SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: Jan – Mar 24 **Maximum Marks: 50 Examination: ETE Exam Date: 30-03-24 Duration: 3 Hrs**		
Programme code: 01 **Programme: Master of Business Administration**	**Class:** FY	**Trimester: III**
College: K. J. Somaiya Institute of Management	**Name of the department/Section/Center:** Business Analytics	
Course Code: 217P01C312	**Name of the Course: Decision Science**	

Instructions:

You have to attempt 5 questions in all. Question 1 is compulsory. Do any 4 questions Question 2 to Question 6. All questions carry equal marks.

You will be assessed for your abilities to formulate the O.R. problem, model it in excel, solve it with Solver, and interpret the results.

Make suitable assumptions if required and state them.

Write all relevant answers and interpretations in your excel sheet with sufficient details to enable a fast evaluation of your answers.

Use Excel and Solver as required and keep saving the file every ten minutes or so.

Make only 1 Excel file with different worksheets pertaining to each question.

Name the files as instructed by the IT staff invigilator.

Question No.		Max. Marks
Q1	The Electro-Poly Corporation is the world's leading manufacturer of slip rings. Each slip ring requires a certain amount of time to wire and harness. Unfortunately, Electro-Poly does not have enough wiring and harnessing capacity to fill the order by its due date and thus is ready to subcontract any portion of this order to one of its competitors. Electro-Poly wants to determine the number of slip rings to make and the number to buy to fill the customer order at the least possible cost. The formulation for this problem is given below: Let M1, M2, M3 be the number of model 1, model 2 and model 3 slip rings to be made in-house respectively. Further, let B1, B2, B3 be the number of model 1, model 2 and model 3 slip rings to be bought from competitor $\text{MIN: } 50M_1 + 83M_2 + 130M_3 + 61B_1 + 97B_2 + 145B_3$ } total cost $\text{Subject to: } M_1 + B_1 = 3{,}000$ } demand for model 1 $M_2 + B_2 = 2{,}000$ } demand for model 2 $M_3 + B_3 = 900$ } demand for model 3 $2M_1 + 1.5M_2 + 3M_3 \leq 10{,}000$ } wiring constraint $1M_1 + 2M_2 + 1M_3 \leq 5{,}000$ } harnessing constrai $M_1, M_2, M_3, B_1, B_2, B_3 \geq 0$ } nonnegativity condi **Sensitivity Report:**	**10**

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowa Decrea
B6	- Make Model 1	3,000	0.00	50	4	
C6	- Make Model 2	550	0.00	83	14	
D6	- Make Model 3	900	0.00	130	8	
B7	- Buy Model 1	0	4.00	61	1E+30	
C7	- Buy Model 2	1,450	0.00	97	8	
D7	- Buy Model 3	0	8.00	145	1E+30	

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowa Decrea
B13	# Available Model 1	3,000	57.00	3000	380	2
C13	# Available Model 2	2,000	97.00	2000	1E+30	1
D13	# Available Model 3	900	137.00	900	211.1111	
E17	- Wiring Used	9,525	0.00	10000	1E+30	
E18	- Harnessing Used	5,000	(7.00)	5000	633.3333	1

Answer the following questions using the Sensitivity Report. **DO NOT SOLVE AGAIN**

a. How much can the cost of making model 1 slip rings increase before it becomes more economical to buy some of them?

b. Suppose the cost of buying model 2 slip rings decreased by $9 per unit. Would the optimal solution change?

c. Suppose to increase the harnessing capacity, Electro-Poly will have to pay workers an extra of $18 per hour. Is it worth increase the harnessing hours? Explain

d. If the demand of Model 1 and Model 2 both reduced by 1000 units, how would that impact the overall cost?

Q2 (10)

The management of Hartman Company is trying to determine the amount of each of two products to produce over the coming planning period. The following information concerns labor availability, labor utilization, and product profitability:

	Product (hours/unit)		Labour hours available
Department	**1**	**2**	
A	1.00	0.35	100
B	0.30	0.20	36
C	0.20	0.50	50
Profit Contribution/unit $	30	15	

Suppose that 10, 6, and 8 hours of overtime may be scheduled in departments A, B, and C, respectively. The cost per hour of overtime is $18 in department A, $22.50 in department B, and $12 in department C.

a. Formulate the problem as an LP model to maximize the profit and determine the optimal production plan. Write the mathematical description of the model.

b. Solve the model in Excel with Solver and obtain the optimal solution.

