PHYS 310 — Homework #6

Reading:

- Review (or read if you haven't already) sections 8.1–8.6

Problems due Tuesday April 5.

1. Hughes and Hase problem 8.2

2. Hughes and Hase problem 8.4. Ignore the step-by-step written underneath the data table. Instead, (a) Determine the average number of times you would expect a particular number to come up (remember that there are 49 possible numbers, but you are drawing 6 balls each of 106 total times); (b) make a histogram of the data; (c) calculate χ^2 for these data, remembering that the uncertainty α for each of these values is the square root of the count (or expected count); and (d) use the stats.chi2.cdf function to determine the probability that – if the hypothesis of each ball being equally likely is valid – that you would get a χ^2 the same or larger; and (e) comment on the validity of the hypothesis and whether or not you think there is reason to suspect foul play.

   To save some time, you can copy the data here:

   ```
   data = np.array([11,11,13,14,11,22,15,9,9,16,17,12,8,13,8,15,9,13,19,9,\
                    12,10,17,13,10,9,10,15,9,14,\
                    16,17,11,13,14,11,13,21,14,13,\
                    12,11,16,13,10,18,16,16,8])
   ```

3. In class #3 we worked on an exercise illustrating how the central limit theorem manifests itself in the context of the coin-tossing simulation we developed in class 2. We simulated the flipping of a coin 100 times, and then we repeated the simulation many times. The histogram of the number of heads looked very like what you would expect if the distribution of the number of heads was gaussian. Review the notebook posted after class #3 (`coin_flip_CLT.ipynb`). Run the notebook and add a couple of lines to calculate the χ^2 statistic, and test the hypothesis that the numbers of heads are distributed normally. (All the information you need to use to caclulate χ^2 is already contained in the notebook. You can complete the calculation of χ^2 with a couple of extra lines of code.)