MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII Semester B. Tech. Common to all Branches

END SEMESTER EXAMINATIONS NOVEMBER 2022

SUBJECT: PE-IV: OPERATIONS MANAGEMENT [HUM 4054]

Max. Marks: 50

Instructions to Candidates:

- Answer ALL the questions and missing data may be suitably assumed.

1A The transport manager of a logistics company is trying to forecast the cost of maintenance for the company's fleet of trucks. The manager believes that the cost of maintaining the trucks increases with their age. The following data was collected. **4**

Age (years)	Yearly Maintenance Cost ($)	Age (years)	Yearly Maintenance Cost ($)
4.5	619	5.0	1194
4.5	1049	0.5	163
4.5	1033	0.5	182
4.0	495	6.0	764
4.0	723	6.0	1373
4.0	681	1.0	978
5.0	890	1.0	466
5.0	1522	1.0	549
5.5	987		

Develop a regression equation to forecast the yearly maintenance cost based on the age of the truck. If the company has 20 three-year-old trucks, what is the forecast for the annual maintenance cost?

1B For the regression model, relating the age of trucks to the maintenance cost, determine the extent of the relation between the independent and dependent variables. Also, determine the percentage of variance in the dependent variable explained by the independent variable. **3**

1C The Surefoot Sandal company manufactures three products (Men's, Women's and Children's sandals). The time standards (Processing and Setup), lot sizes and demand forecasts are given in the following table. The firm operates two 8-hour shifts, five days per week, 50 weeks per year. Experience shows that a capacity cushion of 5 percent is sufficient. **3**

Product	Processing Time (Hrs/Pair)	Set up Time (Hrs/Pair)	Lot Size (Pairs/Lot)	Demand Forecast (Pairs/Year)
Men's	0.05	0.5	240	80000
Women's	0.10	2.2	180	60000
Children's	0.02	3.8	360	120000

	a. How many machines are needed? If the operations currently have two machines, what is the capacity gap? b. Due to market uncertainty, the management is reluctant to make the capital investment in the new machines. What could be the possible alternatives the management can think of to meet the demand?	
2A	The demand for pizzas sold by a local restaurant during the last six weeks is shown in the table below. Forecast the demand for weeks 4 through 7 using the Exponential Smoothing Method by considering a smoothing parameter of 0.3. Assume the initial demand for week 3 to be 63. Week 1 2 3 4 5 6 Demand 50 65 52 56 55 60 Calculate the CFE, MAD and MAPE for the developed forecasts. Assume the actual demand for week 7 as 63.	**5**
2B	Explain expansionist strategy, wait-and-see strategy and capacity cushion.	**3**
2C	Differentiate between manufacturing and service processes	**2**
3A	Techno Corporation is currently manufacturing an item at variable costs of $5 per unit. The annual fixed cost of manufacturing this item is $140000. The current selling price of the item is $10 per unit, and the annual sales volume is 30000 units. a. Techno can substantially improve the item's quality by installing new equipment at an additional annual fixed cost of $60000. Variable cost per unit would increase by $1, but, as more of the better-quality product could be sold, the annual volume would increase to 50000 units. Should Techno buy the new equipment and maintain the current price of the item? Why or why not? b. Alternatively, Techno could increase the selling price to $11 per unit. However, the annual sales would be limited to 45000 units. Should Techno buy this new equipment and raise the price of the item? Why or why not?	**4**
3B	Currently, a consulting company has five jobs in its backlog. The time since the order was placed, and the promised due date are given in the following table. Determine the schedule by considering the FCFS rule and calculate the average flow time and average days past due. Customer A B C D E Time since the order arrived (Days ago) 15 12 5 10 0 Processing Time (Days) 25 16 14 10 12 Due Date (Days from now) 29 27 68 48 80 What can the company do to reduce the average flow time?	**3**
3C	A supermarket in a metropolitan city operates 24 hours per day, 7 days a week. The store manager has been analyzing the efficiency and productivity of store operations recently. The manager decided to observe the need for checkout clerks on the first shift for one month period. At the end of the month, he calculated the average number of checkout registers that should be open during the first shift each day. His results showed peak needs on Saturdays and Sundays. Day M T W Th F S Su Clerks Required 3 4 5 5 4 7 8 Develop a workforce schedule that covers all the requirements while giving two consecutive days off to each clerk. How many clerks are needed? Assume that the	**3**

