MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

Second Semester MBA Degree Examination

Quantitative Methods and Analytics

Time: 3 Hours **Max. Marks: 100**

Note: 1. Answer any FOUR full questions from Q1 to Q7.
2. Question No. 8 is compulsory.
3. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

			M	L	C
Q1	a.	Mr. Arun Lal started a Lal and Co. a logistics company, struggling with the efficient distribution of goods across multiple regions. The management is considering using Operations Research (OR) to improve their distribution network. Explain them about the operations research and discuss the functions of Operations Research and how they can apply to enhance the company's decision-making process.	03	L2	CO1
	b.	A global supply chain company is facing significant challenges in maintaining its efficiency due to increasing complexities in demand forecasting, inventory management, and transportation logistics. The management has decided to implement Operations Research (OR) to optimize their operations. As a consultant, outline the detailed methodology for implementing Operations Research in this scenario which will help them to overcome the challenges.	07	L2	CO1
	c.	Mr. Sachin an agriculturist has a 100-acre farm. He sells all tomatoes, lettuce heads and radishes and gets a price of Rs 1/- per KG of tomato, Rs 0.75 per lettuce head and Rs 2 per kg for radishes. The average yield per acre is 2000 kg of tomatoes, 3000 heads of lettuce, and 1000 kg radishes. Fertilizers are available at Rs 0.50 per kg and the amount required per acre is 100 kg each for tomatoes and lettuce and 50 kg for radishes. Labor required for sowing, cultivating and harvesting per acre is 5-man days each for tomatoes and radishes and 6-man days for lettuce. A total of 400-man days of labor is available at Rs 20 per man day. Mr. Sachin wants to maximize profit. Use the appropriate method using above decision variables and prove it.	10	L4	CO3
Q2	a.	A construction company is using a network diagram to plan and manage a complex project. During a review, the project manager identifies issues related to looping and dangling errors in the diagram, which could lead to inaccurate project scheduling and resource allocation. Explain what looping and dangling errors are in the context of a network diagram. How can these errors impact the project's timeline and resource management?	03	L2	CO1
	b.	A software development company is working on a new mobile application with multiple interdependent tasks. Use appropriate method to draw a network diagram for finding the critical path for the flow of activities along with the duration of the project.	7	L4	CO5

		Activity	A	B	C	D	E	F	G	H	I	J			
		Immediate predecessor	-	A	A	A	B	C	C	E, F	D, G	H, I			
		Duration	12	8	4	3	12	18	5	4	9	6			
	c.	A manufacturing plant produces customized parts using a sequence of machines, and each part must pass through multiple machines in a specific order. They have five jobs, each of which must go through the machines A, B and C in the order ABC. Job no / Machine A: 5, 7, 6, 9, 5 Machine B: 2, 1, 4, 5, 3 Machine C: 3, 7, 5, 6, 7 The plant manager aims to find optimal sequence to minimize the total elapsed time to process all parts in which the machines should operate on each part. Use the appropriate technique to find the right sequence to suggest the plant manager.											10	L3	CO5
Q3	a.	A company that distributes consumer goods across multiple warehouses and retail outlets is encountering an unbalanced transportation problem. Some warehouses have more supply than the demand at retail outlets, while others have less, leading to inefficiencies and increased costs. Explain what an unbalanced transportation problem is and how it can affect the overall logistics and cost structure of the company.											03	L2	CO1
	b.	A construction company is managing a new commercial building project and needs to optimize its schedule to meet the client's deadline. Below is a list seven activities which are given below of the project. Activity / Duration: Immediate predecessor; Most likely; Optimistic; Pessimistic A: -; 3; 1; 7 B: A; 6; 2; 14 C: A; 3; 3; 3 D: B, C; 10; 4; 22 E: B; 7; 3; 15 F: D, E; 5; 2; 14 G: F; 4; 4; 4 You are asked to come up the solution for above problem to analyze how understanding these paths can influence project management decisions, such as resource allocation and risk management, to ensure the project stays on track. The manager also wants you to test the project completion duration with 95% confidence level.											07	L4	CO5
	c.	A logistics company is responsible for transporting goods from its three warehouses to four retail stores. The supply at each warehouse, the demand at each store, and the transportation costs per unit between each warehouse and store are provided in the table below: As the logistics manager, your task is to find the initial feasible solution for this transportation problem. Look for an appropriate method to solve the problem to get the least cost possible.											10	L4	CO5

