Indian Statistical Institute Bangalore

Statistical Quality Control & Operation Research Unit

MS (QMS) First Year [Batch 2023-2024]

Second Semester – **Operation Research-II**

Exam: Endterm | Date: 29th April 2024

Maximum Marks: 50 | Duration: 3 hours

Figure in the right hand margin indicates full marks for the questions

(Answer three full questions)

1 A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can, on average, service 12 customers per hour. Determine the followings: **10**

i) What is the average number of customers waiting for the service of the clerk?

ii) What is the average time a customer has to wait before being served?

iii) The management is contemplating to install a computer system for handling information and reservations. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to Rs 50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise, per minute spent waiting, before being served, should the company install the computer system? Assume an 8 hours working day.

2 a) A dealer supplies you the following information with regard to a product that he deals in: **8**
Annual demand = 20,000 units; Ordering cost = Rs 15 per order; Price = Rs 25 per unit
Inventory carrying cost = 20% of the value of inventory per year?
The dealer is considering the possibility of allowing some backorder (stockout) to occur. He has estimated that the annual cost of backordering will be 25% of the value of inventory.

i) What should be the optimum number of units of the product he should buy in one lot?

ii) What quantity of the product should be allowed to be backordered, if any?

iii) What would be the maximum quantity of inventory at any time of the year?

iv) Would you recommend to allow backordering? If so, what would be the annual cost saving by adopting the policy of backordering.

b) Write a short note on the term "*Economic Order Quantity (EOQ)*" used in inventory systems. **2**

3 a) A company manufactures around 30 items per day. The sale of these items depends upon demand which has the followings distribution. **5**

Sales (Units)	27	28	29	30	31	32
Probability	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and sale price of each unit are Rs.40 and Rs.50 respectively. Any unsold product is to be disposed of at a loss of Rs.15 per unit. There is a penalty of Rs.5 per unit if the demand is not met. Using the following random numbers estimate total profit/loss for the company of the next10 days: 10, 99, 65, 99, 95, 01, 79, 11, 16, 20. If the company decides to produce 25 items per day, will there be any profit or loss to the company?

b) A bakery keeps stock of a popular brand of cake. Previous experience shows the daily demand pattern for the item with associated probabilities, as given below: **5**

Daily demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

P.T.O

Use the following sequence of random numbers to simulate the demand for next 10 days : 48, 78, 19, 51, 56, 77, 15, 14, 68, 9

i) Find out the stock situation if the owner of the bakery decides to make 30 breads every day.

ii) Estimate the daily average demand for the bread on the basis of simulation data.

4 An office equipment manufacturer produces two kinds of products: computer covers (A) and floppy boxes (B). Production of either a computer cover (A) or a floppy box (B) requires 1 hour of production capacity in the plant. The plant has a maximum production capacity of 10 hours per day. Because of the limited sales capacity, the maximum number of computer covers (A) and floppy boxes (B) that can be sold are 6 and 8 per day respectively. The gross margin from the sale of a computer cover (A) is Rs. 80 and Rs. 40 for a floppy box (B). The overtime hour should not exceed 2 hours/day. The plant manager has set the following goals/priorities arranged in order of importance. **10**

P1: To avoid any underutilization of production capacity

P2: To limit the overtime hours to 2 hours

P3: To sell as many computer covers (A) and floppy boxes (B) as possible. Since the gross margin has twice as much desire to achieve the sales goal for computer covers (A) as for the floppy boxes (B).

P4: To minimize the overtime operation of the plant as much as possible.

Formulate the goal programming problem and then solve it by simplex method.

5 a) A distance network consists of eleven nodes which are distributed as shown in the below table. Draw the network and find the shortest path from node-1 to node-11 and their corresponding distance using the Dynamic Programming technique. **8**

Activity (i-j)	Distance	Activity (i-j)	Distance
1-2	8	5-8	12
1-3	7	5-9	7
1-4	1	6-9	9
2-5	5	7-9	6
3-5	9	7-10	13
3-6	2	8-11	4
3-7	8	9-11	2
4-7	10	10-11	15

b) Define dynamic programming problem. Lists the major applications of dynamic programming. **2**

----------***Best off Luck***----------