

MATH 245, Spring 2015
PRACTICE PROBLEMS
in preparation for Exam 2 on Wednesday, May 6, 2015.

The exam covers:

- *Concepts of Mathematical Modeling*, Sections 1.5, 5.1, 5.3A, and pp. 108–110.
- All topics since the first exam, including and not limited to: probability, Leslie matrices, Markov chains, random walks, Monte Carlo models, and computer simulations.
- The topics in Mathematica tutorials 5–7; **be sure to completely understand the waiting room simulation** and the following commands: `RandomInteger`, `RandomReal`, `If`, `For`, `Histogram`, `Tally`

Below are some questions that practice concepts from the class.

- Book questions: 1.5.2
- Q1.** Give the definitions of *sample space* and *random variable*.
- Q2.** Determine the system reliability of the following communication system. There are two different methods of communicating; at least one method must succeed in order for the system to succeed. The first method is by an FM radio, which has reliability 75%. The second method is by a satellite radio; both a physical transmitter must transmit the signal (with 90% reliability) AND the satellite dish must retransmit the signal (with 95% reliability) in order for the satellite radio to succeed.
- Q3.** (7 pts) Suppose that you are setting up a pizza delivery business with three stores, Alpha Pizza in Flushing, Beta Pizza in Long Island City, and Gamma Pizza in Jamaica. When a customer calls a store, that store sends out a delivery person, who delivers the pizza and then returns to the closest store. Because of this, the delivery people end up transitioning from store to store throughout the night.
- Suppose that when Alpha Pizza is called, then $1/2$ of the time the delivery person returns to Alpha, $1/5$ of the time the delivery person goes to Beta, and $3/10$ of the time goes to Gamma.
 - When Beta Pizza is called, then $3/5$ of the time the delivery person returns to Beta and with probability $1/5$ the person goes to each of Alpha or Gamma.
 - When Gamma Pizza is called, then $3/5$ of the time the delivery person returns to Gamma, $4/15$ of the time goes to Alpha, and $2/15$ of the time goes to Beta.
- (a) Set up a Markov Chain model to simulate this situation.
- (b) Suppose that one evening there are 5 delivery people at each store at the beginning of the evening and they are all sent out at the same time. What is the expected distribution of the delivery people when they return from this first delivery?

- (c) Determine the equilibrium distribution of the delivery people at the end of the day.

Here are some *Mathematica* questions that test concepts for this exam:

- M1.** Give the syntax of the `For` command. Make sure to describe the input and output of the command.
- M2.** How would you use a `For` loop to flip five coins? How does this compare to the method you used in Homework #4?
- M3.** What does `%` represent in Mathematica? What would happen if you evaluated it by itself?
- M4.** Give a pseudocode description of how you might use a computer to simulate the situation in Question **Q2** in order to calculate the expected reliability of the system.