

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Dept. of Industrial Engineering and Management

Autumn Mid-Term Examination 2012

Sub: Logistics and Supply Chain Management (IM31008, IM60052)

Total Marks: 50

Time: 2 hrs

**Answer all the questions and clearly state the assumptions (if required) with proper reason.**

- Q. 1.** John & Co. is a small manufacturer of servers that currently builds its entire product in Pune, Maharashtra. As the market for servers has grown dramatically, the plant has reached capacity of 5,000 servers per year. Company is considering two options to increase its capacity. The first option is to add 4,000 units of capacity to plant at an annualized fixed cost of Rs. 10,00,000 plus Rs. 400 labor per server. The second option is to have Bhatia & Co., an independent assembler, manufacture servers for John & Co. at a cost of Rs. 1500 for each server (excluding raw materials cost). Raw materials cost Rs. 7000 per server and John & Co. sells each server for Rs. 13000.

John & Co. must make this decision for a two-year time horizon. During each year, demand for its servers has an 80 percent chance of increasing 50 percent from the year before and a 20 percent chance of remaining the same as the year before. Bhatia & Co.'s prices may change as well. They are fixed for the first year but have a 60 percent chance of increasing 30 percent in the second year and a 40 percent chance of remaining where they are.

Use a decision tree to determine whether John & Co. should add capacity to its plant or if it should outsource to Bhatia & Co. **(10 Marks)**

- Q. 2.** A regional warehouse purchases hand tools from various suppliers and then distributes them on demand to retailers in the region. The warehouse operates 5 days per week, 52 weeks per year. The following data are estimated for one product, namely the 1-inch drill:

Average daily demand = 100 drills

Standard deviation of daily demand = 30 drills

Supplier Lead Time = 3 days

Holding cost = Rs. 9.40 per unit per year

Ordering Cost = Rs. 35 per order

Service Level = 98 %

Design an inventory system (using Reorder Point Model and Periodic Review Model) for this product. **(10 Marks)**

- Q. 3.** CCD (Cafe Coffee Day) carries a particular brand of tea that has a daily demand of 20 units and a standard deviation of 5 units. Its current supplier sells tea to CCD at Rs. 50 per unit but requires two weeks lead time. CCD has an alternative supplier who is willing to supply at Rs. 49.5 per unit but requires three weeks of lead time and insists on a minimum order size of 500 units per order. The CCD has an ordering cost of Rs. 200 per order and an inventory-carrying cost of 25 percent. The management at CCD is of the view that a target level of one stockout in two years is acceptable for tea. Which supplier should the CCD choose? **(10 Marks)**

**Q. 4.** BC Roy Hospital orders its antibiotics every 4 weeks when a sales person from a pharmaceutical company visits it. Zombacycline, which costs Rs. 25 per capsule, is one of its most prescribed antibiotics, with an average daily demand of 50 capsules. The standard deviation of daily demand, derived from examining prescriptions filled over the past 6 months, was found to be 15 capsules. It takes two weeks for the order to arrive. BC Roy Hospital will like 99 percent of all demand from prescriptions to be satisfied from stock. The cost to place an order is Rs. 1000 and the holding costs are 20 percent of the purchase price. The sales person has just arrived and there are currently 1,000 capsules in stock. How many capsules should be ordered?

BC Roy Hospital has just hired a consultant who has suggested that instead of ordering at the time of a sales person's visit, the company should monitor its stocks regularly and place an order whenever they feel appropriate. Devise an optimal ordering policy based on the consultant's suggestion. What will be the cost savings if BC Roy Hospital follows the policy suggested by the consultant?

**(10 Marks)**

**Q. 5.** PrintInk, a manufacturer of printing inks, has five manufacturing plants worldwide. Their locations and capacities are shown in Table 1 along with the cost of producing 1 ton of ink at each facility. The production costs are in the local currency where the plant is located. The major markets for the inks are North America, South America, Europe, Japan and the rest of Asia. Demand at each market is shown in Table 1. Transportation costs from each plant to each market in U.S. Dollars are shown in Table 1. Management must come up with a production plan for 2013.

a) If exchange rates are expected as in Table 2 and no plant can run below 50% of capacity, only formulate the network problem so that it helps an OR manager to find out how much should each plant produce and which markets should each plant supply? **(5 Marks)**

b) If there are no limits on the amount produced in a plant, redesign the network problem so that it again helps an OR manager to find out how much should each plant produce? **(5 Marks)**

Table 1

Capacity, Demand, Production and Transportation Costs for PrintInk							
	North America	Europe	Japan	South America	Asia	Capacity Tons/Year	Production Cost/Ton
US	600	1300	2000	1200	1700	185	\$ 10,000
Germany	1300	600	1400	1400	1300	475	15000 marks
Japan	2000	1400	300	2100	900	50	1,800,000 yen
Brazil	1200	1400	2100	800	2100	200	13,000 real
India	2200	1300	1000	2300	800	80	400,000 INR
Demand (Tons/year)	270	200	120	190	100		

Table 2

Anticipated Exchange Rates for 2013					
	US \$	Mark	Yen	Real	INR
US \$	1	1.52	77.66	2.02	55.45
Mark	0.657	1	51.35	1.33	36.44
Yen	0.013	0.019	1	0.03	0.7141
Real	0.495	0.752	33.33	1	27.35
INR	0.018	0.027	1.4	0.0365	1

### Cumulative Standard Normal Distribution

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9031	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9958	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986