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E1 234 SUPPLY CHAIN MANAGEMENT : Problem Set 4
(PROBLEMS ON INVENTORY MANAGEMENT)

1. (ELP Model). It is observed that a factory produces and instantaneously pushes the products into a factory warehouse, the production rate being 1000 units per week. The demands for these products are met from the warehouse. The demands are observed to be fairly constant at 800 per week. The setup cost for each batch of products is Rs 1000 and there is an inventory holding cost of Rs 10 per unit per week. Answer the following questions using the Economic Lot Production Model.

(a) What is the economic order quantity for this problem. How less is it compared to when the production rate is infinity.
(b) What is the maximum onhand inventory at the warehouse?
(c) What is the time required to deplete this maximum onhand inventory?
(d) What is the average holding cost per week?
(e) What is the average setup cost per week?
(f) If it takes exactly oneday for a batch of products to be shipped from the factory to the warehouse, what is the reorder point?
(g) What would be the reorderpoint if the replenishment lead time is 5 days. What problem do you see here.

2. (Newsboy Model) Due to prohibitive logistics costs, a wholesaler orders replenishments of a particular brand of products only once every month. The replenishment lead time is 10 days, so the retailer orders the pieces on the 20th of every month, so the order arrives on the first of the next month. During the month, the retailer makes a profit of Rs 100 on every piece that he sells while he would make a loss of Rs 20 on every piece that he cannot sell during the month and can only sell during the following month. The estimated demand for a month is 5000 pieces (mean) with a standard deviation of 1000 (assume a normal distytribution). . Because of the uncertainty, the wholesaler has decided to order only 4500 pieces. Is this a good decision. What order quantity would you have recommended?

3. Assume the demands as in the above problem. Now determine the conditions under which the order quantity 4500 will be optimal.

4. In the above two problems, assume the demand distribution to be uniformly distributed. How will your answers change bnecause of the change in distribution.

5. (Adapted from the book by Hopp and Spearman). A particular bicycle company manufactures and stocks bicycles. One of the popular models has a (normally distributed) demand of 1000 cycles per month with a standard deviation of 500. On every bicycle sold, the company makes a profit of Rs 200. On the other hand, an unsold bicycle costs the company Rs 50 every month as inventory and maintenace cost.

(a) If all orders are backlogged and the cost of lost customer goodwill from a single bicycle on backorder is Rs 200, how many bicycles should the company stock (that is what is the order-up-to-level of the inventory the company should keep)?
(b) If orders not filled from the stock are lost (that is, customer buys them from elsewhere), what order-up-to-level should the comany choose?
(c) Why are your answers to (a) and (b) different?

6. (Base Stock Model). A particular inventory facility uses the base stock model. Replenishment orders from the facility arrive in exactly 10 days time. The demand distribution at the facility is observed to be a normal distribution

with mean of 10 per day and a standard deviation of 2. What should be the safety stock level, base stock level, and reorder point if the customer service is to be at least 90 percent. What will they be if the service level is to be at least 99 percent.

7. In the above problem, assume the unit inventory cost as Rs 10 and the unit backorder cost as Rs 90. What will be the values of the safety stock, base stock, and reorder point now if we wish to minimize the overall cost (inventory holding cost + backorder cost). Is this related in any way to the answers to the previous question. What will happen if the inventory cost rises to Rs 20 per unit. What service level will this new optimal values achieve?

8. (Q, r model) (Adapted from the book by Hopp and Spearman). A particular retailer of laser printer toner cartridges stocks repalcement cartridges for which the demand is observed to be 500 per year with a Posson distribution. Each cartridge costs Rs 5000 and it requires three weeks to get them from the factory warehouse. The retailer uses a (Q, r) approach to control stock levels.

(a) If the retailer wishes to restrict the replenishment orders to twice per year on average, what is the optimal batch size Q that he should use. If the retailer wants to maintain a customer service level of at least 98 percent, what should be the reorder point?

(b) If the retailer is willing the increase the number of replenishments to six per year, how do Q and r change? Explain the difference in r.

(c) If the factory warehouse offers a quantity discount of Rs 1000 per cartridge for orders of 200 and above, how does this affect the relative attractiveness of the two replenishments versus six replenishments per year. Make an attempt to frame your answer in definite economic terms.

9. (Multiechelon Inventories). Consider a two echelon inventory system where the first level is a factory warehouse and the second level 10 distrubution centres. The factory warehouse uses a (Q,R) policy while the DCs use abase stock policy. The number of demands at each DC is observed to 100 per month. In a month, it is set that there shall not be more than 5 replenishments at the factory warehouse. It is required that the fill rate at the factory warehouse be at least 95 percent. What will be the optimal order quantity at the factory warehouse and what will be the optimal reorder point at the factory warehouse. By what factor will the inventory investment rise if the service level is stipulated as 98 percent at the factory warehouse.

10. (Bullwhip Effect). Consider a two echelon inventory system, say with a factory warehouse and a distribution centre. Demands in successive observation intervals (weeks) at the DC are observed to have a positive corrlelation coefficient of 0.8. The replenishment lead time at the DC is observed to be two weeks (two time units). Compute the amplication in the demand variability at the factory warehouse if a moving average forecast with 10 observation intervals is used to forecast demands. What will happen if the positive correlation reduces to 0.7. Also what happens if the correlation is observed to be negative at 0.8?