



**Shri Shankaracharya Institute of Professional Management & Technology**  
**DEPARTMENT OF MANAGEMENT STUDIES**  
**QUESTION BANK**  
**ECONOMETRICS & DECISION SCIENCE**  
**576412(76)**

**UNIT – 1**

**INPUT OUTPUT ANALYSIS**

Q1. Given below is a transition matrix showing an input output relationship.

Producing Sector	Consuming Sector			Final Demand	Total Output
	Steel	Transport	Power		
Steel	20	80	60	240	400
Transport	60	40	200	500	800
Power	100	200	40	60	400
Primary input	220	480	100		800

What will be the change in output when final demand of steel sector grows from 240 to 250. Also calculate total labour required.

Q2. We are given the following transitions table. Find the technology matrix and change in output of each sector if final demand next year is expected to be 350, 125 and 250 in sectors A,B and C respectively.

Sector of Origin	Sector of Destination			Final Demand	Total Output
	A	B	C		
A	100	300	50	250	700
B	250	50	400	50	750
C	200	150	100	200	600
Value Added	150	200	100		
Gross Output	700	750	650		

Q3. Given below is a transition matrix showing input output analysis.

Sector of Origin	Sector of Destination			Final Demand	Total Output
	A	B	C		
A	10	50	25	15	100
B	50	10	15	125	200
C	15	20	5	60	100
Labour	25	120	55		

Compute the gross output level if final demand of sector C changes to 70.

Q4. Given below is an transition matrix showing input output analysis.

Producing Sector	Receiving Sector			Final Demand	Total Output
	A	B	C		
A	20	100	50	30	200
B	100	20	30	250	400
C	30	40	10	120	200
Labour	50	240	110		

Construct the technological matrix and explain how to compute the gross output levels of all sectors if the final demand of sector C changes to Rs. 125 million.

Q5. The input output table of a two product economy is given below. Determine the gross output level of the commodities and total man days required.

Producer	Consumer		Final Demand
	Product 1	Product 2	
Product 1	0.5	0.2	100
Product 2	0.4	0.6	150
Labour man days (per unit production )			

Q6. A firm produces both coal and steel, the two commodities serves as intermediate in each other production. 0.4 ton of steel and 0.7 ton of coal is need to produce a ton of steel. Similarly 0.10 ton of steel and 0.60 ton of coal are required to produce a ton of coal. No capital input are needed. 3 and 10 labour days are required to produce a ton of coal and steel respectively. If the firm needs 400 tons of steel and 200 tons of coal. Calculate the gross output of two commodity and total labour required.

Q7. Given

$$A = \begin{pmatrix} 0.10 & 0.30 & 0.10 \\ 0 & 0.20 & 0.20 \\ 0 & 0 & 0.30 \end{pmatrix}$$

and the final demands as  $D_1$ ,  $D_2$  and  $D_3$ . Find the output levels consistent with the model. What will be the output levels if  $D_1 = 120$ ,  $D_2 = 50$  and  $D_3 = 1000$ ?

Q8. Let there be three industries in an economy. Estimate the output of each, with the given input coefficient matrix and final demand.

$$A = \begin{pmatrix} 0.30 & 0.40 & 0.20 \\ 0.20 & 0.0 & 0.50 \\ 0.10 & 0.30 & 0.10 \end{pmatrix} \quad \text{and} \quad F = \begin{pmatrix} 400 \\ 250 \\ 200 \end{pmatrix}$$

Q9. Given is a technology matrix and labour primary input for all the three sectors are as follows:

$$[A] = \begin{matrix} & \begin{matrix} \text{Steel} & \text{Transport} & \text{Power} \end{matrix} \\ \begin{matrix} \text{Steel} \\ \text{Transport} \\ \text{Power} \end{matrix} & \begin{pmatrix} 20/200 & 100/400 & 50/200 \\ 100/200 & 20/400 & 30/200 \\ 30/200 & 40/400 & 10/200 \end{pmatrix} \end{matrix}$$

What will be the change in output when final demand of the steel sector grows from 30 to 40. Draw the transition table and total labour required.

