

## HARCOURT BUTLER TECHNICAL UNIVERSITY, KANPUR

### ASSIGNMENT -1/OPERATIONS RESEARCH / Unit-1 /BMA-341/342

#### III -B.Tech. - ME/CS 2021-22

1. Solve the following L.P.P. using Simplex method,

$$\text{Maximize } z = 2x_1 + 5x_2 + 7x_3$$

$$\text{Subject to: } 3x_1 + 2x_2 + 4x_3 \leq 100, \quad x_1 + 4x_2 + 2x_3 \leq 100, \quad x_1 + x_2 + 3x_3 \leq 100$$

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

2. A firm manufactures 3 products A, B and C. The profits are Rs.3, Rs.2 and Rs. 4 respectively and given below is the required processing time in minutes for each machine on each product.

Products → Machine	A	B	C
G	4	3	5
H	3	2	4

Machine G and H have 2000 and 2500 machine minutes respectively. The firm must manufacture 100A's 200 B's and 50 C's but no more than 150 A's. Set up an LP problem to maximize the profit.

3. Find the dual of *Min.*  $Z = x_1 + 2x_2$ , subject to  $x_1 - x_2 - 3x_3 \geq 4$ ,

$$x_1 - 2x_2 - 2x_3 \geq 3, \quad x_1, x_2, x_3 \geq 0$$

4. A firm plans to purchase at least 200 quintals of scrap containing high quality metal x and low quality metal y. It decides that the scrap to be purchased must contain at least 100 quintal of x-metal and not more than 35 quintals of y-metal. The firm can purchase the scrap from two supplier (A and B) in unlimited quantities. The percentage of x and y metals in terms of weight in the scraps supplied by A and B is given below.

Metals	Supplier A	Supplier B
x	25%	75%
y	10%	20%

The price of A's scrap is Rs. 200 per quintal and that of B's is Rs. 400 per quintal.

Formulate this problem as LP model and solve it by graphical method to determine the quantities that the firm should buy from the two suppliers so as to minimize total purchase cost.

5. Use Two- phase method to solve the L.P problem:

$$\begin{aligned} \text{Minimize } z &= \frac{15}{2} x_1 - 3x_2 \\ \text{Subject to : } &3x_1 - x_2 - x_3 \geq 3, \quad x_1 - x_2 + x_3 \geq 2, \quad x_1, x_2, x_3 \geq 0 \end{aligned}$$

6. Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paisa per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B per gram and costs 20 paisa per gram. The daily minimum requirements of vitamin A and vitamin B are 100 units and 120 units respectively. Find the minimum cost of product mix problem by using Big-M method.

7. Give the dual of the LP problem;

$$\begin{aligned} \text{Min } z &= 2x_1 + 3x_2 + 4x_3 \\ \text{Subject to constraints: } &2x_1 + 3x_2 + 5x_3 \geq 2, \\ &3x_1 + x_2 + 7x_3 = 3, \quad x_1 + 4x_2 + 6x_3 \leq 5, \quad x_1, x_2 \geq 0 \text{ and } x_3 \text{ is unrestricted.} \end{aligned}$$

8. Use dual simplex method to solve;

$$\begin{aligned} \text{Max } z &= -2x_1 - x_3, \\ \text{Subject to; } &x_1 + x_2 - x_3 \geq 5, \quad x_1 - 2x_2 + 4x_3 \geq 8, \text{ and } x_1, x_2, x_3 \geq 0 \end{aligned}$$

9. Prove that the dual of the dual of given primal is primal itself.

10. A toy manufacturing company has two types of dolls: a basic version doll (A) and a deluxe version doll (B). Each doll of type B takes twice as long as one of types A and the company would have time to make a maximum of 2000 dolls per day if only the basic version A is produced. Supply of plastic is sufficient to produce 1500 dolls per day both A and B combined. The deluxe version doll B requires a fancy dress of which there are 600 dresses per day available. If the company makes a profit of Rs. 3 and Rs. 5 per doll of type A and B respectively, Use simplex method to find that how many dolls of type A and B each will have to be produced to maximize the profit.

11. What is the degeneracy in L.P. problem? Explain with an example the method to resolve degeneracy.

12. Explain the duality theory of linear programming.

13. What is degeneracy? Discuss a method to resolve degeneracy in LPP.

14. Solve the following LPP by graphical method,

$$\begin{aligned} \text{Min. } Z &= -x_1 + 2x_2 \\ \text{subject to } &-x_1 + 3x_2 \leq 10, \quad x_1 + x_2 \leq 6 \\ &x_1 - x_2 \leq 2, \quad x_1, x_2 \geq 0 \end{aligned}$$

15. Discuss the main characteristics of OR with suitable examples.