4/17 in Class – Review for Exam 2

Summary

I can't review everything in one class period, so this worksheet is NOT exhaustive. Anything we learned, and especially what we have done problems on (both in class and as homework) is fair game for the exam.

The big ideas we covered were curve fitting and simulations.

For curve fitting, we discussed the method of least squares. We calculated the χ^2 for data we generated, and one set that I gave you. We derived the parameters for a least squared best fit to a line. We generated data that was offset from a line. We tested our method on that data, and then we also learned to us `fminsearch`, which has the advantage of working for any function, not just a line.

For simulations, we learned how to use the `rand` command to generate "flat" random numbers, and we learned about histrograms as a new way to look at distributions of data. We also used `floor` to round down.

Review Problems:

Make one .m file for all!

As practice for the exam, make all of this one .m file. Label each problem number in a comment, and be sure that it runs!

Call it `revEx2_Yourname.m` and turn it in to me at the end of class.

Unlike the exam, you may work together. Some of these are harder than I would give on the exam. (Although now that you will have them, that's less true.)

1. On the class website (and today's date), you can find a file called `revEx2_JCK.txt`
   The data file consists of two columns of data, x and y.
   (a) Read the data in and plot y vs x on Figure(1). Do you think a line would be a good fit?
   (b) Use one of the methods we learned in class to determine the m and b for the line of best fit.
   (c) Plot your line of best fit on top of the data.

2. **D&D dice**
   If you've ever played D&D, you know there are many different "sided" dice. Imagine that a player rolls a 12-sided die and an 8-sided die. Add the two dice. Plot a histogram of the distribution you would expect for the sum of those two dice if they were rolled many, many times. (This is figure(2).) What do you predict is the most common outcome?

3. **One problem to rule them all**
   (I won't do this on the exam, or if I do, there will be steps that don't depend on others.)

   Bi 213 decays into Bi 209 in two possible ways as shown in the figure below. The times given for each of the first three isotopes are the mean lifetimes of each isotope in minutes.

   Imagine that you start with 10,000 atoms of Bi 213. Run a simulation of how those 10,000 atoms of Bi 213 decay and how many decay products there are. Let your simulation run for a total time of 20,000s. Let $dt = 1$s.

   Keep track of the numbers of all four isotopes for each time step and plot all four on the same graph. Plot N(t) vs t for all four on the same set of axes. Actually, do this twice: for

Figure(3), plot all using a regular linear scale and for Figure(4), repeat with a log scale for the y-axis.

Hints: Start with Pb, then do the Ti, then the Bi 213. It sounds strange, but it will help keep one atom from decaying twice in one time step.

For the Bi 213, use the 46 min mean lifetime to determine if the atom decays, then use another random number to figure out if it decays into Pb or Ti.