**Queuing Theory**

The customer support hotline for a computer software company is currently staffed by a single technician. Customer service calls arrive at a rate of four calls per hour and follow a Poisson distribution. Calls are handled on a first-in-first-out basis and customers enter a waiting queue in the event the technician is busy assisting another customer. The technician currently assigned to the hotline is relatively inexperienced and can only handle service calls at an average rate of five calls per hour with the actual time required to handle a given call following an exponential distribution.

The president of the company has received numerous complaints from customers regarding the length of time that they currently have to wait on line before the technician is able to answer their call.

1. What is the average waiting time in the queue (in hours) before the technician answers a customer’s call?
2. What is the average number of customer’s waiting in the queue?
3. What is the utilization factor for the system?
4. What is the percent idle time for the system?
5. What is the total daily service cost for the hotline system? Assume the cost for operating the hotline is $11.00/hour. Assume an eight hour day.
6. What is the total daily waiting cost for the hotline system? Assume the hourly cost of waiting (i.e., cost of customer balking, reneging and dissatisfaction) for each option is $27.00. Assume an eight hour day.
7. What is the total daily cost for the hotline system?

The president of the company has decided that he would like to limit customer waiting time in the queue to an average of five minutes. He has also decided that he would like to limit the average number of customer’s waiting in the queue to two customers. The IT manager has suggested assigning his most experienced technician to the hotline in order to satisfy the president’s criteria for average waiting time in the queue and average length of the queue. This technician is capable of handling an average of eight calls per hour with the actual time required to handle a given call following an exponential distribution. Assume that customer service calls continue to arrive at a rate of four calls per hour and follow a Poisson distribution.

1. Will assigning the more experienced technician enable the system to satisfy the president’s criteria?
2. What would be the utilization factor for the system using a single technician handling an average of eight calls per hour with the actual time required to handle a given call following an exponential distribution?
3. What is the minimum average rate at which a single technician would have to be able to handle customer calls with the actual time required to handle a given call following an exponential distribution in order to satisfy the president’s criteria?
4. What would be the utilization factor for the system using a single technician handling the minimum average number of calls per hour with the actual time required to handle a given call following an exponential distribution in order to satisfy the president’s criteria?

One of the company’s vice presidents has suggested adding a second technician to the customer support hotline in order to satisfy the president’s criteria for average waiting time in the queue (i.e., 5 minutes) and average length of the queue (i.e., two customers in the queue). Assume that both technicians will be capable of handing service calls at an average rate of five calls per hour with the actual time required to handle a given call following an exponential distribution. Assume that customer service calls continue to arrive at a rate of four calls per hour and follow a Poisson distribution.

1. Will assigning a second technician to the help desk enable the system to meet the president’s criteria?
2. What is the average waiting time in the queue (in hours) before the technician answers a customer’s call?
3. What is the average number of customer’s waiting in the queue?
4. What is the utilization factor for the system?

The president of the company has been presented the following two options for improving the performance of the hotline.

* Option one involves hiring a single experienced technician who is capable of handling the minimum average rate of calls per hour determined in question 10 above) with the actual time required to handle a given call following an exponential distribution in order to meet the president’s criteria. The estimated hourly operating cost for the hotline would be $20.00.
* Option two involves assigning two relatively inexperienced technicians, each of whom is capable of handling an average of five calls per hour with the actual time required to handle a given call following an exponential distribution. The hourly operating cost the hotline would be $11.00 per technician.

The hourly cost of waiting (i.e., cost of customer balking, reneging and dissatisfaction) for each option is estimated to be $27.00. Assume the president’s criteria for average waiting time in the queue (i.e., a maximum of 5 minutes) and average length of the queue (i.e., a maximum of two customers in the queue) remain the same. Assume that customer service calls continue to arrive at a rate of four calls per hour and follow a Poisson distribution. Assume an eight hour day.

1. What is the total daily system cost for option one?
2. What is the total daily system cost for option two?
3. Assuming the president’s ultimate objective is to minimize total daily system costs, which option would be the most favorable?