Indian Statistical Institute, Bangalore

M.S. (QMS) First Year

Second Semester – Operations Research II

Max. Marks: 50 Duration: 3 Hrs Date: March 04, 2020

This paper carries 60 marks. You may answer as many questions as you can, but your maximum score will be limited to 50

1. (a) A game board has 3X3 equal squares. It is required to fill each square with a number between 1 and 9 such that the sum of the numbers in each row, each column and each diagonal equals 15. Additionally, numbers in all the squares must be distinct. Formulate this problem as an ILP.

   (b) XYZ Company, which have only one Aircraft, got a contract from a corporation to transport big crates of machine parts periodically from factory to mineral exploration site.

   There are two types of crates, with weight and volumes & Revenue gains as given below;

Type of Crate	Wt.(Kg)	Vol.(m^3)	Revenue(Rs/Crate)
A	3	4	4
B	4	2	3
Aircraft Capacity:	12	9	

   The Company wishes to maximize its revenue.

   (i) Formulate this as ILP

   (ii) Find the solution by B&B method (graphical solution is accepted).

   [6+12 = 18]

2. A vessel will be loaded with 3 different types of items. Each unit of item i (i = 1, 2, 3) has a weight w_i (tons) and value v_i (Rupees) as shown in the following table:

i	w_i	v_i
1	2	32
2	3	48
3	1	15

   The maximum Vessel Capacity is W = 4 tons.

   It is required to determine the most valuable cargo load without exceeding the maximum capacity of the vessel.

   Find the Optimal Solution using Backward Recursive DP method. [18]

3. (a) Derive the Deterministic EOQ formula of Inventory, used to calculate optimal order quantity y*, under the following assumptions:

   (i) No shortage allowed
   (ii) Order is supplied instantaneously
   (iii) Demand rate is known and constant.

   Use the usual notations for deriving the model.

   (b) McBurger orders ground meat at the start of each week to cover the week's demand of 300 lb. The fixed cost per order is $20. It costs about $.03 per lb per day to refrigerate and store the meat.

   (i) Determine the inventory cost per week of the present ordering policy
   (ii) Determine the optimum inventory policy that McBurger should use, assuming zero lead time between the placement and receipt of the order.

[6+6 =12]

4. Consider the inventory situation in which the stock is replenished uniformly (rather than instantaneously) at the rate a. Consumption occurs at the constant rate D. Because consumption also occurs during the replenishment period, it is necessary that $a > D$. The setup cost is K per order, and the holding cost is h per unit per unit time. If y is the order size and no shortage is allowed, show that

   (i) The maximum inventory level is $y(1 - D/a)$

   (ii) The total cost per unit time given y is

$$TCU(y) = KD/y + h/2(1 - D/a)y$$

   (iii) The economic order quantity is

$$y^* = [2KD/h(1 - D/a)]^{1/2}$$

[12]

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