IE375 Fall 2024 Study Set I

Question 1

A forecasting system with trend and seasonal factors has been installed in a company. Seasonality is specified with respect to quarters (i.e. 4 seasons), and prior to the current quarter (beginning of quarter 5) most recent values of the forecast parameters are as follows:

- seasonal factors: 0.9, 1, 0.8, 1.3 for quarters 1 through 4, respectively,
- slope (trend factor): 10.4,
- intercept (level factor): 100, and
- all smoothing parameters are 0.1.

a) What is the forecast for quarter 5 and quarter 6?

b) The current quarter's (quarter 5) demand is realized and is 80 units. Update all the factors.

c) What is the MAD value computed for quarter 5? If smoothing approach is used to update MAD values, what is the new MAD value if the most recent MAD value was 15? Note that all smoothing parameters are 0.1.

Question 2

"Heads will roll" shouted Jack Guillotion, as he stormed out of the meeting with the IE group. This terminated a meeting which had been quickly called when it was discovered that the data used by the recently installed simple moving average of order N periods was partly lost. Good news is that they would be able to recover all the data in a few days. Bad news is for the current period, forecast for the next period is needed.

Assume N = 12. Let t denote the current period and t+1 denote the period to forecast. The following data is still available:

D_t, D_{t-6}, D_{t-8}, D_{t-11}, D_{t-12}, D_{t-13}, $F_{t-2,t-1}$, $F_{t-1,t}$.

Question: Assuming that all you have is the data provided above, can you find the forecast for period t+1 in terms of the data supplied? If your answer is yes, find it. Otherwise, explain in detail why it is not possible.

Question 3 Question from Chapter 2 of your text-book

Lakeroad, a manufacturer of hard disks for personal computers, was founded in 1981 and has sold the following numbers of disks:

Year	Number Sold (in 000s)	Year	Number Sold (in 000s)
1981	0.2	1985	34.5
1982	4.3	1986	68.2
1983	8.8	1987	85.0
1984	18.6	1988	58.0

a. Suppose the firm uses Holt's method for forecasting sales. Assume $S_0 = 0$ and $G_0 = 8$. Using $\alpha = .2$ and $\beta = .2$, find one-step-ahead forecasts for 1982 through 1989 and compute the MAD and MSE for the forecasts during this period. What is the sales forecast for the year 2000 made at the end of 1988? Based on the results of 1988, why might this forecast be very inaccurate?

b. By experimenting with various values of α and β, determine the values of the smoothing constants that appear to give the most accurate forecasts.

Question 4

Consider Doğadan, a producer of herbal and fruit teas in Turkey. Doğadan sells chamomile tea at a rate of 3000 boxes per day. The packaging takes place in a dedicated packaging facility in Ankara. The facility can pack 5000 boxes per day. Each time the facility starts packaging chamomile tea, the facility needs to be cleaned thoroughly. The cleaning costs are 300 TL. Chamomile tea costs 500 TL per box for Doğadan and inventory holding costs are at15% of the cost annually. Assume that the company operates 24 hours a day and there are 365 working days in a year.

a) Find the batch size that minimizes the inventory holding and setup costs.

b) Find the total annual costs that correspond to the solution in Part A.

c) What is the time between consecutive batches for the solution in Part A

d) Assume now that the cleaning prior to packaging takes 18 hours. Is the batch size found in Part A feasible? If not, what is the new optimal batch size?

Question 5

Consider an auto manufacturer that assembles cars in Turkey with a constant rate of 20 cars per day. The car assembly requires engines that are sourced from Japan. Each engine costs the manufacturer 1300 TL and inventory holding costs are 20% of the cost per engine per year. Engines are shipped from Japan over the ocean in one container with a fixed cost of 12000 TL per container. The lead time is 20 days. Assume that the manufacturer works 365 days in a year.

- **a)** Assuming that the container has infinite capacity. How many engines should the car manufacturer order each time? You do not need to have an integer value for the order quantity.
- **b)** What is the resulting optimal annual holding and setup cost?
- **c)** What is the time between consecutive orders (cycle length)?
- **d)** What is the re-order point?
- **e)** Assume that we are in day 0 and the car manufacturer has 1200 engines in inventory. There are no outstanding orders. When is the first time the manufacturer should place an order to its engine supplier in Japan?
- **f)** Engines can be shipped from Japan using one standard container (not more than one) and the container has a limited capacity. Assume now that the container can carry at most 75% of the order quantity you found in **Part a**.
  - **i.** What is the new order quantity the manufacturer would choose?
  - **ii.** What is the additional annual cost the manufacturer would pay compared to your result in **Part b**?

Question 6

A company purchases three items for resale. The table below indicates the present situation where the order sizes have been determined by the rule 'Order every three months'. Thus four orders are currently being placed for each item every year. Assume that demand rate is deterministic and constant. Moreover, backorders are not allowed.

Item	Demand (units/year)	Cost ($/unit)	Annual Usage ($/year)	# of orders/year
1	2 500	4	10 000	4
2	3 200	2	6 400	4
3	500	5	2 500	4

Note that, annual usage (in $) is defined as annual demand * unit cost.

Define investment in inventory, **II**, as the average inventory carried multiplied by unit cost.

a) What is the total present investment in inventory (sum of all items). Note that you need to find the average inventory carried for each item given that 4 orders are placed for each item every year.

b) Keeping the average investment level as found in **a)**, write a model to find the minimum total number of orders that can be placed to determine the order size for each item under the new policy. (Hint: You have to formulate a problem where the objective function is to minimize total number of orders, subject to a constraint on the average value of the inventory.) DO NOT solve the problem.