BZAN 546: Homework #3

Due Wednesday, April 26 @ 11:59pm

1. Consider a banking system involving two inside tellers and two drive-in tellers. Arrivals to the banking system are either for the drive-in tellers or for the inside tellers. The time between arrivals to the drive-in tellers is exponentially distributed with a mean of 1 minute. The drive-in tellers have limited waiting space. Queuing space is available for only three cars waiting for the first teller and four cars waiting for the second teller. The service time of the first drive-in teller is normally distributed with a mean of 2 minutes and a standard deviation of 0.25. The service time of the second drive-in teller is uniformly distributed between 1 and 3 minutes. If a car arrives when the queues of both drive-in tellers are full, the customer balks and seeks service from one of the inside bank tellers. However, it takes a customer between 0.5 and 1 minutes to park and walk inside the bank. Customers who seek the services of the inside tellers directly arrive through a different process, with the time between arrivals exponentially distributed with a mean of 1.5 minutes. However, they join the same queue as those balking from the drive-in tellers. A single queue is used for both inside tellers. A maximum of seven customers can wait in this single queue. Customers arriving when seven are in the inside queue leave. The service times for the two inside tellers are triangularly distributed between 1 and 4 minutes with a mode of 3 minutes. Develop an ExtendSim model to simulate the operation of the bank for an 8-hour period and assess the performance of the current system. Specifically, determine
   a. The average waiting time for drive-in and insider customers.
   b. The average utilization of drive-in and inside tellers.
   c. The average time in system for each of the two types of customers. You may choose to treat the drive-in customers who balk as a different category and report their time in system separately from the other two.
   d. The percentage of drive-in customers who balk as a result of capacity limitations in the drive-in lines.
   e. The percentage of customers who have to leave because of capacity limitations inside the bank.

2. A state driver's license exam center would like to examine its operation for potential improvement. Arriving customers enter the building and take a number to determine their place in line for the written exam, which is self-administered by one of five electronic testers. The testing times are distributed as EXPO(8); all times are in minutes. Thirteen percent of the customers fail the test (it's a hard test with lots of questions!). These customers are given a booklet on the state driving rules for further study and leave the system.

The customers who pass the test select one of two photo booths where their picture is taken and the new license is issued. The photo booth times are distributed TRIA(2.6, 3.6, 4.3). The photo booths have separate lines, and the customers choose the booth with the fewest customers; if there is a tie, they enter the nearest booth, say, Booth 1. These customers then leave the system, proudly clutching their new licenses. The center is open for arriving customers eight hours a day, although the services are continued for an additional hour to accommodate the remaining customers (but no additional incoming customers are allowed into the system). The customer arrival pattern varies over the day and is summarized below.

Hour	Arrivals/hour	Hour	Arrivals/hour
1	22	5	35
2	35	6	43
3	40	7	29
4	31	8	22

Develop a simulation model to represent the system above and run it for ten days, collecting statistics on:

a. The average utilization of the electronic testers and the photo booths
b. Average number in queue (waiting for electronic testing and to have the photo taken)
c. Current number in queue (include a plot)
d. Average time spent in system for the customers who pass the exam
e. Average number of test failures per day