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Following Paper ID and Roll No. to be filled in your Answer Book.

PAPER ID : 37212 Roll No. 1 2 2 0 6 7 5 1 1 1

MBA Examination 2023-24

(Even Semester)

OPERATIONS RESEARCH

Time : Three Hours] *[Maximum Marks : 60*

Note :– Attempt all questions.

SECTION – A

1. Attempt all parts of the following : 8×1=8

   (a) Explain minimax and maximin principle used in the theory of games.

   (b) What is meant by a feasible solution of an LP problem?

   (c) Define iso-profit and iso-cost lines in LP problem.

   (d) Describe the transportation problem with its general mathematical formulation.

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(e) What is degeneracy in transportation problems?

(f) Specify the dual of an assignment problem with example.

(g) Name the various quantitative methods that are useful for decision-making under uncertainty.

(h) Highlight the difficulties encountered in using network techniques.

SECTION – B

2. Attempt any two parts of the following : 2×6=12

(a) Discuss in brief types of OR models in decision-making. Explain how and why operations research methods have been valuable in aiding executive decisions?

(b) On October 1, a company received a contract to supply 6,000 unis of a specialized product. The terms of contract require that 1,000 units of the product be shipped in October; 3,000 units in November and 2,000 units in December. The company can manufacture 1,500 units per month on regular time and 750 units per month in overtime. The manufacturing cost per item produced during regular time is ₹ 3 and the cost

per item produced during overtime is ₹ 5. The monthly storage cost is ₹ 1. Formulate this problem as an LP model so as to minimize total costs.

(c) A company has four warehouses a, b, c and d. It is required to deliver a product from these warehouses to three customers I, II and III. The warehouses have the following amounts in stock :

Warehouse :	A	B	C	D
No. of units :	15	16	12	13

and the customer's requirements are :

Customer :	I	II	III
No. of units :	18	20	18

The table below shows the costs of transporting one unit from warehouse to the customer :

		Warehouse			
		A	B	C	D
Customer	I	8	9	6	3
	II	6	11	5	10
	III	3	8	7	9

(d) Customers arrive at a sales counter in a Poisson fashion with, mean arrival rate λ and exponential service times with mean service rate of μ. Determine :

(i) Average length of non-empty queue

(ii) Average waiting time of an arrival

SECTION – C

Note :– Attempt all questions. Attempt any two parts from each questions. $8 \times 5 = 40$

3. (a) The following matrix gives the payoff (in Rs.) of different strategies (alternatives) S1, S2 and S3 against conditions (events) N1, N2, N3 and N4.

		State of Nature			
		N1	**N2**	**N3**	**N4**
Strategy	**S1**	8	9	6	3
	S2	6	11	5	10
	S3	3	8	7	9

Indicate the decision taken under the following approaches :

(i) Pessimistic

(ii) Optimistic

(iii) Equal probability

(iv) Regret

(v) Hurwicz criterion, the degree of optimism being 0.7.

(b) A company needs to increase its production beyond its existing capacity. It has narrowed down on two alternatives in order to increase the production capacity :

(i) Expansion, at a cost of ₹ 8 million

(ii) Modernization at a cost of ₹ 5 million

Both approaches would require the same amount of time for implementation. Management believes that over the required payback period, demand will either be high or moderate. Since high demand is considered to be somewhat less likely than moderate demand, the probability of high demand has been set at 0.35. If the demand is high, expansion would gross an estimated additional ₹ 12 million but modernization would only gross an additional ₹ 6 million, due to lower

maximum production capability. On the other hand, if the demand is moderate, the comparable figures would be ₹ 7 million for expansion and ₹ 5 million for modernization.

(i) If the company wishes to maximize its expected monetary value (EMV), should it modernize or expand.

(ii) Calculate EVPI.

(c) Describe a business situation where a decision-maker faces a decision under uncertainty and where a decision based on maximizing the expected monetary value cannot be made. How do you think the decision-maker should make the required decision?

4. (a) Use the graphical method to solve the following LP problem :

Maximize $Z = 2x_1 + x_2$

Subject to the constraints :

$$x_1 + 2x_2 \leq 10$$
$$x_1 + x_2 \leq 6$$
$$x_1 - x_2 \leq 2$$
$$x_1 - 2x_2 \leq 1$$

and $x_1, x_2 \geq 0$

(b) Show that a transportation problem is a special type of LP problem. In what areas of management can the transportation model be effectively used? Discuss.

(c) Five men are available to do five different jobs. From past records, the time (in hours) that each man takes to do each job is known and is given in the following table :

		Jobs				
		I	II	III	IV	V
Men	A	2	9	2	7	1
	B	6	8	7	6	1
	C	4	6	5	3	1
	D	4	2	7	3	1
	E	5	3	9	5	1

Find out how men should be assigned the jobs in way that will minimize the total time taken.

5. (a) Use dominance rules to reduce the size of the following payoff matrix to (2 × 2) size and hence, find the optimal strategies and value of the game :

		Player B		
		B1	B2	B3
Player A	A1	3	–2	4
	A2	–1	4	2
	A3	2	2	6

(b) Two firms A and B make colour and black and white television sets. Firm A can make either 150 colours sets in a week or an equal number of black and white sets and make a profit of ₹ 400 per colour set or 150 colour and 150 black and white sets or 300 black and white sets per week. It also has the same profit margin on the two sets as A. Each week there is a market of 150 colour sets and 300 black and white sets and the manufacturers would share market in the proportion in which they manufacture a particular type of set. Write the pay-off matrix of A per week. Obtain graphically A's and B's optimum strategies and value of the game.

(c) Give Johnson's procedure for determining an optimal sequence for processing n items on two machines. Give justification of the rule used in the procedure.

6. (a) Find the cost per period of individual replacement of installation of 300 light bulbs, given the following :

(i) Cost of replacing individual bulb is ₹ 3

(ii) Conditional probability of failure is given below :

Week number	0	1	2	3	4
Conditional probability of failure	0	1/10	1/3	2/3	1

(b) "Queuing theory canbe used effectively in determining optimal service levels". Elucidate this statement with the help of an example.

(c) "PERT provides the framework with which a project can be described, scheduled and then controlled". Discuss and elaborate using suitable examples.

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