IE630 **Team Assignment Topics**

Topic 1

Consider an (M, L) inventory system in which procurement quantity Q is given by

$$Q = \begin{cases} M-I & \text{if } I < L \\ 0 & \text{if } I <= L \end{cases}$$

where I is the level of inventory on hand plus order at the end of the month, M is the maximum inventory level, and L is the reorder point. M and L are under management control, so the pair (M, L) is called inventory policy. Under certain conditions, the analytical solution of such a model is possible, but not always. Use simulation to investigate an (M, L) inventory system with the following properties: The inventory status is checked at the end of the month. Backordering is allowed at a cost of $4 per item short per month. When an order arrives, it will be used to relieve the backorder. The lead time is given by a uniform distribution on the interval [0.25, 1.25] months. Let the beginning inventory stand at 50 units, with no orders outstanding. Let the holding cost be $1 per month in inventory per month. Assume that the inventory position is reviewed each month. If an order is placed its cost is $60 + $5Q, where $60 is the ordering cost and $5 is the cost of each item. However, if the inventory level at a monthly review is zero or negative, a rush order for Q units is placed. The cost for a rush order is $120 + $12Q, where $120 is the ordering cost and $12 is the cost of each item. The lead time for rush order is given by a uniform distribution on the interval [0.10, 0.25] months.

The time between demands is exponentially distributed with a mean of 1/15 month. The sizes of the demand follow this distribution:

Demand	1	2	3	4
Probability	1/2	1/4	1/8	1/8

a) Make ten independent replications, each of run-length 100 months preceded by a 12 months initialization period, for the (M, L) = (50, 30) policy. Estimate long-run mean monthly cost with a 95% confidence interval.
b) Using results of part(a), estimate the total number of replications needed to estimate mean monthly cost within $5. Run the model the required number of replications and construct the CI.
c) *Scenarios for comparing alternatives/ optimization will be provided later*

Topic 2

Consider an (M, L) inventory system in which procurement quantity Q is given by

$$Q = \begin{cases} M\text{-}I & \text{if } I < L \\ 0 & \text{if } I <= L \end{cases}$$

where I is the level of inventory on hand plus order at the end of the month, M is the maximum inventory level, and L is the reorder point. M and L are under management control, so the pair (M, L) is called inventory policy. Under certain conditions, the analytical solution of such a model is possible, but not always. Use simulation to investigate an (M, L) inventory system with the following properties: The inventory status is checked at the end of the month. Backordering is allowed at a cost of $4 per item short per month. When an order arrives, it will be used to relieve the backorder. The lead time is given by a uniform distribution on the interval [0.25, 1.25] months. Let the beginning inventory stand at 50 units, with no orders outstanding. Let the holding cost be $1 per month in inventory per month. Assume that the inventory position is reviewed each month. If an order is placed its cost is $60 + $5Q, where $60 is the ordering cost and $5 is the cost of each item.

The time between demands is exponentially distributed with a mean of 1/15 month. The sizes of the demand follow this distribution:

Demand	1	2	3	4
Probability	1/2	1/4	1/8	1/8

Now, the items are perishable, with a selling price given by the following data:

On the shelf (months)	Selling price
0-1	$10
1-2	$5
>2	$0

Thus, any item that has been on the shelf for more than 2 months cannot be sold. The age is measured at the time the demand occurs. If an item is outdated, it is discarded, and the next time is brought forward. Simulate the system for 100 months.

(a) Make ten independent replications for the (M, L) = (50, 30) policy, and estimate long-run mean monthly cost and profit with a 90% confidence interval.
(b) Using results of part(a), estimate the total number of replications needed to estimate mean monthly cost within $5. Run the model the required number of replications and construct the CI.
(c) *Scenarios for comparing alternatives/ optimization will be provided later*.

Topic 3:

Jobs enter a job shop in a random fashion according to a Poisson process at a stationary overall rate, two every 8-hour day. The jobs are of four types. They flow from work station to work station in a fixed order, depending on type as shown below. The proportions of each type are as shown.

Type	Flow through Stations	Proportions
1	1, 2, 3, 4	0.4
2	1, 3, 4	0.3
3	2, 4, 3	0.2
4	1, 4	0.1

The processing item per job at each station depends on the type, but all times are approximately, normally distributed with mean and standard deviation in hours as follows:

	Station			
Type	1	2	3	4
1	(20, 3)	(30, 5)	(75, 4)	(20, 3)
2	(18, 2)		(60, 5)	(10, 1)
3		(20, 2)	(50, 8)	(10, 1)
4	(30, 5)			(15, 2)

Station i will have $\mathbf{c_i}$ workers, i = 1, 2, 3, 4. Each job occupies one worker at a station for the duration of a processing time. All jobs are processed on a first-in-first-out basis, and all queues for waiting jobs are assumed to have unlimited capacity. Simulate the system for 800 hours, preceded by a 200 hour initialization period. Assume that $c_1 = 8$,$c_2 =8$, $c_3 = 20$, $c_4 =7$.

(a) Based on R = 20 replications , compute a 95% confidence interval for average worker utilization at each of the four stations. Also, compute a 95% confidence interval for mean total response time for each job type, where a total response time is the total time that a job spends in the shop.

(b) *Scenarios for comparing alternatives/ optimization will be provided later*.