OPERATIONS MANAGEMENT

Instructor: Olga Bountali

Assignment 3: Inventory Management

PART A: PRACTICE PROBLEMS (65 pts)

Problem 1 (6 pts)

A retailer sells approximately 10,000 units of a cereal bar per year, which is high in comparison to other similar products. With this fact in mind, the retailer negotiated the following purchase cost per unit with the wholesale to reduce inventory costs:

Order Quantity	Wholesaler Price Per Unit
0-2500	$5.00
2501-7500	$4.50
7501-20000	$4.00

The holding costs account for 25% of each unit's price, and placing an order costs $12 to the company. In the old contract, the company was paying $4.75 per cereal bar unit. Is this new contract worth it?

Problem 2 (6 pts)

A famous hotel chain in Toronto wishes to determine the number of rooms that it should allocate for the summer season. Every allocated incurs a daily expense of $25 to the hotel, due to cleaning and maintenance costs (regardless if the room is occupied or not). Customers pay $200 per night stay. Suppose that daily demand during summer is Normally distributed with mean 100 and variance 49. What is the optimal number of rooms to allocate per day to maximize expected revenue?

Problem 3 (7 pts)

In the calculation of an optimal policy for an all-units discount model, you first compute the EOQ values for each of the three order costs. Suppose, therefore, that you have such a model that obtains: $Q_1^* = 800,\ Q_2^* = 875,\ Q_3^* = 925$. Also, assume that the all-units discount model has breakpoints at 750 and 900. Based on this information only, can you determine what the optimal order quantity is? Explain your answer (Hint: Provide an illustration of the all-unit discounted model function).

Problem 4 (8 pts)

The daily demand for ice creams at i-Scream parlor is normally distributed with a mean of 100 quarts and a standard deviation of 120 quarts. The owner has the ice cream supplied by a wholesaler who charges $2 per quart. The wholesaler charges a $90 delivery charge independent of order size. The opportunity cost of capital to i-Scream is estimated to be 25% per year. Assume 360 days in the year.

a. Assume that an order arrives instantaneously after being placed.

i. How many quarts is it optimal for i-Scream to order? (1 pts)
ii. When does i-scream need to place an order? (1 pts)
iii. What is the average length between two successive orders? (1 pts)
iv. How many orders will be placed in a year on the average? (1 pts)

b. Assume now that it takes 9 days for an order to be supplied. The owners would like to ensure that, 95% of the times, they will experience no stock-outs. When does i-Scream need to place an order now? (1 points).

c. Currently the owners do not follow the EOQ and safety stock policy outlined above. Instead, they order 2000 quarts of ice cream when they have 1000 quarts on hand. Assume that it takes 9 days for an order to be supplied.

i. How much is the safety stock under the current policy? (1 pts)
ii. How much is the average inventory under the current policy? (1 pts)
iii. What is the average time spent by a quart of ice cream at the parlor? (1 pts)

Problem 5 (7 pts)

An airline company is currently reviewing its policies for overbooking compensations. Consider that a nonstop flight from Toronto to Montreal is priced, on average, at $200. The expenses to operate a flight of this length is $120 per seat (this value takes into account crew costs, fuel, maintenance, and in-flight meals and beverages). The company always sells 6 more seats than the aircraft can actually accommodate. Suppose that the number of no-shows is Normally distributed with mean 5 and standard deviation 2.

(a) What is the acceptable overbooking probability that the current airline policy considers for the Toronto-Montreal flight? (2 points)

(b) Given the acceptable overbooking probability in (a), determine the compensation in dollars that the company can provide to its customers in case they experience an overbooking. (5 points)

Problem 6 (6x1=6 pts)

An electronic products retailer is designing its inventory of high-quality laptops for which the company is known for. After negotiations with the manufacturer, the cost for ordering products was set to a fixed amount of $450. The annual costs of maintaining the inventory in stock is $170 per unit. The estimated demand for this special type of laptop is 1,200 per year.

(a) Assuming a traditional economic order quantity model, what is the optimal quantity that the retailer should place per order?

(b) If the order you obtained is fractional, should you round it up or down?

(c) What is the resulting total inventory costs per year?

(d) How many orders will be placed every year on expectation?

(e) What is the expected interval between orders? Assume the year has 250 working days.

(f) To have a more accurate representation of the costs, the company would like to consider the extra purchase cost of $600 per laptop, based on negotiations with the manufacturer. The retailer sells each laptop for $1,500 (already accounting for taxes). What is the annual profit the retailer will have with this laptop brand?

Problem 7 (6 pts)

Following the lead of big online chains such as Amazon, the online store will also offer daily online groceries for its customers. These items are organized in a "grocery basket" with fruits, vegetables, and pantries. Items that are not sold in a day are lost. Each grocery basket costs $57 to prepare and it is priced at $127. The demand is Normally distributed, and the simulation for three days yielded the following results:

Day	Demand
1	25
2	32
3	22

(a) Based solely on the results of the simulation, what is the optimal number of baskets to prepare per day, and what is the resulting profit? (1 points)

(b) Suppose now that the mean and standard deviation of the demand are 22 and 5, respectively. Based solely on the distribution, what is the optimal number of baskets that maximizes expected profit? Using this solution, what is the resulting profit for the three days in the simulation? (3 points)

(c) Which solution was better, and why? Based on your answers, how would you solve the problem of finding the best number of baskets to prepare per day? (2 points)

Problem 8 (9 pts)

A large retailer in Canada is currently re-planning its inventory level of Blu-ray players for 2017. The retailer initially considered a traditional EOQ mode for optimizing its reordering points, but later realized that the demand during the lead time was not Normally distributed. In particular, the company found that this value was uniformly distributed between 40 and 80 (that is, all levels of demand in this interval have the same probability of occurring). Suppose that the holding cost of a Blue-ray player is $5 per year, and the stockout cost (lost sale) is $30 per unit. The company currently places 5 orders per year with a reordering point of 50.

