

**VPM's
DR VN BRIMS, Thane
Programme: MMS (2023-25)
Second Semester Regular Examination April 2024**

Course Name:	Operations Research	Course Code	C203
Roll No.		Marks	60
Total No. of Questions	6	Duration	3 Hours
Total No. of printed pages	3	Date	20-04-2024

Course Outcome Statements:

- CO1:** Recall the concepts of operations research.
CO2: Relate the concepts of Operations research with business problems.
CO3: Apply basic tools of Operations research to solve business problems.
CO4: Classify the types of Business problems.
CO5: Evaluate the best solution out of multiple solutions.

Instructions: -

Q. No 1 (All Questions are Compulsory)

Q. No.	Questions	Marks	BL	CO
Q. 1	Case/Case-let Study (500-800 words)			

An investor has 1200000 INR to invest and there are three attractive opportunities available for investment, Fixed Deposits, NSC, Equity Share Market.
 FD gives 7% returns, NSC gives 8%return and 12%return is expected from Equity Market.
 To minimize the risk, An investor has decided not to invest more than 200000 INR in equity markets.
 For the tax reasons he needs to invest at least double times amount in NSC than FDs.

He converted scenario in to mathematical Model. During this process he solved the investment situation in excel solver and generated following sensitivity report.

Variable Cells						
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$5	x1	333333.3333	0	0.07	0.01	0.23
\$C\$6	x2	666666.6667	0	0.08	0.065	0.01
\$C\$7	x3	200000	0	0.12	1E+30	0.043333333

Constraints						
Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$C\$12		1200000	0.076666667	1200000	1E+30	1000000
\$C\$13		200000	0.043333333	200000	1000000	200000
\$C\$14		0	-0.003333333	0	2000000	1000000

a.	Analyze the above sensitivity report and List all possible valuable insights from this analysis to his dilemma along with proper justifications	6	Level 4	CO4
b.	Interpret the sensitivity report and Explain meaning of all the numbers in variable and constraint cells.	6	Level 5	CO5

Q. 2	Answer Any one from the following.																																					
a.	<table border="1" data-bbox="440 210 1029 405"> <thead> <tr> <th></th> <th>D1-Mumbai</th> <th>D2-Nagpur</th> <th>D3-Gujrat</th> <th>D4-Delhi</th> <th>Factory Capacity/Supply</th> </tr> </thead> <tbody> <tr> <td>O1-Bhiwandi</td> <td>3</td> <td>1</td> <td>7</td> <td>4</td> <td>300</td> </tr> <tr> <td>O2-Thane</td> <td>2</td> <td>6</td> <td>5</td> <td>9</td> <td>400</td> </tr> <tr> <td>O3-Ambarnath</td> <td>8</td> <td>3</td> <td>3</td> <td>2</td> <td>500</td> </tr> <tr> <td>Requirement</td> <td>250</td> <td>350</td> <td>400</td> <td>200</td> <td></td> </tr> </tbody> </table> <p data-bbox="272 414 1203 546">Given three sources O1, O2 and O3 and four destinations D1, D2, D3 and D4. For the sources O1, O2 and O3, the supply is 300, 400 and 500 respectively. The destinations D1, D2, D3 and D4 have demands 250, 350, 400 and 200 respectively.</p> <p data-bbox="272 580 1203 680">Conclude how much quantities to be transported from source O1, O2, O3 to D1, D2, D3, and D4 in such a way that total cost of transportation will be minimized by using ‘Least Cost Cell Method’.</p>						D1-Mumbai	D2-Nagpur	D3-Gujrat	D4-Delhi	Factory Capacity/Supply	O1-Bhiwandi	3	1	7	4	300	O2-Thane	2	6	5	9	400	O3-Ambarnath	8	3	3	2	500	Requirement	250	350	400	200		6	Level 5	CO5
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b.	<p data-bbox="272 719 1203 815">A Company has four men available for work on four separate jobs. Only one man can work on any one job. The cost of assigning each man to each job is given in Table.</p> <p data-bbox="272 815 1203 882">Evaluate the most efficient worker-job assignment by assigning Person to jobs in such a way that the total cost of assignment is minimum.</p> <table border="1" data-bbox="272 913 876 1153"> <thead> <tr> <th rowspan="2">Person</th> <th colspan="4">Jobs</th> </tr> <tr> <th>I</th> <th>II</th> <th>III</th> <th>IV</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>45</td> <td>40</td> <td>51</td> <td>67</td> </tr> <tr> <td>B</td> <td>55</td> <td>40</td> <td>61</td> <td>53</td> </tr> <tr> <td>C</td> <td>49</td> <td>52</td> <td>48</td> <td>64</td> </tr> <tr> <td>D</td> <td>41</td> <td>45</td> <td>60</td> <td>55</td> </tr> </tbody> </table>					Person	Jobs				I	II	III	IV	A	45	40	51	67	B	55	40	61	53	C	49	52	48	64	D	41	45	60	55	6	Level 5	CO5	
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Q. 3	Answer Any one from the following.																																					
a.	<p data-bbox="272 1245 1090 1346">Consider a scenario where you're deciding between two investment options: investing in real estate properties or investing in government bonds.</p> <p data-bbox="272 1368 810 1402">Investment Option 1: Real Estate Properties</p> <ul data-bbox="272 1435 1090 1630" style="list-style-type: none"> ▪ In a favorable market, real estate properties could yield a 10% return on investment annually. ▪ In an unfavorable market (e.g., economic recession), properties may lose 5% of their value. ▪ Market predictions suggest a 70% chance of a favorable market and a 30% chance of an unfavorable market. <p data-bbox="272 1637 783 1671">Investment Option 2: Government Bonds</p> <ul data-bbox="272 1671 1090 1800" style="list-style-type: none"> ▪ Government bonds offer a safe investment with a guaranteed 3% return annually. ▪ Regardless of market conditions, the return on government bonds remains constant. <p data-bbox="272 1805 1090 1906">Analyze the above scenario and conclude which investment option is more attractive by using Decision Theory. Discover Decision Tree from above scenario.</p>					6	Level 4	CO4																														
b.	<p data-bbox="272 1942 1203 2134">Suppose that you want to invest \$10,000 in the stock market by buying shares in one of two companies: A and B. Shares in Company A, though risky, could yield a 50% return during the next year. If the stock market conditions are not favorable (i.e., a “bear” market), the stock may lose 20% of its value. Company B provides safe investments with a 15% return in a “bull” market and only 5% in a “bear” market. All the publications you have consulted (and there is always</p>					6	Level 4	CO4																														

