

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	<p>The table below shows the quarterly sales (in thousands of units) for a manufacturing company from Q1 2021 to Q4 2023. The company wants to forecast the sales for Q1 of 2024.</p> <p style="text-align: center;">Sales Data (in thousands of units)</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Year</th> <th style="text-align: center;">Quarter</th> <th style="text-align: center;">sales</th> </tr> </thead> <tbody> <tr> <td rowspan="4" style="text-align: center;">2021</td> <td style="text-align: center;">Q1</td> <td style="text-align: center;">125</td> </tr> <tr> <td style="text-align: center;">Q2</td> <td style="text-align: center;">145</td> </tr> <tr> <td style="text-align: center;">Q3</td> <td style="text-align: center;">160</td> </tr> <tr> <td style="text-align: center;">Q4</td> <td style="text-align: center;">113</td> </tr> <tr> <td rowspan="4" style="text-align: center;">2022</td> <td style="text-align: center;">Q1</td> <td style="text-align: center;">130</td> </tr> <tr> <td style="text-align: center;">Q2</td> <td style="text-align: center;">152</td> </tr> <tr> <td style="text-align: center;">Q3</td> <td style="text-align: center;">132</td> </tr> <tr> <td style="text-align: center;">Q4</td> <td style="text-align: center;">199</td> </tr> <tr> <td rowspan="4" style="text-align: center;">2023</td> <td style="text-align: center;">Q1</td> <td style="text-align: center;">123</td> </tr> <tr> <td style="text-align: center;">Q2</td> <td style="text-align: center;">112</td> </tr> <tr> <td style="text-align: center;">Q3</td> <td style="text-align: center;">142</td> </tr> <tr> <td style="text-align: center;">Q4</td> <td style="text-align: center;">154</td> </tr> </tbody> </table> <p>a. Calculate a 4-quarter moving average forecast for each quarter from Q1 2022 to Q4 2023. b. Apply exponential smoothing with a smoothing constant (α) of 0.4 to forecast the sales for Q1 2024 using the actual sales data. c. Evaluate the performance of both the moving average and exponential smoothing methods by calculating the Mean Squared Error (MSE) d. Which method is better and why?</p>	Year	Quarter	sales	2021	Q1	125	Q2	145	Q3	160	Q4	113	2022	Q1	130	Q2	152	Q3	132	Q4	199	2023	Q1	123	Q2	112	Q3	142	Q4	154	10
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1B	<p>Finnish Furniture manufactures tables in facilities located in three cities—Reno, Denver, and Pittsburgh with the following capacities:</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;">Facilities</th> <th style="text-align: left;">Supply</th> </tr> </thead> <tbody> <tr> <td>Reno</td> <td>120</td> </tr> <tr> <td>Denver</td> <td>200</td> </tr> <tr> <td>Pittsburgh</td> <td>160</td> </tr> </tbody> </table>	Facilities	Supply	Reno	120	Denver	200	Pittsburgh	160	5																						
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The tables are then shipped to three retail stores located in Phoenix, Cleveland, and Chicago, which have the following demands:

Retail Stores Demand

Phoenix	150
Cleveland	170
Chicago	190

Management wishes to develop a distribution schedule that will meet the demands at the lowest possible cost. The shipping cost per unit (in 100\$) from each of the sources to each of the destinations is shown in the following table:

		Facilities		
		Phoenix	Cleveland	Chicago
Retail Stores	Reno	10	16	19
	Denever	12	14	13
	Pittsburgh	18	12	12

Solve the problem to determine the minimum shipping cost.

OR

The football coaching staff at Tech focuses its recruiting on several key states, including Georgia, Florida, Virginia, Pennsylvania, New York, and New Jersey. The staff includes seven assistant coaches, two of whom are responsible for Florida, a high school talent-rich state, whereas one coach is assigned to each of the other five states. The staff has been together for a long time, and at one time or another all the coaches have recruited in all the states. The head coach has accumulated some data on the past success rate (i.e., percentage of targeted recruits signed) for each coach in each state, as shown in the following table:

Coach	GA	FL	VA	PA	NY	NJ
Allen	62	56	65	71	55	63
Bush	65	70	63	81	75	72
Crumb	46	53	62	55	64	50
Doyle	58	66	70	67	71	49
Evans	77	73	69	80	80	74
Fouch	68	73	72	80	78	57
Goins	72	60	74	72	62	61

Determine the optimal assignment of coaches to recruiting regions that will maximize the overall success rate and indicate the average percentage success rate for the staff with this assignment.

