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**JAIPURIA INSTITUTE OF MANAGEMENT, NOIDA**

**PGDM / PGDM (M) / PGDM (SM)**

**Third TRIMESTER (Batch 2023-25)**

**END TERM EXAMINATIONS, APRIL 2024**

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| --- | --- | --- | --- |
| Course Name | **Operations Research** | Course Code | **20521** |
| Max. Time | **2 hours** | Max. Marks | **40 MM** |

**INSTRUCTIONS:** All questions are compulsory. Use of calculators (simple/ scientific) is permitted.

Q.1. A company manufactures two products, A and B, using two resources, X and Y. The profit per unit of product A is $5, and the profit per unit of product B is $8. The resource requirements and availability are given in the table below:

|   | Resource X | Resource Y |
| --- | --- | --- |
| Product A | 2 units | 3 units |
| Product B | 4 units | 1 unit |
| Availability | 24 units | 18 units |

Formulate a linear programming model to maximize the company's total profit and solve it using graphical method. (10 Marks)

Q.2. Apply the notion of dominance to simplify the rectangular game with the following pay-off matrix, and then solve it graphically. (7 Marks)

$$\left[\begin{matrix}19&15&17&16\\0&20&15&8\\18&15&17&16\end{matrix}\right]$$

Q.3. A grocery store with a bakery department is faced with the problems of how many cakes to buy in order to meet the day’s demand. The grocer prefers not to sell day old goods in competition with fresh products, leftover cakes are therefore, a complete loss. A cake costs $12 and sells for $ 15. Other hand, if a customer desires a cake and all of them have been sold. The disappointed customer will buy elsewhere and the sales will be lost. The grocer has, therefore has collected the information on the past sales on a selected 100-day period as shown in the table below:

|  |  |
| --- | --- |
| Sales per day | No. of days |
| 25 | 10 |
| 26 | 30 |
| 27 | 50 |
| 28 | 10 |

1. Construct opportunity loss table. (3 Marks)
2. Identify the optimal number of cakes that should be bought each day?
	1. Using EOL. (2 Marks)
	2. Using Criteria of Optimism (2 Marks)

Q.4. XYZ Soap company is considering the production of four potential products: Moisturizing Soap, Antibacterial Soap, Natural Soap, and Chemical-Free Soap. It is assumed that the input for all the products can be viewed in terms of just three resources’: oil, water and lye. The composition of these four soaps in terms of these three inputs and maximum supply is shown in the table given below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Moisturizing Soap** | **Antibacterial Soap** | **Natural Soap** | **Chemical-Free Soap** | **Maximum Supply (in lts.)** |
| **Oil**  | 3 | 4 | 4 | 3 | 4700 |
| **Water**  | 2 | 2 | 4 | 3 | 4500 |
| **Lye**  | 1 | 1 | 3 | 2 | 2500 |

The company earns a profit of Rs.29, Rs.32, Rs.72, and Rs.54 by selling each type of soap. Each resource is available in limited quantity. The problem has been formulated and solved, which generated the following report

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **Final** | **Reduced** | **Objective** | **Allowable** | **Allowable** |
| **Cell** | **Name** | **Value** | **Cost** | **Coefficient** | **Increase** | **Decrease** |
| $B$2 | Moisturizing Soap | 0 | -1 | 29 | 1 | 1E+30 |
| $C$2 | Antibacterial Soap | 380 | 0 | 32 | 40 | 1.666666667 |
| $D$2 | Natural Soap | 0 | -8 | 72 | 8 | 1E+30 |
| $E$2 | Chemical-Free Soap | 1060 | 0 | 54 | 10 | 5 |
|  |  | **Final** | **Shadow** | **Constraint** | **Allowable** | **Allowable** |
| **Cell** | **Name** | **Value** | **Price** | **R.H. Side** | **Increase** | **Decrease** |
| $F$4 | Oil  | 4700 | 2 | 4700 | 2800 | 950 |
| $F$5 | Water  | 3940 | 0 | 4500 | 1E+30 | 560 |
| $F$6 | Lye | 2500 | 24 | 2500 | 466.6666667 | 1325 |

Based on the report, propose what the management need to do if the following happens

1. Change in the supply of water
2. Increase the supply of oil by 400 lts.
3. If we force the productions of Moisturizing soaps?
4. If company increase profit on antibacterial soap by Rs 8
5. If company gets an opportunity to get 500 additional lts of lye. However, this time it will cost is increased by Rs 2. (2 x 5 = 10 Marks)

Q.5. Consider the matrix of transition probabilities of a product available in the market in two brands A and B.



Determine the market share of each brand in equilibrium position. (6 Marks)