		a flood of them at the end of the year!) are predicting a 60% chance for a “bull” market and 40% chance for a “bear” market. Analyze the above scenario and conclude which investment option is more attractive by using Decision Theory. Discover Decision Tree from above scenario.																						
Q. 4		Answer Any two from the following.																						
	a.	X and Y are the two companies (Players). Make use of Game theory and Identify Value of the Game <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="2" style="text-align: center;">Y</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">Y1</td> <td style="text-align: center;">Y2</td> </tr> <tr> <td rowspan="2" style="text-align: center;">X</td> <td style="text-align: center;">Strategy</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">X1</td> <td style="text-align: center;">3</td> <td style="text-align: center;">5</td> </tr> <tr> <td></td> <td style="text-align: center;">X2</td> <td style="text-align: center;">1</td> <td style="text-align: center;">-2</td> </tr> </table>			Y				Y1	Y2	X	Strategy			X1	3	5		X2	1	-2	6	Level 3	CO3
		Y																						
		Y1	Y2																					
X	Strategy																							
	X1	3	5																					
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	b.	Let's consider a temple during a busy auspicious day, where devotees arrive to offer prayers. During peak hours, devotees arrive at a rate of 50 devotees per hour. Darshan/ rituals at temple accommodates an average of 60 devotees per hour. Apply the principles of queuing theory to find: I) Probability that the priest is idle (P0) II) Average number of devotees in the queuing system (L) III) Average time a devotee spends in the system (W) IV) Average number of devotees in the queue (Lq) V) Average time a devotee spends in the queue waiting for service (Wq)	6	Level 3	CO3																			
	c.	You are managing inventory for a retail store that sells a specific product. The demand for this product is relatively stable, with an annual demand of 80,000 units. The ordering cost incurred each time you place an order for this product is \$200. Additionally, there is a holding cost associated with keeping the product in inventory, which is 5% of the unit price per item per year. The unit price of the product is \$30. Identify the optimal order quantity that minimizes the total inventory cost, taking into account both ordering and holding costs, while ensuring the annual demand is met.	6	Level 3	CO3																			
Q. 5		Answer Any two from the following.																						
	a.	Demonstrate the concept of Nash equilibrium in game theory. Provide a hypothetical scenario involving two players and explain how to identify the Nash equilibrium using strategic reasoning.	6	Level 2	CO2																			
	b.	Explain minimum 3 applications of a queuing model used in Operations Research.	6	Level 2	CO2																			
	c.	Explain the contrast between "decision" and "choice" using suitable examples. Infer under which scenarios individuals typically make choices versus decisions.	6	Level 2	CO2																			
Q. 6		Answer Any two from the following.																						
	a.	List three examples for application of ‘Indexing Type/ Travelling Salesman type’ problems.	6	Level 1	CO1																			
	b.	Recall the concept of ‘Reduced Cost and Shadow Price’ in sensitivity analysis.	6	Level 1	CO1																			
	c.	Define ‘Operations Research’ and List the applications of the same in the business.	6	Level 1	CO1																			