S.Y. Diploma in Operation Research May - 2008.

Paper : VII - Advance Operation Research, II (for Finance stream, Marketing Stream & Production Stream.

Con. 2184 & (a to b)-08. **BB-8617 to 8619**

(3 Hours) **[Total Marks : 100**

N.B. (1) Attempt any **five** questions.
(2) **Figures** to the **right** indicate **full** marks.
(3) **Necessary** explanations at **intermediate stages** must be given.
(4) Use of **non-programmable** calculator, statistical tables and Log tables is **permitted**.
(5) Answers should be **brief** and to the **points**.
(6) Assumptions, **required** in the questions, where **necessary** must be **explained**.

1. (a) Demand distribution of cakes of a particular type was as follows :— **10**

Demand	20	21	22	23	24
Probability	·15	·20	·22	·23	·20

Purchase price = Rs. 12 per unit and selling price is Rs. 15 for fresh cake and Rs. 11 for one day old cake per unit.
Determine the optimum stock.

(b) Explain the following terms in inventory models. **10**
(i) Reorder Level (ii) Buffer Stock
(ii) Safety Stock (iii) Desired level of performance.

2. (a) Annual demand for an item is 500 units per day. Ordering Cost is Rs. 30 per batch. Production cost per item is Rs. 15. Inventory cost is per unit, 10% of unit cost, per year, Discount is 5%. Determine the break-down order quantity. **10**

(b) An investment corporation must invest Rs. 5 lacs capital in 3 investment projects P_1, P_2 and P_3. The treasurer of the corporation has obtained information on the returns that can be reasonably expected from each project according to the amount of investment. The required information is as follows : **10**

Capital invested in Rs. lacs		**0**	**1**	**2**	**3**	**4**	**5**
Return in Rs. lacs	P_1	20	30	50	80	90	100
	P_2	25	45	55	72	74	75
	P_3	40	55	90	110	113	115

Determine the allocation for each project within the available budget in order to maximise the total returns.

3. (a) There are 4 products P_1, P_2, P_3 and P_4. The necessary information is given below : **20**

k = Production rate, in 100 units *per day*.
r = Demand rate, in 1000 units *per year*
C_1 = Inventory cost per unit per year in Rs.
C_2 = Set up cost, Rs.

Product	**k**	**r**	**C_1**	**C_3**
P_1	10	40	·010	10
P_2	12	55	·015	12
P_3	9	20	·012	20
P_4	12	90	·022	10

(i) Determine the optimum number of runs per year.
(ii) Find the optimum run length for each product.

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4. (a) Explain Bellman's Principle in Dynamic Programming with illustration. 10

(b) A company's sales (in Rs. 1,000) for a certain product in 3 marketing areas, A, B and C for various levels of sales effort, are given as follows : 10

Area	Levels of sales efforts (in Rs. 1000)				
	1	2	3	4	5
A	40	45	50	60	55
B	45	50	55	65	60
C	70	75	85	80	50

Budget available for sales efforts is Rs. 5,000. Using Dynamic Programming approach, determine the optimum allocation of the budget in each Marketing Area. (Assume that moneys is spent in Rs. 1,000).

5. (a) For an inventory models, the following information is given :— 10

Annual Demand = 12000 units
Unit cost = Rs. 10
Set up cost = Rs. 15
Holding Cost = Rs. 0·10 per unit per year
Normal Lead Time = 20 days
Maximum Lead Time = 30 days

Calculate :

(i) Buffer Stock
(ii) reorder Level
(iii) Safety Stock
(iv) Maximum Inventory
(v) Minimum Inventory
(vi) Average Inventory

(b) Explain the following, with illustration : 10

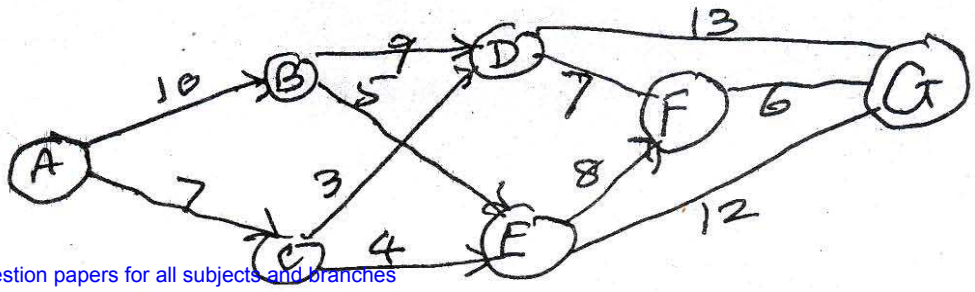
(i) Markovian Process
(ii) Ergodic Process
(iii) Bayesian approach in Decision making.