Q10. Consider the input output table for the following system.

Input \ Output	Agriculture	Steel	Final Demand	Total Output
Agriculture	200	150	1050	1400
Steel	----	750	1150	1900
Primary Input	1200	1000	-----	2200
Total Input	1400	1900	2200	

Examine the extent to which the output level of agriculture will rise as a result of increase in its household consumption by Rs. 60 (in '00million').

Q11. If the final demand vector and technology matrix for goods 1 and 2 are

$$F = \begin{pmatrix} 7611 \\ 2246 \end{pmatrix} \quad \text{and} \quad A = \begin{pmatrix} 0.204 & 0.089 \\ 0.037 & 0.441 \end{pmatrix}$$

Find the value added in the two sectors. What shall be the required increase in output of the final demand increases by 4.25% and 7.16% respectively?

Q12. There are three industries  $X_1$ ,  $X_2$  and  $X_3$ ;  $X_1$  requires 20% of the product of  $X_1$ , 40% of  $X_2$  and 10% of  $X_3$  (all in money terms).  $X_2$  requires 30%, 10% and 30% of  $X_1$ ,  $X_2$  and  $X_3$ .  $X_3$  requires 20%, 20% and 20% of  $X_1$ ,  $X_2$  and  $X_3$ . Find the output required for each industry if the demand in money terms for the products of three industries are Rs.20, Rs.5 and Rs.4 lakh respectively.

Q13. For three sectors A, B and C based on the following data:

Technology Matrix

	A	B	C
A	0.10	0.15	0.10
B	0.50	0.05	0.15
C	0.15	0.10	0.05

	Output
A	100
B	200
C	300

- (iv) Prepare input-output transition table.
- (v) Find final demand of each sector.
- (vi) Calculate primary inputs of each sector.

## UNIT - 2

### GAME THEORY

Q1. Solve the game whose payoff matrix is given by

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	1	3	1
	A <sub>2</sub>	0	-4	-3
	A <sub>3</sub>	1	5	1

Q2. Solve the game whose payoff matrix is given by

		Player B			
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
Player A	A <sub>1</sub>	20	15	12	35
	A <sub>2</sub>	25	14	8	10
	A <sub>3</sub>	-9	4	11	0

Q3. A two person zero sum game, has the following payoff matrix. Solve the game

		Player B	
		B <sub>1</sub>	B <sub>2</sub>
Player A	A <sub>1</sub>	8	-1
	A <sub>2</sub>	3	0
	A <sub>3</sub>	0	-2
	A <sub>4</sub>	-7	-4

### MIXED STRATEGY

Q4. Solve the following payoff matrix. Determine the optimal strategies and the value of game.

$$\begin{array}{c} \text{Player A} \\ A_1 \\ A_2 \end{array} \begin{array}{c} \text{Player B} \\ B_1 \quad B_2 \\ \left( \begin{array}{cc} 5 & 3 \\ 1 & 4 \end{array} \right) \end{array}$$

Q5. Solve the following game and determine the value of game.

$$\begin{array}{c} \text{Player A} \\ A_1 \\ A_2 \end{array} \begin{array}{c} \text{Player B} \\ B_1 \quad B_2 \\ \left( \begin{array}{cc} 4 & -4 \\ -4 & 4 \end{array} \right) \end{array}$$

Q6. Solve the following game and determine the value of game.

$$\begin{array}{c} \text{Player A} \\ A_1 \\ A_2 \end{array} \begin{array}{c} \text{Player B} \\ B_1 \quad B_2 \\ \left( \begin{array}{cc} 8 & -7 \\ -6 & 4 \end{array} \right) \end{array}$$

Q7. In a game of matching coins with two players suppose A wins one unit of value when there are two heads, wins nothing when there are two tails, losses  $\frac{1}{2}$  units of value when there are one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of game.

