PGDM & PGDM (IB), 19-21

Supply Chain Management

DM-444 / IB-442

Trimester-IV, End Term Examination, September 2020

Time allowed: 2 hr 30 min

Max Marks: 50 Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means**. In case of rough work, please use answer sheet.

Section A: Please attempt all questions. Internal choices are given in some questions. (Total marks 30)

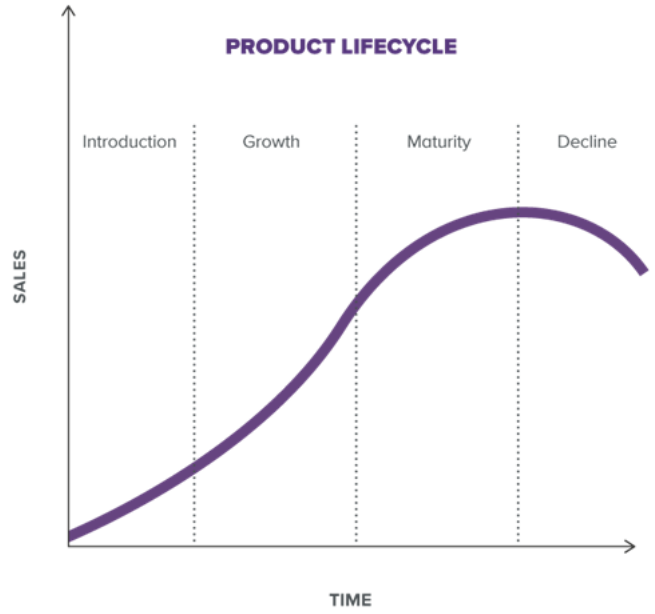
A1. XYZ Ltd. Manufactures and sells a special bathing soap that is popular all across the country. Presently, its customers are retail outlets spread all over the geography. These retailers place orders for the soap, which are then supplied directly to each retailer from the inventory kept at the single plant operated by XYZ. To improve its response time to the orders, XYZ is contemplating opening a few distribution centers where inventory can be kept. Under this arrangement, the retailer orders will be fulfilled from the inventory stored at the DCs. In a table, compare the logistics cost of the proposed configuration with the present one. Also, briefly explain why a cost component would increase or come down.

(CILO 1; 5 marks)

OR

A product firm faces very high demand uncertainty. According to published empirical data, its products should enjoy high margins. But the firm's product margins are poor. What could be the possible reasons? Please be brief (bullet points would be preferred). **(CILO 1; 5 marks)**

A2. In the push-pull perspective of supply chains, firms follow either a make-to-order, or assemble-to-order, or engineer-to-order strategy for their products. Consider the PLC shown below and briefly write which of these strategies are suited for each stage. Please be brief.



(CILO 1; 5 marks)

OR

McMaster-Carr sells maintenance, repair, and operations (MROs) equipment directly from five warehouses in the United States. Customer orders are received via the web. Its competitor WW Grainger also sells MRO products, but from more than 350 retail locations, supported by several warehouses. Briefly discuss the merits and demerits of the two distribution strategies (preferably in a tabular form).

(CILO 1; 5 marks)

A3. A retailer is contemplating to place order for woolen garments for children for the next winter season, which lasts for barely three months. The average retail selling price of a garment is Rs.500 per unit. The wholesale price paid by the retailer to the concerned manufacturer is Rs.300 per unit. Unsold stock can be disposed off at the end of the season at a discount store for Rs.80 per unit. The manufacturer incurs fixed production cost of Rs.100,000 and the variable production cost per unit is Rs.100. Assume that the retailer orders only once, well before the season starts.

From the past experience the retailer estimates the demand to be:

Sr. No.	Demand in units	Probability
1.	1000	0.15
2.	2000	0.15
3.	3000	0.20
4.	4000	0.30

4.	5000	0.20

a. What is the critical ratio for the retailer?
b. Given the data in this question, how much quantity should the retailer order to maximize its expected profitability?
c. What is the critical ratio for the entire channel? Assume that the channel consists of the manufacturer and the retailer.
d. How much should the retailer order to maximize the channel profit?
e. What should be the wholesale price offered to the retailer so that it makes sense for him/her to order the quantity you estimated in part d?