			W1	W2	W3	Supply			
		F1	48	60	56	140			
		F2	45	55	53	260			
		F3	50	65	60	360			
		F4	52	64	55	220			
		Demand	200	320	250				
Q4	a.	A retail company is looking to enhance its decision-making process by leveraging data analytics. The management is keen to understand the potential scope of analytics within their organization to improve customer insights, optimize inventory, and increase sales. Describe the scope of analytics in this context, outlining the various areas within the company where analytics can be applied. Discuss how data analytics can help the company make informed decisions, identify trends, and drive business growth. Provide examples of specific analytics techniques that could be used to address the company's challenges.					03	L2	CO1
	b.	A tech company is allocating four software development projects to its four teams based on their expertise and estimated completion times. Each of these has 4 strategies. The costs to the company are given for every pair of strategy choice.					07	L3	CO4
		Union strategy	Company strategy						
			I	II	III	IV			
		I	20	15	12	25			
		II	25	14	8	10			
		III	40	2	10	5			
		IV	-5	4	11	0			
		The goal is to assign each project to a team in a way that minimizes the total completion time. As the project manager, use the assignment method to determine the optimal assignment of projects to teams. Check if there is a saddle point in the matrix and explain its significance. If a saddle point exists, describe how it influences the assignment strategy. What will the two sides adopt? Also determine the value of game.							
	c.	Two competing tech firms, B1 and B2 are deciding on their marketing strategies for a new product launch. Each firm has two strategies: an aggressive campaign (Strategy A) or a moderate campaign (Strategy B). The payoff matrix below represents the expected gains Solve the following game by graphical method					10	L3	CO4
		Player	Player B						
			B1	B2					
		A1	-2	0					
		A2	3	-1					
		A3	-3	2					
		A4	5	-4					
		As the marketing strategist use the graphical method to solve this two-player, zero-sum game and determine the optimal strategy.							
Q5	a.	A transportation company is considering implementing a new warehouse layout to improve its efficiency and reduce operational costs. However, the management is concerned about the potential risks and disruptions that might occur during the transition. Elaborate on simulation and explain three advantages of using simulation in this context. How can simulation help the company in making informed decisions about the warehouse layout? Discuss the benefits in terms of risk reduction, cost savings, and operational efficiency.					03	L2	CO1