Q8. Consider a modified form of matching based coins game problem. The matching player is paid Rs. 8 if the coins turn both heads and Rs. 1 if both the coins turn tail. The non matching player is paid Rs. 3 when the two coins do not match. Give the choice of being the matching or non matching, which one would you choose and what would be your strategy.

## GRAPHICAL METHOD

Q9. Solve the following game graphically.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	1	3	11
	A <sub>2</sub>	8	5	2

Q10. Solve graphically

		Player B	
		B <sub>1</sub>	B <sub>2</sub>
Player A	A <sub>1</sub>	1	-3
	A <sub>2</sub>	3	5
	A <sub>3</sub>	-1	6
	A <sub>4</sub>	4	1
	A <sub>5</sub>	2	2
	A <sub>6</sub>	-5	0

Q11. Solve the following game using graphical approach.

		Player B			
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
Player A	A <sub>1</sub>	8	5	-7	9
	A <sub>2</sub>	-6	6	4	-2



Q12. Solve the following game using the graphical method.

		Player B	
		B <sub>1</sub>	B <sub>2</sub>
Player A	A <sub>1</sub>	-7	6
	A <sub>2</sub>	7	-4
	A <sub>3</sub>	-4	-2
	A <sub>4</sub>	8	-6

Q13. Solve the game with the following payoff matrix.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	6	4	3
	A <sub>2</sub>	2	4	8

### **DOMINANCE RULE**

Q14. Solve the game using dominance rule.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	12	-8	-2
	A <sub>2</sub>	6	7	3
	A <sub>3</sub>	-10	-6	2

Q15. Solve the game

		Player B			
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
Player A	A <sub>1</sub>	4	-2	3	-1
	A <sub>2</sub>	-1	2	0	1
	A <sub>3</sub>	-2	1	-2	0

Q16. Find the optimal strategies for A and B in the following game. And also obtain the value of game.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	9	8	-7
	A <sub>2</sub>	3	-6	4
	A <sub>3</sub>	6	7	4

Q17. A and B play a game in which each has three coins a 5 paisa, 10 paisa and 20 paisa. Each select a coin without the knowledge of others choice. If the sum of the coins is an odd amount A win's B's coin. If the sum is even B's win's A's coin. Find the best strategy for each player and the value of game.

Q18. Is the following two person zero sum game is stable. The payoff is for player A. solve the game.

		Player B			
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>
Player A	A <sub>1</sub>	5	-10	9	0
	A <sub>2</sub>	6	7	8	1
	A <sub>3</sub>	8	4	15	2
	A <sub>4</sub>	3	4	-1	4

## ARITHMETIC METHOD

Q19. Solve the game.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	7	1	7
	A <sub>2</sub>	9	-1	1
	A <sub>3</sub>	5	7	6

Q20. . Solve the game.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	-1	2	1
	A <sub>2</sub>	1	-2	2
	A <sub>3</sub>	3	4	-3

Q21. . Solve the game.

		Player B		
		B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
Player A	A <sub>1</sub>	0	1	2
	A <sub>2</sub>	2	0	1
	A <sub>3</sub>	1	2	0

Q21. There are two players in a game, player A and player B. Each of them randomly shows selected fingers of his right hand. If the sum of the number of fingers shown by both the players is an even number, then the player B has to give money in rupees equivalent to the number of fingers shown by him to the player A. if the sum of the numbers of finger shown by both the players is an odd number, then the player A has to give money in rupees equivalent to the number of fingers shown by him to the player B. Construct the payoff matrix with respect to the player A and find the optimal solution for this game.

Q22. There is a famous Italian game called two finger morra. This game is played by two people each of whom shows one or two fingers and simultaneously guesses the number of fingers his opponent will show. If just one player guesses correctly, he wins an amount equal to the sum of the fingers shown by himself and by his opponent, otherwise game is considered a draw. Obtain the payoff matrix corresponding to it.

Q23. In an election of two MLA, two political parties A and B are thinking of nominating a candidate in a closed session, whose result are to announced simultaneously. The following odds are offered for the various possible combinations of candidates.

