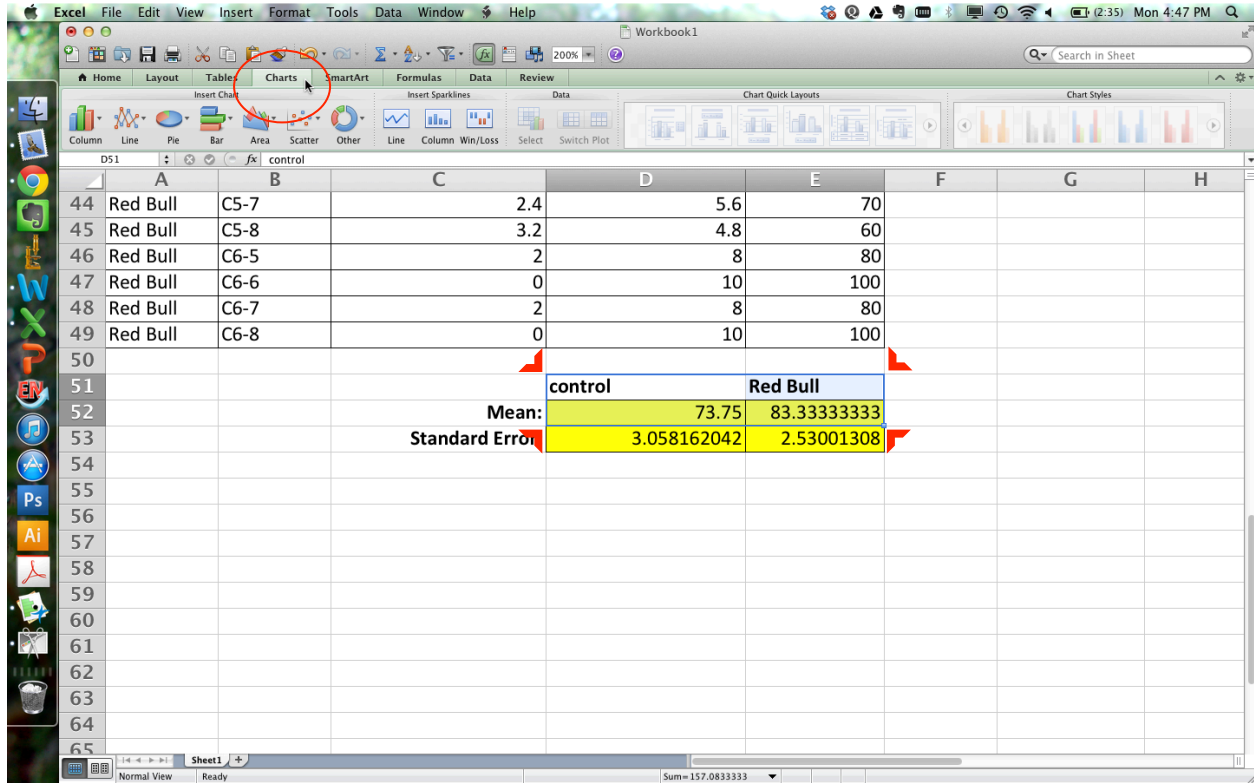
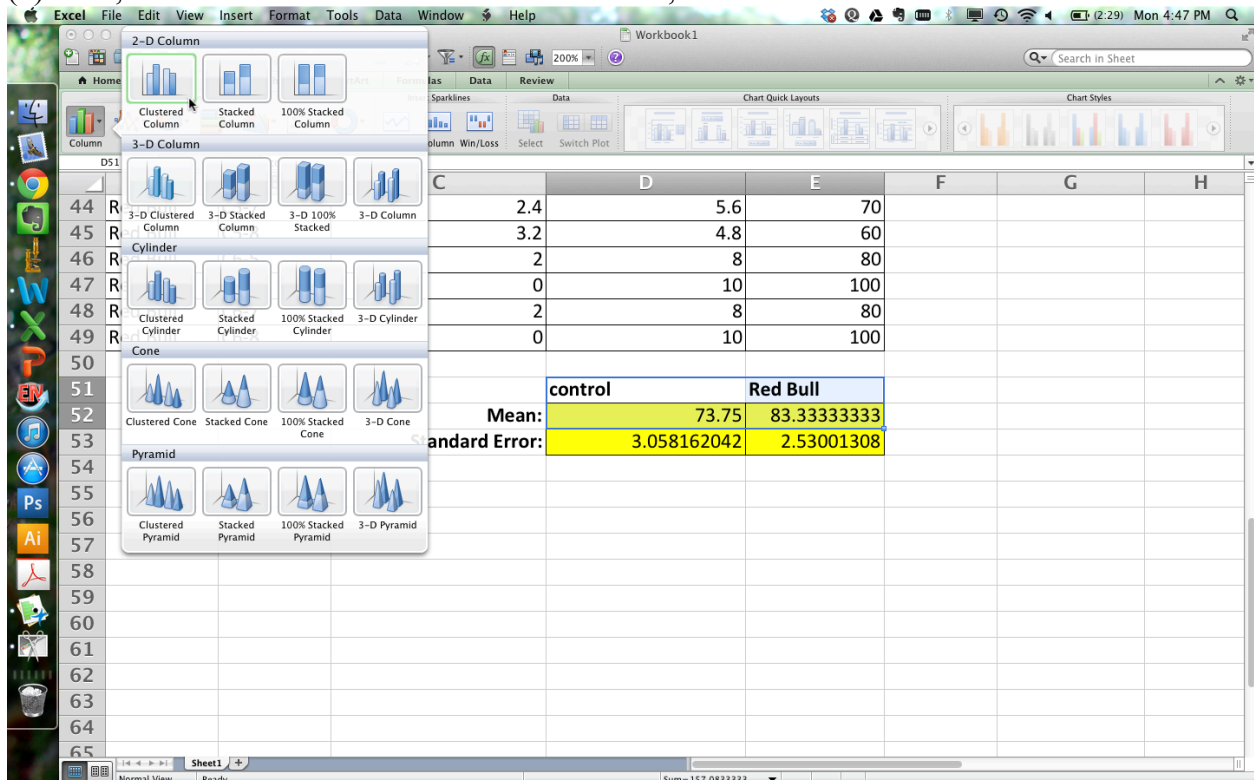


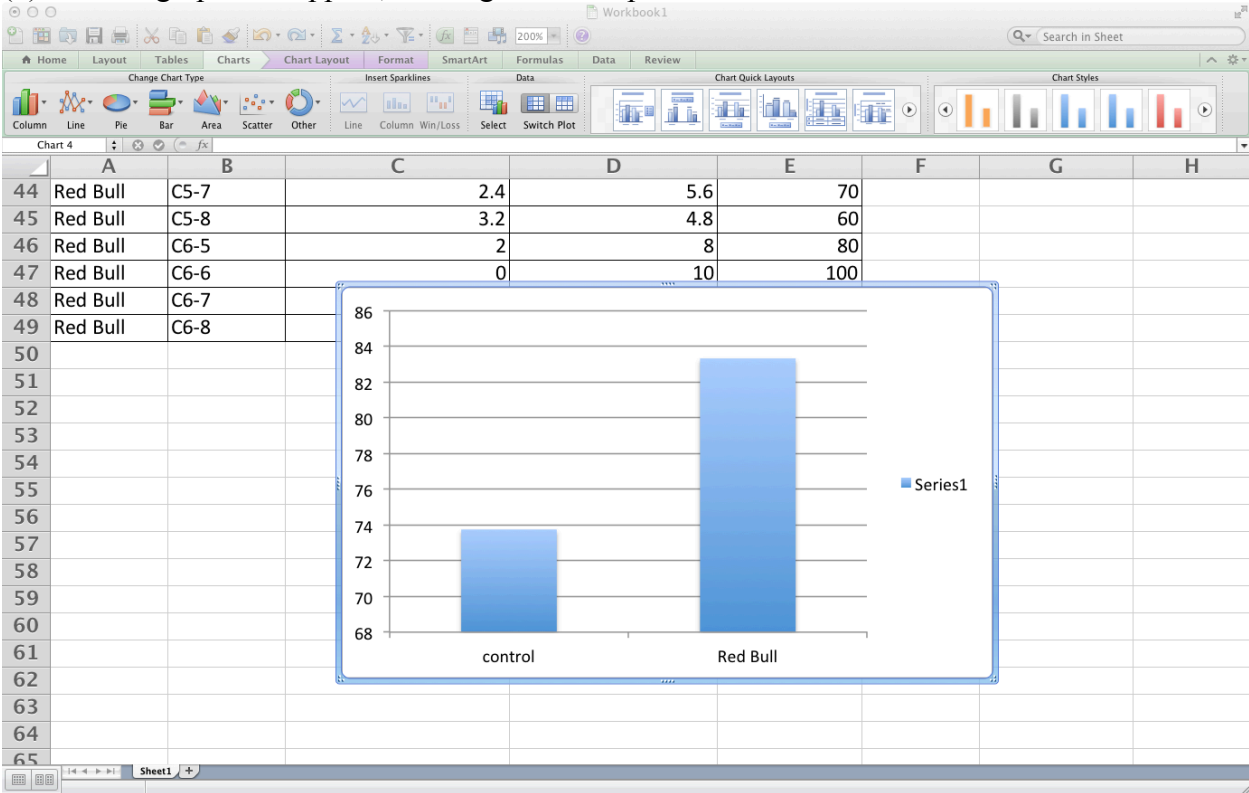
(4) To make a bar graph from this small summary data table, first select the 2x2 block of cells indicated below, which includes the header row and the mean values (you can select a block of cells in Excel by clicking and holding the left mouse button, then dragging the mouse over the cells you want to select). Then click the Charts tab at the top of the screen:



