This question paper contains 8 printed pages]

Your Roll No. .....

1060

B.Sc. (Hons.)/III **C**

STATISTICS -Paper XXIII

(Operational Research)

(Admissions of 1999 and onwards)

Time : 2 *Hours* *Maximum Marks* : 38

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

Attempt *four* questions in all.

selecting *two* questions from each Section.

Section I

1. Solve the following linear programming problem :

Max $Z \quad 3x_1 + 2x_2 + x_3$

subject to the constraints :

$3x_1 + 5x_2 + x_3 = 12,$

$3x_1 + 4x_2 \quad = 11,$

x_1 is unrestricted in sign and $x_2, x_3 \geq 0.$

Also write its dual and find the optimal solution of the dual problem. 9½

P.T.O.

2. (*a*) Solve the following NLPP :

$$\text{Max } Z = 2x_1 + 3x_2 - x_1^2 - 2x_2^2$$

subject to :

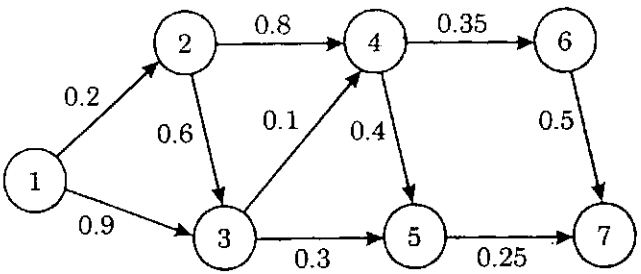
$$x_1 + 3x_2 \leq 6,$$

$$5x_1 + 2x_2 \leq 10,$$

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

(*b*) Mrs. P drives daily to work. Having just completed a course in network analysis, she is able to determine the shortest route to work. Unfortunately, the selected route is heavily patrolled by police and with all the fines paid for speeding, the shortest route may not be the best choice. P has thus decided to choose a route that maximizes the probability of not being stopped by the police. The following network shows the possible routes

between home and work and the associated probabilities of not being stopped on each segment.



Determine the route that maximizes the probability of not being fined. 5,4½

3. (*a*) Consider the following L.P.P. :

$$\text{Min } Z = -x_1 + 2x_2 + 3x_3$$

subject to :

$$-x_1 + x_2 + x_3 \geq 3,$$

$$x_1 + 2x_2 + x_3 \leq 10.$$

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

The optimal solution is displayed in the table below :

Basic variables	Solution values	x_1	x_2	x_3	x_4	x_5	x_6
x_2	a	c	1	1	-1	0	1
x_5	b	d	0	−1	2	1	-2
	$z_j - c_j$	−1	0	−1	-2	0	$2-m$

(*i*) Find a, b, c and d and hence the optimal solution.

(*ii*) If a new variable x_7 is introduced through the addition to A of a column $(2, -1)^T$ and to c^T of a component c_7 1, find the new optimum solution through sensitivity analysis.

(*b*) A contractor has to supply 1000 units per day. He can produce 25000 units per day. The cost of holding a unit in stock is Rs. 2 per year and the set up cost per run is Rs. 1,800. How frequently, and of what size, the production run be made ? Assuming there are 300 working days in a year. 5,4½

Section II

4. (*a*) A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below :

Production per day	Probability
196	0.05
197	0.09
198	0.12
199	0.14
200	0.20
201	0.15
202	0.11
203	0.08
204	0.06

The finished mopeds are transported in a specially design lorry that can accommodate only 200 mopeds. Using the given 15 random numbers, 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54, 10, simulate the process to find out :

(*i*) What will be the average number of mopeds waiting in the factory ?

(*ii*) What will be the average number of empty spaces in the lorry ?

(*b*) Solve the game whose pay off matrix is given below :

Player B

Player A		B_1	B_2	B_3	B_4
	A_1	4	–2	3	–1
	A_2	–1	2	0	1
	A_3	–2	1	–2	0

5,4½

5. (*a*) A company is faced with the problem of assigning 4 machines to 6 different jobs (one machine to one job only).

The profits are estimated as follows :

	Machine			
Job	**A**	**B**	**C**	**D**
1	3	6	2	6
2	7	1	4	4
3	3	8	5	8
4	6	4	3	7
5	5	2	4	3
6	5	7	6	4

Solve the problem to maximize the total profit.

(*b*) Using North-West corner method to find the starting solution, obtain an optimum solution to the following transportation problem :

From \ To	D_1	D_2	D_3	Supply
S_1	8	5	6	120
S_2	15	10	12	80
S_3	3	9	10	80
Demand	150	80	50	

5,4½

6. Write short notes on the following :

(*a*) Shadow price in L.P.P.

(*b*) Kuhn-Tucker conditions for solving general N.L.P.P.

(*c*) Monte-Carlo simulation. 3,3,3½