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UNIVERSITY OF PETROLEUM & ENERGY STUDIES

DEHRADUN

End Semester Examination – April 2018

Program/course	: MBA Logistics & Supply Chain Management	**Semester**	: IV
Subject	: Supply Chain Modelling, Design & Simulation (MDSL823)	**Duration**	: **3** Hrs.
No. of page/s	: **4**	**Max. Marks**	: 100

SECTION A: ANSWER THE FOLLOWING QUESTIONS — Marks = 20

QUESTION # 01

a. In Kendell's Queueing Notation M/D/1/∞/∞ what does M, D, 1, ∞, ∞ stand for? **(MARKS 04)**

b. In standard Linear Programing Problem notation, what does a, b, c stand for? **(MARKS 03/07)**

c. In forecasting literature, what does MAD, MSE, RMSE, MAPE stand for? **(MARKS 04/11)**

d. Non-stationary Time Series data, has four components; what are they? **(MARKS 04/15)**

e. Modelling is done, to take three kinds of decisions; what are they? **(MARKS 03/18)**

f. Modelling Solution procedure/approaches are, two types; what are they? **(MARKS 02/20)**

SECTION B: ANSWER ANY 04 OUT OF 05 QUESTIONS GIVEN BELOW — Marks 05x04^{Q} = 20

QUESTION # 02

What is Mathematical Modelling; briefly discuss, give an example.

QUESTION # 03

What is Market Potential, Market Size, Industry Sales and, Company Sales; how are they connected?

QUESTION # 04

In the context of Queuing Theory, who are Reneging, Switching and Balking Customers?

QUESTION # 05

What forecasting methods are used when forecasting for a New Product - which is (01) due to Disruptive Technological Invention and (02) due to Incremental Technological Invention; and, why?

QUESTION # 06

Discuss True-isms in the context of Forecasting in a Supply Chain

SECTION C: ANSWER ANY 03 OUT OF 04 QUESTIONS GIVEN BELOW — Marks 10x03Q = 30

QUESTION # 07

Formulate the following typical Transportation Problem as a Linear Programing problem for minimum total cost.

A firm has two factories that ship to three regional warehouses; the cost of transportation of one unit of the product from the factory to the warehouses and the demand of the market served by the warehouses are given below. Factory F_2 is old; the variable manufacturing cost is Rs. 20 per unit here, whereas Factory F_1 is modern and produces at reduced variable cost, Rs. 10 per unit. The monthly capacity of F_1 and F_2 are 400 and 250 units respectively.

From Factory	Unit Cost of Transportation to Warehouses		
	W_1	W_2	W_3
F_1	2	2	5
F_2	4	2	3
Warehouse Requirement	**200**	**100**	**250**

QUESTION # 08

What is Forecasting, Demand Planning, Aggregate Planning and Sales & Operations Planning; and, the connection between them; discuss.

QUESTION # 09

When will you use the following forecasting tools: (a) Naïve Method, (b) Time Series - Smoothing Techniques, (c) Time Series – Analysis of Seasonality, (d) Regression Methods and, why?

QUESTION # 10

In Queuing Theory literature, what is (a) Arrival Characteristics, (b) Queue Characteristics and, (c) Service Facility Characteristics; discuss.

SECTION D: ANSWER THE FOLLOWING QUESTIONS — MARKS = 30

QUESTION # 11: With reference to the case given below, answer the following questions.

A. Suggest at least two supply chain solutions to Menon's problem; consider post GST scenario? **(MARKS 10)**
B. Forecast the sale for the first quarter of 2018-19. **(MARKS 20)**

MAHINDRA & MAHINDRA LTD. (FARMS' DIVISION)

On the morning of February 3, 2012, Vinod Menon, Deputy General Manager of sales at Mahindra & Mahindra, Ltd., Farm Division (MMFD), received a telephone call from a dealer. The dealer was complaining about the irregular and short supply of tractors from the company stockyard. Menon was frustrated with the way that the dealer was speaking to him but was not able to address the issue during their conversation. Instead, he tried to pacify the dealer with one excuse or another, but the dealer remained upset.

The conversation was becoming more heated with every passing second, and Menon was clearly irritated by the straight questions that were being asked by the dealer. Deep inside, he knew that the dealer was speaking logically, but he did not have the right answers. He finally ended the call after assuring the dealer that he would get the problem resolved. He was also not happy about the frequent complaints from other dealers regarding the short supply of tractors.

Menon had worked for MMFD for over a decade. Initially, he received dealer complaints of irregular tractor supplies only during the peak season, but it had now become a year-round problem. The company was currently operating four manufacturing plants in India, and Menon wondered why it was still unable to provide an adequate supply of tractors to its dealers.