Party A	Odds	Party B
Sharma	3:1	Singh
Sharma	4:1	Gill
Sharma	1:3	Bajwa
Goel	3:7	Singh
Goel	3:2	Gill
Goel	1:4	Bajwa
Kapoor	4:1	Singh
Kapoor	1:4	Gill
Kapoor	1:3	Bajwa

The parties want to select candidate in accordance with standard minimum criterion. What are the optimal strategies for party A and party B.

Q24. Two separate firms A and B for ten years have been selling a competing product, which forms part of both firm's total sales. The marketing executive of firm A raised the question what should be the firm's strategies in terms of advertising for the product in question? The market research team of firm A developed the following data for varying degree of advertising.

a. No advertising, medium and large advertising for the both firm's will result in equal market share.

b. Firm A with no advertising

people  
his

40% of the market with medium advertising by firm B and 28% of the market with large advertising by firm B

c. Firm A using medium advertising

70% of the market with no advertising by firm B and 45% of the market with large advertising by firm B.

d. Firm A using large advertising

75% of the market with no advertising by firm B. 47.5% of the market with medium advertising by firm B.

Based on the aforesaid information answer the marketing executive answer.

## UNIT - 3

### MARKOV CHAIN ANALYSIS

Q1. In a market only two brands of powder A and B are sold. Given that a lady last purchase powder A, there is 80% chance that she would buy the same brand in the next purchase, while if a lady purchase brand B, there is 90% chance that her next purchase would be brand B. Using this information develop the transition probability matrix. Now, calculate.

- a. The probability that if a customer is currently a brand A purchaser, she will purchase brand B two purchases from now.
- b. The probability that if a customer is a brand B purchaser, she will purchase brand A three periods from now.
- c. The probability that three periods from now, a customer shall buy brand B, given that the current market share of the two brands is as follows:  
Initial share of the company is A 70% and B 30%.
- d. Steady state probabilities.

Q2. Recently a market research team has conducted a survey of consumer buying habits with respect of three brands of telcum powder in an area. It estimates that 20% of the customer buy brand A, 50% of the customer buy brand B and 30% of them buy brand C. In addition the firm has analysed its survey data and has determine the following brand switching matrix.

Brand Just Bought	Brand Next Bought		
	A	B	C
A	0.60	0.30	0.10
B	0.40	0.50	0.10
C	0.20	0.10	0.70

What will be the expected distribution of customer 2 time period later.

Q3. Suppose that new razor blades were introduced in the market by three companies at the same time. When they were introduced each company had an equal share of the market but during the first year the following changes took place.

- a. Company A retained 90% of its customers, lost 3% to B and 7% to C.
- b. Company B retained 70% of its customers, lost 10% to A and 20% to C.
- c. Company C retained 80% of its customers, lost 10% to A and 10% to B.

Assuming that no changes in the buying habit of the consumer occur:

- a. What are the market share of the three companies at the end of the first year and second year?
- b. What are the long run market share of the three companies.

Q4. On January first this year Bakery A had 40% of its local market share. While the other two bakeries B and C had 40% and 20% respectively of the market share. Based upon a study by marketing research firm, the following facts were compiled. Bakery A retains 90% of its customer, while gaining 5% of competitor B's customer and 10% of C's customer. Bakery B retains 85% of its customers, while gaining 5% of A's customer and 7% of C's customer. Bakery C retains 83% of its customer and gains 5% of A's customer and 10% of B's customer

What will be each firm share will be on January first next year and what will each firm's market share be at equilibrium?

Q5. A market survey is made on two brands of breakfast foods A and B. Every time a customer purchases he may buy the same brand or switch to another brand. The following transaction matrix is given below.

From	To	
	A	B
A	0.80	0.20
B	0.60	0.40

At present it is estimated that 60% of the people buy brand A and 40% buy brand B. Determine the market share of brand A and B in the steady state.

Q6. A house wife buys three kinds of cereals  $C_1$ ,  $C_2$  and  $C_3$ . It is known that she never buy the same cereals on successive weeks. If she buys cereal  $C_1$ , then the next week she buy cereal  $C_2$ . However if she buys cereal  $C_2$  or  $C_3$ , then the next week she is thrice as likely to buy  $C_1$  as the other brand.

