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:

1. **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.**
2. **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.**
3. **Make suitable assumptions if required and state them.**
4. **Write all relevant answers and interpretations in your excel sheet with sufficient details to enable a fast evaluation of your answers.**
5. **Use Excel and Solver as required and keep saving the file every ten minutes or so.**
6. **Make only 1 Excel file with different worksheets pertaining to each question.**
7. **Name the files as instructed by the IT staff invigilator.**

Question No.		Max. Marks
Q1	The Porsche Club of America sponsors driver education events that provide high performance driving instruction on actual race tracks. Because safety is a primary consideration at such events, many owners elect to install roll bars in their cars. Deegan Industries manufactures two types of roll bars for Porsches. Model DRB is bolted to the car using existing holes in the car's frame. Model DRW is a heavier roll bar that must be welded to the car's frame. Model DRB requires 20 pounds of a special high alloy steel, 40 minutes of manufacturing time, and 60 minutes of assembly time. Model DRW requires 25 pounds of the special high alloy steel, 100 minutes of manufacturing time, and 40 minutes of assembly time. The unit profit contributions are used to generate the total profit function. A linear programing problem is formulated to optimize the profit within the resource limitations as shown in the formulation below:	**10**

$$\text{Max} \quad 200DRB + 280DRW$$

s.t.

$$\begin{aligned} 20DRB + 25DRW &\le 40{,}000 && \text{Steel available} \\ 40DRB + 100DRW &\le 120{,}000 && \text{Manufacturing minutes} \\ 60DRB + 40DRW &\le 96{,}000 && \text{Assembly minutes} \\ DRB, DRW &\ge 0 \end{aligned}$$

Use the sensitivity report given below to answer the questions that follow. **DO NOT SOLVE AGAIN.**

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B2	DRB	1000	0	200	24	88
C2	DRW	800	0	280	220	30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
B12	Steel Available LHS	40000	8.8	40000	909.090909	10000
B13	Manufacturing Minutes LHS	120000	0.6	120000	40000	5714.28571
B14	Assembly Minutes LHS	92000	0	96000	1E+30	4000

a. Identify the binding and non-binding constraints and interpret the same.

b. Because of increased competition, Deegan is considering to increase the price of model DRW such that the new contribution to profit is $300 per unit. How would this change in price affect the optimal solution? Explain.

c. If the available manufacturing time is increased by 400 hours, will the dual value for the manufacturing time constraint change? Explain how might this affect the profit.

	d. Simultaneously with increase in manufacturing time, Deegan Industries is supplied with an additional 500 pounds of the steel alloy. Will this be profitable for Deegan? Explain.	
Q2	**A.** An investor is given the following investment alternatives and percentage rates of return. *States of Nature (Market Conditions)* Low / Medium / High Regular shares: 2% / 5% / 8% Risky shares: –5% / 7% / 15% Property: –10% / 10% / 20% On the basis of these data, state the optimal investment strategy for the investor under the Hurwicz Rule (=0.3) and the LaPlace Criterion. **B.** In a small town, there are only two stores that handle sundry goods-ABC and XVZ. The total number of customers is equally divided between the two, because price and quality of goods sold are equal. Both stores have good reputation in the community, and they render equally good customer service. Assume that a gain of customer by ABC is a loss to XVZ and vice versa. Both stores plan to run annual pre-Diwali sales during the first week of November. Sales are advertised through a local newspaper, radio or television media. With the aid of an advertising firm, store ABC constructed the game matrix given below. (Figures in the matrix represent a gain or loss of customers.) **Strategy of ABC** / **Strategy of XYZ**: **Radio**, **Television** **Newspaper**: 40, -80 **Television**: 20, 50 Determine optimal strategies for both players ABC and XYZ and interpret the value of the game.	**10**
Q3	A trust officer at the Blacksburg National Bank needs to determine how to invest $100,000 in the following collection of bonds to maximize the annual return. Bond / Annual Return / Maturity / Risk / Tax-Free A: 9.5% / Long / High / Yes B: 8.0% / Short / Low / Yes C: 9.0% / Long / Low / No D: 9.0% / Long / High / Yes E: 9.0% / Short / High / No The officer wants to invest at least 50% of the money in short-term issues and no more than 50% in high-risk issues. At least 30% of the funds should go into tax-free investments and at least 40% of the total annual return should be tax-free. a. Formulate an LP model for this problem. b. Create a spreadsheet model for this problem and solve it using Solver. c. What is the optimal solution?	**10**
Q4	A nutraceutical company is planning a promotional program for one of its health supplements. The promotional program envisages a cost of ₹3000000 per month if the monthly demand for the supplement is estimated to not exceed 50000 packs, or ₹1000000 per month if the monthly demand for the supplement is estimated to exceed 50000 packs. The production cost of one pack of the health supplement is uniformly distributed between ₹230 to ₹270 and its selling price is ₹850 per pack. The monthly demand for the health supplement is estimated to be normally distributed with a mean value of 50000 and a standard deviation of 2000. Simulate the profit for 40 random trials & determine the average monthly promotional program cost and the average monthly profit.	**10**
Q5	Listed below is the selling price for a share of PepsiCo Inc. at the close of each year. **Year** / **Amount** 2000: 35.0230 2001: 49.5625 2002: 48.68 2003: 42.22	**10**

	2004 46.62 2005 52.20 2006 59.85 2007 62.00 2008 77.51 2009 54.77 2010 60.80 a. Calculate a three-year moving average and weighted moving average of the given data. b. Use an appropriate metric to comment on which method is a better forecast for the given data. c. Plot the results and interpret.	
Q6	A market research firm's three clients each requested that the firm conduct a sample survey. Four available statisticians can be assigned to these three projects; however, all four statisticians are busy, and therefore each can handle only one client. The following data show the number of hours required for each statistician to complete each job; the differences in time are based on experience and ability of the statisticians. a. Solve the above assignment problem and obtain the optimal assignment. b. If Statistician 4 is unavailable, how does the assignment change? Which scenario is more optimal?	**10**

Statistician	***Client***		
	A	**B**	**C**
1	150	210	270
2	170	230	220
3	180	230	225
4	160	240	230