In 2017, the domestic tractor market in India, although geographically fragmented, was the largest in the world, and it was still growing. The industry was very competitive with 16 companies manufacturing and selling tractors in the country, including the foreign players Kubota, John Deere, New Holland Agriculture, Same Deutz-Fahr and Massey Ferguson. The top four companies contributed more than 80 per cent of the sales in the domestic market. There were a number of tractor models available to satisfy customer preferences and demand.

The primary demand for tractors came from agriculture, and the secondary demand came from other uses, such as haulage, construction, etc. The demand for tractors followed a seasonal pattern; the peak seasons were April through June and September through November.

MMFD'S BUSINESS MODEL

MMFD had more than 800 dealers selling its tractors to customers across India. The tractors were manufactured at one of four plants located at Mumbai, Jaipur, Rudrapur and Nagpur and were then transported by road to one of the company's stockyards, which were located in each state. From the stockyards, the tractors were billed to dealers as per their needs and availability. This helped the company avoid paying a central sales tax of 4 per cent on the tractor price (the average tractor price was US$9,044; one India Rupee is 0.0161 US$).

MMFD had 26 sales offices located across India. Their main role was to coordinate supplies between the dealers and the company. They provided a rolling tractor demand forecast for the current month plus two months in the future. This forecast was used to manufacture tractors and to enable placing parts supply orders in advance. The manufacturing plants supplied tractors to the stockyards per the current monthly forecast. The tractor availability at the stockyards was a key concern given the demand from dealers according to the sales season: tractor sales were seasonal with a minus 20 per cent to plus 40 per cent change . MMFD had approximately 197 tractor models, the top 25 of which accounted for 73 per cent of sales; another 25 models accounted for the next 16 per cent of sales, and the remaining 147 models accounted for 11 per cent of sales (see Exhibit 02). The present dealer stock had an accuracy level of 63 per cent for fulfilling sales demands.

MMFD management was sensitive to monthly sales and market shares since this information was reported in the media and impacted the company's share price. This led to frequent changes in end-of-the- month manufacturing and supply to stockyards.

THE FORECASTING AND SUPPLY CHAIN DILEMMA

Dealers were carrying tractor stock equal to 40 days of their annual sales, and an additional 20 days of stock were held at company stockyards. Thus, there were 60 days of finished goods waiting for customers, who were willing to wait for five to 15 days to receive a new tractor. The production of tractors was driven by material availability as well as changing customer demands.

Menon did not want to lose sales; therefore, to cater to market demand, he frequently did mid-month revisions in the forecast plan and inter-stockyard transfer of tractors in order to meet dealer demand (stockyard to stockyard transfers of tractors accounted for 6.7 per cent of the annual sales volume with an average transportation cost of US$145 per tractor). But even then, dealers were often forced to sell alternate models at discounted prices to customers due to the lack of availability of the desired model. This was the main reason for the high level of dealer dissatisfaction.

In the next month's sales planning meeting, Menon decided to talk to his superiors about his stress and the dealers' low satisfaction level due to the improper supply of tractors, but he wanted to go into the meeting with a solution to the problem instead of just a complaint.

EXHIBIT 01: MONTHLY SALES

(in units of Tractors)

MONTHS	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
April	4,698	6,492	8,029	10,905	9,682	10,684	11,282	15,697	17,740
May	4,605	6,832	8,650	9,842	9,052	11,693	12,870	16,653	17,952
June	4,859	8,867	9,960	12,259	11,477	14,439	17,811	15,411	21,552
July	4,136	4,998	7,152	9,285	8,242	9,081	12,128	13,534	15,699
August	3,872	5,305	7,322	7,950	7,674	9,781	10,161	12,454	15,059
September	5,938	7,618	9,239	11,482	10,339	10,307	16,359	16,300	23,508
October	8,790	11,443	14,123	15,817	13,919	14,800	17,796	23,378	30,519
November	6,825	8,716	9,566	10,288	10,531	7,960	11,604	16,975	16,175
December	4,858	6,119	7,341	8,743	8,435	6,858	11,517	15,135	15,315
January	5,907	7,408	9,404	10,419	9,750	9,438	15,925	19,430	17,950
February	6,386	7,493	8,613	8,801	8,477	8,487	13,532	17,534	13,534
March	9,085	8,541	9,425	8,631	9,814	10,609	14,648	17,822	15,054

EXHIBIT 02: PARETO ANALYSIS OF MAHENDRA TRACTOR MODELS

Tractor Models	Annual Sales	Percentage
1–25	159,959	72.69%
26–50	36,111	16.41%
51–100	23,524	10.69%
101–197	463	00.21%