

**VPM's**  
**DR VN BRIMS, Thane**  
**Programme: MMS (2022-24)**  
**Second Semester Regular Examination September 2023**

<b>Course Name:</b>	<b>Operations Research</b>	<b>Course Code</b>	<b>C-203</b>																																																		
<b>Roll No.</b>		<b>Marks</b>	<b>60</b>																																																		
<b>Total No. of Questions</b>	6	<b>Duration</b>	<b>3 Hours</b>																																																		
<b>Total No. of printed pages</b>	3	<b>Date</b>	<b>11-09-2023</b>																																																		
<b>Course Outcome Statements:</b>																																																					
<ol style="list-style-type: none"> <li>1. Recall the concepts of operations research and relate with business problems.</li> <li>2. Interpret business insights for optimization of business problems.</li> <li>3. Apply appropriate operations research tools in relevant business scenarios.</li> <li>4. Examine the business problems and prescribe probable solutions.</li> <li>5. Recommend alternate solutions to business problems.</li> <li>6. Propose appropriate models for core business functions resulting in effective business management.</li> </ol>																																																					
<b>Instructions: -</b>			<b>Marks</b>	<b>BL</b>	<b>CO</b>																																																
Interpretation/ Conclusion / Recommendation should be mentioned in the Answer sheet after data analysis.																																																					
<b>Q. No 1 (All Questions are Compulsory)</b>																																																					
<b>Q. No.</b>		<b>Questions</b>																																																			
<b>Q. 1</b>		Case/Case-let Study (500-800 words)																																																			
		<p>A dealer deals in only two items—tables and chairs. He has Rs 50,000 to invest and has storage space of at most 60 pieces. A table costs Rs 2500 and a chair Rs 500. He estimates that from the sale of one table, he can make a profit of Rs 250 and that from the sale of one chair a profit of Rs 75. He wanted to know how many tables and chairs he should buy from the available money so as to maximize his total profit, assuming that he can sell all the items which he buys. He converted scenario in to mathematical Model. During this process he solved the business situation in excel solver and generated following sensitivity report.</p> <p><b>Microsoft Excel 16.0 Sensitivity Report</b>  <b>Worksheet: [Solver.xlsx]LPP 1</b></p> <p>Variable Cells</p> <table border="1"> <thead> <tr> <th>Cell</th> <th>Name</th> <th>Value</th> <th>Final Value</th> <th>Reduced Cost</th> <th>Objective Coefficient</th> <th>Allowable Increase</th> <th>Allowable Decrease</th> </tr> </thead> <tbody> <tr> <td>\$C\$5</td> <td>x</td> <td>10</td> <td>10</td> <td>0</td> <td>250</td> <td>125</td> <td>175</td> </tr> <tr> <td>\$C\$6</td> <td>y</td> <td>50</td> <td>50</td> <td>0</td> <td>75</td> <td>175</td> <td>25</td> </tr> </tbody> </table> <p>Constraints</p> <table border="1"> <thead> <tr> <th>Cell</th> <th>Name</th> <th>Value</th> <th>Final Value</th> <th>Shadow Price</th> <th>Constraint R.H. Side</th> <th>Allowable Increase</th> <th>Allowable Decrease</th> </tr> </thead> <tbody> <tr> <td>\$C\$14</td> <td></td> <td>50000</td> <td>50000</td> <td>0.0875</td> <td>50000</td> <td>100000</td> <td>20000</td> </tr> <tr> <td>\$C\$15</td> <td></td> <td>60</td> <td>60</td> <td>31.25</td> <td>60</td> <td>40</td> <td>40</td> </tr> </tbody> </table>				Cell	Name	Value	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease	\$C\$5	x	10	10	0	250	125	175	\$C\$6	y	50	50	0	75	175	25	Cell	Name	Value	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease	\$C\$14		50000	50000	0.0875	50000	100000	20000	\$C\$15		60	60	31.25	60	40	40
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	<b>a.</b>	<b>Analyze</b> the above sensitivity report and List all possible valuable insights from this analysis to his business along with proper justifications.																																																			
	<b>b.</b>	<b>Interpret</b> the sensitivity report and Explain meaning of all the numbers in variable and constraint cells.																																																			
<b>Q. 2</b>		Answer <b>Any one</b> from the following.																																																			

