Homework #12 – *due Wednesday, May 5th, 2021*

Part I

1. A large research hospital has accumulated statistical data on its patients for an extended period. Researchers have determined that patients who are smokers have an 18% chance of contracting a serious illness such as heart disease, cancer, or emphysema, whereas there is only a .06 probability that a nonsmoker will contract a serious illness. From hospital records, the researchers know that 23% of all hospital patients are smokers, while 77% are nonsmokers. For planning purposes, the hospital physician staff would like to know the probability that a given patient is a smoker if the patient has a serious illness.

2. A metropolitan school system consists of three districts – north, south, and central. The north district contains 25% of all students, the south district contains 40%, and the central district contains 35%. A minimum-competency test was given to all students; 10% of the north district students failed, 15% of the south district students failed, and 5% of the central district students failed.

   (a) Draw a probability tree showing all the branch probabilities.

   (b) What is the probability that a student selected at random failed the test?

Part II

3. The Hoylake Rescue Squad receives an emergency call every 1, 2, 3, 4, 5, or 6 hours, according to the following probability distribution. The squad is on duty 24 hours per day, 7 days per week:

Time between Emergency calls (hr.)	**Probability**
1	.05
2	.10
3	.30
4	.30
5	.20
6	.05

   (a) Simulate the emergency calls for 3 days (note that this will require a "running", or cumulative, hourly clock), using Excel.

   (b) Compute the average time between calls and compare this value with the expected value of the time between calls from the probability distribution. Why are the results different?

   (c) How many calls were made during the 3-day period? Can you logically assume that this is an average number of calls per 3-day period? If not, how could you simulate to determine such an average?

4. A robbery has just been committed at the Corner Market in the downtown area of the city. The market owner was able to activate the alarm, and the robber fled on foot. Police officers arrived a few minutes later and asked the owner, "How long ago did the robber leave?" "He left only a few minutes ago," the store owner responded. "He's probably 10 blocks away by now," one of the officers said to the other. "Not likely," said the store owner. "He was so stoned on drugs that I bet even if he has run 10 blocks, he's still only within a few blocks of here! He's probably just running in circles!"

   Perform a simulation experiment that will test the store owner's hypothesis. Assume that at each corner of a city block there is an equal chance that the robber will go in any one of the four possible directions: north, south, east, or west. Simulate for ten trials and then indicate in how many of the trials the robber is within 2 blocks of the store.

5. The Paymore Rental Car Agency rents cars in a small town. It wants to determine how many rental cars it should maintain. Based on market projections and historical data, the manager has determined probability distributions for the number of rentals per day and rental duration (in days only) as shown in the following tables:

Number of Customers/Day	**Probability**
0	.20
1	.20
2	.50
3	.10
	1.00

Rental Duration (days)	**Probability**
1	.10
2	.30
3	.40
4	.10
5	.10
	1.00

   Design a simulation experiment for the car agency and simulate using a fleet of four rental cars for 10 days. Compute the probability that the agency will not have a car available on day 10 by running 10 trials of your simulation. Should the agency expand its fleet? Explain how a simulation experiment could be designed to determine the optimal fleet size for the Paymore Agency.