SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: Jan – Mar 24		
Maximum Marks: 50 **Examination: ETE Exam** **Date: 04-04-24** **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	Bearland Manufacturing produces 4 different types of wood paneling. Each type of paneling is made by gluing and pressing together a different mixture of pine and oak chips. The available quantity of glue, available hours for pressing, and available pounds of pine-chips and oak chips are limited. Hence, Bearland would like to determine the optimal number of pallets of paneling to produce for the 4 types such that the profit is maximized within the given constraints. The above problem as a linear programing problem has been defined below.	**10**

Decision Variables: X1 = Pallets of Tahoe paneling to produce ; X2 = Pallets of Pacific paneling to produce ; X3 = Pallets of Savannah paneling to produce ; X4 = Pallets of Aspen paneling to produce.

$$\text{MAX} \quad 450\,X_1 + 1150\,X_2 + 800\,X_3 + 400\,X_4$$

$$\begin{aligned}
\text{ST} \quad & 50\,X_1 + 50\,X_2 + 100\,X_3 + 50\,X_4 \le 6{,}000 && \text{Glue Quantity} \\
& 50\,X_1 + 150\,X_2 + 100\,X_3 + 50\,X_4 \le 7{,}500 && \text{Pressing Hours} \\
& 500\,X_1 + 400\,X_2 + 300\,X_3 + 200\,X_4 \le 30{,}000 && \text{Pounds of Pine Chips} \\
& 500\,X_1 + 750\,X_2 + 250\,X_3 + 500\,X_4 \le 62{,}500 && \text{Pounds of Oak Chips}
\end{aligned}$$

The maximum profit attained at the optimal solution is approximately $60,429. Refer to the sensitivity report below and answer the questions that follow. **DO NOT SOLVE again.**

Decision Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B6	Pallets Tahoe	23.5714286	0.00	450	300.000001	50.0000001
C6	Pallets Pacific	15	0.00	1150	42.857143	714.285714
D6	Pallets Savannah	40.7142857	0.00	800	100	16.6666668
E6	Pallets Aspen	0	-7.14285714	400	7.14285714	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
F10	Glue Quantity	6,000	0.428571	6000	1500	2590.90909
F11	Pressing Hours	7,500	7.142857	7500	3300	1500
F12	Pounds of Pine chips	30,000	0.142857	30000	27333.3333	8250
F13	Pounds of Oak chips	33,214	0.000000	62500	1E+30	29285.7143

a. Suppose the profit per pallet of Tahoe panels went down by $40. Would the optimal solution change? Explain.

b. Simultaneous to the above, if profit per pallet of Pacific went down by 150 units, what impact would it have on the optimal solution.

Explain.

c. Suppose the profit per pallet of Aspen panels went up by $40. Would the optimal solution change?

d. How much should the company be willing to pay to obtain 1,000 additional hours of pressing capacity?

e. Suppose the company has received an offer to buy 5,000 pounds of its pine chips for $1,250. Should it accept this offer? Explain your answer.

Q2 **10**

The Marketing Department of Everest Company has collected information on the problem of advertising for its products. This relates to the advertising media available, the number of families expected to be reached with each alternative, cost per advertisement, the maximum availability of each medium and the expected exposure of each one (measured as the relative value of one advertisement in each of the media): The information is as given here:

Advertising Media	*No. of Families Expected to Cover*	*Cost per Ad (Rs)*	*Maximum Availability (No. of times)*	*Expected Exposure (Units)*
TV (30 sec)	3,000	8,000	8	80
Radio (15 sec)	7,000	3,000	30	20
Sunday edition of a daily (1/4 page)	5,000	4,000	4	50
Magazine (1 page)	2,000	3,000	2	60

Other information and requirements:

i. The advertising budget is Rs 70,000

ii. At least 40,000 families should be covered.

iii. At least 2 insertions be given in Sunday edition of a daily but not more than 4 ads should be given on the TV.

Formulate the above problem as a linear programming problem if the company wishes to allocate media such that it maximise the expected exposure.

