OPRE 6398.003 Prescriptive Analytics
Homework 9

Due 04/04/17
(1:00 p.m.)

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Note: 1. Your homework submission must be typewritten.

2. be sure to show detail calculations to earn full credit.

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1. Read Readings 11 and 12.

2. Burger Dome sells hamburgers, cheeseburgers, French fries, soft drinks, milk shakes, and a limited number of specialty items. The restaurant is located in a small shopping center right next to the UTD campus. Data collected shows that customers arrive at a rate of 45 per hour and Joe, who is the only food server, can take and fill each order in one minute on average. Answer the following questions under the assumptions that the customer arrivals follow a Poisson distribution and the service times follow an exponential distribution.

   (1) What is the probability that there are 120 customer arrivals during a one-hour period?

   (2) What is the probability that an order can be taken and filled in less than two minutes?

   (3) On average, how many minutes per hour can Joe take a break?

3. The WFD International Airport currently operates with one runway. Airplanes arrive at a rate of 17 per hour and the average landing time is three minutes. The estimated average fuel consumption for an aircraft stacking in the air is 10 liters per minute, and a liter of fuel costs $20. Answer the following question under the assumptions of Poisson arrivals and exponential service times.

   (1) How heavily is the runway used on the average?

   (2) What is the average number of planes stacking in the air and waiting for permission to land?

   (3) What is the average cost of fuel burned by an aircraft waiting to land?

   (4) What is the chance of finding less than three airplanes in the airport area including those that are in the waiting line and the one that is landing?

4. Dairy Queen is a take-out yogurt shop owned by Linda Smith. Customers arrive at a rate of 20 per hour. Linda serves a customer, on the average, in 2 minutes. Assume that the arrivals and the service times are Poisson distributed and exponentially distributed, respectively.

   (1) What is the probability that a customer will spend an average of 3 to 6 minutes in waiting for service?

   (2) During the noontime rush, the arrival rate increases to one customer every 2.5 minutes. How fast does Linda have to work (i.e., how many customer does Linda have to serve per hour) to ensure that a noontime customer will not spend an average of more than 5 minutes in the yogurt shop?

5. Each of Professor A and Professor B in the School of Business at Walla Walla University has a private secretary, who can type four letters per hour. The letters are generated at a rate of three per hour by each of the two professors, who have been wondering if they would benefit from pooling the two secretaries. Suppose that the (M/M/1 FCFS/∞/∞) model and the (M/M/ FCFS/∞/∞) model may be used to described the current system and the proposed system, respectively. Answer the following questions.

   (1) What is the average waiting time of a letter in the current system?

(2) Repeat (1) in the proposed system by using the manual approach to compute P_0, L_q, W_q, and W.

(3) Based on your findings in (1) and (2) above, which of the two systems is more efficient and why?

(4) Use the table at the end of Chapter 13 to find P_0 and L_q in (2) above. Are the results very similar to P_0 and L_q computed manually in (2)?