MATH 245, Spring 2015
Homework 4
due 10:45am on Monday, May 4.

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. (a) (3 pts) **Determine the reliability of a computer**, where five types of components are required for printing out your group's project: *power*, *desktop*, *input*, *drive*, *printer*. The *power supply* works 99.6% of the time and the *desktop* works 99.9% of the time. There are two types of *input*, one of which must work: a keyboard with reliability 99.99% and a mouse with reliability 99.98%. There are three types of *drives*, one of which must work: the hard drive with reliability 99.7%, the CD-ROM with reliability 99.2%, and the flash drive with reliability 98%. Last, there are two connected *printers*, one of which must work for success: a laser printer with reliability 99.5% and a color printer with reliability 99%.

(b) (1 pts) Write a sentence or two discussing the assumptions that are required for your answer and calculations to be correct.

(c) (2 pts) Use *Mathematica* to generate nine variables to simulate how well the parts of the computer work. Then use `&&` and `||` operators to model the success of the computer. Last, run your model 10000 times and compare the answer you get with the theoretical probability of success you calculated in part (a).

5-2. (7 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) Create a simulation that flips five coins simultaneously and counts how many tails appear.

(b) Now use a `Table` command to repeat this experiment 1000 times. (Or more if you get carried away!) The result will be a list of 1000 numbers, each representing how many tails appear out of five. Take the average of this list by using the command `Mean`. Is the average what you expect?

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

(d) Using basic probability, calculate the theoretical probability that when five coins are flipped, three turn up tails.

(e) Use the `Tally` command on the list from part (b) and see how often three of the five coins are tails in your simulation. How close is this to the theoretical answer?

5-3. (7 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 the doctor determines that patients are more likely to arrive in the first half of the morning (9:00 to 10:29am) than in the second half of the morning (10:30 to 11:59am). Choose arrival probabilities for these two time periods that continues to ensure that the expected number of patients that arrive in any day is 13.5. (Make sure that you justify that your choices ensure this restriction.) Run your simulation at least 1000 times to determine if your modification increases, decreases, or keeps the same the expected number of patients in the waiting room at noon. Discuss whether the answer you find is what you expected to find.