Indian Statistical Institute, Bangalore
M.S. (QMS) First Year
First Semester – Operations Research I

Mid Term Exam Duration: 2 Hrs Date: September 13, 2016 Max Marks: 50

Answer as many questions as you can. Maximum score will be limited to 50

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 an LP model, the feasible solution space can be changed when nonbinding constraints are deleted.
(iv) If a unit worth of resource (dual price) is positive, the resource must necessarily be scarce.
(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) The selection of the entering variable from among the current non-basic variables as the one with the most negative objective coefficient guarantees the most increase in the objective value in the next iteration.

2. Use the graphical method to solve the following LP Problem: [12]
A diet for a sick person must contain at least 4000 units of vitamins, 50 units of minerals and 1400 calories. Two foods A and B are available at a cost of Rs.4 and Rs.3 per unit respectively. One unit of A contains 200 units of vitamins, 1 unit of mineral and 40 calories. The corresponding figures for one unit of B is 100 units of vitamins, 2 units of minerals and 40 calories. What combination of foods to be used to have least cost?

3. [8 + 8 = 16]
(i) A manufacturer produces three models (I, II, and III) of a certain product. He uses two types of raw material (A and B), of which 4000 and 6000 units are available, respectively. The raw material requirements per unit of the three models are:

Raw Material	Requirement per Unit of given model		
	I	II	III
A	2	3	5
B	4	2	7

The labor time for each unit of model I is twice that of model II and three times that of model III. The entire labor force of the factory can produce the equivalent of 1500 units of model I. A market survey indicates that the minimum demand for the three models is 200, 200, and 150 units, respectively. However, the ratios of the number of units produced must be equal to 3:2:5. Assume that the profit per unit of models I, II, and III is $30, $20, and $50, respectively. Formulate the problem as a linear programming model to determine the number of units of each product that will maximize profit.

(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.

4. Solve the following LP Problem using Simplex Algorithm. [20]

Maximize $Z = 2x_1 + 4x_2 + 3x_3 + x_4$

Subject to

$$3x_1 + x_2 + x_3 + 4x_4 \leq 12$$
$$x_1 - 3x_2 + 2x_3 + 3x_4 \leq 7$$
$$2x_1 + x_2 + 3x_3\ a - x_4 \leq 10$$
$$x_1, x_2, x_3, x_4 \geq 0$$