

**JAIPURIA INSTITUTE OF MANAGEMENT, NOIDA**  
**PGDM / PGDM (M) / PGDM (SM)**  
**THIRD TRIMESTER (Batch 2021-23)**  
**ENDTERM EXAMINATION, April 2022**

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

**INSTRUCTIONS:**

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- All questions are compulsory and carries equal marks (10 marks each).
- Answer sheet is to be saved as (roll no-student name) a single excel file and uploaded on Moodle.
- For different questions, students are required to create separate worksheets named as Q1, Q2 etc..
- Students need to be precise while answering questions and interpretation is required for each result they obtain.

Q1. There is a newspaper boy and he is thinking of selling, a special one-time edition of a sports magazine to his regular newspaper customers. Based on his knowledge of his customer, he believes that he can sell between 9 to 12 copies. The magazines can be purchased at 8\$ each if 10 or less copies are purchased but cost \$7 if more than 10 copies are purchased. The magazine can be sold for 12\$ each. Magazines that are not sold can be returned to the publisher for a refund of 50%. Evaluate each course of action and help newspaper boy by suggesting the optimal number or magazines he should buy using different (all) criteria of decision making. (10)

Q2. In a small town, there are only two stores, ABC and XYZ that handle sundry goods. The total number of customers are equally divided between the two, because the price and quality of goods sold are equal. Both stores have good reputation in the community, and they render equally good customer service. ABC is planning to run annual pre-diwali sales during the third week of October. Sales are advertised through a local newspaper, radio and TV media. Though ABC is aware that XYZ is also planning to do the same. Figures in the following table shows the profits (in thousands) gained by ABC after promoting pre-diwali sales in different media.

		XYZ		
		Newspaper	Radio	Television
ABC	Newspaper	7	3	-5
	Radio	-1	0	5
	Television	3	5	-3

Formulate the given situation as linear programming problem and determine the optimal strategies and the worth of such strategies for both ABC and XYZ. (10)

Q3. A computer is inspected at the end of every hour. It is found to be either working (up) or failed (down). If the computer is found to be up, the probability of its remaining up for the next hour is 0.9. If it is down, the computer is repaired, which may require more than 1 hour. Whenever the computer is down (regardless of how long it has been down), the probability of its still being down 1 hour later is 0.55. Construct the (one-step) transition matrix for this Markov chain. If the computer is working right now, find the probability that it will be down 2 hours from now?

(6)

Q4. The Circulation Unlimited Co. has two factories producing a product that must be shipped to two warehouses A and B. Factory 1 can be send unlimited amount by rail line to warehouse A only, whereas factory 2 can send an unlimited amount by rail line to warehouse B only. However, independent truckers can be used to ship up to 70 units from each factory to a distribution centre located in Kolkata. From this distribution center up to 60 units can be shipped to each warehouse. The profit per unit for each alternative is shown in the following table

From \ To	Warehouse A	Warehouse B	Distribution Center
Factory 1	\$7	----	\$3
Factory 2	----	\$9	\$4
Distribution Center	\$2	\$4	----

Factory 1 and factory 2 is producing 100 units and 90 units respectively. Demands at warehouse A and warehouse B are 80 and 110 units respectively. Construct a network diagram and formulate this problem as the maximal flow problem.

(14)

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Q1 Jia and Ojus run a small shop called "Z to A equipments" selling treadmills . They must order treadmills in the beginning of each year for the coming season. Orders for the treadmills must be placed in quantities of twenty (20). The cost per treadmills is \$70 if they order 20, \$67 if they order 40, \$65 if they order 60, and \$64 if they order 80. The treadmills will be sold for \$100 each. Any treadmills left over at the end of the season can be sold (for certain) at \$45 each. If Jia and Ojus run out of treadmills during the season, then they will suffer a loss of "goodwill" among their customers. They estimate this goodwill loss to be \$5 per customer who was unable to buy a treadmills. Jia and Ojus estimate that the demand for treadmills this season will be 10, 30, 50, or 70 treadmills with probabilities of 0.2, 0.4, 0.3, and 0.1 respectively. Evaluate each course of action and help Jia and Ojus by suggesting the optimal stock they should keep for coming season. (10)

Q2 Assume that two firms A and B are competing for market share for a particular product. Each firm is considering what promotional strategy to employ for the coming period. To improve its market share, company A decides to launch the following strategies: give discount coupons; home delivery service; free gifts. Whereas, company B decides to use media advertising to promote its product. They decided on using the media as internet; newspaper; magazine. Assume that the following payoff matrix describes the increase in market share of firm A and the decrease in market share of the firm B. determine the optimal strategies for each firm.