a.	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2"></th> <th colspan="4" style="text-align: center; color: green;">Destination</th> <th></th> </tr> <tr> <th colspan="2"></th> <th style="color: purple;">D1</th> <th style="color: purple;">D2</th> <th style="color: purple;">D3</th> <th style="color: purple;">D4</th> <th style="color: green;">Supply</th> </tr> </thead> <tbody> <tr> <th rowspan="3" style="color: green;">Source</th> <th style="color: purple;">O1</th> <td style="text-align: center;">3</td> <td style="text-align: center;">1</td> <td style="text-align: center;">7</td> <td style="text-align: center;">4</td> <td style="text-align: center;">300</td> </tr> <tr> <th style="color: purple;">O2</th> <td style="text-align: center;">2</td> <td style="text-align: center;">6</td> <td style="text-align: center;">5</td> <td style="text-align: center;">9</td> <td style="text-align: center;">400</td> </tr> <tr> <th style="color: purple;">O3</th> <td style="text-align: center;">8</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> <td style="text-align: center;">500</td> </tr> <tr> <th colspan="2" style="color: green;">Demand:</th> <td style="text-align: center;">250</td> <td style="text-align: center;">350</td> <td style="text-align: center;">400</td> <td style="text-align: center;">200</td> <td style="text-align: center; color: green;">1200</td> </tr> </tbody> </table> <p>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><b>Conclude</b> 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>			Destination							D1	D2	D3	D4	Supply	Source	O1	3	1	7	4	300	O2	2	6	5	9	400	O3	8	3	3	2	500	Demand:		250	350	400	200	1200	6	Level 5	CO5
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b.	<p>Consider a scenario involving a fast-food restaurant and its drive-thru operation. The cars arrive at the restaurant at the rate of 40 cars per hour, and the average service rate of the drive-thru is 50 cars per hour.</p> <p><b>Determine</b> the following:</p> <ol style="list-style-type: none"> <li>Probability that there are no cars in the drive-thru queue.</li> <li>The average number of cars in the drive-thru system.</li> <li>The average time a car spends in the drive-thru system.</li> <li>The average number of cars waiting in the queue.</li> <li>The average time a car spends waiting in the queue before getting service.</li> <li>The probability that the cashier at the service counter is busy when a car arrives at the drive-thru.</li> </ol>	6	Level 5	CO5																																								
<b>Q. 3</b>	<b>Answer Any one</b> from the following.																																											
a.	<p><b>Conclude</b> where to invest a \$10,000 budget, either in Project A or Project B, considering the provided data. Project A offers a projected 15% return with a 10% loss, whereas Project B is expected to yield a 12% return with a 5% loss. With a 60% probability of success for Project A and a 40% probability for Project B.</p>	6	Level 4	CO4																																								
b.	<p>Examine the benefits of applying ‘Transportation Model’ of Operations Research for businesses.</p>	6	Level 4	CO4																																								
<b>Q. 4</b>	<b>Answer Any two</b> from the following.																																											
a.	<p>You have 1200000 INR to invest and there are three attractive opportunities available for investment, Fixed Deposits, NSC, Equity Share Market.</p>	6	Level 3	CO3																																								

		FD gives 7% returns, NSC gives 8% return and 12% return is expected from Equity Market. To minimize the risk you have decided not to invest more than 200000 INR in equity markets. For the tax reasons you need to invest at least double times amount in NSC than FDs. Analyse the above situation and develop a mathematical model of the same in terms of objective function and constraints.																														
	<b>b.</b>	<b>Develop</b> an optimal inventory policy for a manufacturing company that produces smartphones. The company replaces smartphone components at a rate of 500 units per day. Placing an order involves a cost of \$150, and storing one set of smartphone components incurs a daily cost of \$0.03. The lead time for orders is 10 days.	<b>6</b>	<b>Level 3</b>	<b>CO3</b>																											
	<b>c.</b>	Two oil companies, India Oil Co. and Caltex operating in a city, are trying to increase their market at the expense of the other. The Indian Oil Co. is considering possibilities of decreasing price, giving free soft drinks on Rs. 40 purchases of oil, or giving away a drinking glass with each 40 litre purchase. Obviously Caltex cannot ignore this and comes out with its own programme to increase its share in the market. The pay-off matrix from the viewpoints of increasing or decreasing market shares is given in the table below: <table border="1" data-bbox="327 929 1045 1355"> <thead> <tr> <th colspan="2"></th> <th colspan="3">CARTLEX</th> </tr> <tr> <th colspan="2"></th> <th>Decrease Price</th> <th>Free drinks on Rs.40 purchase</th> <th>Soft on 40 purchase</th> <th>Free drinking glass on 40 liters or more</th> </tr> </thead> <tbody> <tr> <th rowspan="3">INDIAN OIL CO.</th> <th>Decrease Price</th> <td>-5</td> <td>-3</td> <td></td> <td>1</td> </tr> <tr> <th>Free Soft drinks on Rs.40 purchase</th> <td>1</td> <td>-1</td> <td></td> <td>2</td> </tr> <tr> <th>Free drinking glass on 40 liters or more</th> <td>2</td> <td>3</td> <td></td> <td>4</td> </tr> </tbody> </table> <p><b>Identify</b> the optimum strategies for the two oil companies and also find the value of the game.</p>			CARTLEX					Decrease Price	Free drinks on Rs.40 purchase	Soft on 40 purchase	Free drinking glass on 40 liters or more	INDIAN OIL CO.	Decrease Price	-5	-3		1	Free Soft drinks on Rs.40 purchase	1	-1		2	Free drinking glass on 40 liters or more	2	3		4	<b>6</b>	<b>Level 3</b>	<b>CO3</b>
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<b>Q. 5</b>		Answer <b>Any two</b> from the following.																														
	<b>a.</b>	<b>Illustrate</b> M/M/1 Queuing Model with example.	<b>6</b>	<b>Level 2</b>	<b>CO2</b>																											
	<b>b.</b>	<b>Explain</b> the concept of decision tree and its application in business.	<b>6</b>	<b>Level 2</b>	<b>CO2</b>																											
	<b>c.</b>	<b>Explain</b> business applications of OR with relevant examples	<b>6</b>	<b>Level 2</b>	<b>CO2</b>																											
<b>Q. 6</b>		Answer <b>Any two</b> from the following.																														
	<b>a.</b>	<b>What</b> is the role of Sensitivity analysis in Linear programming.	<b>6</b>	<b>Level 1</b>	<b>CO1</b>																											
	<b>b.</b>	<b>Discuss</b> the importance of Game theory in business decisions.	<b>6</b>	<b>Level 1</b>	<b>CO1</b>																											
	<b>c.</b>	<b>What</b> are the steps involved in solving LPP problem by graphical method.	<b>6</b>	<b>Level 1</b>	<b>CO1</b>																											