Sept 15, 2000

E1 234 SUPPLY CHAIN MANAGEMENT : Problem Set 2

1. A make-to-stock supply chain has raw material arriving into the system in Poisson fashion at the rate of 100 lots per day. The system cannot hold more than 10 lots inventory (queueing space) at any point of time. Raw lots arriving into the system which find the queue full will be rejected. If we do not want to reject any more than 5 percent of the arriving lots, what should be the (exponential) service rate of the supply chain. Hint: Use an M/M/1 model.

2. A make-to-order supply chain has customer orders arriving in Poisson fashion at the rate of 90 orders per day. Raw material and subassemblies are always on hand. The facility assembles these on receipt of an order and the customers receive them immediately. If the processing time is exponentially distributed with rate 96 orders per day (average processing time = 15 minutes), compute the following:

   (a) Average number of backorders
   (b) Probability of at least 20 backorders
   (c) Probability of no backorders
   (d) Average lead time for a typical order
   (e) Standard deviation of lead time for each order
   (f) Fraction of orders which have lead time less than 2 hours
   (g) Fraction of orders which have lead time greater than 1 day
   (h) Throughput rate of the system

3. For the above system, compute the average number of backorders, average lead time for oder, and average throughput rate assuming the processing time as in each case below:

   (A) uniformly distributed in the range (10, 20) minutes
   (B) normally distributed with mean 15 minutes and standard deviation 5 minutes
   (C) deterministic with 15 minutes

4. Now assume that the inter-arrival times of customer orders are i.i.d. with mean 16 minutes and standard deviation 6 minutes. In each cases (A), (B), and (C) above, compute the average number of backorders, average lead time for oder, and average throughput rate.

5. It is required to choose between two warehouses A and B. Warehouse A can service requests at 10 orders per hour while warehouse B can service at 20 orders per hour. The maintenance cost for A is100 units per month while it is 180 units per month for B. Assume 200 working hours per month. Customer orders arrive in Posson fashion at the rate of 8 orders per hour. The backorder cost at each warehouse is 1 unit per order per hour. Which of the warehouses is more cost-effective?

6. A crossdoc complex is to be designed. In partcular, we have to choose the number of crossdoc platforms to be used. Logistics vehicles arrive at the crossdoc in Poisson fashion at the rate of 1000 vehicles. Each vehicle uses a platform to unload/load its contents onto another waiting vehicle in 2 minutes time on an average (exponentially distributed).Thus each platform can service 30 vehicles on an average per hour. When all the platforms are busy, arriving vehicles have to wait outside the platforms. If we do not want more than 100 vehicles to be waiting outside the platforms, how many minimum number of platforms should we choose?

7. Consider a make-to-order supply chain with three stages: procurement (P), assembly (A), and outbound logistics (L). Orders flow through these stages in that order, however, rejections, reworks, feedbacks, etc. are possible. The routing matrix is given as:

	P	**A**	**L**
P	0.1	0.9	0
A	0.05	0.1	0.8
L	0	0.1	0

Assume the orders to arrive in Poisson fashion at 10 orders per day. Also assume that the procurement, assembly, and logistics sections can handle an average of 20 orders per day. Is this system stable? Why? Compute the average order-to-delivery time per order.