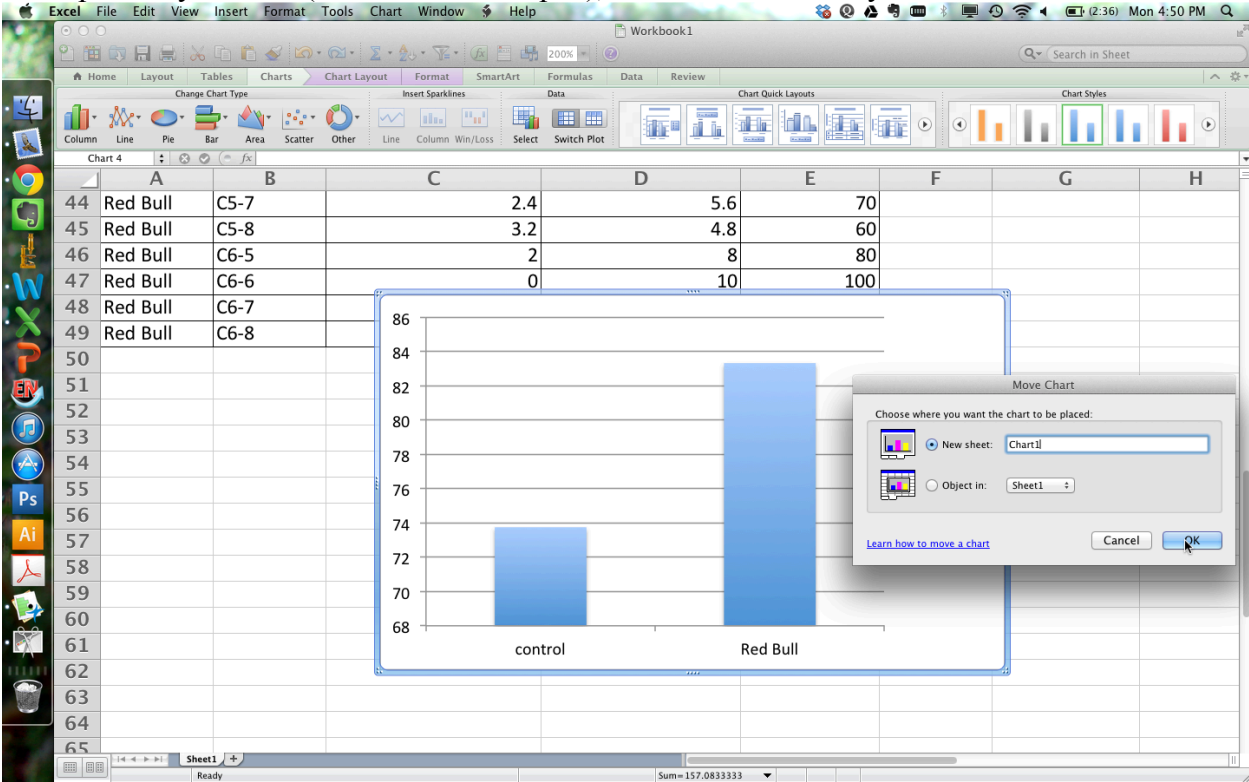
(5) Next, click on “Column” under the “Charts” tab, and select “Clustered Column”:



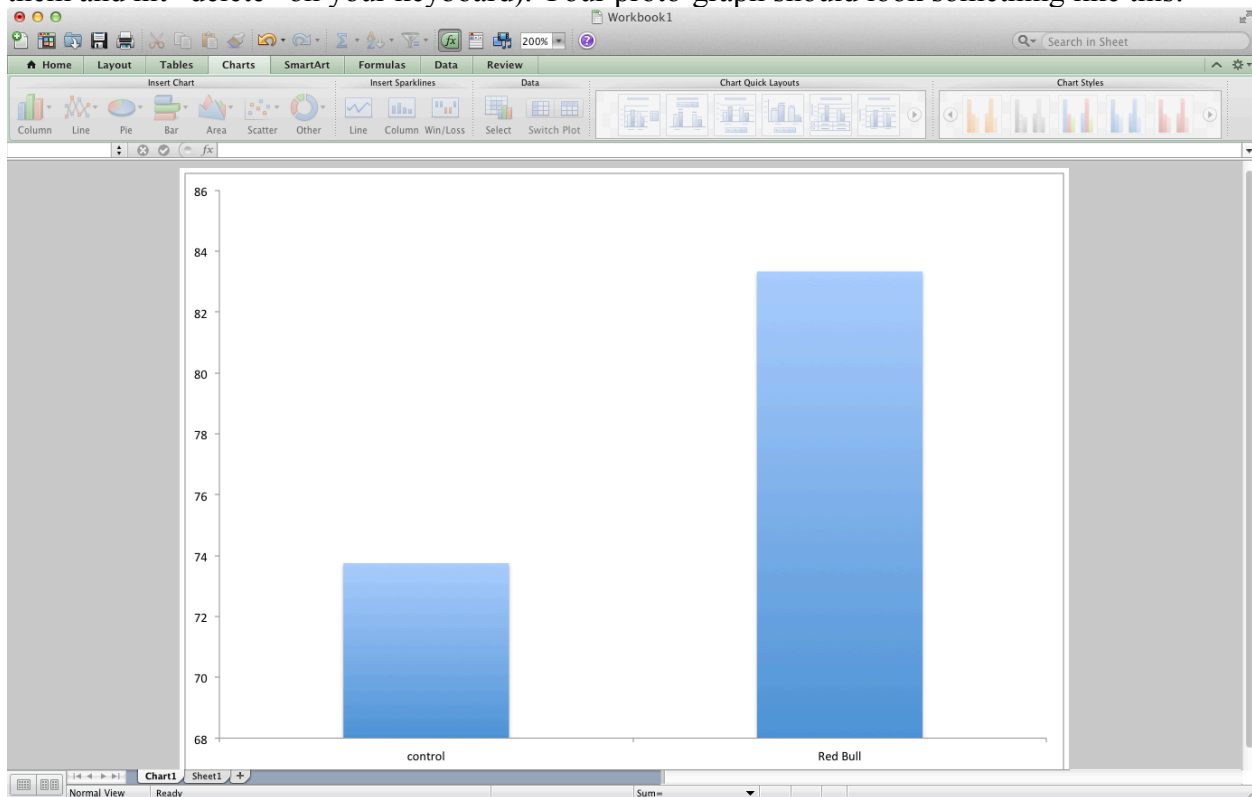
(6) A small graph will appear, floating over the spreadsheet:



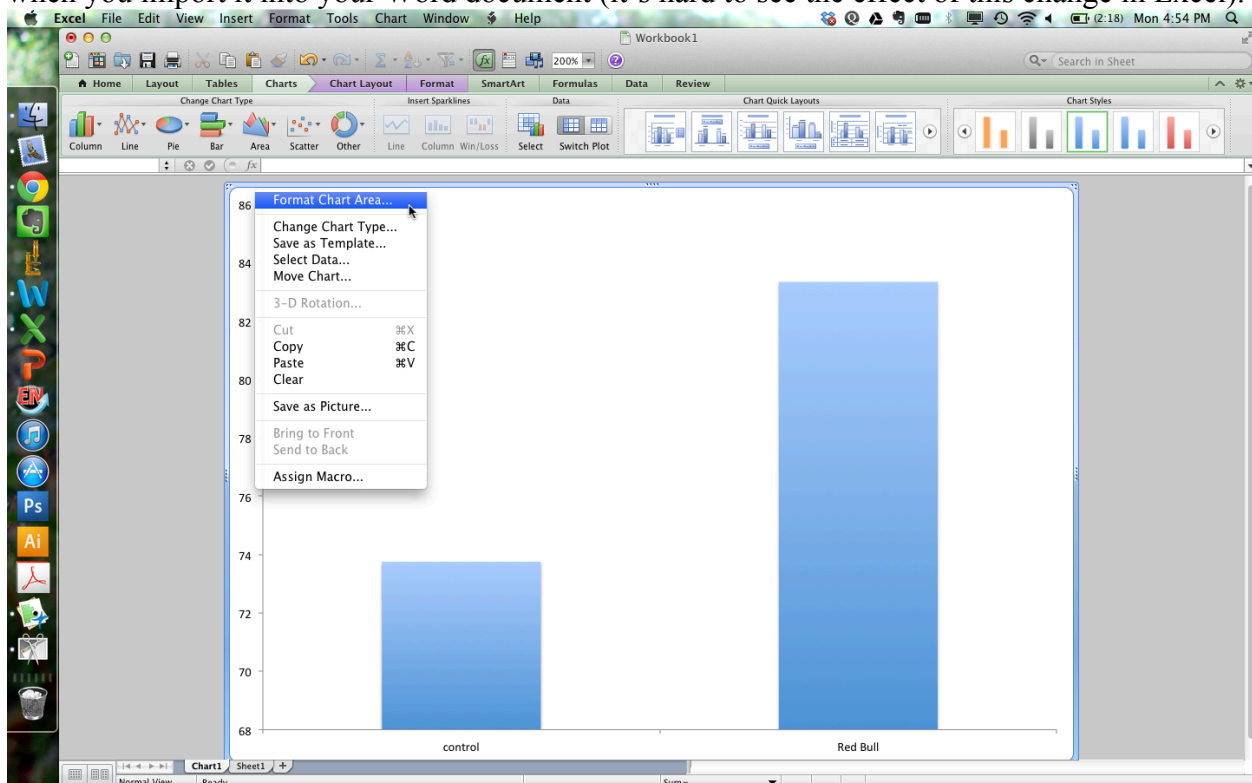
(7) Right click on the graph, select “Move Chart...”, then click the “New Sheet” button in the dialogue box that pops up. You can change the name of the sheet from “Chart 1” to something descriptive if you want (like “RedBullGraph”), but it’s not necessary. Then click OK.



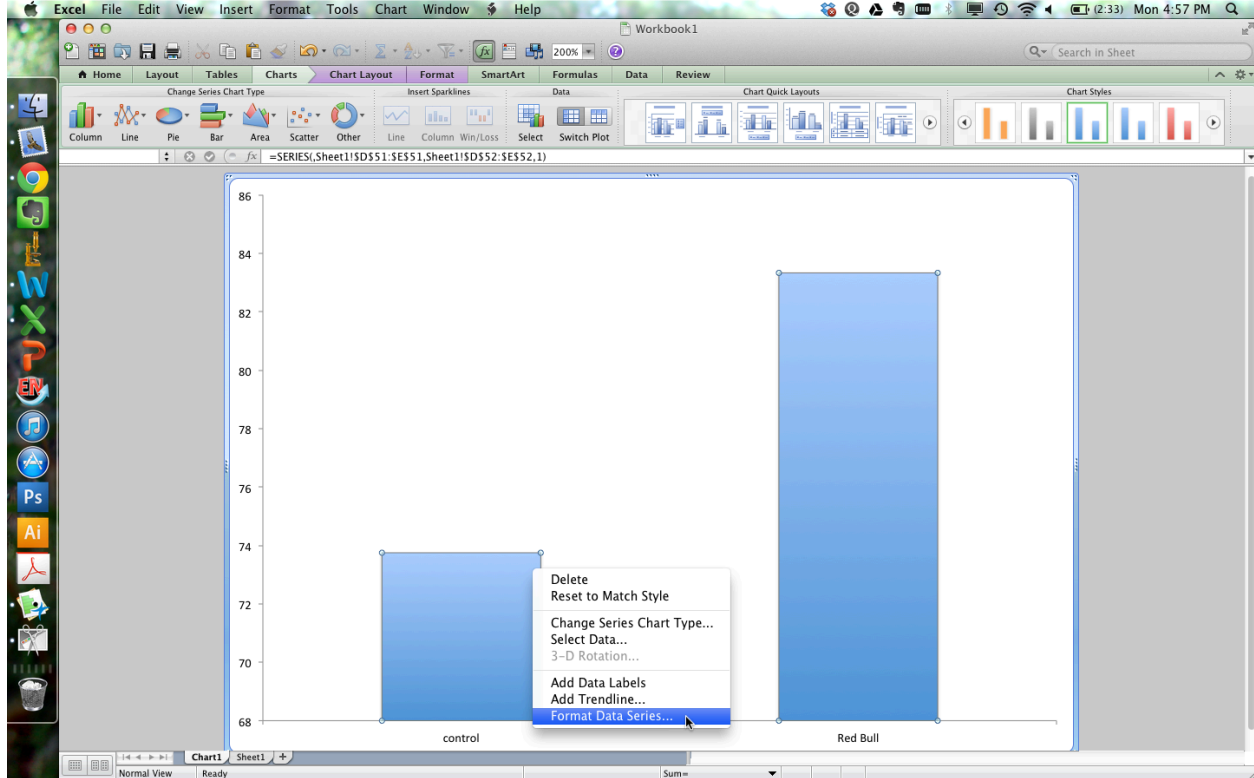
(8) Now the graph will be in its own, large tab. The first thing you should do is click on the graph legend and the horizontal gridlines on the graph, and delete them (you can just click on them and hit “delete” on your keyboard). Your proto-graph should look something like this:



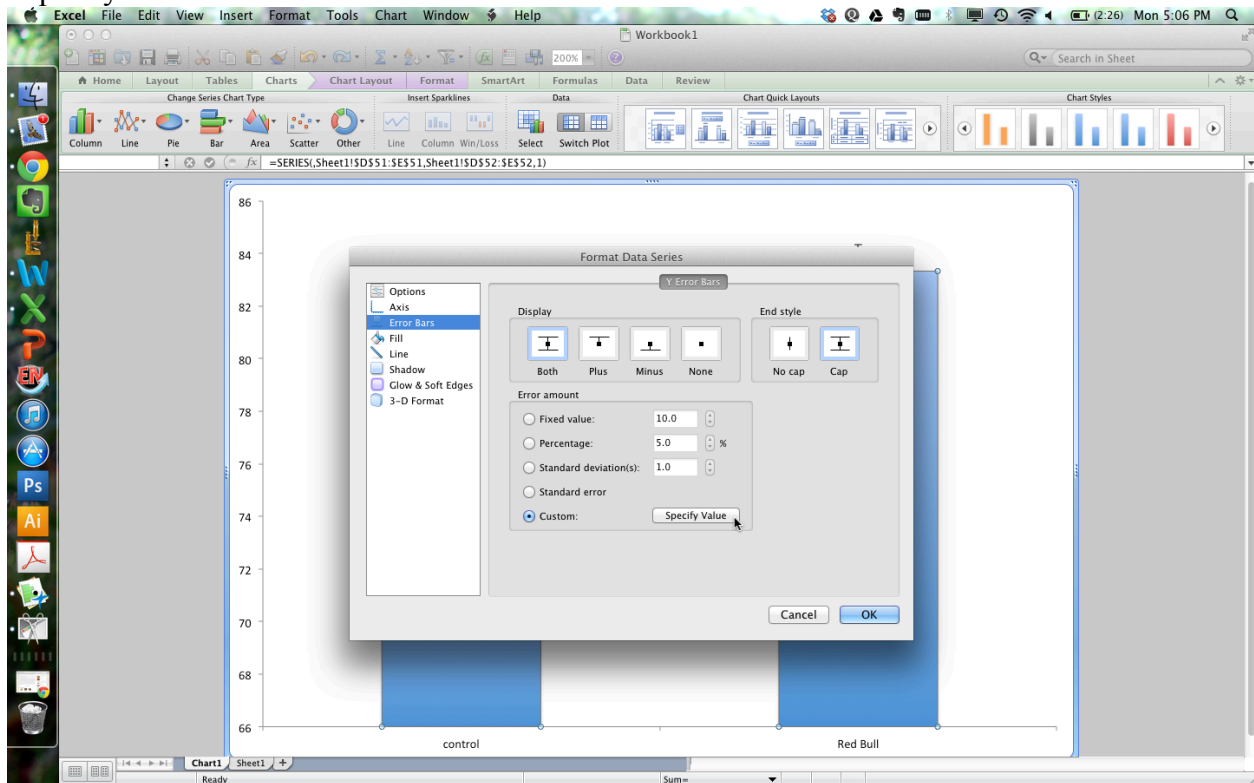
(9) Now you need to format the appearance of the graph so it looks professional. Right click in one of the corners of the chart and click “Format Chart Area”. Set the “Color:” dropbox under the “Line” section to “No Line”. This will keep there from being a box around the whole graph when you import it into your Word document (it’s hard to see the effect of this change in Excel).