(CILO 3; 5x2 marks)

OR

Consider the following distribution system:

- Single product
- Two plants, referred to as P1 and P2
- Plant P2 has an annual capacity of 60,000 units
- The two plants have the same production costs
- Two existing warehouses, referred to as W1 and W2, have identical warehouse handling costs
- Three market areas: C1, C2 and C3, with demands of 50,000; 100,000; and 50,000 units respectively

Following table provides distribution cost per unit. For instance, distributing one unit from plant P1 to warehouse W2 costs $5, and from W2 to market C1 costs $2.

Distribution costs per unit					
Facility: Warehouse	P1	P2	C1	C2	C3
W1	0	4	3	4	5
W2	5	2	2	1	2

Company's objective is to find a distribution strategy that specifies the flow of products from the suppliers through the warehouses to the market areas without violating the plant P2 production capacity constraint that satisfies market demands, and minimizes the total distribution costs.

a. Draw a supply chain network using nodes to represent facilities/markets and arrows to represent flows.
b. Write down the objective function using usual symbols to represent costs and flow units.

c. Write down the constraints using usual symbols to represent flow units, capacities and demands. Assume that P1 capacity is unconstrained.

(CILO 3; 2+2+6 marks)

A4. Weekly demand for gaming consoles at Liverpool, a Mexican department store chain, is normally distributed with a mean of 1,000 and a standard deviation of 400. The replenishment lead time from the supplier is four weeks. Liverpool is targeting a CSL of 95 percent and uses a periodic review policy under which it reorders consoles every eight weeks.

a. How much safety inventory of consoles should Liverpool carry?
b. What should its order up to level be?

c. By how much does the average inventory carried change if Liverpool switched to a continuous review policy?

(CILO 2; 3 + 4 + 3 marks)

OR

DoorRed Pharmacy replenishes one of its best-selling drugs using a continuous review policy. Daily demand for the drug is normally distributed, with a mean of 300 and a standard deviation of 100. The wholesaler can process a replenishment request in two days. The current replenishment policy is to order 1,500 units when there are 750 units on hand.

a. What is the average inventory carried by DoorRed?

b. What is the cycle service level that DoorRed achieves with its policy?

c. DoorRed wants to adjust its ROP from 750 to achieve a CSL of 95%. What ROP should it use?

(CILO 2; 3 + 4 + 3 marks)

Section B: Case study; 20 marks

Brent Cartier, Manager for Special Projects in the Materials Department of Hewlett-Packard (HP) Company's Vancouver Division, is preparing for Monday's meeting with Group Management on worldwide inventory levels for the DeskJet Printer product line.

The DeskJet printer was introduced in 1988 and had become one of HP's most successful products. Sales had grown steadily, reaching a level of over 600,000 units in 1990 ($400 million). Unfortunately, inventory growth had tracked sales growth closely. Already, HP's distribution centres had been filled with pallets of the DeskJet printer. Worse yet, the DC in Europe was claiming that inventory levels there needed to be raised even further to maintain satisfactory product availability.

The situation was especially urgent in Europe. His mind was still filled with the faxed picture that he had received the previous day, showing the dip in product availability levels for some versions of the product at the European DC, yet he was sure that loads and loads of DeskJets have been shipped to Europe in the past months. His voicemail had been filled with angry messages from the sales offices, and yet the European DC was telling Vancouver that they had run out of space to store Vancouver's products.

The DeskJet Supply Chain

The DeskJet printer supply chain is represented in Exhibit 1. Manufacturing was done by HP in Vancouver. There were two key stages in the manufacturing process: (1) printed circuit assembly and test (PCAT) and (2) final assembly and test (FAT). The components needed for PCAT and FAT were sourced from other HP divisions as well as from external suppliers worldwide.

Selling the DeskJet in Europe required customizing the printer to meet the language and power supply requirements of the local countries, a process known as "localization." Specifically, the localization of the DeskJet for different countries involved assembling the appropriate power supply module, which reflected the correct voltage requirements (110 or 220) and power cord terminator (plug), and packaging it with the working printer and a manual written in the appropriate language. The design of the product was such that the assembly of the power supply module had to be done as part of the final assembly and test process, and therefore the localization of the printer was performed at the factory at Vancouver. Hence, the finished products of the factory consisted of printers destined for all of the different countries. These products were then sorted into three groups destined for the three distribution centres: North America, Europe and Asia-Pacific.