6. (a) Following is the transition probability matrix for states S_1 and S_2. 10

From \ To	S_1	S_2
S_1	315	215
S_2	217	517

Determine the limiting probabilities for the Ergodic Process.

(b) Determine the shortest route, using dynamic programming frm A to G in the following diagram. Figures on the arcs indicate distances in kms, between cities A, B, C, D, E, F and G as shown below : 10



7. (a) The following table gives 3 proposals from branch Managers of each of the 3 plants P_1, P_2 and P_3 with their costs (c) and revenues (R) in Rs. lacs. Total budget available is Rs. 5 lacs. 10

Proposal No.	P_1		P_2		P_3	
	C	R	C	R	C	R
1	0	0	0	0	0	0
2	2	4	3	9	2	6
3	4	8	5	14	3	9

Determine the optimal allocation of the budget for proposals of each of these plants in order to maximize the total revenue.

(b) Write short notes on : 10

(i) Markovian Decision Process with rewards

(ii) Howardes Policy Space Technique.

8. There are 6 market zones A, B, C, D, E and F and 6 workers. The following table indicate the sales volumes (in Rs. 1000) in each region with number of workers. The region F requires minimum 2 workers. Allocate the six workers, to the regions in order to maximise the total sales volume. 20

Region	No. of Workers						
	0	1	2	3	4	5	6
A	3	5	6	8	12		
B	4	5	6	7	9		
C	5	8	10	11	13		
D	6	10	12	14	16		
E	5	6	9	11	13		
F			14	16	15	20	24

Con. 2184 (a)-08. BB-8618

(3 Hours) [Total Marks : 100

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(3) **Necessary** explanations at **intermediate stages** must be given.
(4) Use of **non-programmable** calculator, statistical tables and Log tables is **permitted**.
(5) Answers should be **brief** and to the **points**.
(6) Assumptions, **required** in the questions, where **necessary** must be **explained**.

1. (a) The following data represent distances, in kms, between 7 cities A, B, C, D, E, F and G. 10
AB = 5, AC = 3, AD = 4, BC = 3, BD =7, BE = 3
CD = 3, CF = 6, DE = 4, DF = 8, EG = 10 FG = 9.
Using Dynamic Programming, determine the shortrest route from A to G.

(b) An item is produsedat the rate of 80 units per day, while demand per day is 50 units. If the set up get is Rs. 200 per run and the inventory cost is five paise per unit per day, obtain : 10

(i) EOQ, and (ii) the minimum total cost per run.

2. Consider 4 products A, B, C and D with information as shown below : 20

k = Production per day (in 100 units)
r = Demand per year (in 1000 units)
C_1 + Inventory cost per unit per year
C_3 = Set up cost, in Rs.

Assume that there are 250 days of production in a year.

Product	A	B	C	D
k	10	13	10	14
r	45	60	30	100
C_1	·01	·02	·03	·01
C_3	10	12	20	15

(i) Determine the optimum run length for each product.
(ii) What is the optimum number of runs per year ?

3. (a) A company has to invest Rs. 5 lacs of capital in 3 projects P_1, P_2 and P_3. The following table in each project, in lacs of Rs. 10

X = capital invested in Rs. lacs.

Revenue in Rs. lacs	X	0	1	2	3	4	5
	P_1	0	5	9	15	22	30
	P_2	0	10	20	25	26	35
	P_3	0	8	13	25	40	50

Using Dynamic Programming, determine the company's optimum allocation plan.

