Seat No. : _______________

AI-116

April-2016

M.Sc., Sem.-VIII

Quantitative Techniques

Time : 3 Hours] **[Max. Marks : 100**

Instruction : Non-programmable scientific calculator can be used.

1. Attempt any **two** : **20**

(1) A food products company is contemplating the introduction of a revolutionary new product with new packaging or replace the existing product at much higher price (S_1) or a moderate change in the composition of the existing product with a new packaging at a small increase in price (S_2) or a small change in the composition of the existing product except the word 'New' with a negligible increase in price (S_3). The three possible states of nature or events are (i) High increase in sales (N_1) (ii) No change in sales (N_2) and (iii) decrease in sales (N_3). The marketing department of the company worked out the payoffs in terms of yearly net profits for each of the strategies of three events (expected sales). This is represented in the following table :

Strategies	**States of Nature**		
	N_1	N_2	N_3
S_1	700000	300000	150000
S_2	500000	450000	0
S_3	800000	300000	300000

Which strategy should the concerned executive choose on the basis of

(i) Maximin criterion

(ii) Maximax criterion

(iii) Minimax regret criterion

(iv) Laplace criterion

(2) The Manager of a flower shop promises its customers delivery within four hours on all flower orders. All flowers are purchased on the previous day and delivered to parker by 8.00 a.m. the next morning. The daily demand for roses is as follows :

Dozens of roses :	70	80	90	100
Probability :	0.1	0.2	0.4	0.3

The manager purchases roses for ₹10 per dozen and sells them for ₹ 30. All unsold roses are donated to a local hospital. How many dozens of roses should parker order each evening to maximize its profits ? What is the optimum expected profit ?

(3) A company manufactures goods for a market in which the technology of the product is changing rapidly. The research and development department has produced a new product which appears to have potential for commercial exploitation. A further ₹ 60,000 is required for development testing.

The company has 100 customers and each customer might purchase at the most one unit of the product. Market research suggests that a selling price of ₹ 6,000 for each unit with total variable costs of manufacturing and selling estimate are ₹ 2,000 for each unit.

From previous experience, it has been possible to derive a probability distribution relating to proportion of customers who will buy the product as follows :

Proportion of Customers :	0.04	0.08	0.12	0.16	0.20
Probability :	0.10	0.10	0.20	0.40	0.20

Determine the expected opportunity losses, given no other information than that stated above, and state whether or not the company should develop the product.

2. Attempt any **two** : **20**

(1) The Purchasing Manager of a distillery company is considering three sources of supply for Oak barrels. The first supplier offers any quantity of barrels at ₹ 150 each. The second supplier offers barrels in lots of 150 or more at ₹ 125 per barrel. The third supplier offers barrels in lots of 250 or more at ₹ 100 each. The distillery uses ₹ 1,500 barrels a year at a constant rate. Carrying costs are 40 per cent and it costs the purchasing agent ₹ 400 to place an order. Calculate the total annual cost for the orders placed to the probable suppliers and find out the supplier to whom the orders should be placed.

(2) A dealer supplies you the following information with regard to a product dealt-in by him.

Annual Demand	10,000 units
Ordering cost	₹ 10 per order
Inventory carrying cost	20% of values of inventory per year
Price	₹ 20 per unit

The dealer is considering the possibility of allowing some back-order (Stock-out) to occur. He has estimated that the annual cost of back-ordering will be 25% of the value of inventory.

(i) What should be the optimum number of units of the product he should buy in one lot ?

(ii) What quantity of the product should be allowed to be back-ordered, if any ?

(iii) What would be the maximum quantity of inventory at any time of the year ?

(iv) Would you recommend to allow back-ordering ? If so, what would be the annual cost saving by adopting the policy of back-ordering ?

(3) The demand for an item is 24,000 per year. Its production rate is 4000 per month. The carrying cost is ₹ 0.25/unit/month and the set-up cost is ₹ 800 per set-up. The shortage cost is ₹ 15 unit/year. Find various parameters of the inventory system.

