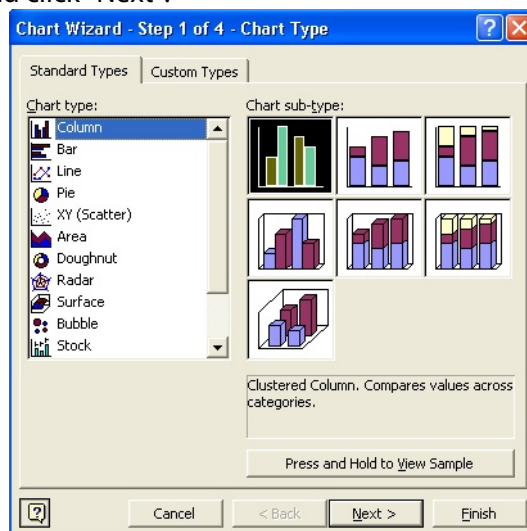


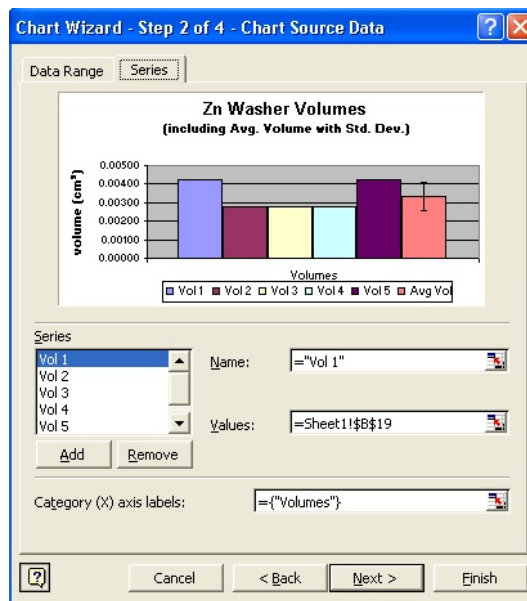
Directions for creating a column graph and plotting the standard deviation of the average in Excel:

We will create a column graph comparing volumes and average volume from five Zn washers. Also, we would like to plot a standard deviation error bar on our average volume column to show the spread/dispersion of our data experimental volume data.

1. First, enter your raw experimental data into Excel. Let the columns be for individual washers (i.e. 1-5, average) while the rows designated for washer properties (i.e. volume, surface area, thickness, etc).
2. After the washer data has been entered and the individual properties (like washer volume) calculated, we need to plot the data generated. Go to "Insert" > "Chart". Under "Chart Sub-Type" select "CLUSTERED COLUMN" and click "Next":

