1. For Part A: Try each plot both with and without lines connecting the dots. For your final printout, remove any lines and just show the dots. In your notebook, try to comment on the results. Are there any observable patterns? What seems to be happening on a *year-to-year* basis for each of the 5 plots?
2. For Part B: Again, try it both with and without connecting lines. Why do some of the plots appear to have more dots? Now, save your work, then start a whole new workbook.
3. For Part C: This plot will be of population vs. μ. This plot can be frustrating and slow to make!
   a. Label cell A1 as μ. In the cells below it, generate values ranging from 0 to 3.5 in steps of 0.01, and then from 3.5 to 4.0 in steps of 0.001.
   b. Create labels in cells B1, C1, etc., starting with "year 0", then "year 1", etc., up to "year 400". Then, enter a "random" starting population into cell B2 (e.g., 0.8 or something). Use this same value down the entire column. As you can see, each *row* represents a separate population as it evolves over time (unlike most plots, which use rows for time).
   c. Use the logistic equation in cell C2 to find the population at the next time for the first row. Be sure to use a $ correctly to make sure you always use the μ value of the same row!
   d. Drag the formula from cell C2 horizontally over all the columns for your 400 years.
   e. Double click the lower-right corner of the selected group of cells to copy this formula into all the cells below. Now *all* the populations are calculated! The hard part is next: plotting. Before doing anything else, SAVE your work!!
   f. Make a plot that has column A as the horizontal axis, vs. years 398 through 400 as the vertical data. You will need to use the control key while selecting. Then, make a scatter plot.
   g. Be patient. Delete the legend. Be patient. Change the horizontal axis limit to range only from 0.0 to 4.0, and the vertical axis to range from only 0.0 to 1.0. Be patient. Then (this will seem crazy at first), change the axis number font to size 72 for both axes.
   h. Change the zoom level to 10% (lower right). Your plot will now look pretty tiny, so drag the lower right corner of the plot so that it almost fills the screen. The reason we do this is that (in an odd decision by Microsoft), both the marker size and font size scale with zoom level. So, we are effectively reducing the size of the markers here to a smaller size. The 72 size font should look normal now.
   i. Click once on the plot. If you look at the data cells, you'll see a blue box surrounding the cells for the currently chosen years (398 to 400). Drag the upper left corner of this blue box to the left, so that it includes a total of 255 years of data, instead of just 3. By only selecting years 146 through 400, we are looking at each population only at "final" (or "steady state", or even simply "large") times. Looking at the plot, if the "food level" is at μ= 1.5, then it is not possible for the population to end up at 0.6. In fact, there are many such "missing" populations. It seems that only certain populations can exist at large time, regardless of the food availability μ.
   j. Under no circumstance print this plot! It will not print during your lifetime. Instead, when the plot looks good, press the "print screen" button, and paste the resulting image into a Word or Powerpoint document. You can crop the image so that only the relevant image appears, and then print this document instead of the Excel document.
4. For Part D: Save your part C, and start over in a new workbook for each of the next two parts:
   a. Repeat everything as before, but generate μ values only from 3.52 to 3.67 in increments of 0.0001. Make a plot for years 146 through 400 only in the region $3.52 \le \mu \le 3.67$, and for populations between 0.25 and 0.71. This plot is nothing more than a zoom-in of one of the primary bifurcations from part C.
   b. Repeat everything as before, but generate μ values only from 3.846 to 3.856 in increments of 0.00001. Make a plot for years 146 through 400 only in the region $3.846 \le \mu \le 3.856$, and for populations between 0.953 and 0.964. Notice that this plot is a *very* zoomed region from the main plot.