Semester: June – Sep 24			
Maximum Marks: 50 **Examination: ETE Exam** **Date: 6/11/2024** **Duration: 2 Hours**			
Programme code: 1 **Programme: MBA**		**Class:** FY	**Semester/Trimester: I**
College: K. J. Somaiya Institute of Management		**Name of the department/Section/Center: Business Analytics**	
Course Code: 317P01C103		**Name of the Course: Decision Science**	

Instructions:

1. All questions are compulsory. There is an internal choice in Que 1B and in Que 3.

2. Make suitable assumptions if required and state them.

3. Write all relevant answers and interpretations in your Excel sheet, with sufficient details in an easily readable manner to enable a fast evaluation of your answers.

4. Keep saving the file every ten minutes or so.

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

6. The naming convention for the file should have your roll number and name.

7. Please follow the instructions of the faculty/IT staff on duty.

Question No.		Max. Marks
1A	The CEO of a medium-sized electronics company is concerned about the rising production costs of its flagship product over recent years. The data below show the cost per unit of production for the company's main product over the past eight years: <table><tr><td>Year</td><td>Cost per Unit ($)</td></tr><tr><td>1</td><td>12</td></tr><tr><td>2</td><td>17.8</td></tr><tr><td>3</td><td>21</td></tr><tr><td>4</td><td>19</td></tr><tr><td>5</td><td>25.3</td></tr><tr><td>6</td><td>27.9</td></tr><tr><td>7</td><td>36</td></tr><tr><td>8</td><td>38</td></tr></table> a. Construct a time series plot. What type of pattern exists in the data? b. Find the parameters for the line that minimizes the Mean Squared Error (MSE) for this time series. c. What is the average cost increase the company has experienced per year? d. Estimate the cost per unit for the next year (Year 9).	10
1B	Coal is mined and processed at the following four mines in Kentucky, West Virginia, and Virginia: **Location** **Capacity (tons)** Cabin Creek 90 Surry 50	5

Old Fort   80

McCoy   60

These mines supply the following amount of coal to utility power plants in three cities:

Plant   **Demand (tons)**

Richmond   120

Winston-Salem 100

Durham   110

The railroad shipping costs (in thousands of dollars) per ton of coal are shown in the following table.

		Location		
		Richmond	**Winston-Salem**	**Durham**
Plant	**Cabin Creek**	7	10	5
	Surry	12	9	4
	Old Fort	7	3	11
	McCoy	9	5	7

Solve the problem to determine the minimum shipping cost.

OR

A shop has four machinists to be assigned to four machines. The hourly cost of having each machine operated by each machinist is as follows:

Machinist	Region (Days)			
	A	**B**	**C**	**D**
1	$12	$11	$8	$14
2	$10	$9	$10	$8
3	$14	$8	$7	$11
4	$6	$8	$10	$9

However, because he does not have enough experience, machinist 3 cannot operate machine B. Determine the optimal assignment and compute total minimum cost.

---

2   **15**

Maria runs a bakery that specializes in theme based caked. The demand distribution is listed below:

Demand (cakes/day)	Probability
5	.05
10	.20
15	.40
20	.20
25	.10

Each cake cost her $3. She sells the cake for $10. The cakes that are sold the next day are sold at $6. The revenue from the unsold cakes is included in the revenue of its baking day for accounting purposes.

a.   Simulate trials for 30 days and find potential profits.

b.   Determine the service level. (Hint: Ratio of Total Sales/Total Demand)

c.   Does the store need to change its current policy of preparing 20 cakes each day?

---

3   Kathy Roniger, campus dietitian for a small Idaho college, is responsible for formulating a nutritious meal plan for students. For an evening   **20**

meal, she feels that the following five meal-content requirements should be met: (1) between 900 and 1,500 calories; (2) at least 4 milligrams of iron; (3) no more than 50 grams of fat; (4) at least 26 grams of protein; and (5) no more than 50 grams of carbohydrates. On a particular day, Roniger's food stock includes seven items that can be prepared and served for supper to meet these requirements. The cost per pound for each of the seven food items and the contribution of each to the five nutritional requirements are given in the table on this page. What combination and amounts of food items will provide the nutrition Roniger requires at the least total food cost?

	FOOD VALUES					
FOOD ITEM	CALORIES/ LB	IRON (MG/LB)	FAT (GM/ LB)	PROTEIN (GM/LB)	CARBOHYDRATES (GM/LB)	COST/ LB ($)
Milk	295	0.2	16	16	22	0.60
Ground meat	1,216	0.2	96	81	0	2.35
Chicken	394	4.3	9	74	0	1.15
Fish	358	3.2	0.5	83	0	2.25
Beans	128	3.2	0.8	7	28	0.58
Spinach	118	14.1	1.4	14	19	1.17
Potatoes	279	2.2	0.5	8	63	0.33

OR

Zippy Motorcycle Manufacturing produces two popular pocket bikes (miniature motorcycles with 49cc engines): the Razor and the Zoomer. In the coming week the manufacturer wants to produce up to 700 bikes and wants to ensure the number of Razors produced does not exceed the number of Zoomer by more than 300. Each Razor produced and sold results in a profit of $70 while each Zoomer results in a profit of $40. With additional limitations on the availability of polymer (900 pounds) and labour hours (2400 hours), the above problem is formulated as an LPP as given below:

Let R = number of Razors produced, Z = number of Zoomers produced

$$\text{MAX} \quad 70\,R + 40\,Z$$
$$\text{ST} \quad R + Z \leq 700 \qquad \text{(To produce up to 700 bikes)}$$
$$R - Z \leq 300 \qquad \text{(Razors should not exceed Zoomers by 300)}$$
$$2\,R + 1\,Z \leq 900 \qquad \text{(Available pounds of Polymer)}$$
$$3\,R + 4\,Z \leq 2400 \qquad \text{(Available labour hours)}$$
$$R, Z \geq 0$$

Solve the above problem using Solver and generate the sensitivity report to answer the following questions:

a. If the profit on Razors decreased to $35, how would it impact the optimal solution?

b. What is the impact on the optimal solution if the profit on both Razors and Zoomers increases by $5?

c. Suppose that the manufacturers realise that during supply some raw material was destroyed and now they have only 750 pounds of polymer available. How would this impact the profit?

d. Why is the shadow price $0 for the constraint limiting the production of pocket bikes to no more than 700 units?

e. Suppose the company could obtain 300 additional labor hours in production at a total cost of $900. How do the additional hours impact the optimal level of profit? Would you advise the company to avail the additional hours?