Indian Statistical Institute, Bangalore
MS (QMS) First Year
Second Semester - Operations Research II

Midterm Exam   Date: February 27, 2019
Maximum marks: 50   Duration: 2 hours

1. (a) Metalco is planning to produce at least 2000 widgets on three machines. The
   minimum lot size on any machine is 500 widgets. The following table gives the
   pertinent data of the situation:

Machine	Setup cost ($)	Production cost/unit ($)	Capacity (units)
1	300	2	600
2	100	10	800
3	200	5	1200

   Formulate the problem as an Integer Linear Program (ILP) [with an appropriate
   objective function].

   (b) Solve the following ILP Problem using Branch and Bound (B&B) method. You may
   use either Simplex Algorithm method or Graphical Method as per your choice, to
   solve.

$$\text{Maximize } Z = 3x_1 + 5x_2$$

Subject to: $2x_1 + 4x_2 \leq 25$

$$x_1 \leq 8$$
$$2x_2 \leq 10 \hspace{4cm} [8 + 12 = 20]$$

2. (a) An item sells for $25 a unit, but a 10% discount is offered for lots of 150 units or
   more. A company uses this item at the rate of 20 units per day. The setup cost for
   ordering a lot is $50, and the holding cost per unit per day $.30. The lead time is 12
   days. Should the company take advantage of the discount? You may make any other
   assumption if required.

(b) The owner of a newsstand wants to determine the number of newspapers of Times of India to be stocked at the start of each day. The owner pays Rs. 1.50 for a copy and sells it for Rs.5.00. The sale of newspaper occur between 7:00 and 7:30 A.M. (practically instant demand). Unsold newspapers left at the end of the day are resold at Rs. 0.20 per copy. How many copies should the owner stock every morning, assuming that the demand for the day can be treated as a Normal Distribution with mean 250 copies and standard deviation 22 copies?   [10 + 10 = 20]

3. An electronic device consist of three components. The three components are in series so that the failure of one component causes the failure of the device. The reliability,(i.e. probability of no failure) of the device can be improved by installing one or two standby units in each component. The table listed below charts the reliability, r, and the cost c. The total capital available for the construction of the device is \$10,000. Use the *Dynamic Programming methodology* to find out how the device should be constructed so as to maximize the reliability $r_1 r_2 r_3$ of the device. [16]

Number of parallel units	Component 1 r_1	c_1 (\$)	Component 1 r_2 ($)	c_1	Component 1 r_3	c_1 (\$)
1	.6	1000	.7	3000	.5	2000
2	.8	2000	.8	5000	.7	4000
3	.9	3000	.9	6000	.9	5000

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