K. J. Somaiya Institute of Management Studies and Research

Program: PGDM-Executive Trimester V

Subject: Data Modeling and Decision Making
(End Term Examination)

Maximum Marks: 25 Date: 16th December, 2019
Duration: 2 hours

Notes:

1. **You have to attempt 3 questions in all. Question 1 is compulsory and carries 15 marks. Do any 2 questions out of remaining 4. Questions 2 to 4 carry 5 marks each.**
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 every ten minutes or so.**
5. **Make only 1 Excel file with different worksheets pertaining to each question.**
6. **Name the file with your name and roll number. Finally, before handling over the answer sheet, transfer the file to an exam folder, as per on-the-spot instructions given to you.**

1. Management Sciences Associates (MSA) is a marketing and computer research firm based in Washington, D.C., that handles consumer surveys. One of its clients is a national press service that periodically conducts political polls on issues of widespread interest. In a survey for the press service, MSA determines that it must fulfill several requirements in order to draw statistically valid conclusions on the sensitive issue of new U.S. immigration laws:

   i. Survey at least 2,300 U.S. households in total

   ii. Survey at least 1,000 households whose heads are 30 years of age or younger

   iii. Survey at least 600 households whose heads are between 31 and 50 years of age

   iv. Ensure that at least 15% of those surveyed live in a state that borders on Mexico

   v. Ensure that no more than 20% of those surveyed who are 51 years of age or over live in a state that borders on Mexico

   MSA decides that all surveys should be conducted in person. It estimates that the costs of reaching people in each age and region category are as follows:

Region	Cost Per Person Surveyed ($)		
	Age ≤ 30	**Age 31 - 50**	**Age ≥ 51**
State Bordering Mexico	7.50	6.80	5.50
State Not Bordering Mexico	6.90	7.25	6.10

MSA would like to meet the five sampling requirements at the least possible cost. **Formulate and solve the LPP.**

2.

a. The Greene Daisy Company offers a spring tune up-service for power lawn mowers at a price of Rs. 25. Labor and supplies cost an average of Rs. 10 per tune-up, and overhead charged to the operation is Rs. 5,000 per month.

   i. What profit or loss would result if from 375 tune-ups are performed per month?

   ii. What is the monthly volume needed to break-even?

b. Solve the following LPP **using Excel Solver**.

$$\begin{aligned} \text{Max} \quad & 25x_1 + 40x_2 \\ \text{s.t.} \quad & \\ & 2x_1 + x_2 \leq 60 \\ & 4x_1 - x_2 \leq 20 \\ & x_1 \geq 80 \\ & x_1, x_2 \geq 0 \end{aligned}$$

3. Solve the following LPP **using Excel Solver and give the complete optimal solution**. **Also determine binding and non-binding constraints**. Generate the sensitivity report and **answer any 4 parts:**

$$\begin{aligned} \text{Max} \quad & x_1 + 1.25x_2 \\ \text{s.t.} \quad & 5x_1 + 7x_2 \leq 4480 \\ & 3x_1 + x_2 \leq 2080 \\ & 2x_1 + 2x_2 \leq 1600 \\ & x_1, x_2 \geq 0 \end{aligned}$$

a) Determine and interpret the range of optimality for objective function coefficients of x_1 and x_2.

b) If the objective function coefficient of x_1 is increased to 1.2 from 1, will the optimal solution change?

c) If the objective function coefficient of x_2 is decreased to 0.5 from 1.25, will the optimal solution change?

d) Suppose the objective function coefficient of x_1 is increased to 3 and the objective function coefficient of x_2 is decreased to 1. What will be the impact on optimal solution?
e) Interpret the dual prices of 1st and 2nd constraints.
f) If the RHS of 1st constraint is decreased to 4400 and RHS of 3rd constraint is decreased to 1500, will the dual prices still be applicable?
g) What is the range of feasibility of 3rd constraint? Interpret.

4. A state in Missouri has three major power-generating companies (Hill St., Park Ave., and Drury L.). During the months of peak demand, the Missouri Power Authority authorizes these companies to pool their excess supply and to distribute it to smaller independent power companies that do not have generators large enough to handle the demand. Excess supply is distributed on the basis of cost per kilowatt hour transmitted. The following table shows the demand and supply in millions of kilowatt hours and the cost per kilowatt hour of transmitting electric power to four small companies in cities Reno, Phoenix, Denver, and Cleveland:

To From	Reno	Phoenix	Denver	Cleveland	**Supply**
Hill St.	12	4	9	5	**55**
Park Ave.	18	1	6	6	**45**
Drury L.	1	12	4	7	**60**
Demand	**40**	**20**	**50**	**20**	

Find an optimal transmission assignment so as to minimize the cost per kilowatt hour.

5. The hospital administrator at St. Charles General must appoint head nurses to four newly established departments: Urology, Cardiology, Orthopedics, and Obstetrics. In anticipation of this staffing problem, she had hired four nurses: A, B, C, and D. Believing in the quantitative analysis approach to problem solving, the administrator has interviewed each nurse, considered his or her background, personality, and talents, and developed the following cost matrix:

	Urology	**Cardiology**	**Orthopedics**	**Obstetrics**
A	28	18	15	X
B	32	48	23	38
C	X	36	24	36
D	25	38	55	12

X indicates that assignment is not possible. Find the optimal nurse-department assignment in order to minimize the cost.

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