighter line.

5. Click on the “Font” tab to can change the font and the font size to your favorite. Make the font size at least 10 or 12 point. If you also uncheck the box labeled “Auto scale” in the lower left corner, the font size will not change if you alter the size of the figure. (This is important!)

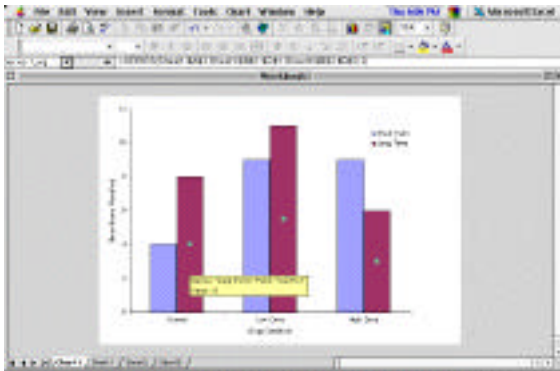
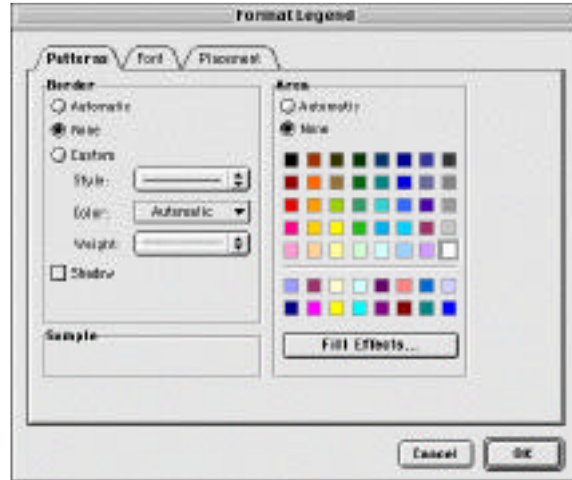


6. Make the editing changes to the y-axis in the same manner as for the x-axis. On the Scale window, you can make alterations to the numbers on the y-axis. If your dependent variable has a maximum value, use that value.

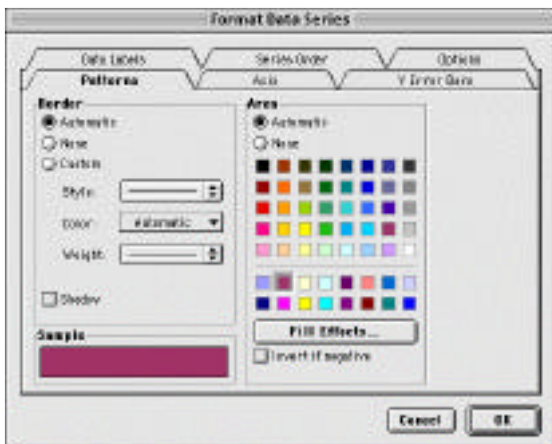


7. Double click on the axis titles to increase the font size to at least 10 point, or some easily readable size. Uncheck the auto scale.

- Double click on the legend to set the font size and remove the border. To remove the border, select "None" on the "Patterns" tabbed window. Change the font on the "Font" window. Uncheck the auto scale.



- Excel will give you colored bars for the plotted data. You need to change the colors to black, and a shade (or shades) of gray. Double click one of the bars, and be sure you see all the bars of that series with the little squares. When you reach the "Format Data Series" window, you can select a color for the bars. Black, dark gray and light gray provide good contrast. If you must, you can choose patterns to distinguish the bars by clicking on Fill Effects - no smiley faces, please!



- After setting the first series to one shade, do the same with the other. Color graphs are not acceptable for your assignments.

- Once you have completed the formatting, you are ready to print the graph to check the results. The final version of the graph appears on the next page. Graphs turned in for credit should be formatted like this.