(b) Profits, in thousand rupees, of a certain store from 2000 to 2005 are given below : 10

Year	2000	2001	2002	2003	2004	2005
Profits	40	45	55	60	80	100

Fit a quadratic regression equation to estimate profit in a given year.

4. Acompany wants to decide whether to continue with regional distribution of a product (a) or expand to national distribution, (b) Research predicts that chancer for (a) are 70% with an expected return of Rs. 5 lacs and for (b) 30% with an expected return of Rs. 2 lacks. Draw a decision tree and determine what decision the company should take. 20

5. (a) The following data gives the demand for an item, in 100 units, in 5 years 2002 to 2006. 10

Year	2002	2003	2004	2005	2006
Demand	50	55	60	67	68

The initial value of the average of the period 1996-2001 is 3500. The initial value of the trend is zero. Using exponential smoothing with α = 0·3, estimate the demand for the year 2007.

(b) Explain the following terms with examples :— 10

(i) Hertz and Hiller model for investment under uncertainty.
(ii) Markovian Decision Process with rewards
(iii) Ergodic Process.

6. (a) Vehicles are passing through a toll gate at the rate of 60 per hour. The average time to pass through the gate is 40 seconds. The arrival rate and service rate follow Poisson Distribution. There is a complaint that arrivales wait for long time. The authorities are willing to install one more gate to reduce the average time to pass through the gate to 30 seconds if the idle time at the toll gate is less than 8% and the average queue length at the gate is more than 6 vehicles. Is the installation of the second gate is justified ? 10

(b) Explain the following terms : 10

(i) Johnson's rule for 3 machines and n jobs with condition.
(ii) Gupta's Algorithm (iii) Markovian Process.

6. A company maintains inventory on 3 items **A**, **B** and **C** with the following characteristics :— **10**

Item	A	B	C
Yearly demand in 100 units	20	120	4
Price, in Rs. per unit.	20	10	15

Current policy is to order each item once each month.

(i) What is the optimal ordering policy which gives the same total average inventory ?

(ii) If the order cost is Rs. 30 and the inventory. Cost is 10% per year per unit what is the optimal policy ?

(iii) Suppose the company can afford average investment of only Rs. 15,000, what would be the change in the ordering policy so as to minimise total cost under this restriction ?

7. An electronic device has 3 types of components A, B and C connected in series so that the failure of any one of them, will cause the failure of the device. The reliability (probability of not failure) of the device can be increased by installing one or more additional units of each of the component, in parallel. The following data gives reliability (R) and cost (C) for each components parallel units. **10**

If the total available budget is Rs. 5,000, determine the optimal allocation.

No. of parallel units	Component I		Component II		Component III	
	R	C	R	C	R	C
1	·6	500	·6	1500	·5	1000
2	·7	1000	·8	2500	·7	2000
3	·9	1500	·9	3000	·8	2500

8. (a) A company has 4 salesmen for allocation to 3 market areas A, B and C. Volumes of sales, in thousand rupees, of each area with number of salesmen are as given below : **10**

No. of salesmen	0	1	2	3	4
A	13	14	16	19	24
B	14	15	18	21	25
C	18	20	23	28	30

Determine the allocation of number of salesmen to each area in order to maximise the total sales volumes with 4 salesmen together.

(b) Explain with illustrations, the following terms : **10**

(i) EPPI and EVPI

(ii) Howards Policy Space Technique

(iii) Value Determination Operation and Policy Improvement Routine.

Con. 2184 (b)-08. BB-8619

(3 Hours) **[Total Marks : 100**

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(2) **Figures** to the **right** indicate **full** marks.
(3) Use of **Statistical Tables** and **Non-programmable Calculator** is **permitted.**
(4) Answers should be **brief** and to the points.
(5) **Intermedite explanations** and **calculations must** be given.
(6) Assumptions, wherever **necessary**, should be **clearly stated.**

1. (a) Explain the following Qualitative Techniques in forecasting : **10**
(i) Judgement (ii) Delphi technique. **10**

(b) Sales for 6 months are given below :

Month No.	1	2	3	4	5	6
Demand	450	500	510	485	465	570

Forecast for month 7 was 480 and initial value for new level was 10. taking $\alpha = 0{\cdot}2$ $\beta = 0{\cdot}3$ forecast sales for month 8, by Peter Winter's Model.