2

Tracy McCoy is shopping for a new car. She has identified a particular sports utility vehicle she likes but has heard that it has high maintenance costs. Tracy has decided to develop a simulation model to help her estimate maintenance costs for the life of the car. Tracy estimates that the projected life of the car with the first owner (before it is sold) is uniformly distributed with a minimum of 2.0 years and a maximum of 8.0 years. She has determined from automobile association data that the maintenance cost per mile driven for the vehicle she is interested in is normally distributed, with a mean of \$0.08 per mile and a standard deviation of \$0.02 per mile.

Develop a simulation model using 100 trials and determine the average maintenance cost for the life of the car with Tracy and the probability that the cost will be less than \$3,000.

15

3

Eddie Kelly is running for re-election as mayor of a small town in Alabama. Jessica Martinez, Kelly's campaign manager during this election, is planning the marketing campaign, and there is some stiff competition. Martinez has selected four ways to advertise: television ads, radio ads, billboards, and newspaper ads. The costs of these, the audience reached by each type of ad, and the maximum number available are shown in the following table:

20

TYPE OF AD	COST PER AD	AUDIENCE REACHED/AD	MAXIMUM NUMBER
TV	\$800	30,000	10
Social media	\$400	22,000	10
Billboards	\$500	24,000	10
Newspapers	\$100	8,000	10

In addition, Martinez has decided that there should be at least six ads on TV or social media or some combination of those two. The amount spent on billboards and newspapers together must not exceed the amount spent on TV ads. While fund raising is still continuing, the monthly budget for advertising has been set at \$15,000. Formulate and solve the above problem as a linear programming problem and answer the following:

- How many ads of each type should be placed to maximize the total number of people reached?
- Interpret the non-binding constraints.

OR

Industrial Designs has been awarded a contract to design a label for a new wine produced by Lake View Winery. The company estimates that 150 hours will be required to complete the project. The firm's three graphic designers available for assignment to this project are Lisa, a senior designer and team leader; David, a senior designer; and Sarah, a junior designer. Because Lisa has worked on several projects for Lake View Winery, management specified that Lisa must be assigned at least 40% of the total number of hours assigned to the two senior designers. To provide label-designing experience for Sarah, she must be assigned at least 15% of the total project time (i.e. 15 hours). However, the number of hours assigned to Sarah must not exceed 25% of the total number of hours assigned to the two senior designers. Due to other project commitments, Lisa has a maximum of 50 hours available to work on this project. Hourly wage rates are \$30 for Lisa, \$25 for David, and \$18 for Sarah. The above problem has been formulated as a LPP to determine the number of hours each graphic designer should be assigned to the project in order to minimize total cost. Solve the given LPP using Solver and answer the questions on sensitivity analysis that follows:

Let L = number of hours assigned to Lisa, D = number of hours assigned to David, S = amount allocated to Sarah

Min	$30L$	+	$25D$	+	$18S$	
s.t.	L	+	D	+	S	= 150 Total Time
	$0.6L$	-	$0.4D$			≥ 0 Lisa 40% requirement
					S	≥ 15 Minimum Sarah
	$-0.25L$	-	$0.25D$	+	S	≤ 0 Maximum Sarah
	L					≤ 50 Maximum Lisa

- How many hours should each graphic designer be assigned to the project? What is the optimal cost?
- Identify and interpret the non-binding constraints.
- Lake View Winery wanted to reduce the overall cost. Hence, after some negotiation, both the senior designers are willing to charge \$4 less. How will this affect the optimal solution?
- If Lisa could be assigned more than 50 hours, what effect would this have on the optimal solution? Explain.
- If the total completion time was estimated wrongly and needs additional 5 hours, how would this change affect the overall cost?