

25 (2) OPRE 208 (N)

2011

OPERATIONS RESEARCH

Paper : 208

( New Syllabus )

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer any **five** questions

1. (a) Arvind Corporation has collected the following information for designing a promotional campaign for its products :

Advertising Media	No. of Families Expected to Cover	Cost per Advertisement (Rs)	Maximum Times Available per Month	Exposure Quality Units
TV (30 sec)	1000	8,000	15	65
Sunday TV (1 min)	2000	7,000	10	90
Daily Newspaper	1500	3,000	25	40
Sunday Edition of a Daily	2500	4,000	4	60
Radio (30 sec)	300	5,000	30	20

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( Turn Over )

The advertising budget has been set as Rs 70,000 for the 1st month's campaign. In addition, the following restrictions have been set : At least 10 television commercials must be used, at least 40000 families must be reached, and no more than Rs 35,000 be spent on television advertisements.

Formulate this as a linear programming problem so that the company's objective of maximizing the total exposure quality units is met.

(b) Solve the following linear programming problem using graphical method :

Maximize  $Z = 100x_1 + 80x_2$

subject to

$5x_1 + 10x_2 \leq 50$

$8x_1 + 2x_2 \geq 16$

$3x_1 - 2x_2 \geq 6$

$x_1, x_2 \geq 0$

2. (a) Consider the following transportation problem involving three sources and four destinations. The cell entries represent the cost of transportation per unit :

		Destination				Supply
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
Source	S <sub>1</sub>	3	1	7	4	300
	S <sub>2</sub>	2	6	5	9	400
	S <sub>3</sub>	8	3	3	2	500
Demand		250	350	400	200	

(i) Obtain the initial basic feasible solution using Vogel's approximation method (VAM).

(ii) Is the solution optimal? 5+3=8

(iii) Solve the following assignment problem of assigning four salespersons to four different sales regions. The cell entries represent the annual sales figures in crores of rupees :

		Sales region			
		1	2	3	4
Salesperson	A	5	11	8	9
	B	5	7	9	7
	C	7	8	9	9
	D	6	8	11	12

(a) Solve the following linear programming problem using the simplex method :

Maximize  $Z = 6x_1 + 8x_2$

subject to

$5x_1 + 10x_2 \leq 60$

$4x_1 + 4x_2 \leq 40$

$x_1, x_2 \geq 0$

(b) Explain the relationship between the primal and the dual. How is the knowledge of this relationship beneficial?

4. (a) Players A and B play a game in which each player has three coins (20 p, 25 p and 50 p). Each of them selects a coin without the knowledge of the other person. If the sum of the values of the coins is an even number, A wins B's coin. If the sum is an odd number, B wins A's coin.

- (i) Develop a payoff matrix with respect to player A.
- (ii) Find the optimal strategies for the players.

(b) What is a 0-1 integer programming Problem (IPP)? Cite two situations which give rise to 0-1 IPPs.

5. (a) For an activity in a PERT network, the following information is available :

Expected time = 9.5 days

Optimistic time = 5 days

Variance = 6.25 days<sup>2</sup>

Calculate the most likely and pessimistic times of this activity.

(b) The critical activities of a project, their expected durations and standard deviations (in weeks) are given here :

Activity	: B	E	G	H	K	L
Expected duration	: 12	3	8	7	5	6
Standard deviation	: 2/3	1/3	2	5/3	4/3	0

Find the probability that the project will be completed in 45 weeks.

If the manager wants to be 90% sure that the project will be completed by a certain due date, how many weeks prior to the deadline should he start the project?

3+3=6

The RMC corporation blends three raw materials to produce two products : fuel additive and a solvent base. Each ton of fuel additive is a mixture of 0.4 ton of material 1 and 0.6 ton of material 3. A ton of solvent base is a mixture of 0.5 ton of material 1, 0.2 ton of material 2 and 0.3 ton of material 3. RMC's production is constrained by a limited availability of the three raw materials. For the current production period, RMC has 20 tons of material 1 available, 5 tons of material 2 and 21 tons of material 3 available.

The management has specified the following goals :

Goal 1 : Produce at least 30 tons of fuel additive

Goal 2 : Produce at least 15 tons of solvent base

Goal 3 : Produce a product mix to make a profit of at least Rs 4,600

Formulate this as a goal programming problem.

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6. (a) The following table gives data on normal time and cost, and crash time and cost for a project :

Activity	Duration (in weeks)		Total cost (in Rs)	
	Normal	Crash	Normal	Crash
1-2	3	2	300	450
2-3	3	3	75	75
2-4	5	3	200	300
2-5	4	4	120	120
3-4	4	1	100	190
4-6	3	2	90	130
5-6	3	1	60	110

- (i) Draw the network and find the critical path and the normal project duration.
- (ii) If the indirect costs are Rs 100 per week, find the optimum duration by crashing and the corresponding project costs.  $4+6=10$

- (b) When asked to compare three soft drinks with respect to flavour, an individual stated that—

- (i) A is moderately more preferable than B;
- (ii) A is equally to moderately more preferable than C;
- (iii) B is strongly more preferable than C.

Set up the pairwise comparison matrix for this problem.

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7. Elaborate on the following (any two) :  $7 \times 2 = 14$

- (a) Application of OR in different sectors
- (b) Simulation of an inventory system
- (c) Sensitivity analysis for changes in objective function coefficients
- (d) Pure strategy in game theory

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