ENE3031 Computer Simulation – Fall 2014

Homework 6

Due Friday Dec/12 6:00pm (leave it in a box in front of my office - 706-2, Engineering Center)

(You may use the MS EXCEL program and submit the file via email.)

1. Consider an (M, L) inventory system, in which the procurement quantity Q is defined by

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

Where I is the level of inventory on hand plus on order at the end of a 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 the 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 each month. Backordering is allowed at a cost of $4 per time short per month. When an order arrives, it will first 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 level stand at 50 units, with no orders outstanding. Let the holding cost be $1 per unit 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 demands follow this distribution:

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

(a) Make ten independent replications, each of run length 100 months preceded by a 12-month initialization period, for the (M, L) = (50, 30) policy. Estimate long-run mean monthly cost with a 90% confidence interval.

(b) Using the results of part (a), estimate the total number of replications needed to estimate mean monthly cost within $5.

2. Recall the previous example, except that, 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 a rush order is given by a uniform distribution on the interval [0.10, 0.25] months.

(a) Make ten independent replications for the (M,L) policy, and estimate long-run mean monthly cost with a 90% confidence interval.

(b) Using the results of part (a), estimate the total number of replications needed to estimate mean monthly cost within \$5.

3. A store selling Mother's Day cards must decide 6 months in advance on the number of cards to stock. Reordering is not allowed. Cards cost \$0.45 and sell for \$1.25. Any cards not sold by Mother's Day go on sale for \$0.50 for 2 weeks. However, sales of the remaining cards are probabilistic in nature according to the following distribution.

32% of the time, all cards remaining gets sold

40% of the time, 80% of all cards remaining get sold

28% of the time, 60% of all cards remaining get sold

Any cards left after 2 weeks are sold for \$0.25. The card-shop owner is not sure how many cards can be sold, but thinks it is somewhere (I.e., uniformly distributed) between 200 and 400. Suppose that the card-shop owner decides to order 300 cards. Estimate the expected total profit with an error of at most \$5.00. [Hint: Make ten initial replications. Use these data to estimate the total sample size needed. Each replication consists of one Mother's Day.]

4. Suppose that the output process from a queuing simulation is $\mathrm{L(t)}, 0 \leq \mathrm{t} \leq \mathrm{T}$, the total number in queue at time t. A continuous-time output process can be converted into the sort of discrete-time process $Y_1, Y_2, \ldots$ described in this chapter by first forming k =T/m batch means of size m time units:

$$Y_j = \frac{1}{m}\int_{(j-1)m}^{jm} L(t)dt$$

For j= 1, 2 … k. Ensemble averages of theses batch means can be plotted to check for initial-condition bias. Show algebraically that the batch means over 2m time units can be obtained by averaging two adjacent batch means over m time units. [Hint: This implies that we can start with batch means over rather small time integrals m and build up batch means over longer intervals without reanalyzing all of the data.]