(a) What is the probability of observing a demand of d during the lead time? (2 points)
(b) If we observe a demand of d during the lead time and we experience a stockout, how much will the company pay due to stockout costs? (2 points)
(c) What is the annual expected stockout cost that the company pays when waiting for each lead time? Use your solution for items a and b to answer this question. (3 points)
(d) Would it be worth it to keep a safety stock of 20 units? (2 points)

Problem 9 (10x1=10 pts)

Answer the following multiple choice questions. No justification needed.

1. Suppose the purchase price of an item increases. However, the annual demand, the ordering/setup cost, and the percentage carrying cost remain unchanged. Then, the order quantity computed using the EOQ formula
   a) Increases.
   b) Decreases.
   c) Does not change.
   d) I need more information to answer this question.

2. Suppose the lead time for the delivery of a product increases while the service level and the distribution of the daily demand remain unchanged. Then, the (optimal) reorder point in the fixed order quantity model
   a) Increases.

b) Decreases.
c) Does not change.
d) I need more information to answer this question.

3. Consider the fixed order quantity model under two scenarios: Under scenario A, the price of the product is $1. Under scenario B, the price of the product for orders under 1000 units is $1. However, the price for orders over 1000 is $0.9. Suppose under each decision, you compute the optimal order quantity and place orders of that size. Which of the following statements is correct?
   a) The annual setup cost under scenario A is greater than or equal to that under scenario B.
   b) The annual holding cost under scenario A is less than or equal to that under scenario B.
   c) Choices (a) and (b).
   d) None of the above.

4. The operations manager of Air Canada would like to decide on the number of seats to overbook. She knows that the number of no-shows follows a uniform distribution with the minimum of 0 passengers and the maximum of 9 passengers. The price of each ticket is $200. If the manager cannot accommodate a passenger, she has to return their $200 and pay them an extra $850 for their inconvenience. How many seats should the manager overbook?
   a) 0
   b) 1
   c) 2
   d) 7
   e) 8
   f) 9

5. Which of the following statements about the newsvendor model are incorrect?
   a) If the cost of understocking and overstocking are the same, the optimal order quantity is equal to the expected demand.
   b) Increasing the salvage value increases the optimal order quantity.
   c) Increasing the standard deviation of the demand increases the safety stock.
   d) Choices (a) and (c).
   e) None of the above.

6. Under which of the following conditions the critical fractile (service level) is negative?
   a) The salvage value is greater than the purchase price.
   b) The salvage value is less than the purchase price.
   c) The demand is normally distributed, and the z-value is negative.
   d) None of the above.

7. Consider the fixed order quantity model with random demand. Suppose we use the optimal order quantity and the optimal reorder point. Which of the following statements are correct?
   a) The expected annual holding cost is less than the expected annual ordering/setup cost.
   b) The expected annual holding cost is equal to the expected annual ordering/setup cost.
   c) The expected annual holding cost is greater than the expected annual ordering/setup cost.

d) We do not have sufficient information.

8. If the lead-time for receiving the orders from the supplier doubles, the order quantity in the fixed order quantity model
   a. Halves.
   b. Doubles.
   c. Increase by a factor of $\sqrt{2}$.
   d. None of the above.

9. In the fixed order quantity model, if the standard deviation of the daily demand (σ_d) increases (while other system parameters are kept the same), then
   a. The optimal order quantity increases
   b. The average number of orders placed every year increases
   c. The annual holding cost increases
   d. The safety stock decreases

10. Consider a newsvendor model with normally distributed demand. Suppose that the cost of overage is greater than the cost of underage. If the demand variance is reduced,
    a. The optimal order quantity increases.
    b. The optimal order quantity stays the same.
    c. The optimal order quantity decreases.
    d. Cannot say.

If needed, you can assume the following with regards to the normal distribution service level values:

- for a 95% service level, z = 1.65
- for a 92.65% service level, z = 1.45
- for a 87.5% service level, z = 1.15
- for a 82.12% service level, z = 0.92
- for a 79.10% service level, z = 0.81
- for a 73.47% service level, z = 0.63
- for a 69.15% service level, z = 0.50
- for a 62.55% service level, z = 0.32
- for a 55.11% service level, z = 0.13
- for a 52.39% service level, z = 0.06

PART B: BLANCHARD IMPORTING & DISTRIBUTING CO. CASE STUDY (35 PTS)

Read the Blanchard Case Study and answer the following questions:

1. What is wrong with the way that the EOQ and ROP quantities have been determined for each of the five items mentioned in the case? (15 points)
2. Based on your answer above, how would you correct the EOQ/ROP quantities for the five items? (10 pts).
3. Overall, is your revised EOQ system /model good to be used for scheduling bottling runs at Blanchard? Justify your answer by considering both the demand and product angles. (2x5=10 pts)