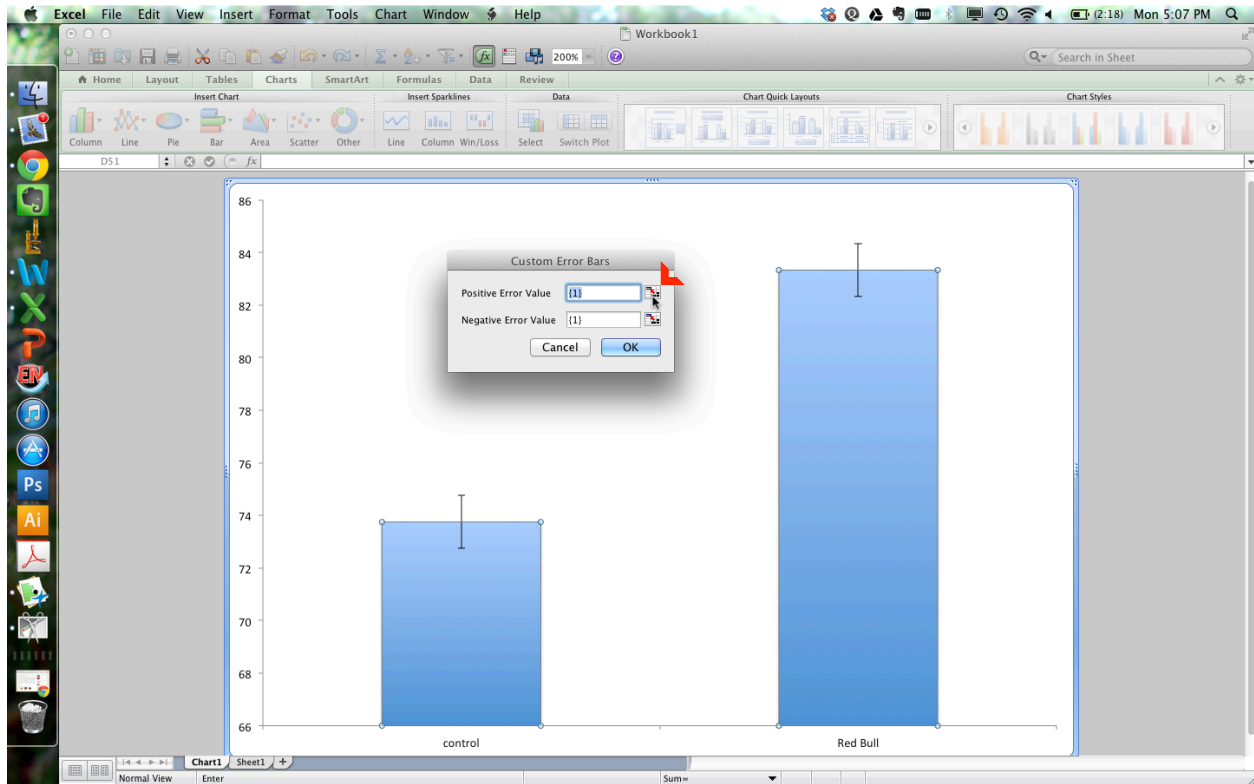
(10) Next, we want to add error bars to the graph. These will let the reader know at a glance how noisy the gathered data were. The smaller the error bars, the more confident we can be in our average measurement. First, right click directly on one of the two bars, then select “Format Data Series. . .



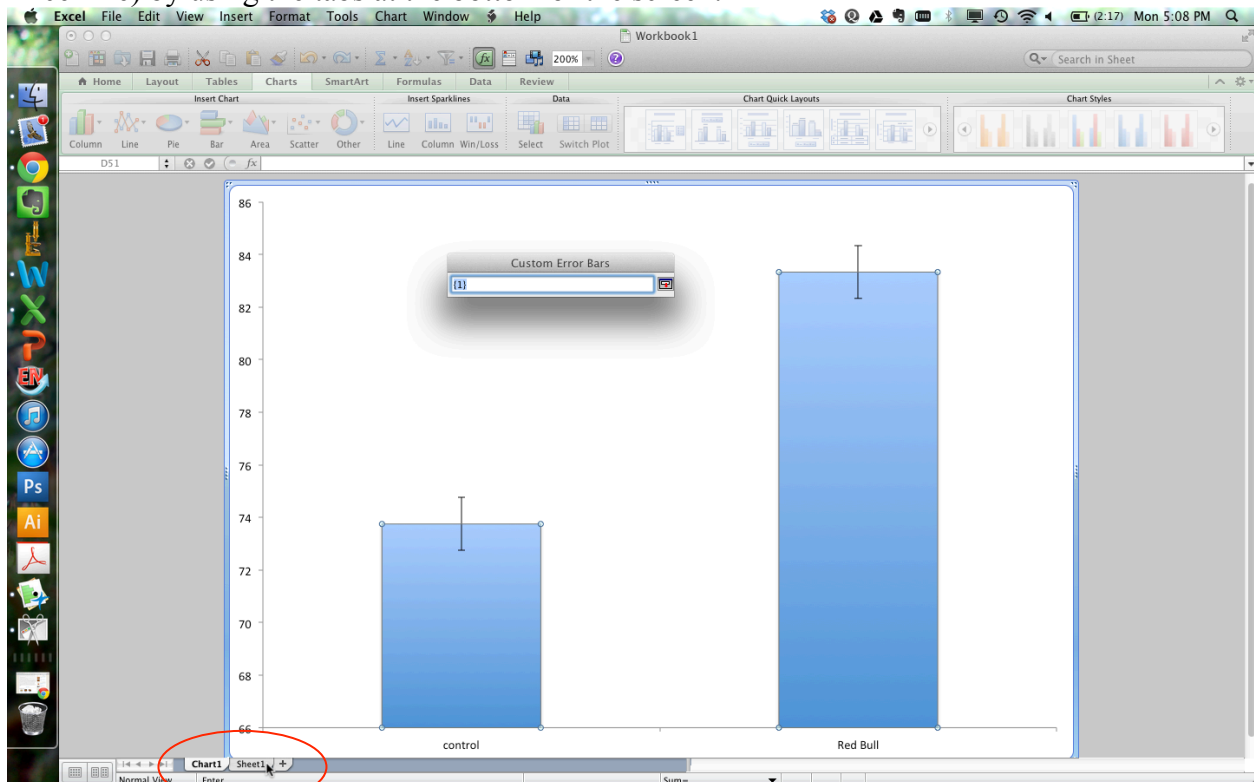
(11) In the “Error Bars” section, set the following options: under “Display”, click “Both”; under “End style”, click “Cap”; under “Error amount”, click the “Custom” radio button, then click the “Specify Value” button.



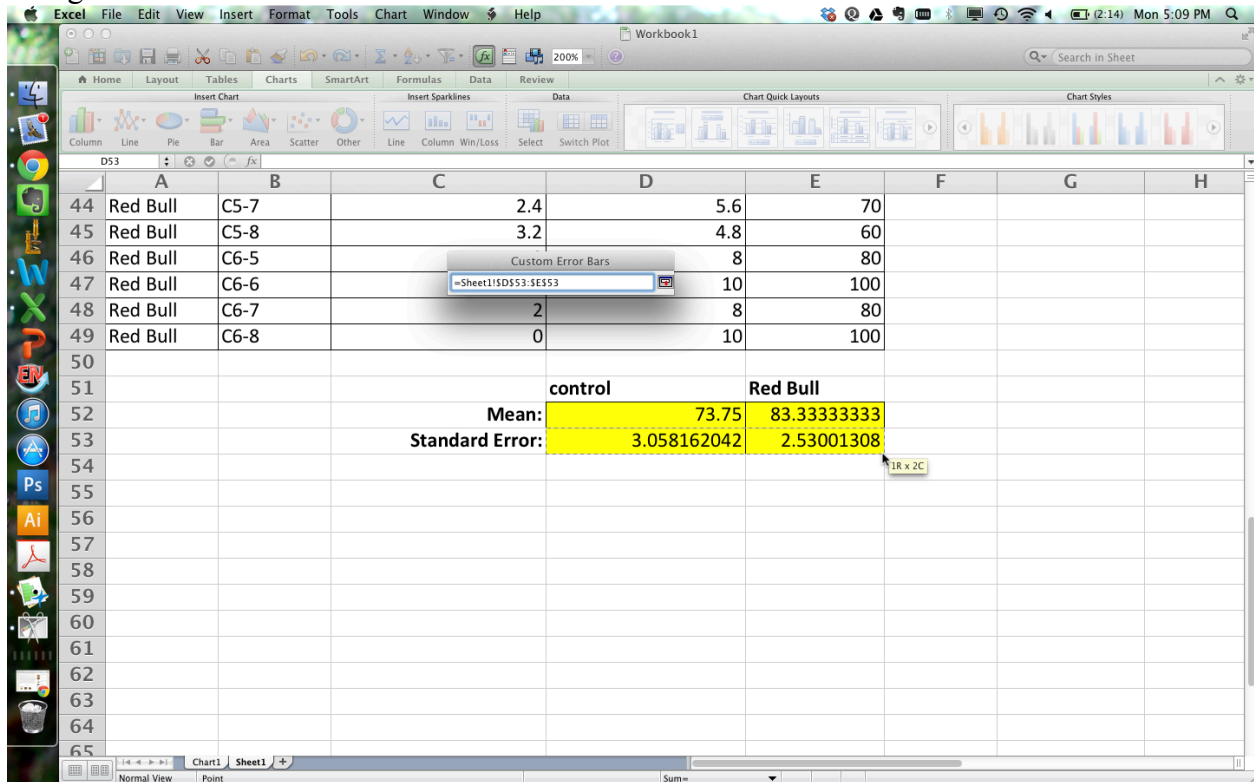
(12) We want to tell Excel to use the standard errors we calculated for each mean as the error bars. To do this, in the dialogue box that pops up, first click the small square button next to the “Positive Error Value” box:



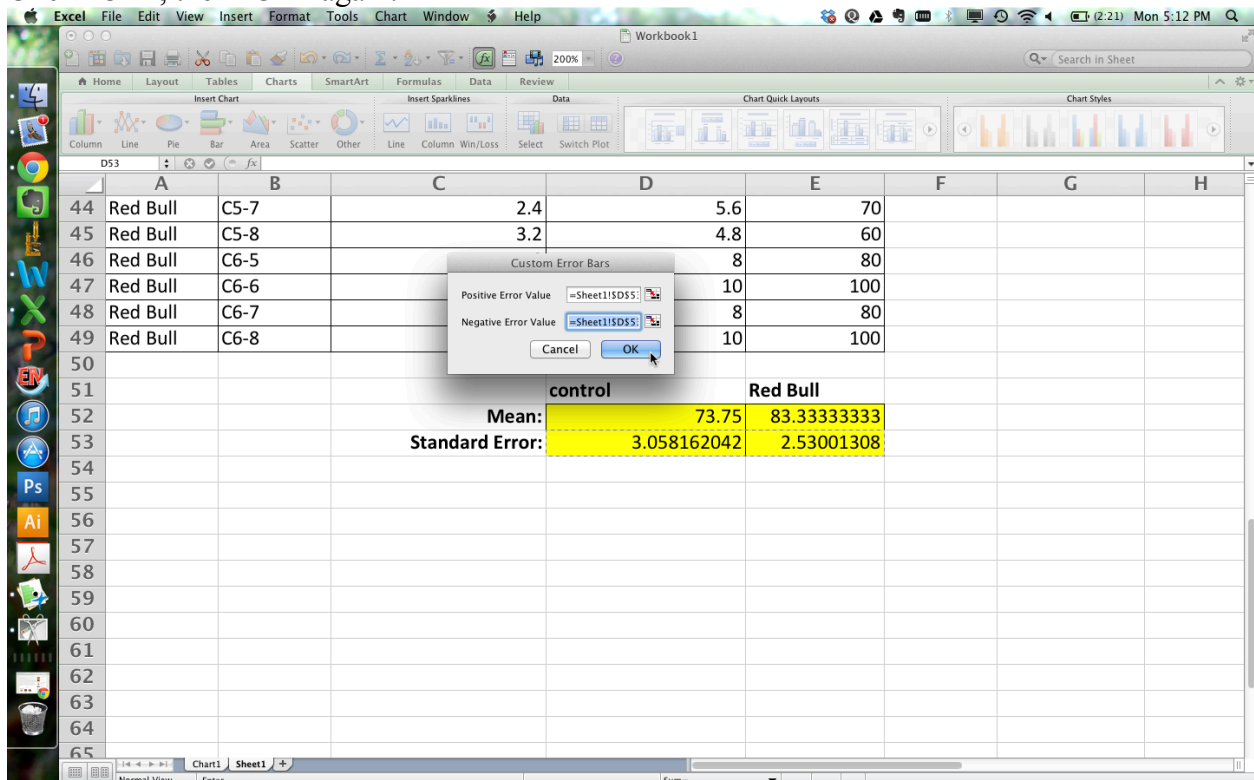
(13) The box will collapse in size. Now, navigate back to the spreadsheet (the other tab in your Excel file) by using the tabs at the bottom of the screen:



(14) Click and drag to select both cells in the “Standard Error” row. This will automatically change the text in the “Custom Error Bars” window. Press Enter.

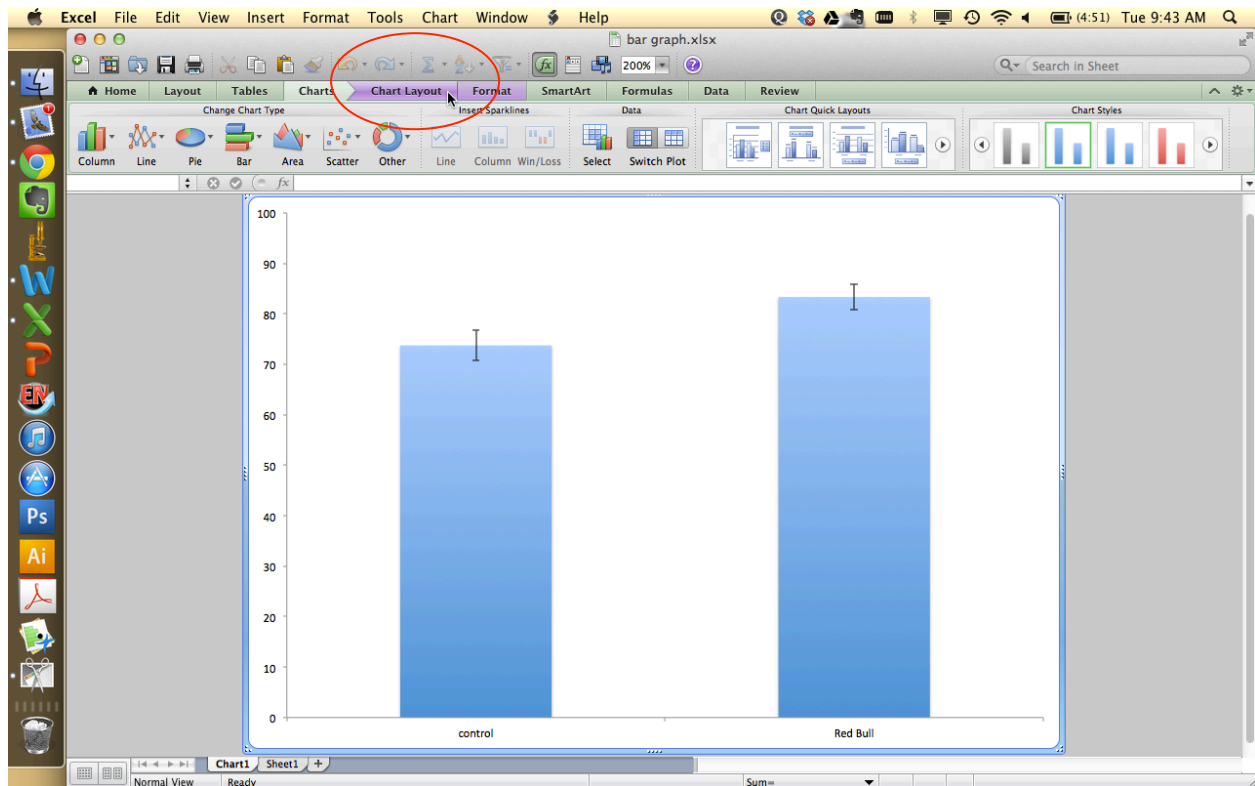


(15) Repeat steps 12 – 14 to set the “Negative Error Value” in the same way (you want the positive and negative error bars to both be the same value, so just repeat the steps exactly). Click “OK”, then “OK” again.