Q3 (10)

A. Maria Rojas is considering the possibility of opening a small dress shop on Fairbanks Avenue, a few blocks from the university. She has located a good mall that attracts students. Her options are to open a small shop, a medium-sized shop, or no shop at all. The market for a dress shop can be good, average, or bad. The net profit or loss figures for the medium-sized and small shops for the various market conditions are given in the following table. Building no shop at all yields no loss and no gain.

ALTERNATIVE	GOOD MARKET ($)	AVERAGE MARKET ($)	BAD MARKET ($)
Small shop	75,000	25,000	–40,000
Medium-sized shop	100,000	35,000	–60,000
No shop	0	0	0

What is the optimal decision under the Hurwicz Criterion where the coefficient of optimism (α) is 0.45?

Does the optimal decision change if the Maria chooses to adopt the minmax Regret rule?

B. Two opposing armies, Red and Blue, must each decide whether to attack or defend. These decisions are made without knowledge of the opposing army's decision. The payoff table, in terms of value of property gained or lost for the Red Army, appears below. Any gains for the Red Army are losses for the Blue Army.

		Blue Army: Attack	Blue Army: Defend
Red Army	Attack	30	50
	Defend	40	0

Identify the optimal mixed strategy for the Red Army and the Blue Army. Also identify the property gained by Red Army in this process.

Q4 (10)

A coaching institute preparing students for competitive exams admits students to its coaching program on the basis of an entrance test. Every student scoring 95 marks or more in the entrance test is offered a full scholarship worth ₹90000. Those who obtain below 35 are not admitted to the coaching institute. The remaining students are offered admission and charged full coaching fees. From past data, the coaching institute knows that marks of students in the entrance test are normally distributed with a mean value of 67 and a standard deviation of 18. In the upcoming year, the coaching center plans to conduct the entrance test for 150 students. Determine:

a. Number of students who will pass the entrance test
b. The total no. of students that will be offered full scholarship
c. The total scholarship amount that the coaching institute will have to bear.

(Assume student marks to be discrete values only).

Q5 (10)

The amount of movie tickets sold at the Library Cinema-Complex between 1998 and 2010 are listed here, in thousands.

Year	Number of tickets sold
1998	8.61
1999	8.14
2000	7.67
2001	6.59
2002	7.37
2003	6.88
2004	6.71
2005	6.61
2006	5.58
2007	5.87
2008	5.94
2009	5.49
2010	5.43

a. Calculate a four-year moving average and four-year weighted moving average (weights: 0.28, 0.22, 0.34, 0.16) of the given data.

b. Compare the performance metrics of the above methods and comment on which method is more accurate.

c. Plot the results and interpret.

Q6

10

A. Tri-County Utilities, Inc., supplies natural gas to customers in a three-county area. The company purchases natural gas from two companies: Southern Gas and Northwest Gas. Demand forecasts for the coming winter season are Hamilton County, 400 units; Butler County, 200 units; and Clermont County, 300 units. Contracts to provide the following quantities have been written: Southern Gas, 500 units; and Northwest Gas, 400 units. Distribution costs for the counties vary, depending upon the location of the suppliers. The distribution costs per unit (in thousands of dollars) are as follows:

	To		
From	**Hamilton**	**Butler**	**Clermont**
Southern Gas	10	20	15
Northwest Gas	12	15	18

Solve the above model that can be used to determine the plan that will minimize total distribution costs.

B. A production supervisor is considering how he should assign the four jobs that are to be performed, to four of the workers. He wants to assign the jobs to the workers such that the aggregate time to perform the jobs is the least. Based on previous experience, he has the information on the time taken by the four workers in performing these jobs as given in the table below:

	Job			
Worker	**A**	**B**	**C**	**D**
1	45	40	51	67
2	57	42	63	55
3	49	52	48	64
4	41	45	60	55

Solve the above problem to obtain the optimal assignment of workers to the respective jobs.