	clerks have no preference regarding which days they have off. Also, calculate the slack available in this schedule, and on what days?	
4A	A manufacturer must produce a certain product in sufficient quantity to meet contracted sales in the next four months. The production facilities available for this product are limited, but by different amounts in respective months. The unit cost of production also varies each month. The product may be produced in one month and then held for sale in a later month but at an estimated storage cost of Rs.1 per unit per month. No storage cost is incurred for goods sold in the same month in which they are produced. There is no initial inventory, and none is desired at the end of four months. Given the following table, show how much to produce in each of the four months in order to minimize total cost. Assume a backorder cost of Rs. 25 per unit per month. Formulate the above problem as a transportation problem and develop the basic feasible solution using the north-west corner rule.	**5**
4B	Optimize the above basic feasible solution using the modified distribution method to arrive at the least cost plan.	**3**
4C	Discuss any four types of waste as classified by the lean philosophy.	**2**
5A	Presently, the Delhi Transport Corporation (DTC) in New Delhi operates its bus system at an annual deficit of Rs 400,000. The municipal corporation has therefore decided to raise bus fares to offset this deficit. The director believes that this will decrease ridership unless the system capacity is increased. She suggests that expanded services be offered simultaneously with the fare increase to offset negative community reaction, which may perhaps also increase ridership. The system capacity expansion will cost Rs 300,000. If the system capacity is enhanced, the probabilities of increased, sustained, and decreased use are estimated to be 0.2, 0.5, and 0.3, respectively (decreased usage due to still-prevalent congestion, inconvenience, and other factors). The corresponding deficits to DTC would be Rs 800.000, R 2400,000, and R 4000,000, respectively. An influential member suggests an alternative plan. He would increase the fare now but delay the capacity expansion decision for two years. However, the capacity expansion two years hence would cost Rs 450,000. If expansion is delayed, the director is sure that ridership will either decrease or remain unchanged at current levels. The probabilities of decreased and sustained use in this scenario are 0.3 and 0.7, respectively. Further, DTC will incur an additional operating deficit of Rs 500,000 (in case of decreased use) and Rs 800,000 (in case of sustained use) during this intervening two-year period. If after two years, sustained use is observed, DTC may again either opt or not opt for service expansion. If they still do not expand, ridership may either be sustained or will decrease. The probabilities of decreased and sustained usage in this scenario are 0,8 and 0.2, respectively. If the service capacity is expanded on observing sustained use in two years, then ridership will increase, sustain, or decrease. The probabilities of increased, sustained, and decreased use in this scenario two years hence are 0.2, 0.4, and 0.4, respectively. Again, on observing decreased use after two years, DTC has the option of opting or not opting for service expansion. Non-expansion decisions will lead to either decreased or sustained ridership with equal probabilities of 0.5 each. If DTC decides to expand on observing decreased use after two years, the probabilities of	**5**

Month	1	2	3	4
Contracted Sales	20	30	50	40
Maximum Production	40	50	30	50
Unit cost of production	14	16	15	17

	increased, sustained, and decreased use are 0.4, 0.5, and 0.1, respectively. The deficits to DTC on not expanding even after two years would be Rs 1500,000 and Rs 2400,000, respectively, for sustained and decreased use. Similarly, the deficits to DTC on expanding after two years would be Rs 600,000, Rs 1800,000, and Rs 3000,000, respectively, for increased, sustained, and decreased use. The problem being complex, the director decides to use a decision tree analysis to evaluate this problem and to arrive at a decision. Place yourself in the position of the director and draw a decision tree.	
5B	Determine the expected payoff at each decision and event node for the DTC decision tree.	**3**
5C	Suggest the best course of action for DTC based on the decision tree analysis.	**2**

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