SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: Jan – Mar 24		
Maximum Marks: 50 **Examination: ETE Exam** **Date: 05-04-24** **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 Weedwacker Company manufactures two types of lawn trimmers: an electric model and a gas model. The company has contracted to supply a national discount retail chain with a total of 30,000 electric trimmers and 15,000 gas trimmers. However, Weedwacker's production capability is limited in three departments: production, assembly, and packaging. Weedwacker needs to decide how many electric and gas trimmers to buy and how many to be made in the least costly manner. The decision variables and the linear programing formulation subject to various constraints for the same are given below: **Decision Variables:** Let M1= number of electric trimmers to make ; M2= number of gas trimmers to make ; B1= number of electric trimmers to buy ; B2= number of gas trimmers to buy. $\text{MIN } 55M_1 + 85M_2 + 67B_1 + 95B_2$ $\text{ST } M_1 + B_1 = 30{,}000$ Supply of Electric Trimmers $M_2 + B_2 = 15{,}000$ Supply of Gas Trimmers $0.20M_1 + 0.40M_2 \le 10{,}000$ Production Hours $0.30M_1 + 0.50M_2 \le 15{,}000$ Assembly Hours $0.10M_1 + 0.10M_2 \le 5{,}000$ Packaging Hours $M_i, B_i \ge 0$ The minimum cost that the company has to bear at the optimal solution is \$2,97,50,000. Refer to the sensitivity report below to answer the questions that follow. **DO NOT SOLVE the LPP again**	**10**

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B4	Number to Make Electric	30,000	0	55	7.000000003	1E+30
C4	Number to Make Gas	10,000	0	85	10	14.00000001
B5	Number to Buy Electric	0	7	67	1E+30	7.000000003
C5	Number to Buy Gas	5,000	0	95	14.00000001	10

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
B10	Supply of Electric	30,000	60	30000	20000	10000
C10	Supply of Gas	15,000	95	15000	1E+30	5000
D14	Production Hours	10,000	-25	10000	800	4000
D15	Assembly Hours	14,000	0	15000	1E+30	1000
D16	Packaging Hours	4,000	0	5000	1E+30	1000

a. How much would electric trimmers have to cost in order for the company to consider purchasing these items rather than making them?
b. If the cost to make gas trimmers increased to $90 per unit, how would the optimal solution change?
c. How much should the company be willing to pay to acquire additional hours for assembly? Explain.
d. How much should the company be willing to pay to acquire additional hours for production? Explain
e. The optimal cost value of $2,97,50,000 is the most sensitive to which constraint? Explain.

Q2 (10)

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:

	COST PER PERSON SURVEYED ($)		
REGION	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 5 sampling requirements at the least possible cost. Formulate the given problem as a linear programing problem and obtain the optimal number of surveys to be conducted for every region under the given age categories.

Q3 (10)

A. A car dealer is offering three leasing options over the next 2 years that vary on monthly payment and the allowable miles. Assume that a customer expects to drive either 15,000, 20000, 25000 or 30000 miles during the next two years but is uncertain as of now. The payoff matrix for this decision problem is given below.

	Miles expected to drive in next 2 years			
Plan:	15,000	20,000	25,000	30,000
I	-$6,225.0	-$6,700.0	-$7,175.0	-$7,650.0
II	-$8,016.0	-$8,266.0	-$8,516.0	-$8,766.0
III	-$5,340.0	-$6,040.0	-$6,740.0	-$7,440.0

Obtain the optimal plan that the car dealer should opt for using the

i. Conservative (maximin) approach and

ii. Minimax Regret Approach

B. Assume that two firms are competing for market share for a particular product. Each firm is considering what promotional strategy to employ for the coming period. Assume that the following payoff matrix describes the increase in market share for firm A and decrease in market share for firm B.

Firm A's strategy	*Firm B's strategy*		
	No promotion	*Moderate promotion*	*High promotion*
No promotion	0	2	–15
Moderate promotion	12	8	–4
Price cut	20	15	6

Obtain the optimal strategy for both the firms and interpret the value of the game.

Q4 **10**

A personal grooming company has observed that daily demand for its popular men's shaving razor is normally distributed with a mean value of 1200 and a standard deviation of 104. However, the daily demand for the razor blades follows a uniform distribution ranging from 200 to 300. A shaving razor is sold at ₹270, and a razor blade at ₹180. Run a simulation for 120 days in a quarter & determine the

a. Total quarterly revenue of the company
b. The average quarterly revenue of the company
c. The maximum and minimum quarterly revenue of the company
d. Probability of the quarterly revenue being lesser than 3,50,000

Q5 **10**

Listed below is the net sales in $ million for Home Depot Inc. and its subsidiaries from 1993 to 2009.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production Year (thousands)	9,239	12,477	15,470	19,535	24,156	30,219	38,434	45,738	53,553

Year	2002	2003	2004	2005	2006	2007	2008	2009
Production Year (thousands)	58,247	64,816	73,094	81,511	90,837	77,349	71,300	66,200

a. Plot the time series and interpret the pattern observed.
b. Compute the trend equation and forecast the sales for the next 2 years.
c. Compute a 4 year Moving average and forecast the sales for 2010.
d. Which method gives a better forecast for the above data?

Q6 **10**

A. A swimming coach is putting together a relay team for the 400-meter relay. Each swimmer must swim 100 meters of breaststroke, backstroke, butterfly, or freestyle, and each swimmer can swim only one race. The coach believes that each swimmer can attain the times given in the table below. To minimize the team's total time for the race, what is the optimal assignment of swimmers to the strokes?

	Free	**Breast**	**Butterfly**	**Back**
Hall	54	54	51	53
Spitz	51	57	52	52
Montgomery	50	53	54	56
Jastremski	56	54	55	53

B. Don Yale, president of Hardrock Concrete Company, has plants in three locations and is currently working on three major construction projects, located at different sites. The shipping cost per truck load of concrete, plant capacities, and project requirements are provided in the accompanying table.

To / **From**	**Project A**	**Project B**	**Project C**	**Plant Capacities**
Plant 1	$10	$4	$11	70
Plant 2	$12	$5	$8	50

		Plant 3	\$9	\$7	\$6	50
		Project Requirements	40	50	60	
		Determine the truck load of concrete that must be shipped from each plant to the respective project sites such that the overall shipping cost is minimised.				