The total factory cycle time through the PCAT and FAT stages was about a week. The transportation time from Vancouver to the US DC, located in San Jose, California, was about a day, whereas it took 4-5 weeks to ship the printers to Europe and Asia. The long shipment time to the DCs in Europe and Asia was due to ocean transit and the time to clear customs and duties at port of entry.

The Inventory and Service Crisis

The magnitude of demand imbalances was especially alarming in Europe. It was becoming quite common to have product shortages for model demands from some countries, while inventory of some other models kept piling up. In the past, the target inventory levels at the DCs were based on safety stocks that were a result of some judgmental rule of thumb. It seemed like the increasing difficulty of getting the right balance of inventory for the various production options meant that the safety stock rules would have to be revisited.

David Arkadia had solicited the help of a young inventory expert from Corporate HP, Dr. Billy Corrington to help him put in place a scientifically based safety stock system which would be responsive to demand uncertainties and replenishment lead times. Billy had formed a team consisting of Laura Rock, an industrial engineer, Jim Bailey, the planning supervisor and Jose Fernandez, the purchasing supervisor from Vancouver to rehaul the safety stock management system. They were to recommend a method for calculating appropriate safety stock levels for the various models and options at the European DC. Gathering appropriate data turned out to be a task that the team spent a lot of time at. They now felt that they had a good sample of demand

data (Exhibit 2), which was approximately normally distributed for each of the product variant. Brent was hoping that this new methodology would solve the inventory and service problem.

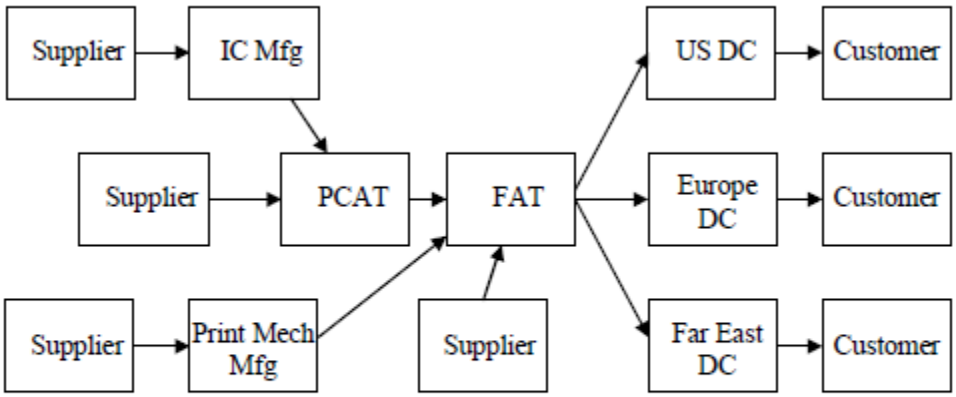
B1. Take a look at the demand data at Exhibit 2. Using this data, determine the safety stock for each of the six variants of the DeskJet printer to be carried at each local country location.

B2. One of the proposals that the HP management is evaluating is to modify the printer design so that the 'localization' can be done at the European DC. This would result in a generic printer model that gets shipped from Vancouver to the European DC and customization is done in Europe based on local demand. Determine the safety stock needed for this generic model at the European DC.

HP wants to maintain a CSL of 95% for the printers.

(CILO 2, 5+5 marks)

Exhibit 1. The DeskJet printer supply chain



Key: IC Mfg: Integrated Circuit Manufacturing
PCAT: Printed Circuit Board Assembly and Test
FAT: Final Assembly and Test
Print Mech Mfg: Print Mechanism Manufacturing

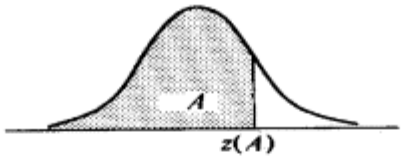
Exhibit 2.

Demand Data for Europe by Product Variant

Europe Variants	Monthly Mean	Monthly Std Dev
A	42.3	32.4
AA	420.2	203.9
AB	15830.1	5624.6
AQ	2301.2	1168.5
AU	4208.0	2204.6
AY	306.8	103.1
Total*	23108.6	6244.0

*Total figures are for all the variants taken together.

Entry is area A under the standard normal curve from $-\infty$ to $z(A)$



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998