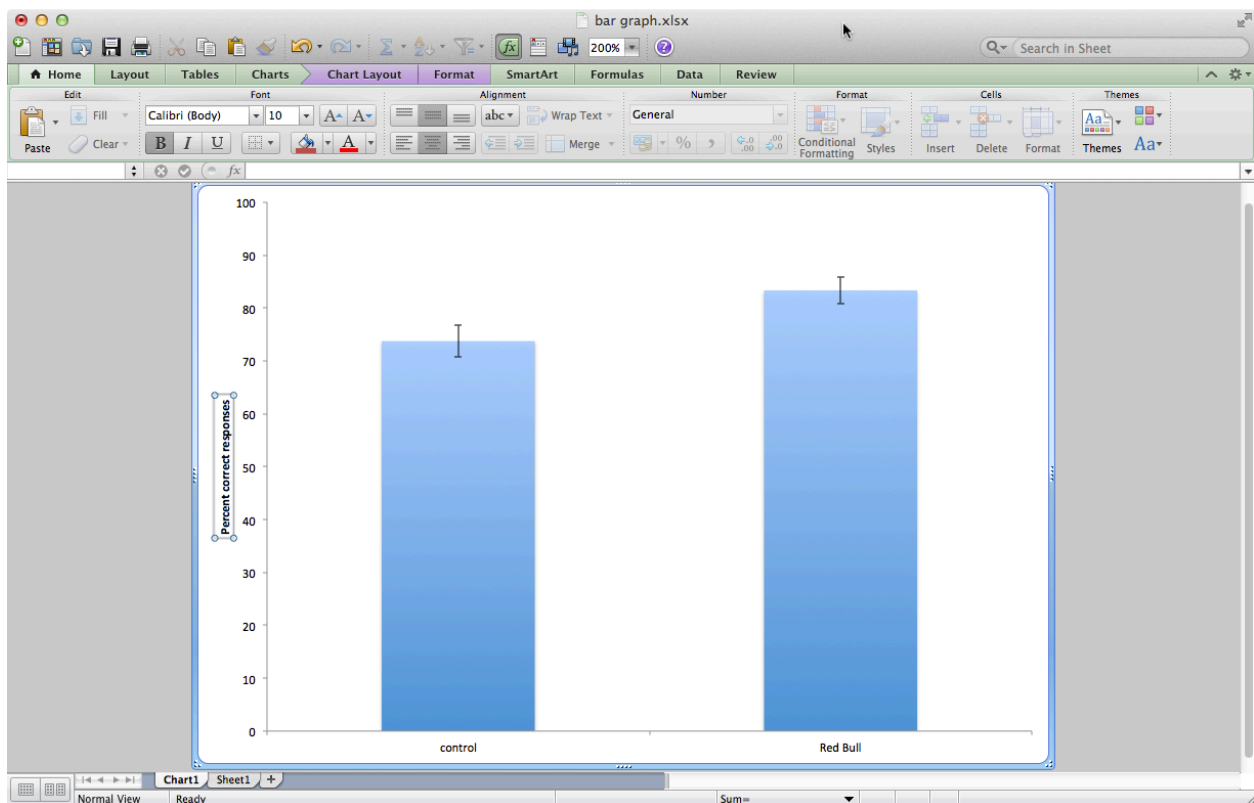
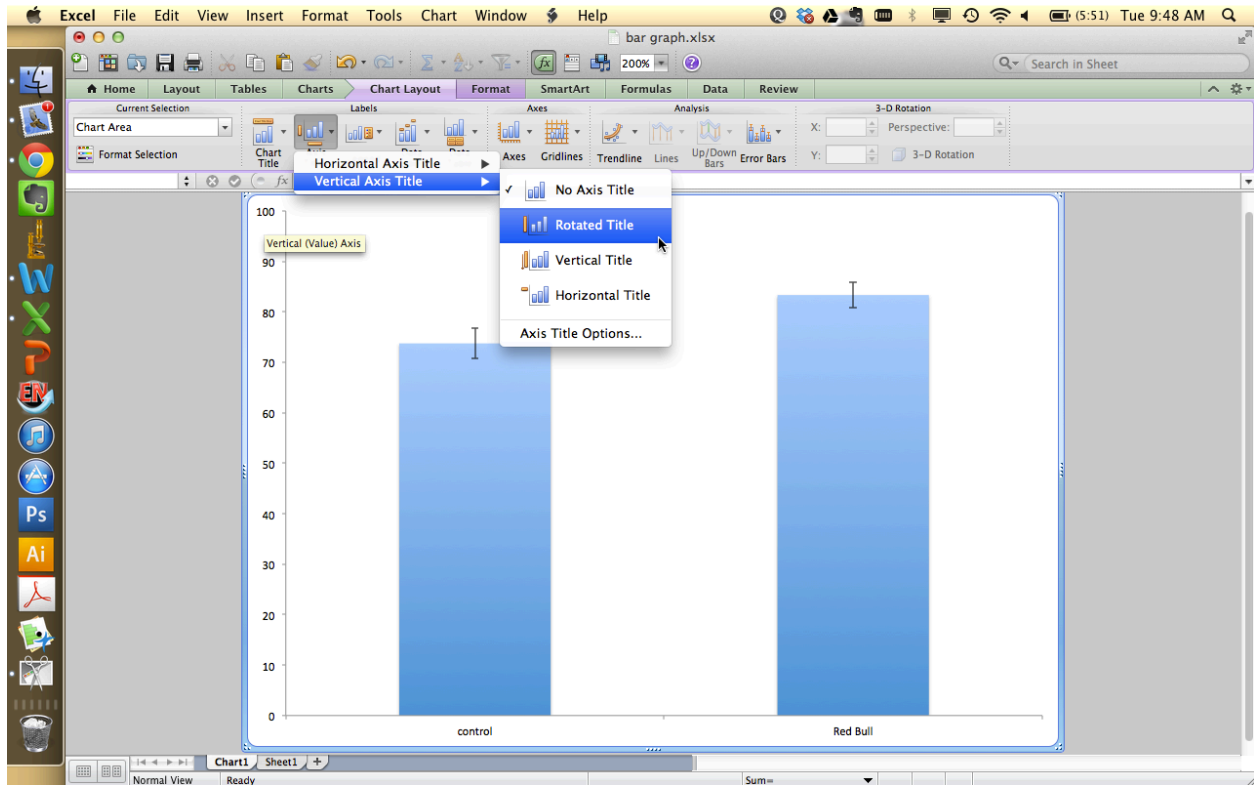


Your bars should now have error bars on them.

(16) You now want to correctly label the axes of the graph. Click on the “Chart Layout” subtab of the “Charts” tab.



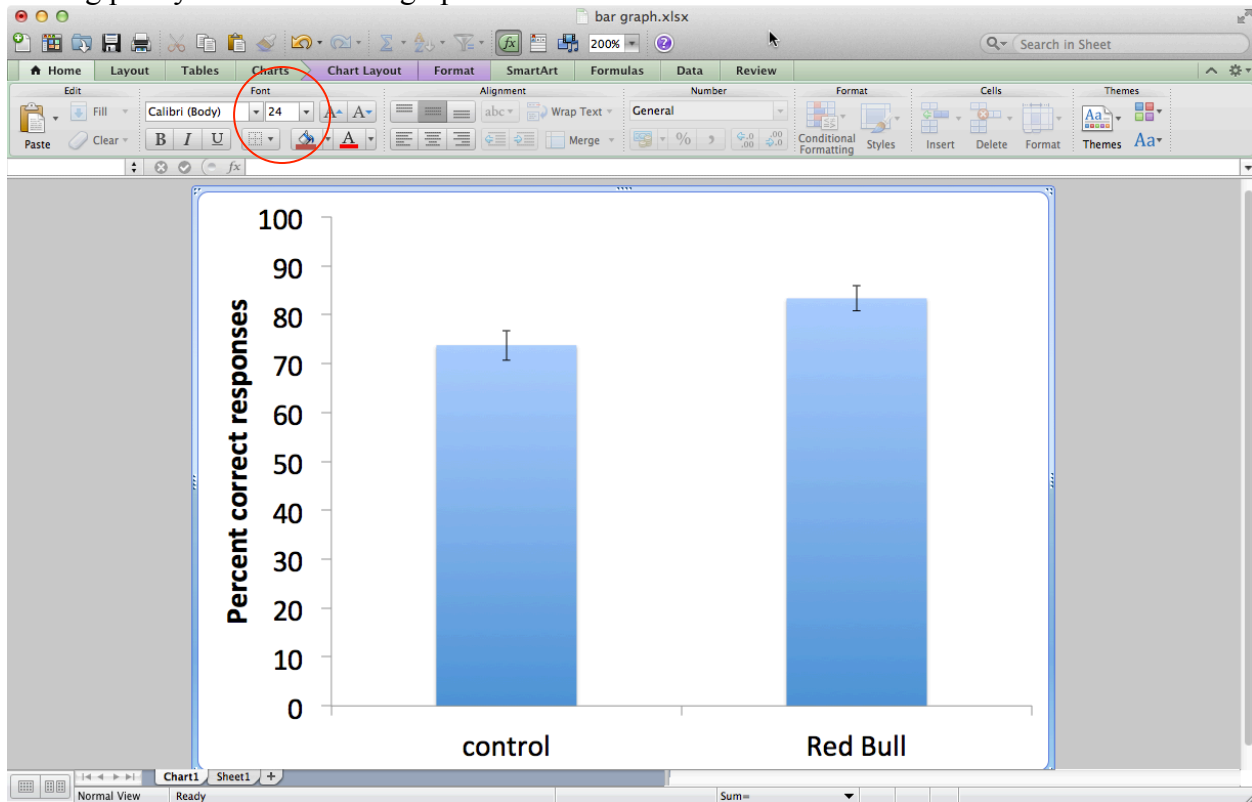
(17) Go to “Axis Titles” -> “Vertical Axis Title” -> “Rotated Title”. A word box will appear next to the y-axis of your graph. Label the axis something straightforward – In my case, I’m going with “Percent correct responses”. If the y-axis was measuring something with units, I would put those in the axis title as well (e.g., “Pulse rate (bpm)”), but since this axis is a percent, there are no units.