		<b>Company B</b>		
		<b>B1</b>	<b>B2</b>	<b>B3</b>
	<b>A1</b>	3	-4	2
<b>Company A</b>	<b>A2</b>	1	-7	-3
	<b>A3</b>	-2	4	7

Formulate the given situation as linear programming problem and suggest the best strategies for both the companies. (10)

Q3 The leading brewery on the west coast (labeled A) has hired you as an OR analyst to analyze its market position. It is particularly concerned about its major competitor (labeled B). The analyst believes that brand switching can be modeled as a Markov chain using three states, with states A and B representing customers drinking beer produced from the aforementioned breweries and state C representing all other brands. Data are taken monthly, and you prepared the following transition matrix from past data.

	A	B	C
A	0.80	0.15	0.05
B	0.25	0.70	0.05
C	0.15	0.05	0.80

Analyze the given situation and suggest the steady state market shares for the two major breweries?

(6)

Q4 You need to take a trip by car to another town that you have not visited before. Therefore, you are studying a map to determine the shortest route to the destination. Depending on which route you choose, there are five other towns (A, B, C, D & E) that you might pass through on the way. The map shows mileage along each road that directly connects two towns without any intervening towns. These numbers are summarized in the following table:

Town	Miles between adjacent towns					
	A	B	C	D	E	Destination
Origin	40	60	50	-	-	-
A		10	-	70	-	-
B			20	55	40	-
C				-	50	-
D					10	60
E						80

Formulate this problem as a shortest-path problem by drawing a network where nodes represent towns, links represent roads and numbers indicate the length of each link in miles.

(14)

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**ENDTERM RE-EXAMINATION, April 2022**

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

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Q1 You are working with a friend on a joint project. Each of you can either work hard or goof off. If your friend works hard then you prefer to goof off (the outcome of the project would be better if you worked hard too, but the increment in its value to you is not worth the extra effort). You prefer the outcome of your both working hard to the outcome of your both goofing off (in which case nothing gets accomplished), and the worst outcome for you is that you work hard and your friend goofs off (you hate to be "exploited"). If your friend has the same preferences then tabulate the suitable payoffs which can be assigned. Also, find the value of the game. (8)

Q2 Ken and Larry, Inc., supplies its ice cream parlors with three flavors of ice cream: chocolate, vanilla, and banana. Due to extremely hot weather and a high demand for its products, the company has run short of its supply of ingredients: milk, sugar, and cream. Hence, they will not be able to fill all the orders received from their retail outlets, the ice cream parlors. Due to these circumstances, the company has decided to choose the amount of each flavor to produce that will maximize total profit, given the constraints on supply of the basic ingredients. The chocolate, vanilla, and banana flavors generate, respectively, \$1.00, \$0.90, and \$0.95 of profit per gallon sold. The company has only 200 gallons of milk, 150 pounds of sugar, and 60 gallons of cream left in its inventory.

- Formulate the given situation and solve for optimal solution. (6)
- If the profit per gallon of banana changes to \$1.00, analyze the change in the optimal solution change, and what would be its effect on total profit? (2)
- If the profit per gallon of banana changes to 92¢, analyze the change in the optimal solution, and what would be its effect on total profit? (2)
- If the company discovers that 3 gallons of cream have gone sour and so must be thrown out. Examine its effect on total profit? (2)
- Suppose the company has the opportunity to buy an additional 15 pounds of sugar at a total cost of \$15. Should they? Examine. (2)

Q3 A company is trying to decide whether to bid for a certain contract or not. They estimate that merely preparing the bid will cost £10,000. If their company bid then they estimate that there is a 50% chance that their bid will be put on the "short-list", otherwise their bid will be rejected. Once "short-listed" the company will have to supply further detailed information (entailing costs estimated at £5,000). After this stage their bid will either be accepted or rejected. The company estimate that the labour and material costs associated with the contract are £127,000. They are considering three possible bid prices, namely £155,000, £170,000 and £190,000. They estimate that the probability of these bids being accepted (once they have been short-listed) is 0.90, 0.75 and 0.35 respectively. Propose the most optimal course of action and find the related expected monetary value. (10)

Q4 Assume that a student can be in 1 of 4 states: Rich, Average, Poor and In Debt. Assume the following transition probabilities:

If a student is Rich, in the next time step the student will be:— Average: .75— Poor: .2— In Debt: .05

If a student is Average, in the next time step the student will be:— Rich: .05— Average: .2— In Debt: .45

If a student is Poor, in the next time step the student will be:— Average: .4— Poor: .3— In Debt: .2

If a student is In Debt, in the next time step the student will be:— Average: .15— Poor: .3— In Debt: .55

Model the above as a discrete Markov chain and

- (a) Develop the corresponding Markov chain and create the corresponding stochastic matrix.
- (b) Assuming that a student starts their studies as “Average”. Solve for the probability of them being “Rich” after three time steps? (8)