

## PHYS 310 — Homework #2

### Reading:

- For homework:
  - Hughes and Hase, Chapter 3.3–3.4
  - Supplement to Hughes and Hase on the binomial distribution
- For Jan. 30 class: Hughes and Hase Chapter 3.5, Chapter 4

### Problems due Tuesday January 30:

1. Hughes and Hase, 3.5
2. Hughes and Hase, 3.7
3. Hughes and Hase, 3.8
4. Hughes and Hase, 3.9
5. In class you used a Monte Carlo simulation to determine the probability of obtaining 60 or more heads in a trial of 100 flips of a fair coin. Let's use the variable  $N$  for the number of trials used in a simulation. Modify your code so that it stores the data of the number of heads obtained in each "experiment" in an array.
  - (a) Let  $N = 100$  and a histogram of the data using the command  

```
plt.hist(data, 101, [30,70])
```

where `data` is the name of your array, 101 is the number of bins, and 30 and 70 are the lowest highest values of the number of heads that you want to consider.
  - (b) Repeat for  $N = 100,000$ .
6. Use a computer to simulate a single lab section's results for the PHYS 211 experiment in which students in section each open a bag of M&Ms and count the number of brown M&Ms. Because this is a probabilistic process, you will not all get the same answer. [**NOTE:** You will probably want to use one additional `numpy` function beyond those we used in class on Thursday: `np.bincount()`.] Make the following assumptions:

- There are 24 students in the lab section;
- There are 60 M&Ms in each bag;
- There are six different colors of M&Ms (brown, yellow, blue, orange, red, and green);
- The colors in a bag are determined probabilistically, with each color occurring with equal probability.

Make a histogram of the the results of your section, showing the number of bags with 0 brown M&Ms, the number with 1 brown M&M, etc.

7. You draw six times from a deck of 52 playing cards, replacing the card and reshuffling after every draw. Find the probability that you would draw exactly  $\nu$  hearts in six draws, for  $\nu = 0, 1, \dots, 6$ .