

**Birla Institute of Technology & Science, Pilani**

**First Semester 2023-2024**

**Comprehensive Examination**

Course No. : MPBA G 520  
Course Title : Supply chain Analytics  
Nature of Exam : Open Book  
Weightage : 35%  
Duration : 3 Hours  
Date of Exam : (FN)

No. of Pages = 2  
No. of Questions = 4

**Note:**

- Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
- Each question carry equal marks.
- All parts of a question should be answered consecutively. Each answer should start from a fresh page.
- Mobile phones and computers of any kind should not be brought inside the examination hall.
- Use of any unfair means will result in severe disciplinary action.

Q.1 Consider the nodes described below, and note that the depot is located at node 0. Suppose you would like to solve this vehicle routing problem (VRP) using the savings algorithm, for the constraint that each vehicle has a capacity of 30 units (meaning it can carry less than or equal to 30 units). Find out the solution. **[8 Marks]**

Distance	Node 0	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Demand
Node 0									0
Node 1	4								12
Node 2	4	5.66							12
Node 3	2.83	6.32	2.83						6
Node 4	4	8	5.66	2.83					16
Node 5	5	8.54	8.06	5.39	3				15
Node 6	2	4.47	6	4.47	4.47	4.12			10
Node 7	4.24	3.16	7.62	7.07	7.62	7	3.16		8

Q.2 A company owns both a factory to produce and retail outlet to sell them. A certain new product will be sold through this exclusively through retail outlet. Its inventory of this product

will be replenished through the factory when needed, wherein an administrative and shipping cost of \$200 is incurred each time this is done. Factory will replenish its own inventory when needed by setting up for quick production run. A set ups cost of \$ 5000 incurred when this is done. The annual cost holding an unit \$10 when it's held at factory and \$11 when its held at retail outlet. The retail outlet expects to sell 1000 units of product each month. All assumptions of serial two echelon inventory managements are held as discussed in class.

- (a) Suppose that the factory and the retail outlet separately optimize their own inventory policies for the product. Calculate the resulting optimal Q for retail and factory and optimal value of n and total cost. **(3)**
- (b) Suppose that company simultaneously optimizes the joint inventory policy for the factory and retail outlet for the product. Calculate the resulting optimal Q for retail and factory and optimal value of n and total cost. **(3)**
- (c) Calculate the percentage decrease in the total variable cost per unit time that is achieved by the simultaneous optimization approach. **(2)**

**Q.3** Members of Willow Greek company emergency rescue squad know from past experience that they will receive between zero and six emergency calls each night. According to following probability distribution. The rescue squad classifies the emergency calls into one of three categories: Minor, regular and major emergency. The probability that a particular call will be of each type is

(d) Calls	Probability	Emergency type	Probability
(e) 0	0.05	Minor	0.30
(f) 1	0.12	Regular	0.56
(g) 2	0.15	Major	0.14
(h) 3	0.25		
(i) 4	0.22		
(j) 5	0.15		
(k) 6	0.06		

- (l) The type of emergency call determines the size of crew sent in response. Minor emergency call requires two persons, regular requires three person and Major emergency call requires five-person crew team. Simulate call received for 10 nights and determine the maximum no. of crew members that might be needed on any given night. **[8 Marks]**

**Q.4** What do you mean by supply chain segmentation. Why supply chain segmentation is required. What are the types of analytics to be used for supply chain segmentation **[8 Marks]**

**Q.5** The Ranch House, Inc., operates five fast-food restaurants. Input measures for the restaurants include weekly hours of operation, full-time equivalent staff, and weekly supply expenses. Output measures of performance include average weekly contribution to profit, market share, and annual growth rate. Data for the input and output measures are shown in the following tables: **[8 Marks]**

<b>Input Measures</b>			
<b>Restaurant</b>	<b>Hours of Operation</b>	<b>FTE Staff</b>	<b>Supplies (\$)</b>
<b>Bardstown</b>	96	16	850
<b>Clarksville</b>	110	22	1400
<b>Jeffersonville</b>	100	18	1200
<b>New Albany</b>	125	25	1500
<b>St. Matthews</b>	120	24	1600
<b>Output Measures</b>			
<b>Restaurant</b>	<b>Weekly Profit</b>	<b>Market Share (%)</b>	<b>Growth Rate (%)</b>
<b>Bardstown</b>	\$3,800	25	8.0
<b>Clarksville</b>	\$4,600	32	8.5
<b>Jeffersonville</b>	\$4,400	35	8.0
<b>New Albany</b>	\$6,500	30	10.0
<b>St. Matthews</b>	\$6,000	28	9.0

- (a) Develop a linear programming model that can be used to evaluate the performance of the Clarksville Ranch house restaurant.
- (b) Is the Clarksville ranch house restaurant relatively efficient? Discuss.