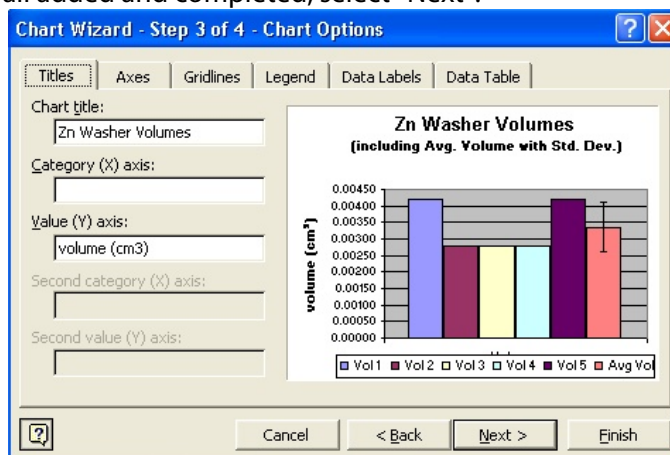


3. Click on the series tab:

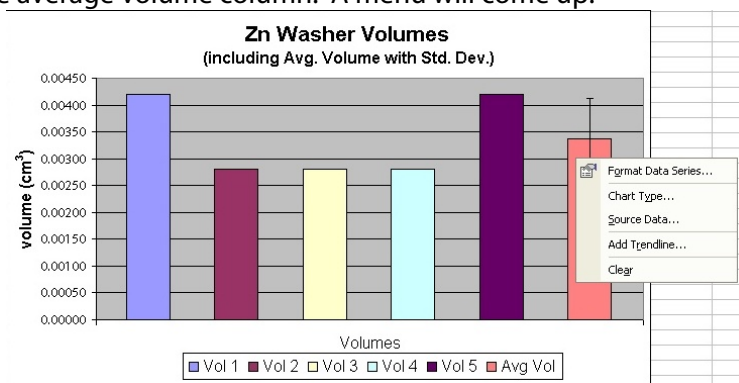


- a. We need to create six series (5 washers+1 average). Since the first series is already created for us, we need to assign a name to it. Do this under "Names." Another way to assign series names is to click the little red arrow on the red/blue icon at the right of this box... this will take you to the spreadsheet. Select the first column title ("Volume 1" for example... for the first series, etc). Your titles are now transferred to the graph.

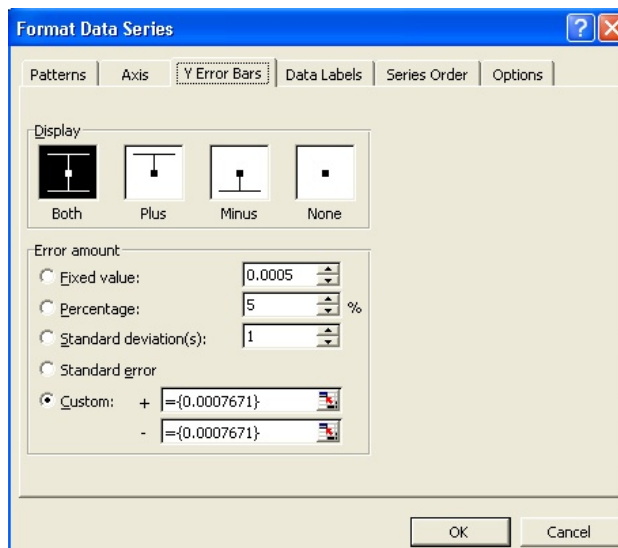
- b. To assign a "Value," click on the red/blue icon at the right of this box. This will take you back to the spreadsheet. Select the value that corresponds to the column titled. When it is highlighted, click again on the same icon. Your data value is now transferred to the graph.
 - c. The next step is to create a new series. Click "Add" under the "Series" box. Now repeat the steps above (a and b) to create a series for each washer (total of 6).
 - d. For the average washer volume, just treat it like a typical washer, but remember to call it something distinct (like "Average," "Avg," etc.).
4. After the series are all added and completed, select "Next":



5. We now need to give a "Chart Title" as well as a "Y Axis Value" to the plot.
6. We can now click the individual tabs along the top and adjust the "axes", "gridlines", etc. to make the plot look nice and professional. After this is completed, select "Finish". You can save the plot as either a separate sheet or added as a box to the spreadsheet you are working on. (This does not matter, since it will eventually be copied and pasted into your Word document)
7. Next, the standard deviation error bar needs to be added to the "average" column. To do this, we right-click on the average volume column. A menu will come up:



Left-click "Format Data Series" (During our Radioactivity experiment in a few weeks, here we would click "Add Trendline" to add a trendline to our radioactive decay plot). Now we will get the menu below. Click the "Y Error Bars" tab:



8. From here we need to Click the "Both" Display since we want the + and – standard deviations to show.
9. Click "Custom." Enter the standard deviation values by either using the red/blue icon at the right of this box (and thus clicking the standard deviation value on the spreadsheet) or by inputting the standard deviation value itself into both boxes. **Do not** enter data into the "Standard Deviation(s)" box. We might use that box later on in the semester. When completed, click "Ok."
10. You will need to have 3 plots total for the formal lab. So duplicate this type of plot for washer Surface Area and Zn thickness (in atoms).