	b.	A manufacturing company is working on optimizing its supply chain by using the transportation method. During the initial solution phase, the operations team encounters a situation of degeneracy, which is affecting their ability to find an optimal solution. As the team lead, develop a comprehensive training plan that covers the various objects in R and the types of operations that can be performed on these objects.	07	L3	CO2
	c.	A healthcare analytics firm is working with a large dataset containing patient records, including demographic information, medical history, and treatment outcomes. The firm's goal is to identify trends and patterns that can improve patient care and operational efficiency. However, the raw data is complex and unstructured, requiring extensive data manipulation and visualization to derive meaningful insights. 2 3 7 5 4 8 3 3 ? ? 6 4 As the lead data scientist, design a detailed workflow for the project that includes advanced data manipulation techniques, visualization strategies, also discuss about the process to clean and preprocess the data, handle missing values, and transform the dataset to make it suitable for analysis.	10	L3	CO2
Q6	a.	A manufacturing company is working on optimizing its supply chain by using the transportation method. During the initial solution phase, the operations team encounters a situation of degeneracy, which is affecting their ability to find an optimal solution. Explain what degeneracy in the transportation problem is and how it can impact the process of finding an optimal solution.	03	L2	CO1
	b.	A pharmaceutical company is planning a new drug development project that involves multiple stages, each with specific tasks that must be completed in sequence or parallel. Come out with the solution for the given problem to get the right path along with starting and ending time and suggest a conclusion based on various floats by prioritizing tasks, allocating resources, and mitigating potential delays. Activity 1-2 1-3 2-6 3-4 3-5 4-6 5-6 5-7 6-7 Duration 4 6 8 7 4 6 5 19 10	07	L4	CO5
	c.	A manufacturing company needs to assign four tasks to four different machines to minimize the total processing time. The time (in hours) required for each machine to complete each task is shown in the matrix below. J1 J2 J3 J4 1 12 30 21 15 2 18 33 9 31 3 44 25 24 21 4 23 30 28 14 As the operations manager, use the Hungarian Assignment Method (HAM) to solve this assignment problem and determine the optimal assignment of tasks to machines that minimizes the total processing time. Analyze potential challenges or limitations of the Hungarian Method in more complex or dynamic assignment scenarios.	10	L3	CO4
Q7	a.	A retail company is deciding on pricing strategies for its new product in a competitive market. The company creates a payoff matrix to analyze the potential profits based on different pricing strategies against its main competitor. During the analysis, the management comes across the term "saddle point." Explain what a saddle point is in the context of game theory. How can identifying a	03	L2	CO1

		saddle point in the payoff matrix help the company make more informed pricing decisions?			
	b.	A furniture manufacturing company produces two types of products: chairs and tables. The company wants to maximize its profit while considering the constraints of available resources. Minimize $Z = 40X_1 + 24X_2$ Subject to constraint $20X_1 + 50X_2 \geq 4800$ $80X_1 + 50X_2 \geq 7200$ $X_1, X_2 \geq 0$ As the production manager, he has come across the liner programming techniques but not familiar with the methodology. You being a consultant workout the problem and find out the optimal solution so that you can suggest the best combination of products which has best fit. Also calculate the maximum profit achievable to prove your methodology right.	07	L4	CO3
	c.	A global automotive company is planning to launch a new electric vehicle (EV) in multiple markets. The company must decide on production levels, pricing strategies, and marketing investments. However, the decision-making environment is complex, with varying degrees of uncertainty due to fluctuating market demand, regulatory changes, and competitor actions.	10	L3	CO4

Factor	Type	Value/range	Probability (If applicable)
Production cost per EV	Certainty	₹500,000	N/A
Marketing cost	Certainty	₹100,000	N/A
Estimated demand (low)	Risk	5,000 units	30%
Estimated demand (medium)	Risk	10,000 units	50%
Estimated demand (high)	Risk	20,000 units	20%
Government policy changes	Uncertainty	No subsidies or large subsidies	N/A
Competitor price cuts	Uncertainty	Yes / No	N/A
Battery technology advances	Uncertainty	Slow / Rapid	N/A

As a senior decision analyst, identify the different types of decision-making environments that the company might face: certainty, risk, and uncertainty. Select the decision-making tools and strategies which are most suitable for each type of environment, and propose a comprehensive decision-making framework that the company can use to address the uncertainties ad complexities of the EV market launch.

Q8		**CASE STUDY (Compulsory)** A food distribution company needs to transport fresh produce from its three warehouses to four different grocery stores. The supply at each warehouse and the market demand are given below.			

		.	20	L4	CO3

	Per Unit cost (Rs)				
	Market demand				
		A	B	C	D
Ware house	X	13	7	19	0
	Y	17	18	15	7
	Z	11	22	14	5

Activity in warehouse:
X: 200 units
Y: 500 units
Z: 300 units

Demand in the market
A: 180 units
B: 320 units
C: 100 units
D: 400 units

As the logistics manager, use the best method to find out initial solution and also find the optimal solution using suitable method to optimize the transportation plan and find the minimum transportation cost.

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