Obtain the transition probability matrix and determine how often she would buy each of the following cereals in the long run.

Q7. To investigate brand switching between different brands of detergent powder, a research company surveyed shoppers in an area to discover their behaviour. The survey on a number of shoppers in relation to three leading brands super wash, clean and shine has revealed the following information.



Current Buy	Previous Buy	Number
Super wash	Super wash	200
Clean	Clean	150
Shine	Shine	100
Clean	Super wash	50
Shine	Super wash	25
Super wash	Clean	80
Shine	Clean	45
Super wash	Shine	130
Clean	Shine	20

- Using the information, develop transition probability matrix.
- Calculate the market share for each brand after two purchases.
- Calculate the market share for each brand in the long run.

**Q8.** The price of an equity share of a company may increase, decrease or remain constant on any given day. It is assumed that the change in price on any day affects the change on the following transition matrix.

		Change Tomorrow			
Change Today	Increase	{	0.50	0.20	0.30
	Decrease		0.70	0.10	0.20
	Unchanged		0.40	0.50	0.10

- d. If the price of the share increased today, what are chances that it will increase, decrease or remain unchanged tomorrow.
- e. If the price of the share decreased today, what are the chances that it will increase tomorrow?
- f. If the price of the share remain unchanged today, what are the chances that it will increase, decrease or remain unchanged day after tomorrow.

Q9. A market survey is made on two brands of breakfast foods A and B. Every time a customer purchases he may buy the same brand or switch to another brand. The following transaction matrix is given below.

From	To	
	A	B
A	0.80	0.20
B	0.30	0.70

- d. Calculate the probability that a randomly selected customer would buy the same brand two periods hence as he buys now.
- e. Calculate the probability that a customer who is buying brand B today will buy brand A two periods from now.
- f. Determine the market share of brand A and brand B in the steady state.

At present it is estimated that 60% of the people buy brand A and 40% buy brand B. Determine the market share of brand A and B in the steady state.

Q10. A small city with 1,700 customers has three shoe stores  $S_1$ ,  $S_2$  and  $S_3$ . Suppose that due to its location, there are no new customers added and the old ones also do not leave.

A survey of the number of customers visiting each store in the past year reveals the following:

Store	Customers as on Jan 1, year 1	Change during the year		Customers as on Jan 1, year 2
		Gains	Losses	
S <sub>1</sub>	800	250	350	700
S <sub>2</sub>	400	275	200	475
S <sub>3</sub>	500	150	125	525

Using the following information about gain/loss summary, obtain the transition probability matrix that defines the market structure for the three stores.

Customers as on Jan 1, year 1	Gains From			Losses to		
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>
S <sub>1</sub>	0	150	100	0	250	100
S <sub>2</sub>	250	0	25	150	0	50
S <sub>3</sub>	100	50	0	100	25	0

Q11. A researcher is analysing switching between two competing products. The shares for the two products are found to be as given here:

Period	Percentage market share	
	Product A	Product B
1	60.0	40.0
2	64.0	36.0
3	65.6	34.4

The researcher believes that an accurate representation of the market share in any period can be obtained by using Markov processes. Assuming his belief is correct:

- Estimate the transition probability matrix.
- Obtain the market shares in period 4 using the estimated transition matrix.
- If the actual market shares for period 4 were 66 and 34 percent, would you revise your estimate of the transition matrix? Give reason.

Q12. (a) The purchase pattern of two brands of toothpaste can be expressed as a Markov process with the following probabilities:

	Special B	MDA
Special B	0.90	0.10
MDA	0.05	0.95

- Which brand appears to have most loyal customers? Explain
  - What are the projected market shares for the two brands?
- (b) Suppose that in part (a) a new toothpaste brand enters the market such that the following transition probabilities exist:

	Special A	MDA	T-White
Special B44	0.80	0.10	0.10
MDA39	0.05	0.75	0.20
T-White17	0.40	0.30	0.30

What are the new long run market shares? Which brand will suffer from the introduction of the new brand of toothpaste?

Q13. A manufacturing company has a certain piece of equipment that is inspected at the end of each day and classified as just overhauled, good, fair or inoperative. If the piece is inoperative, it is overhauled, a procedure that takes one day. Assume that the working condition of the equipment follows a Markov process with the following transition matrix:

From State	To State			
	1	2	3	4
1	0	$\frac{3}{4}$	$\frac{1}{4}$	0
2	0	$\frac{1}{2}$	$\frac{1}{2}$	0
3	0	0	$\frac{1}{2}$	$\frac{1}{2}$
4	1	0	0	0

It costs Rs. 125 to overhaul a machine (including lost time) on the average and Rs. 75 in production is lost if a machine is found inoperative. Using the steady-state probabilities, compute the expected per day cost of maintenance.

## UNIT - 4

### Decision Theory

Q1. A book store sells a particular book of tax laws for Rs.100. It purchases the book for Rs. 80 per copy. Since some of the tax laws change every year. The copies unsold at the end of a year become out dated and can be disposed off for Rs. 30 each. According to past experience the annual demand for this book is between 18 and 23 copies. Assuming that the order for this book can be placed only once during a year. The problem before the store manager is to decide how many copies of the book should be purchased for next year.

Q2. A major consumer goods manufacturer wishes to decide which of the two new products to bring out in the market and what level of advertisement to use the profitable for this products are as follows:

(Profits are in units of Rs.10000)

Demand		Ozone			Life		
		A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
S <sub>1</sub>	High	140	160	200	200	210	230
S <sub>2</sub>	Average	100	130	160	160	170	190
S <sub>3</sub>	Low	80	120	140	120	130	140

Where,

A<sub>1</sub> = Low expenditure advertisement program

A<sub>2</sub> = Medium expenditure advertisement program

A<sub>3</sub> = High expenditure advertisement program

The prior probability distributions are as follows:-

Demand	Ozone	Life
S <sub>1</sub>	0.40	0.20
S <sub>2</sub>	0.50	0.20
S <sub>3</sub>	0.10	0.60

Calculate:-

1. Which product and advertisement level would you recommend?
2. What is the expected value of perfect information for each product?

Q2. A news paper vendor has to decide how many copies of a particular magazine he should buy for the coming month. Each magazine cost him Rs.5. Which he sells for Rs. 10 at the end of the month the unsold magazines are thrown away. The demand distribution of the magazines are as follows:

No of copies demanded	10	11	12
Probability	1/3	1/3	1/3

Construct a payoff table according to maxi min criteria how many copies should we purchase? Which number of copies will maximize the expected payoff.

Q3. Payoff of 3 acts X,Y and Z and the states of nature of L, M and N are given below.

State of nature	Acts		
	X	Y	Z
L	- 20	- 50	200
M	200	- 100	- 50
N	400	600	300

The probability of the states of nature are 0.3, 0.4 and 0.3 respectively. Calculate the EMV for the above data and select the best act.

Q4 A farmer wants to decide which of the three crops he should plant on his 100 acre firm. The profit from each is dependent on the rainfall during the growing season. The farmer has categorised the amount of rainfall as high, medium and low. His estimated profit for each crop is shown in the table below.

Estimated Conditional Profit (Rs)

Rainfall	Crop A	Crop B	Crop C
High	8000	3500	5000
Medium	4500	4500	5000
Low	2000	5000	4000

If the farmer is going to plant only one crop. Decide which should be his best crop using.

1. Maximax Criteria
2. Maximin Criteria
3. Hurwicz Criteria(Farmer degree of optimissim being 0.6)
4. Laplase Criteria
5. Minimax Regret Criteria

Q5. The research department of Hindustan liver has recommended to the marketing department to launch a shampoo of three different types. The marketing manager has to decide of the type of shampoo to be launched under the following estimated pay off for various level of sales.

