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Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1207**

Unique Paper Code : **237404** **E**

Name of the Paper : **Operational Research (STHT-403)**

Name of the Course : **B.Sc. (Hons.) (Statistics)**

Semester : **IV**

Duration : **Three Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *Five* questions.

Use of simple calculator is allowed.

Attempt *all* parts of a question in continuation.

Section I

1. A manufacturer produces three products daily, X, Y and Z. The three products are each processed through three production operations with time constraints and then stored. The problem has been formulated as :

Maximize $Z = 32x_1 + 35x_2 + 45x_3$ (Profit)

Subject to the constraints

$$2x_1 + 3x_2 + 2x_3 \leq a, \quad \text{(operation 1, hr)}$$

$$4x_1 + 3x_2 + x_3 \leq b, \quad \text{(operation 2, hr)}$$

$$3x_1 + 2x_2 + 4x_3 \leq c, \quad \text{(operation 3, hr)}$$

$$x_1 + x_2 + x_3 \leq d, \quad \text{(storage, ft}^2\text{)}$$

$$x_1, x_2, x_3, a, b, c, d \geq 0$$

where a, b, c and d are constants.

P.T.O.

The final optimal simplex tableau for this problem is as follows :

Basic Variable	Solution Values	X_1	X_2	X_3	S_1	S_2	S_3	S_4
S_1	10	–1/2	0	0	1	0	1/2	–4
S_2	60	2	0	0	0	1	1	–5
x_3	10	1/2	0	1	0	0	1/2	–1
x_2	30	1/2	1	0	0	0	–1/2	2
Net Evaluation Z_j–C_j		8	0	0	0	0	5	25

(*a*) Find the values of the constants *a*, *b*, *c* and *d*.

(*b*) On the basis of the above information, answer the following :

(*i*) Determine the optimal solution

(*ii*) Does it have multiple solution ?

(*iii*) Determine the amount of used and unused resources.

(*iv*) What are the shadow prices of the resources ?

(*v*) Is it profitable for the management to produce one more product P which requires 1 hr. of each operation respectively, 1 sq. ft. of storage and contributes Rs. 25 as profit ?

3,12

2. (*a*) The cost of a machine is Rs. 6,100 and its scrap value is only Rs. 100. The maintenance costs are found to be as follows :

Year	**Maintenance Cost** (Rs.)
1	100
2	250
3	400
4	600
5	900
6	1250
7	1600
8	2000

When should the machine be replaced ?

(*b*) Write the dual of the following LPP and solve it.

Min. $Z = 4x_1 + 3x_2 + 6x_3$

subject to the constraints :

$$x_1 + x_2 \geq 2$$

$$x_2 + x_2 \geq 5$$

$$x_1, x_2, x_3 \geq 0.$$

Hence obtain the optimal solution to the primal problem. 7,8

3. (*a*) Use simplex method to solve the following LPP :

Max. $Z = 2x_1 - x_2 + x_3$

subject to the constraints :

$3x_1 + x_2 + x_3 \leq 60$

$x_1 + x_2 + 2x_3 \leq 10$

$x_1 + x_2 - x_3 \leq 20$

and $x_1, x_2, x_3 \geq 0$.

(*b*) Obtain an optimum basic feasible solution for the following transportation problem :

Destinations

Sources	**I**	**II**	**III**	**IV**	**Capacity**
I	2	3	11	7	6
II	1	0	6	1	1
III	5	8	15	9	10
Requirement	7	5	3	2	

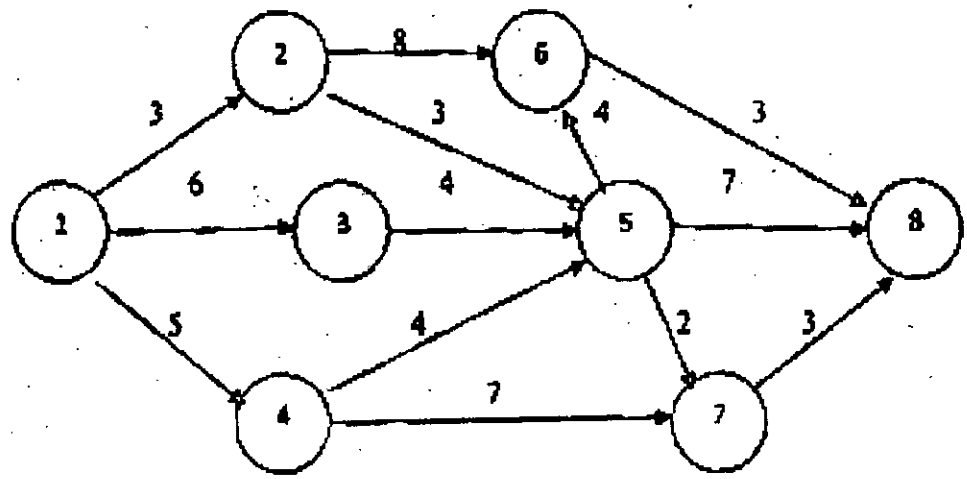
7,8

Section II

4. (*a*) Solve the following two person zero sum game :

		Player B			
Player A	5	−10	9	0
	6	7	8	1
	8	7	15	2
	3	4	−1	4

(*b*) The distance (in miles) between different stations is shown on each link in the given network. Determine the shortest route from station 1 to station 8. Also determine the shortest distance. 7,8



5. (*a*) A department's head has four tasks to perform and three subordinates, the subordinates differ in efficiency. How he should allocate the tasks one to each man, so as to minimize the total man hour ?

Task	Man		
	A	B	C
I	9	26	15
II	13	27	6
III	35	20	15
IV	18	30	20

(*b*) The automobile company manufactures around 150 scooters. The daily production varies from 146 to 154 depending upon the availability of raw materials and other working conditions :

Production per day	Probability
146	0.04
147	0.09
148	0.12
149	0.14
150	0.11
151	0.10
152	0.20
153	0.12
154	0.08

The finished scooters are transported in a specially designed lorry accommodating 150 scooters. Using the following random numbers

80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57,

simulate the process to find out :

(*i*) what will be the average number of scooters waiting in the factory ?

(*ii*) what will be the average number of empty space on the lorry ? 7.8

6. Write short notes on the following (any *two*) :

(*i*) Dominance property in competitive games

(*ii*) Economic Interpretation of duality

(*iii*) Standard and canonical forms of L.P.P. 7.8