3. Attempt any **two** : **20**

(1) Describe briefly Arrival process, Service process and Queue structure.

(2) A repairman is to be hired to repair machines that breakdown, following a Poisson process with an average rate of four per hour. The cost of non-productive machine is ₹ 10 per hour. The company has the option of choosing either a fast or a slow repairman. The fast repairman charge ₹ 7 per hour and will repair machines at an average rate of ₹ 8 per hour. The slow repairman charges ₹ 4 per hour and will repair machines at an average rate of ₹ 6 per hour. Which repairman should be hired ? (Assuming 8 hours working shift)

(3) Arrival rate of telephone calls at a telephone booth are according to Poisson distribution. With an average time of 9 minutes between two consecutive arrivals, the length of telephone call is assumed to be exponentially distributed, with mean 3 minutes.

(i) Determine the probability that a person arriving at the booth will have to wait.

(ii) Find the average queue length that is formed from time to time.

(iii) Find the expected number of customers in the telephone booth.

(iv) Find the expected number of customers in the queue.

(v) Find the expected waiting time in the queue.

4. Attempt any **two** : **20**

(1) A book store wishes to carry a particular book in stock. Demand is not certain and there is a lead time of 2 days for stock replenishment. The probabilities of demand are given below :

Demand (units/day) :	0	1	2	3	4
Probability :	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of ₹ 10 per order. The store also incurs a carrying cost of ₹ 0.5 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day. The manager of the book store wishes to know about the following option for his inventory decision.

"Order 5 books when present inventory plus any outstanding order falls below 8 books."

Currently (beginning of 1st day) the store has a stock of 8 books plus 6 books ordered two days ago and are expected to arrive next day. Carryout simulation run for 10 days by using following random numbers.

89, 34, 78, 63, 61, 81, 39, 16, 13, 73

Find out total ordering cost, holding cost and total cost. Also find out closing stock of 10 days.

(2) What do you mean by Simulation ? Explain procedure of Monte Carlo simulation. Also state advantages of simulation.

(3) A firm has a single channel service station with the following arrival and service time probability distributions :

Interarrival Time	**Probability**
10	0.10
15	0.25
20	0.30
25	0.25
30	0.10

Service Time	**Probability**
5	0.08
10	0.14
15	0.18
20	0.24
25	0.22
30	0.14

The customer's arrival at the service station is a random phenomenon and the time between the arrivals varies from 10 minutes to 30 minutes. The service time varies from 5 minutes to 30 minutes. The queuing process begins at 10 am and proceeds for nearly 8 hours. An arrival goes to the service facility immediately, if it is free otherwise it will wait in a queue. The queue discipline is first-come first served.

If the attendant's wages are ₹ 10 per hour and the customer's waiting time cost ₹ 15 per hour, then would it be an economical proposition to engage a second attendant ?

Random Number for arrival time	20, 73, 30, 99, 66, 83, 32, 75, 04, 15, 29, 62, 37, 68, 94
Random Number for service time	26, 43, 98, 87, 58, 90, 84, 60, 08, 50, 37, 42, 28, 84, 65

5. Attempt any **two** : **20**

(1) Given the following data :

(i) Develop the estimating equation best describing these data.

(ii) Estimate the yield, if fertilizer used in 30.5 kg/acre and rainfall is 15 cms.

(iii) Also check goodness of fit.

Yield (Y)	40	50	50	70	65	65	80
Fertilizer (X_1)	10	20	30	40	50	60	70
Rainfall (X_2)	10	20	10	30	20	20	30

(2) Obtain the least square regression equation of Y on X and X on Y from the following data :

X :	25	28	35	32	31	36	29	38	34	32
Y :	43	46	49	41	36	32	31	30	33	39

Use the regression equation to forecast values of Y when X = 30.

(3) Fit a straight line trend to the following data on average monthly domestic demand for motor fuel. What is the forecast of demand for the year 2010 and 2017 ?

Year	**Demand**
1999	61
2000	66
2001	72
2002	76
2003	82
2004	90
2005	96
2006	100
2007	103
2008	110
2009	114