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[55/A-11]

Sardar Patel University
B.Sc. Semester - III Examination
Saturday, 30th November, 2019

Time: 2.00 to 4.00 pm | Course Code: US03ESTA01 | M.Marks: 70

(Operations Research - I)

Note: (i) Graph paper will provide on request. (ii) Q.3 to 6, each sub question has 5 marks

Q.1 Multiple Choice Questions (10×1)

(1) In the optimal simplex table $C_j - Z_j = 0$ value indicates
(a) unbounded solution (b) alternate solution (c) cyclic solution (d) None of the above

(2) In simplex method, we add _____ variables in case of " = "
(a) Slack variable (b) Surplus variable (c) Artificial variable (d) None

(3) One disadvantage of using North – West corner method is
(a) it does not take in to account transportation cost (b) it is complicated to use
(c) it leads to a degenerate solution (d) all of the above

(4) A basic feasible solution of a LPP is said to be _____ if at least one of the basic variable is zero
(a) degenerate (b) Non - degenerate (c) infeasible (d) unbounded

(5) A minimization problem can be converted into maximization problem by changing the sign of coefficients in the
(a) constraints (b) objective function (c) both (a) and (b) (d) None

(6) From the following methods _____ is a method to obtain initial solution to TP
(a) Hungarian (b) Simplex (c) North - West (d) Newton Raphson

(7) A given TP is said to be unbalanced, if the total supply is not equal to the total_____
(a) optimization (b) demand (c) cost (d) none

(8) The coefficient of artificial variable in the objective function of maximization problem is
(a) 0 (b) M (c) – M (d) none

(9) The TP is said to be unbalanced if
(a) $\sum ai \neq \sum bi$ (b) $\sum ai = \sum bi$ (c) $m = n$ (d) $m + n - 1$

(10) Feasible solution satisfies
(a) only constraints (b) only non – negative restrictions
(c) (a) and (b) both (d) (a), (b) and optimum solution

Q.2 Short Type Questions (Attempt Any Ten) (10×2)

(1) With reference to LPP, define the following:
(i) feasible solution (ii) optimum solution
(2) When is dummy required in transportation problem?
(3) How do you convert the unbalanced TP into a balanced one?
(4) With reference to LPP, dual of the dual is _____.
Fill in the blank and justify your answer by giving an example.
(5) Write down the steps of the graphical method to obtain an optimum solution to a LPP.
(6) Write down the limitations of Graphical method? How will you resolve it?
(7) Write the mathematical formulation for transportation problem?
(8) From the simplex table, how will you identify the cases of infeasible solution, unbounded solution and alternate optimal solutions?
(9) Describe the method of determining incoming and outgoing variables in simplex method.
(10) What do you mean by degeneracy in a TP?
(11) Write down the standard form of LPP

(1)

(P.T.O.)

$Max\ Z = 3X_1 + 5$

Subject to constraints

$2X_1 + 3X_2 \leq 4, \quad 3X_1 + 2X_2 \leq 7, \quad X_1, X_2 \geq 0$

(12) What is unbalanced TP?

Q.3(a) A housewife wishes to mix two types of foods $F1$ and $F2$ in such a way that vitamin contents of the mixture contain at least 8 units of vitamin A and 11 units of vitamin B. Food F1 costs Rs 60 per kg and Food $F2$ costs Rs 80 per kg. Food $F1$ contains 3 units/kg of vitamin A and 5 units /kg of vitamin B while Food $F2$ contains 4 units/kg of vitamin A and 2 unit/kg of vitamin B. Formulate this problem as a linear programming problem to minimize the cost of such a mixture.

(b) What are the advantages and limitations of Graphical method in solving LPP?

Obtain the solution of the following LPP using Graphical Method

$Max\ Z = 3X_1 + 4X_2$

Subject to constraints

$5X_1 + 4X_2 \leq 200, \quad 3X_1 + 5X_2 \leq 150, \quad 5X_1 + 4X_2 \geq 100, \quad 8X_1 + 4X_2 \leq 80, \quad X_1, X_2 \geq 0$

OR

Q.3(a) A firm produces products, A & B, each of which requires two resources, namely raw materials and labour. Each unit of product - A requires 2 & 4 units and each unit of product - B requires 3 & 3 units respectively of raw materials and labour. Every day at least 60 units of raw materials and at most 96 units of labour must be used. If the unit profit contribution of product - A is Rs. 40/-, product - B is Rs.35/- , determine the number of units of each of the products that should be made each day to maximize the total profit contribution.