Estimated level of sales (unit)

Types of shampoo	15000	10000	5000
Egg	30	10	10
Clinic	40	15	5
Delux	55	20	3

What will be the marketing manager decision if maximin, minimax, laplace and minimax regret criteria is applied.

Q6. A businessman has three alternatives open to him each of which can be followed by any of the four possible event. The conditional pay off (in Rs) for each action event combination are given below.



Payoff conditional on event

Alternative	A	B	C	D
X	8	0	-10	6
Y	-4	12	18	-2
Z	14	6	0	8

Determine which alternative should the business choose.

1. Maximin criteria
2. Maximax criteria
3. Hurwicz alpha rule (0.7)
4. Minimax regret criteria
5. Laplace

Q7. Hindustan sales corporation is a dealer firm in white goods. It finds that the weekly holding cost per unit of an air cooler is Rs.30 per week. Non availability of an air cooler results in losing a customer. The cost for losing a customer is estimated to be Rs. 80. The dealer expects that the weekly demand for an air cooler will range from 0 to 3 units per week.

1. Construct a payoff matrix.
2. Determine the optimum quantity to be stored per week and the corresponding weekly cost using.

- (a) Maximin criteria.
- (b) Maximax criteria.
- (c) Laplace
- (d) Regret criteria
- (e) Hurwicz criteria if the decision is optimistic about the demand for 60% of times.

3. Probability distribution of the demand is as follows:

Demand	0	1	2	3
Probability	0.1	0.3	0.4	0.2

Q8. An ice cream retailer by an ice cream at a cost of Rs.5 per cup and sell it for Rs. 8 per cup. Any remaining unsold at the end of the day can be disposed off at a salvage price of Rs. 2 per cup. Past sell have range between 15 to 18 per cup per day. There is no reason to believe that sales volume will take on any other magnitude in future. Find the EMV. If the sells history has the following probabilities.

Market Size	15	16	17	18
Probability	0.10	0.20	0.40	0.30

Q9. A certain output is manufactured at Rs. 8 and sold at Rs. 14 per unit. The product is such that if it is produced but not sold during a day time, it becomes worth less. The daily sales record in the past hours are as follows:

Demand per day	30	40	50	60	70
No of day each sales level were recorded	24	24	36	24	12

1. Calculate the average expected sales of a day.
2. Find the expected payoff and optimum policy.
3. Also find the value of perfect information.

Q10. The probability distribution of demand for cakes is given below:

No of cakes demanded	0	1	2	3	4	5
Probability	0.05	0.10	0.25	0.30	0.20	0.10

If the cost of cake is Rs. 3 per unit and selling price is Rs. 4 per unit. How many cakes should the baker make to maximize his profit? Assume that if cake is not sold at the end of the day is value is zero.

Q11. A trader of boat has estimated the following distribution of demand for a particular kind of boat.

No of demand	0	1	2	3	4
Probability	0.05	0.20	0.35	0.25	0.15

Each boat cost him Rs. 7000 and he sells them for Rs. 10000 each. Boats that are left unsold at the end of the season must be disposed off for Rs. 6000 each. How many boats should be stocked so as to maximize his expected profit? Also solve the problem by ignoring the given probability.

### Decision Tree

Q12. Crown auto is trying to decide about the size of the plant to be build in Gujarat. Three alternatives of annual capacity 10000 units, 20000 units, 30000 units are under consideration. Demand for the product is not known with certainty but the management has estimated the probabilities for 5 different levels of demand. The profit for each size of plant at different levels of demand is as follows.

Level of Demand	Probabilities	Profit (RS. in lakhs) for different actions. Build plant with the capacity of		
		10000 units	20000 units	30000 units
Very High	0.15	- 4	- 6	- 8
Light	0.30	1	0	- 2
Moderate	0.25	1	7	5
Low	0.20	1	7	11
Very Low	0.10	1	7	11

What plant capacity would you suggest to the management also draw decision tree.