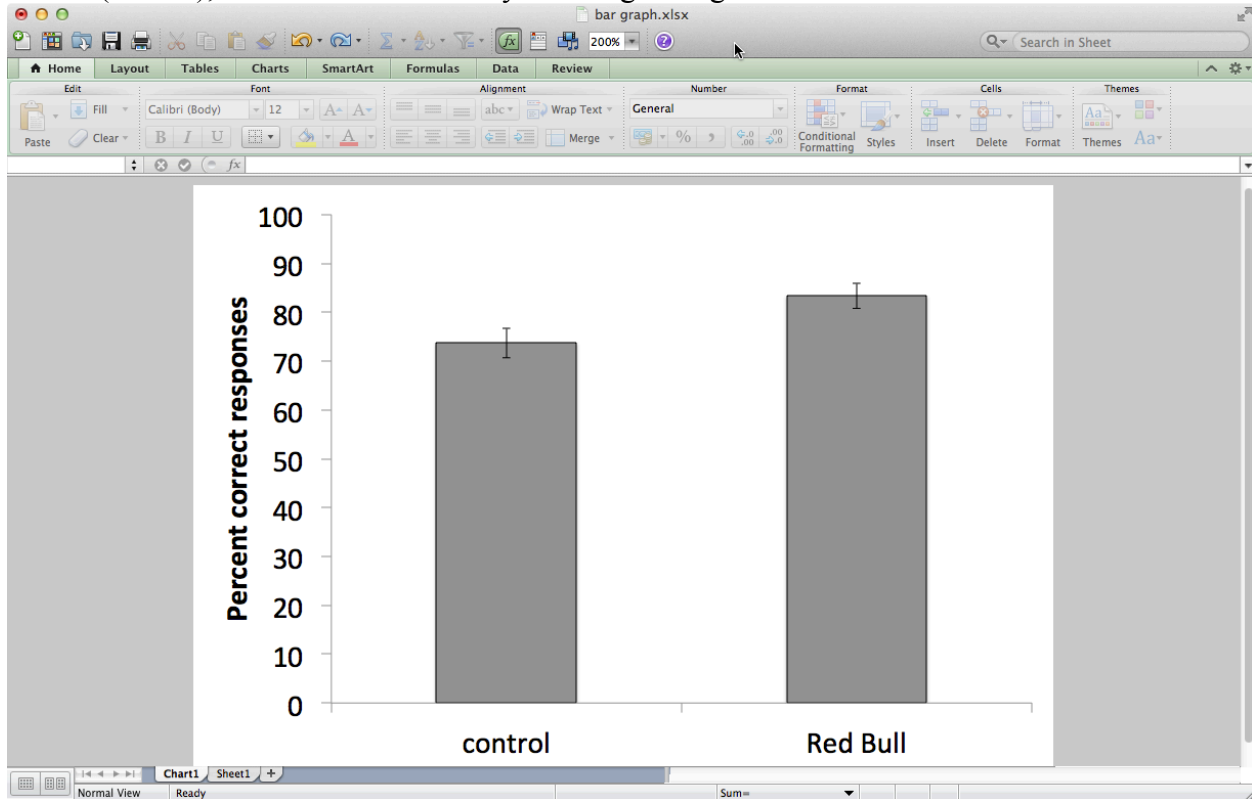
Normally, it's good practice to label the x-axis of a graph as well as the y-axis. However, when the x-axis is exceedingly straightforward, as it is in this case, it is often left unlabeled (i.e. it is obvious, since there are only two bars, that the x-axis here represents two different experimental treatments – labeling it as “Treatment” or “Drug Treatment” or something similar wouldn't add much to the graph).

(18) Now all that's left is to format the style of the graph to improve readability. You have some discretion here, and different scientific disciplines can have different conventions. In general, though, you will want to at least (a) make sure the fonts are big enough that they can be easily read; (b) make the graph black and white, instead of color (most journals print in black and white or charge a lot extra for color figures, so black and white is a good default for simple figures); and (c) maybe alter the y-axis scale to better convey the differences between treatments.

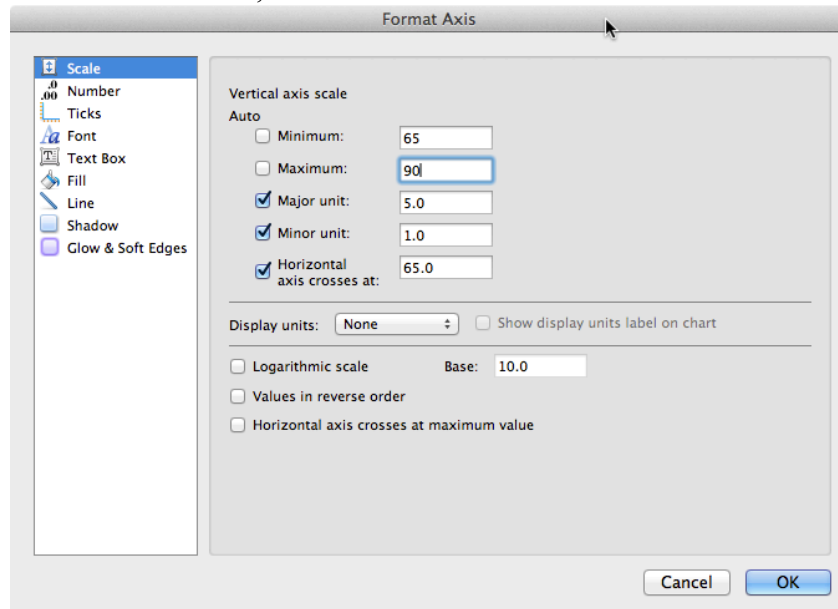
(a) Font sizes: click in one of the corners of the graph to select the whole thing. Then use the “Font” dropdown box in the “Home” tab to increase the size of all the text in the graph (you could also click on and set the font size of each element individually if for example you wanted the y-axis to have a different font size than the x-axis or something like that). I've gone with size 24 font, which looks like a good compromise between being big enough to read, while still leaving plenty of room for the graph itself to be readable.



