MATH 245, Spring 2016
Homework 4
due 10:45am on Monday, May 9.

Background reading: Section 5.1 and Tutorials 6 and 7.

Follow the posted homework guidelines when completing this assignment. I ask that you do not contact previous Math Modeling students when completing this assignment. Provide details of calculations and assertions that you include. Don't forget to provide acknowledgments for those who helped you with the assignment and those resources that you consulted. As always, make sure to include text cells in your *Mathematica* notebook in order to explain what you are doing.

5-1. (10 pts) This question involves random simulation in *Mathematica*. As always, make sure to include text cells in your *Mathematica* notebook in order to explain what you are doing.

(a) Simulate rolling a 120-sided die 50 times, where the values on the sides of the die are the integers 1 through 120. Modify the simulation in two ways. In one modification, keep track of the sum of the 50 rolls. In a second modification, keep track of the highest value that is rolled.

(b) Now use a `Table` command to repeat each experiment 1000 times. (Or more if you get carried away!) Take the average of each list by using the command `Mean`. Is the average what you expect?

(c) Input the lists from part (b) into the `Histogram` command to see a visualization of the 1000 trials, and discuss how this is related to real-life die rolling.

(d) Using basic probability, calculate the probability that when 50 120-sided dice are rolled, you get a number between 1 and 12.

(e) Use the `Tally` command on the first list from part (b) and see how often you get a number between 1 and 12 in your simulation. How close is this to your theoretical answer?

5-2. (10 pts) In this problem you will modify the waiting room algorithm from the notes and tutorial in order to better simulate the arrival of patients.

Suppose that some patients need more or less time with the doctor. Suppose that with 50% probability, a patient spends 10 minutes with the doctor, with 25% probability, the patient spends 15 minutes with the doctor, and with 25% probability, the patient spends 25 minutes with the doctor.

- Determine the expected time that the doctor spends with a patient. How does this compare to the original simulation?
- How do we modify the simulation code to take this modification into account?

Now run your simulation at least 1000 times and answer the following questions, with one paragraph each.

- How does this modification change the expected number of patients in the waiting room at the end of the day?
- How does this modification change how long the doctor expects to stay after noon?
- Do the plots of how busy the doctor is or the distributions of patients in the waiting room look different?