

**K. J. SOMAIYA INSTITUTE OF MANAGEMENT STUDIES AND RESEARCH**

**Program PGDM B Tri (III)**

**Subject: Operations Research**  
**(End-Term Examination)**

**Date of Exam:06/04/2017**

**Time: 3 hours**

**Marks:50**

**Notes:**

- 1. You have to attempt 5 questions in all.**
- 2. Make suitable assumptions if required and state them.**
- 3. Write all relevant answers in your answer sheet, with sufficient detail to enable a fast evaluation of your answers.**
- 4. Use Excel as required and keep saving the file on the desktop every ten minutes or so.**
- 5. Make only 1 Excel file with different worksheets pertaining to each question.**
- 6. Name the file with your division and roll number only (no names). Finally, before handing over the answer sheet, transfer the file to an exam folder, as per on-the-spot instructions given to you.**
- 7. You can use Andersen Sweeney Textbook for Reference since this is an open book exam.**

**Question 1**

**10 mks**

- A. Does the following linear programming problem exhibit infeasibility, unboundedness, or alternate optimal solutions? Explain.

Min  $3X + 3Y$

s.t.  $1X + 2Y \leq 16$   
 $1X + 1Y \leq 10$   
 $5X + 3Y \leq 45$   
 $X, Y \geq 0$

- B. The Tiernan Gallery and Art Museum distributes to its visitors a printed guide to its collections. There are about 18000 visitors per year. Holding costs for the brochures are 20% and it costs \$30 to place an order with the printer. The printer has offered the following discount schedule:

Category	Order Size	Unit Cost
1	0 - 1499	\$2.50
2	1500 - 2999	\$2.20
3	3000 and over	\$1.80

How many brochures should be printed at a time?

### Question 2

10 mks

The formulated LP model represents a problem whose solution will tell a specialty retailer how many of four different styles of umbrellas to stock in order to maximize profit. It is assumed that every one stocked will be sold. The variables measure the number of women's umbrellas, golf umbrellas, men's umbrellas, and folding umbrellas, respectively. The constraints measure storage space in units, special display racks, demand, and a marketing restriction, respectively.

### **SOLVE THE LINEAR PROGRAMMING PROBLEM USING SOLVER**

$$\text{MAX} \quad 4 X_1 + 6 X_2 + 5 X_3 + 3.5 X_4$$

SUBJECT TO

$$2) \quad 2 X_1 + 3 X_2 + 3 X_3 + X_4 \leq 120$$

$$3) \quad 1.5 X_1 + 2 X_2 \leq 54$$

$$4) \quad 2 X_2 + X_3 + X_4 \leq 72$$

$$5) \quad X_2 + X_3 \geq 12$$

Answer the questions.

- How many women's umbrellas, golf, men's and folding umbrellas be stocked?
- How much space is left unused?
- How many racks are used?
- By how much is the marketing restriction exceeded?
- What is the total profit?
- By how much can the profit on women's umbrellas increase before the solution would change?
- To what value can the profit on golf umbrellas increase before the solution would change?
- By how much can the amount of space increase before there is a change in the dual price?
- You are offered an advertisement that should increase the demand constraint from 72 to 86 for a total cost of \$20. Would you say yes or no?

**Question 3**

**10 mks**

- A.** FarmFresh Foods manufactures a snack mix called TrailTime by blending three ingredients: a dried fruit mixture, a nut mixture, and a cereal mixture. Information about the three ingredients (per ounce) is shown below.

Ingredient	Cost	Volume	Fat Grams	Calories
Dried Fruit	.35	1/4 cup	0	150
Nut Mix	.50	3/8 cup	10	400
Cereal Mix	.20	1 cup	1	50

The company needs to develop a linear programming model whose solution would tell them how many ounces of each mix to put into the TrailTime blend. TrailTime is packaged in boxes that will hold between three and four cups. The blend should contain no more than 1000 calories and no more than 25 grams of fat. Dried fruit must be at least 20% of the volume of the mixture, and nuts must be no more than 15% of the weight of the mixture. Develop a model that meets these restrictions and minimizes the cost of the blend. **DO NOT SOLVE, ONLY FORMULATE.**

- B.** A professor has been contacted by four not-for-profit agencies that are willing to work with student consulting teams. The agencies need help with such things as budgeting, information systems, coordinating volunteers, and forecasting. Although each of the four student teams could work with any of the agencies, the professor feels that there is a difference in the amount of time it would take each group to solve each problem. The professor's estimate of the time, in days, is given in the table below. Use SOLVER to see which team works with which project.

Team	Projects			
	Budgeting	Information	Volunteers	Forecasting
A	32	35	15	27
B	38	40	18	35
C	41	42	25	38
D	45	45	30	42

**Question 4**

**10 mks**

- a. The manager of Home Office Supplies, Gigi Staples, has just received demand forecasts and capacity (supply) figures for next month. These are summarized along with unit shipping costs in the following transportation table.

To	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	Supply
From						
O <sub>1</sub>	8	4	--	11	9	220
O <sub>2</sub>	7	6	10	5	6	260
O <sub>3</sub>	12	13	9	16	9	200
Demand	140	180	150	140	195	

Suppose that route from O<sub>1</sub> to D<sub>3</sub> is unacceptable, solve the transportation problem to determine the optimal shipping schedule that minimizes the total cost.

- b. The following data show the average monthly cellular telephone bill:

Year	1998	1999	2000	2001	2002	2003
Amount (\$)	39.43	41.24	45.27	47.37	48.40	49.91

- i. Graph the time series. Does a linear trend appear?
- ii. Develop the equation for the linear trend component for this time series.
- iii. Use the trend equation to estimate the average monthly bill for 2004.

**Question 5**

**10 mks**

South Central Airlines operates a commuter flight between Atlanta and Charlotte. The plane holds 30 passengers and the airline makes a \$100 profit on each passenger on the flight. When South Central takes 30 reservations for the flight experience has shown that on an average 2 passengers do not show up. As a result, with 30 reservations, South Central is averaging 28 passengers with a profit of 28(100) = \$2800 per flight. The Airline operations office has asked for an evaluation of an overbooking strategy where they would accept 32 reservations even though the airplane holds only 30 passengers. The probability distribution for the number of

passengers showing up when 32 reservations are accepted is as follows:

Passengers showing up	Probability
28	0.05
29	0.25
30	0.5
31	0.15
32	0.05

The airline will receive a profit of \$100 for each passenger on the flight upto the capacity of 30 passengers. The airline will incur a cost for any passenger denied seating on the flight. This cost covers added expenses of rescheduling the passenger as well as loss of goodwill estimated to be \$150 per passenger. Develop a worksheet model that will simulate the performance of the overbooking system. Simulate the number of passengers showing up for each of 100 flights. Use the results to compute the profit for each flight.

- Does your simulation recommend the overbooking strategy? What is the mean profit per flight if overbooking is implemented?

**Question 6**

**10 mks**

Quarterly billing for water usage is shown below. Forecast the billing for year 5. Make suitable assumptions, draw the graph and state which Forecasting model you are using and why. Show all necessary workings, interim figures and final forecasts.

Quarter	Year			
	1	2	3	4
Winter	64	66	68	73
Spring	103	103	104	120
Summer	152	160	162	176
Fall	73	72	78	88

-----End of Paper-----