(b) Solve the following LPP by graphical method:

$Max\ Z = 10X_1 + 8X_2$

Subject to the constraints

$2X_1 + X_2 \leq 20, \quad X_1 + 3X_2 \leq 30, \quad X_1 - 2X_2 \geq -15, \quad X_1, X_2 \geq 0$

Q.4(a) Use duality to solve the LPP

$Min\ Z = 2X_1 + 2X_2$

Subject to the constraints

$2X_1 + 4X_2 \geq 1, \quad -X_1 - 2X_2 \leq -1, \quad X_1 + X_2 \geq 1, \quad X_1, X_2 \geq 0$

(b) Solve the following problem, using Big – M method

$Max\ Z = 6X_1 + 4X_2$

Subject to the constraints

$2X_1 + 3X_2 \leq 30, \quad 3X_1 + 2X_2 \leq 24, \quad X_1 + X_2 \geq 3, \quad X_1, X_2 \geq 0$

Find at least two solutions.

OR

Q.4 Cadbury India Ltd. produces three varieties of Chocolates – Hard, mild & soft from three different inputs I_1, I_2 & I_3. One unit of Hard requires 2 units of I_1 and 4 unit of I_2. One unit of mild requires 5 units of I_1 , 4 units of I_2 and 3 units of I_3 and one unit of soft requires 10 units of I_1 & 15 units of I_3. The total available of inputs in the company's warehouse is as under:

$I_1 = 100$ units	$I_2 = 400$ units	$I_3 = 50$ units

The profit per unit for hard, mild & soft are Rs. 20, 30 and 40 respectively.

Formulate the problem so as to maximize the total profit by using Simplex method.

Q.5(a) Goods have to be transported from sources S_1, S_2 and S_3, to destinations D_1, D_2 and D_3. The transportation cost per unit capacities if the sources and requirements of destinations are given in the following table.

	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	

Determine the transportation schedule so that cost is minimized.

(b) List out various methods of finding initial basic feasible solution (i.b.f) of Transportation Problem (TP). Determine an i.b.f solution using North West Corner Method.

		Distribution centre				Supply
		D_1	D_2	D_3	D_4	
Plant	P_1	2	3	11	7	6
	P_2	1	0	6	1	1
	P_3	5	8	15	9	10
Demand		7	5	3	2	

OR

Q.5(a) (i) What is unbalanced transportation problem? Does any extra cost required to considered in case of such problem?

(ii) The occurrence of degeneracy while solving a transportation Problem means what?

(b) List out the various methods of obtaining an i.b.f solution of TP. Obtain an i.b.f solution of following TP using any one method.

Plants	Warehouses				Supply
	W_1	W_2	W_3	W_4	
P_1	6	2	6	12	120
P_2	4	4	2	4	200
P_3	13	8	7	2	80
Demand	50	80	90	180	400

Q.6 A steel company has three open hearth furnaces and five rolling mills. Transportation cost (Rs/kg.) for shipping steel from furnaces to rolling mills are shown in the following table:

		Mills					Capacities (in kg.)
		M_1	M_2	M_3	M_4	M_5	
Furnaces	F_1	4	2	3	2	6	8
	F_2	5	4	5	2	1	12
	F_3	6	5	4	7	3	14
Requirements (in kg.)		4	4	6	8	8	

What is the optimal shipping schedule?

OR

Q.6 A product is produced at 4 factories F_1, F_2, F_3 and F_4. Their unit production costs are Rs. 2, 3, 1 and 5 respectively. Production capacities of the factories are 50, 70, 30 and 50 units respectively. The product is supplied to 4 stores S_1, S_2, S_3 and S_4, the requirements of which are 25, 35, 105 and 20 respectively. Unit costs of transportation are given below:

Factories	Stores			
	S_1	S_2	S_3	S_4
F_1	2	4	6	11
F_2	10	8	7	5
F_3	13	3	9	12
F_4	4	6	8	3

Find the transportation plan such that the total production and transportation cost is minimum.

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