

St. Clare College

Autonomous, Bengaluru

ROLL NO:

DATE:

PG END SEMESTER EXAMINATION-OCT/NOV 2025

MBA SECOND SEMESTER

MBA 2624: QUANTITATIVE TECHNIQUES AND OPERATION RESEARCH

TIME: 3 hours.

MAX. MARKS: 70

This paper contains FOUR printed pages and FOUR parts

Instructions:

1. Verify and ensure that the question paper is completely printed.
2. Any discrepancies or questions about the exam paper must be reported to the COE within 1 hour after the examination.
3. Students must check the course title and course code before answering the questions.

PART-A

Answer SEVEN questions out of NINE. Each answer carries TWO marks.

[2x7 = 14]

1. What are the two main errors commonly encountered in network diagrams? Explain each briefly.
2. Define Analog Models and Iconic Models of operation research.
3. What is Game Theory, and how are the maximin and minimax principles relevant in decision-making within this theory?
4. Comparing PERT and CPM, which one is a probabilistic model and why?
5. Describe the various terminologies used in sequencing problems.
6. Define Monte Carlo Simulation and highlight the use of random numbers in the technique.
7. Identify and describe the various servers in a queuing model.
8. Define Operation Research and state its history briefly.
9. Differentiate between the Travelling Salesman Problem and the Transportation Problem

PART-B

Answer any FOUR questions out of SIX. Each answer carries FIVE marks.

[4x5=20]

10. A logistics company purchases a delivery van for Rs. 40,000. Registration and branding charges amount to Rs. 5,000. Based on the yearly maintenance costs given below, determine in which year the van should be replaced if the salvage value at replacement is estimated at Rs. 5,000. Present your recommendation using an average annual cost analysis. Advise when the van must be replaced, showing all workings and justification for your answer.

Year	1	2	3	4	5
Maintenance in Rs.	13,000	15,000	17,000	20,000	22,000

11. Use the Dominance Principle and help the companies choose their optimum strategy and value of the game. Consider two firms, Firm A and Firm B, engaged in a strategic competition. The payoff matrix below shows the profits (in thousands) for different strategies employed by both firms:

	B1	B2	B3	B4
A1	35	65	25	5
A2	30	20	15	0
A3	40	50	0	10
A4	55	60	10	15

12. In a bank branch, there is a single teller serving customers. During peak hours, customers arrive at an average rate of 20 per hour. The teller can serve customers at an average rate of 24 per hour. Answer the following:
- What is the average time a customer spends in the system?
 - What is the average number of customers waiting in the queue?
 - What is the average waiting time a customer spends in the queue before being served?

13. A company plans to fill six positions. Since the positions are known to vary considerably with respect to skill and responsibility, different types of aptitude tests and interviews are required for each. While the aptitude tests are conducted by people from the clerical positions, the job interviews are held by the personnel from the management cadre. First is the aptitude test (Room 1) and then the job interview (Room 2). The time required (in minutes) by each of the positions is given here:

Position	P1	P2	P3	P4	P5	P6
Aptitude test (Room 1)	140	180	150	200	170	100
Job interview (Room 2)	70	120	110	80	100	90

Find the sequence or order in which the positions can be handled. Also, find the total elapsed time.

14. Discuss the practical applications of transportation and the assignment problem in detail.
15. Solve the following LPP Graphically

$$\begin{aligned} \text{Max } Z &= 10x_1 + 15x_2 \\ \text{Subject to the constraints: } 6x_1 + 12x_2 &\leq 48 \\ 25x_1 + 20x_2 &\leq 100 \text{ where } x_1, x_2 > 0 \end{aligned}$$

PART-C

Answer any TWO questions out of FOUR. Each answer carries TEN marks.

[10X2=20]

16. A national bookstore chain wants to optimize the distribution of textbooks from its regional warehouses to its major city branches to minimize shipping cost. The supply at each warehouse and the demand at each city branch (Branch 1, Branch 2, Branch 3) are shown. The shipping cost in rupees from each warehouse to each branch is provided below.

Sources	Branch 1	Branch 2	Branch 3	Warehouse Supply
Warehouse A	7	5	11	130
Warehouse B	10	9	5	70
Warehouse C	8	10	7	60
Branch Demand	110	100	50	260/260

Use Vogel's Approximation Method to determine the most economical shipment policy. Test the solution for optimality using the MODI Method.

17. A shop sells bouquets every morning to customers. The bouquet display stand can hold only thirty bouquets. Any extra bouquets made beyond this limit are discarded at the end of the day. The daily bouquet demand varies from 27 to 35, with probabilities as shown below. Simulate the daily demand based on the given data.

Random numbers generated for simulation over 12 days are: 12, 25, 38, 42, 57, 63, 70, 83, 88, 94, 02, 14.

Daily Demand (Bouquets)	27	28	29	30	31	32	33	34	35
Probability	0.05	0.1	0.1	0.15	0.1	0.1	0.15	0.15	0.1

Simulate the demand for 12 days and answer the questions based on the above data and scenario.

- How many days does the display stand not get filled?
 - How many bouquets are wasted because the display stand is full?
 - If one bouquet costs Rs. 50 to make, how much money is lost due to wastage over the simulation period?
18. A retail chain is planning the rollout of a new flagship store. The project involves multiple dependent tasks, including site preparation, interior design, fixture installation, technology setup, merchandise delivery, staff onboarding, marketing, testing, and launch. Each activity has been estimated using optimistic, most likely, and pessimistic time estimates based on experience:

Activity		Optimistic	Most Likely	Pessimistic
Site Prep	1 - 2	4	6	8
Design	2 - 3	5	7	15
Fixtures	2 - 4	4	8	12
Tech Setup	3 - 6	15	20	25
Merchandise	3 - 5	10	18	26
Staff	4 - 6	8	9	16
Marketing	5 - 7	4	8	12
Pilot Testing	6 - 7	1	2	3
Grand Opening	7 - 8	6	7	8

- Draw the network diagram for the above and find the critical path
- Variance and Standard Deviation for critical path activities.
- Expected project length of completion.
- The probability that the project will be completed -
 - Within 43 weeks
 - 4 weeks later than expected

19. A manufacturing plant operates 900 hydraulic pumps critical for production. The failure probabilities of these pumps by the end of each year are given below:

Year	1	2	3	4	5	6
Failure Probability	0.12	0.28	0.43	0.63	0.89	1.00

The cost of replacing an individual pump is ₹550, while the cost of replacing all pumps together in a group replacement is ₹320 each. Determine the optimal replacement interval for group replacement to minimize cost and compare it with the individual replacement strategy.

PART-D

Answer the following.

[16X1=16]

20. A manufacturing firm produces three premium products: X, Y, and Z. Each product requires labor hours, machine hours, and raw material units, with specific costs and profits attached. Due to limited resources in labor (maximum 2000 hours), machinery (maximum 3600 hours), and raw materials (maximum 2400 units), managerial staff must decide the optimal product mix that yields the highest possible profit while adhering to these constraints. How many units of each product should be manufactured to maximize profits, and what will be the maximum achievable profit? Solve using the Simplex Method.

Resource	Labor hours	Machine hours	Raw materials	Profit per unit
Product X	1	2	1	16
Product Y	1	1	2	17
Product Z	1	1	2	10
Maximum Available	≤2000	≤3600	≤2400	
