

Indian Statistical Institute, Bangalore

**M.S. (QMS) First Year
First Semester – Operations Research I**

Mid Term Exam Duration: 2 Hrs Date: September 12, 2015 Max Marks: 50

Answer as many questions as you can.

1. State “true” or “false”, for each of the following statement. No justification required. [7]

- (i) In an LP Model, changes in the coefficient of the objective function will definitely result in changing the optimal values of the variables.
- (ii) In an LP Model, the variable representing the activity with the largest profit per unit in the objective function will always appear at positive level in the optimal solution.
- (iii) In the Simplex method, all variables must be nonnegative.
- (iv) Every feasible point in a bounded LP solution space can be determined from its feasible extreme points.
- (v) In the simplex method, the feasibility condition for the maximization and minimization problems are different.
- (vi) Degeneracy can be avoided if redundant constraint can be deleted.
- (vii) If the solution space is unbounded, the objective value will also be unbounded.

2. Convert the following LP Problem into “Standard Form”: [5]

Minimize $4x_1 + 6x_2$ ($= Z$)

Subject to

$$4x_1 + 12x_2 \leq -3,$$
$$3x_1 + 6x_2 = 4,$$

$$x_1 \geq 0, \quad x_2 \text{ any real number.}$$

3. Use the graphical method to solve the following LP Problem: [10]

Minimize $3x_1 + 2x_2$

Subject to

$$5x_1 + x_2 \geq 10$$
$$x_1 + x_2 \geq 6$$
$$x_1 + 4x_2 \geq 12,$$

$$x_1, x_2 \geq 0,$$

4. (i) A plant makes two types of auto parts, A and B. It buys castings that are *machined, bored and polished*. The capacity of machining is 25 per hour for A and 24 per hour for B. Capacity of boring is 28 per hour for A and 35 per hour for B, and capacity of polishing is 35 per hour for A 25 per hour for B. Castings for part A cost Rs.2 and sell for Rs.5 each and those for part B cost Rs. 3 and sell for Rs. 6 each. The three machines have running cost of Rs.20. Rs.14 and Rs.17.50 per hour. Assume that any combination of Parts A and B can be sold. Formulate this as a LP model with the objective of maximizing total profit. Formulate this as an LP Model.

(ii) A paint manufacturing company manufactures paint at two plants. Firm order has been received from three large Contractors. The firm has determined that the following shipping cost data are appropriate for these contractors w.r.t. its two plants:

Contractor	Order size(gallon)	Shipping Cost /gallon(Rs)	
		From plant I	From plant II
A	750	1.80	2.00
B	1,500	2.60	2.20
C	1,500	2.10	2.25

Each gallon of paint must be blended and tinted. The company's costs with respect to these two operations at each of the two plants are as follows:

Plant	Operation	Hours required per gallon	Cost/hour (Rs.)	Hours Available
Plant I	Blending	0.10	3.80	300
	Tinting	0.25	3.20	360
Plant II	Blending	0.15	4.00	600
	Tinting	0.20	3.10	720

Formulate this problem as a LP Model.

[8+8 = 16]

5. Solve the following LP Problem using Simplex Algorithm.

[16]

$$\begin{aligned}
 &\text{Maximize} && 4x_1 + 5x_2 \quad (= Z) \\
 &\text{Subject to} && \\
 &&& 3x_1 + 5x_2 \leq 24 \\
 &&& 4x_1 + 2x_2 \leq 16 \\
 &&& x_1 + x_2 \geq 3 \\
 &&& x_1, x_2 \geq 0
 \end{aligned}$$