Q3 **10**

A. Informatics Corporation prepares international information reports (on a weekly basis), which are purchased weekly by mutual funds, banks and insurance companies. This information is very expensive and the demand for the reports is limited to a maximum of 30 units. The possible demands are 0, 10, 20 and 30 reports per week. The profit per report sold is Rs 30. No production of extra reports during a week is possible. There is a penalty cost of Rs 250 for not meeting the demand. Unsold reports cannot be carried on to the next week and result in a loss of Rs. 20 per report. Informatics Corporation must decide on how many reports to prepare (on a weekly basis). The pay-off table is given below:

		Demand: Number of Reports per week			
		0	**10**	**20**	**30**
Alternatives: Number of Reports to be prepared	**0**	0	-250	-250	-250
	10	-200	300	50	50
	20	-400	100	600	350
	30	-600	-100	400	900

a. Find out the number of reports to be produced under the Maximin and Maximax decision rules.

b. If the coefficient of optimism is 0.45 then how does the optimal decision change?

B. Two television stations compete with each other for viewing audience. Local programming options for the 5:00 P.M. weekday time slot include a sitcom rerun, an early news program, or a home improvement show. Each station has the same programming options and must make its preseason program selection before knowing what the other television station will do. The viewing audience gains in thousands of viewers for Station A are shown in the payoff table.

		Station B		
		Sitcom Rerun b1	**News Program b2**	**Home Improvement b3**
Station A	**Sitcom Rerun a1**	10	-5	3
	News Program a2	8	7	6
	Home Improvement a3	4	8	5

Determine the optimal strategy for each station. What is the value of the game?

Q4 **10**

A motor manufacturing company offers a 1-year warranty on its motors where it guarantees replacement or repair of the motor components in case of any manufacturing defects. The weekly number of warranty claims is normally distributed with a mean value of 11 and a standard deviation of 3.4. The cost to the company on each warranty claim is a sum of 2 varying components. Component 1 is uniformly distributed between ₹850 and ₹1050. Component 2 has the following distribution:

Component 2	Probability of Occurrence
₹350	0.1
₹400	0.25
₹450	0.45
₹500	0.3

Simulate the weekly costs to the company for 52 weeks, and determine the total warranty cost to the company. (Assume the weekly number of warranty claims to be a discrete value).

Q5 **10**

The quarterly production of pine lumber, in millions of board feet, by Northwest Lumber since 2006 is:

	Quarter			
Year	**Winter**	**Spring**	**Summer**	**Fall**
2006	7.8	10.2	14.7	9.3
2007	6.9	11.6	17.5	9.3
2008	8.9	9.7	15.3	10.1
2009	10.7	12.4	16.8	10.7
2010	9.2	13.6	17.1	10.3

a. Identify the seasonal component for the production data.

b. When does the company's production experience the largest seasonal effect? Does this result appear to be reasonable? Explain.

Q6 **10**

A. The Ace Manufacturing Company has orders for three similar products. Three machines are available for the manufacturing operations. All three machines can produce all the products at the same production rate. However, due to varying defect percentages of each product on each machine, the unit costs of the products vary depending on the machine used. Develop the minimum cost production schedule by assigning each product to each machine.

Machine	Product A	Product B	Product C
1	$ 1.00	$ 1.20	$ 0.90
2	$ 1.30	$ 1.40	$ 1.20
3	$ 1.10	$ 1.00	$ 1.20

B. The products produced using the above 3 machines need to be transported to 3 different retailers. Number of units ordered by the retailers, production capacity of the 3 machines and the marginal profit that the manufacturer will gain from selling these products to the retailers are given below. Solve the following problem to obtain the optimal transportation schedule such that it maximizes the company's profit

Retailer	Orders (units)
X	2000
Y	500
Z	1200

Machine	Capacity (units)
1	1500
2	1500
3	1000

Machine	Retailer X	Retailer Y	Retailer Z
1	$ 2.00	$ 3.20	$ 2.90
2	$ 1.50	$ 1.80	$ 1.60
3	$ 2.20	$ 1.50	$ 1.40