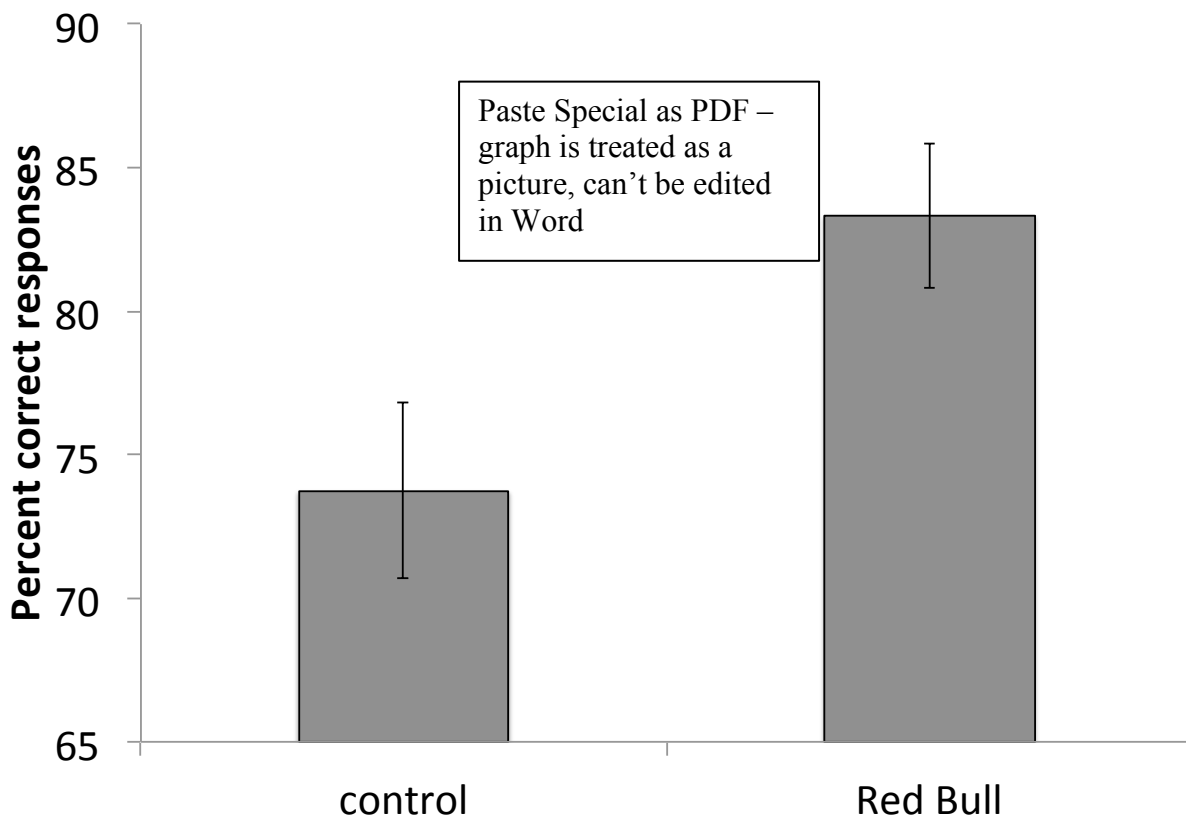
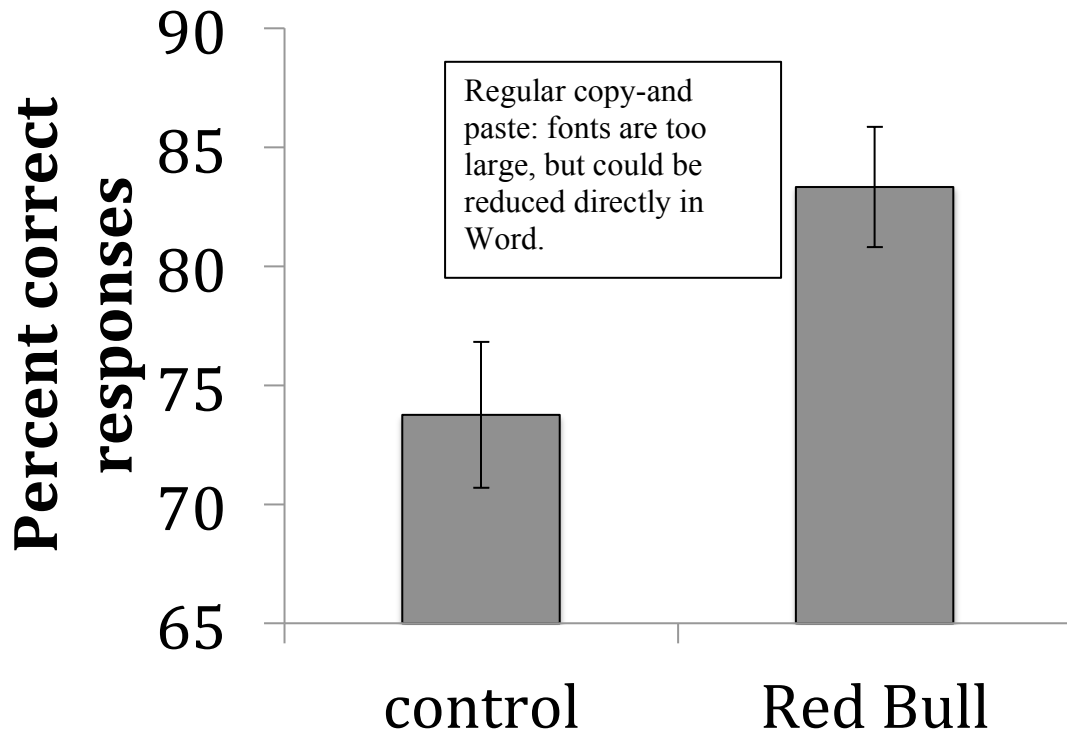
(b) Bar color: click directly on one of the bars on the graph so that they are selected. Go to the “Format” subtab of the “Charts” tab. Use the “Fill” and “Line” dropdown boxes to set the color of the bars to whatever you want. There are multiple reasonable options here: all-black bars, black outlines with white fill, or gray bars. I’ve chosen to go with gray bars (“Fill”) with a black border (“Line”), which is a common style among biologists.



(c) Y-axis scale: The y-axis here is bigger than it needs to be – neither group averaged below 60-70%, but the axis starts at 0%. Some journals ask that all axes begin at 0, like this one, but others allow the axis to be set so the differences between treatments are clear. In this case, if I set the y-axis to go from 65-90%, the differences between control and Red Bull-treated groups will be clearer. To do so, Right click on the y-axis (right over the numbers on the axis), go to “Format Axis...” and, under the “Scale” tab, enter 65 and 90 into the “Minimum” and “Maximum” fields:



(19) Import your graph into Word. You can just copy and paste the whole graph into your Word document, which allows you to edit the appearance of the graph in Word (i.e., changing font sizes) but it generally doesn't look great initially. If the graph is already formatted well in Excel, it might be easier (but less flexible) to do the following: copy the graph in Excel, then, in Word, go to "Edit -> Paste Special..." and pick the "PDF" option.



(20) Lastly, remember to caption your figure! Explain what the bars represent (averages AKA means) and what the error bars represent (in this case standard errors, aka standard error of the mean, often abbreviated as s. e. m., SEM, SE, or something similar).

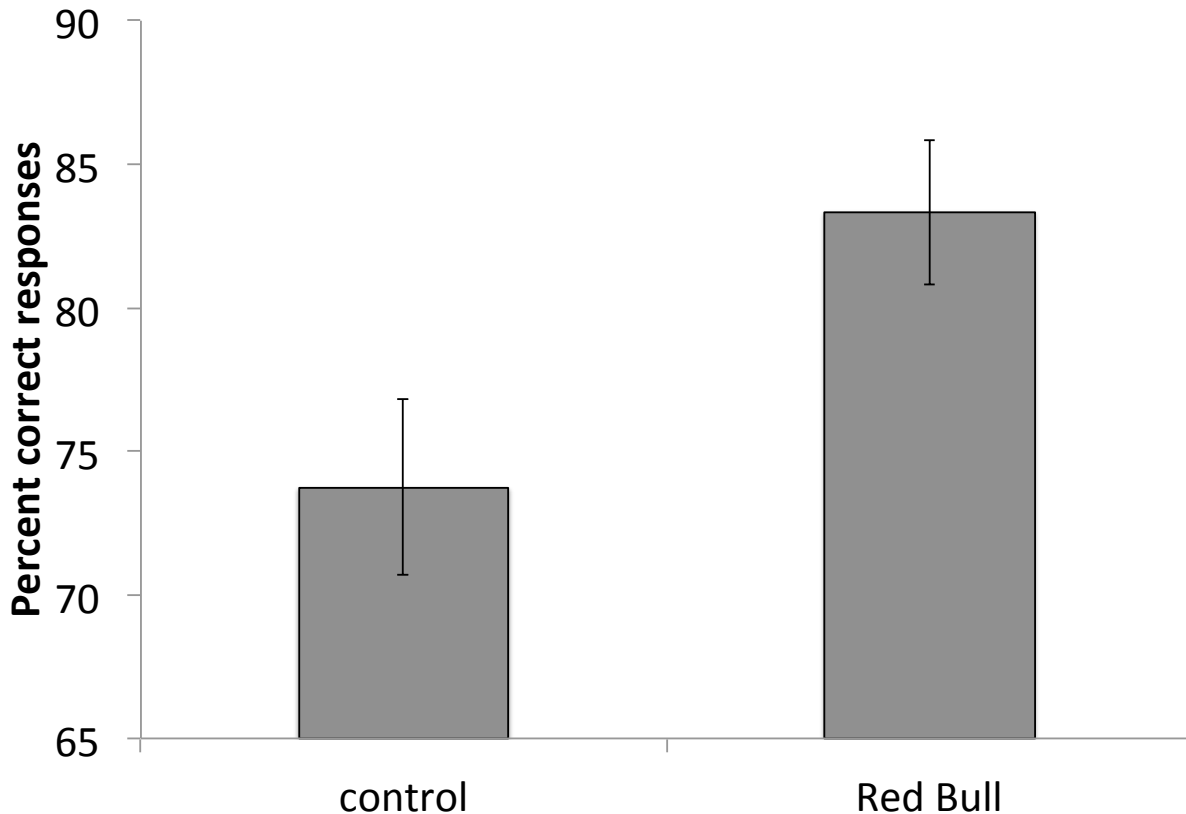


Figure 1. Mean \pm s. e. m. lab quiz scores for students that did (Red Bull) or did not (control) consume energy drinks 30 min prior to quiz administration.

Making bar graphs with more than two treatments is just an extension of the two-treatment case outlined above. Start by again making a summary table with treatment names, means, and measures of variability (e.g. standard errors), which you can get from the output of statistical software (i.e. Vassar Stat) or calculate yourself. Then highlight the two rows containing treatment means and names:

	balanced	high carb	high protein	high fat
Mean:	23	32	26	22
Standard Error:	2.2	2.6	1.9	2.3

Create a “Clustered Column” graph as before, and go through all the above steps to produce a quality figure. NOTE: for ANOVA’s, you sometimes WILL label the x-axis, because with more than two treatments it is not always obvious what the x-axis represents:

