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25(2) OPRE 205

2010

OPERATIONS RESEARCH

Paper : 205

Full Marks - 70

Time - Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) A local travel agent is planning a charter trip to a sea port. The eight day / seven night package includes the fare, food and lodging etc. The trip is restricted to 200 persons and past experience indicates that there will not be any problem for getting 200 clients. The problem for the travel agent is to determine the number of Deluxe, Standard and Economy tour packages to offer for this trip. The given table summarizes the estimated prices for the three packages and expenses

[Turn over

for the travel agent. The agent has hired an aircraft for a flat fee of Rs. 2,00,000 for the entire trip.

In planning the trip the following considerations must be taken into account :

- (i) At least 10% of the packages must be of the Deluxe type.
- (ii) At least 35% but not more than 70% must be of the Standard type.
- (iii) At least 30% must be of the Economy type.
- (iv) The maximum number of Deluxe packages available is restricted to 60.
- (v) The hotel desires that at least 120 of the tourists should be on the Deluxe and Standard packages taken together.

Price and costs for tour packages per person.

Tour Plan	Price	Hotel costs	Meal and other expenses
Deluxe	10,000	3,000	4,750
Standard	7,000	2,200	2,500
Economy	6,500	1,900	2,200

The travel agent wishes to determine the number of packages to offer in each type so as to maximize the total profit.

Formulate this as a linear programming problem. 7

(b) Solve graphically the following LPP : 7

$$\text{Minimize } Z = 4x_1 + 3x_2$$

$$\text{subject to } x_1 + 3x_2 \geq 9$$

$$2x_1 + 3x_2 \geq 12$$

$$x_1 + x_2 \geq 5$$

$$x_1, x_2 \geq 0$$

A factory is engaged in producing two items, I_1 and I_2 , each of which has to pass through three machines M_1 , M_2 and M_3 . One unit of I_1 requires one hour of machining on M_1 , 2 hours on M_2 and 1 hour on M_3 , while one unit of I_2 requires machining of one hour each on M_1 and M_2 and 3 hours on M_3 . In a week, a maximum of 40 hours on machine M_1 , 70 hours on M_2 and

90 hours on machine M_3 are available. It is given that the per unit profit on I_1 is Rs. 40 and that on I_2 is Rs. 60.

The present production mix of the factory is : I_1 30 units and I_2 10 units, per week. This implies that the present profit is Rs. 1800 a week. Also, machines M_1 and M_2 are fully utilized.

In your opinion, is the present production mix optimal ? If not, specify what should it be and find the increase in profit that would result if the new mix determined by you is adopted. Also determine the time for which some machine may be idle. (Use Simplex Method for this problem)

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3. (a) Write the dual of the following linear programming problem : 7

$$\begin{aligned} \text{Maximize } Z &= 3x_1 + 4x_2 + 7x_3 \\ \text{subject to } x_1 + 4x_2 + x_3 &\leq 10 \\ 4x_1 - x_2 - x_3 &\geq 15 \\ x_1 + x_2 + x_3 &= 7 \\ x_1, x_2 &\geq 0 \end{aligned}$$

(b) The table given below has been taken from the solution procedure of a transportation problem, involving minimisation of cost (in rupees) :

Factory	Stockists			Monthly capacity
A	4	8	8	56
B	16	24	16	82
C	8	16	24	77
Monthly Demand	72	102	41	

- Test the optimality of the above solution using the MODI method.
- Does the problem have multiple optimal solution ? Give reasons.
- If the cost from A to Z is increased by Rs. 5 per unit will the solution change ?
4+2+1=7

4. (a) As part of its promotional campaign, the marketing department of Oriental Motors (OM) has decided to send personalized

invitations to test drive the new model to two target groups : (1) current owners of an OM luxury car and (2) owners of luxury cars manufactured by one of OM's competitors. The cost of sending an invitation is Re.1 per letter. Based on previous experience, OM estimates that 25% of the customers contacted from group 1 and 10% of the customers contacted from group 2 will test drive the new car. As part of this campaign, OM has set the following goals.

Goal 1: Get at least 10,000 customers from group 1 to test drive the new car.

Goal 2: Get at least 5000 customers from group 2 to test drive the new car.

Goal 3: Limit the expense of sending out the invitations to Rs.70,000.

Assume that goals 1 and 2 are P_1 priority level goals and that goal 3 is a P_2 priority level goal. Formulate a goal programming model of the Oriental Motors problem. 7

(b) Activities and their immediate predecessors are shown as follows : $3+3+1=7$

Activity: A B C D E F G H I

Immediate: - - A,B A,B B C D D,F E,G,H

Predecessor

- (i) Draw the project network.
- (ii) If the duration (in days) of these nine activities are 5, 4, 6, 9, 4, 2, 8, 8, 4, then what is the project completion time ?
- (iii) Which are the critical activities ?

5. (a) A transportation company operates everyday four routes with four trucks. Relevant data is given in the following table. The table contains the km run per litre of diesel consumption by each of the trucks in the given four routes. 7

	Routes			
Trucks	A	B	C	D
1	5.2	5.5	5.0	5.6
2	4.9	5.1	5.2	5.4
3	4.8	5.2	4.9	5.3
4	5.0	5.0	5.2	5.4
Distance to be covered (km)	220	320	360	250

Find out the assignment of trucks to routes in order to reduce the consumption of diesel per day.

(b) Answer either (i) or (ii) :

(i) A small retailer has studied the weekly receipts and payments over the past 2 weeks and has developed the following information :

Weekly receipts(Rs.)	Probability	Weekly payments(Rs.)	Probability
3000	0.20	4000	0.30
5000	0.30	6000	0.40
7000	0.40	6000	0.20
12,000	0.10	10,000	0.10

Using the following sequence of random numbers, simulate the weekly pattern of receipts and payments for the first 8 weeks of the next quarter, assuming that the beginning bank balance is Rs. 8000. What is the estimated balance at the end of the 8 weekly period? What is the highest weekly balance? What is the average weekly balance?

Random Numbers

For receipts : 03 91 38 55 17 46 32 43

For payment : 61 96 30 32 03 88 48 28

Or

An individual is interested in determining which of the two stocks to invest in, Greentech or Srei Software. The criteria thought to be most relevant are Yield and Risk. The pairwise comparison matrix is :

Criterion	Yield	
	Greentech	Srei
Yield	1	2
Risk	1/2	1

	Risk	
	Greentech	Srei
Greentech	1	1/2
Srei	2	1

- Compute the priorities for each of the pairwise comparisons.
- Develop the overall priority for the two investments. Which is preferred based on yield and risk?

(ii) (a) A construction work involves 9 activities. Their time estimates (in months) and precedence relationship are given below :

Activity	A	B	C	D	E	F	G	H	I
Preceding Activity	-	A	-	C	B,D	E	B,D	G	F,H

Optimistic :	1.5	1.5	1	1.5	0.5	1	3	3	2.5
Most likely :	2	2	2	2	1	2	3.5	4	2
Pessimistic :	2.5	2.5	3	2.5	1.5	3	7	5	2.5

- (i) Draw the PERT network for the project.
 - (ii) What activities need special attention for completion of the project on time?
 - (iii) What is the expected completion time?
 - (iv) What is the probability of completing the work within 18 months? 11
- (b) Briefly discuss the significance of sensitivity. 3

Analysis from a managerial viewpoint.

7. ✕ Write short notes on any two: 7×2=14

- (a) Economic Interpretation of the Dual
- (b) Integer Programming Problem
- (c) Sequencing Problem
- (d) Degeneracy in a Transportation Problem
- (e) Monte Carlo Simulation.