[TURN OVER

2. (a) Demand for an item is 20 units per month. Set up cost is Rs. 20. Production cost per item is Rs. 4. Inventory carrying cost is Re. 0·5 per item per month. Shortage cost is Rs. 2 per item per month. Determine how often to make production runs and what size it should be, when shortage cost is allowed. **10**

(b) Explain procedure for multi proiduct EOQ when no shortage is permitted. **10**

3. (a) The probability distribution of the demand for a product is as follows : **10**

Sales per day	0	1	2	3	4	5
Probability	0·05	0·08	0·35	·15	·20	·17

The cost per unit is Rs. 60 and selling price is Rs. 100 per unit. If a product is unsold then it is a waste. Assuming no reordering is possible, how many optimum units should be purchased per day ?

(b) Explain (i) various components of a time series model (ii) additive model and multiplicative model for analysis of time series. **10**

4. Consider 4 products A, B, C and D with the following information. Assume that there are 250 days of production in a year. **20**

Product	Demand per year (in 1000 units)	Production per day (in 100 units)	Inventory Cost per year per unit	Set up Cost Rs.
A	35	10	·010	7
B	90	9	·015	10
C	50	12	·005	15
D	30	7	·020	8

(a) Determine the optimum number of runs per year.
(b) What will be the optimum run length for each product ?

5. (a) In the machine shop of a small scale industry, machines break-down with a mean rate of 4 per hour. The maintenance shop of the industry has 3 mechanics who can attend to the breakdown machines individually. The service rate of each of the mechanics is 2 machines per hour. Initially there are 10 working machines in the machine shop. FInd : **10**
(i) P_0 (ii) L_q (iii) L_s (iv) W_q and (v) W_s.

(b) For the following 3 × 4 problem find optimal sequence of jobs by using (i) Palmeri's algorithm and (ii) CDS algorithm. **10**

	Time, in minutes, for pocessing			
	J_1	J_2	J_3	J_4
M_1	14	2	4	2
M_2	12	6	9	5
M_3	11	8	6	3

6. (a) Vehicles are passing through a toll gate at the rate of 60 per hour. The average time to pass through the gate is 40 seconds. The arrival rate and service rate follow Poisson Distribution. There is a complaint that arrivales wait for long time. The authorities are willing to install one more gate to reduce the average time to pass through the gate to 30 seconds if the idle time at the toll gate is less than 8% and the average queue length at the gate is more than 6 vehicles. **10**
Is the installation of the second gate is justified ?

(b) Explain the following terms : **10**
(i) Johnson's rule for 3 machines and n jobs with condition.
(ii) Gupta's Algorithm (iii) Markovian Process.

7. (a) There are 4 market regions and 6 salesmen. The following table indicates the sales volumes, in hundred rupees, in each region with the number of salesmen. Allocate the 6 salesmen in the corresponding regions, in order to maximize the total sales volume. **10**

No. of Salesmen

Region	0	1	2	3	4	5	6
A	6	7	10	15	17	20	25
B	5	6	7	8	10	12	15
C	4	6	8	10	13	15	20
D	5	4	8	6	7	12	15

(b) The following table gives transition probabilities for two states S_1 and S_2 :— **10**

From \ T_0	S_1	S_2
S_1	2/3	1/3
S_2	2/5	3/5

Determine the steady state probabilities.

8. (a) There are 3 market shares S_1, S_2 and S_3 where— **10**

S_1 = 20% or more = Rs. 30 lacs (high)
S_2 = 10% to 20% = Rs. 10 lacs (medium)
S_3 = Below 10% = Rs. (– 5) lacs (Low)

Priori probabilities for 3 states of nature are $P(S_1) = 0{\cdot}4$, $P(S_2) = 0{\cdot}5$, $P(S_3) = 0{\cdot}1$

A_1 = Commenalize the product
A_2 = Do not commenalize the product.

Calculate, EMV, EPPI and EVPI.

(b) Explain the following :— **10**

(i) Markovian Process with Rewards
(ii) Howard Policy Space Technique.

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