Q13. Grow fast company is evaluating 4 alternative single period opportunities whose returns are based on the state of economy and the associated probability distribution is as follows:

State	Fair	Good	Great
Probability	0.2	0.5	0.3

The return for each investment opportunities and each state of economy are as follows:

State of Economy

Alternative	Fair	Good	Great
W	Rs. 1000	Rs. 3000	Rs. 6000
X	Rs. 500	Rs. 4500	Rs. 6800
Y	Rs. 0	Rs. 5000	Rs. 8000
Z	Rs. - 4000	Rs. 6000	Rs. 8500

Using the decision tree approach determine the expected return for each alternative. Which alternative investment proposal would you recommend? If the EMV criteria is to be employed.

Q14. The investment staff of TNC bank is considering 4 investment proposal for a client Share, Bond, Real Estate and Saving Certificate. These investment will be held for one year. The past data regarding the four proposal are given below:

1. Share :- There is 25% chance that share will decline by 10%, a 30% chance that they will remain stable and a 45% chance that they will increase in value by 15%. Also the share under consideration do not pay any dividend.

2. Bonds:- These bond's stands a 40% chance of increase in value by 5% and 60% chance of remaining stable and the yield 12%.

3. Real Estate:- These proposal has a 20% chance of increasing 30% in value, a 25% chance of increasing in 20% of value, a 40% chance if increase in 10% value, a 10% chance of remaining stable and a 5% chance of losing 5% of its value.

4. Saving Certificate:- This certificate yield 8.5% with certainty.

Use a decision tree to structure the alternative available to the investment staff and using the EMV, choose the alternative with highest expected value.

Q15. A finance manager is considering drilling a well. In the past, only 70% of wells drilled were successful at 20 meters depth in that area. Moreover on finding no water at 20 meter's, some persons in that area drilled it further up to 25 meters but only 20% struck water at that level. The prevailing cost of drilling is Rs. 500 per meter. The finance manager estimated that in case he does not get water in his own well, he will have to pay Rs. 15000 to buy water from outside for the same period of getting water from the well. The following decisions are considered:

(i) Do not drill any well

(ii) Drill up to 20 meters, and

(iii) If no water is found at 20 meters, drill further up to 20 meters.

Draw an appropriate decision tree and determine the finance manager's Optimal strategy.

Q16. A company has developed a new product in its R&D laboratory. The company has the option of setting up production facility to market this product straight away. If the product is successful then over the three years expected product life, the returns will be Rs. 120 lakh with a probability of 0.70. If the market does not respond favourably then the returns will be only Rs. 15 lakh with probability of 0.30.

The company is considering whether it should test market this product building a small pilot plant. The chance that the test market will yield favourable response is 0.80. If the test market gives favourable response, then the chance of successful total market improves to 0.85.

If the test market gives poor response then the chance of success in the total market is only 0.30. As before, the returns from a successful market will be Rs. 120 lakh and from an unsuccessful market only Rs. 15 lakh. The installation cost to produce for the total market is Rs. 40 lakh and the cost of the test marketing pilot plant is Rs. 5 lakh. Using decision tree analysis, draw a decision tree diagram, carry out necessary analysis to determine the optimal decision.

Q17. The Oil Indian Corporation is considering whether to go for an offshore drilling contract to be awarded in Bombay High. If they bid, value would be Rs. 600 million with 65% chance of gaining the contract. The corporation may set up a new drilling operation or move already existing operation, which has proved successful to new site. The probability of success and expected returns are as follows:-

Out Come	New Drilling Operation		Existing Operation	
	Probability	Expected Revenue (Rs)	Probability	Expected Revenue (Rs)
Success	0.75	800	0.85	700
Failure	0.25	200	0.15	350

If the corporation does not bid or lose the contract, they can use Rs. 600 million to modernise their operations. This would results in a return of either 5% or 8% on the sum invested with probabilities 0.45 & 0.55 respectively.

- (a) Construct a decision tree for the problem showing clearly the course of action.
- (b) By applying an appropriate decision criterion recommend whether or not the corporation should bid the contract.

Q18. A Client ask an estate agent to sell their properties A, B and C for him and agree to pay him 5% commission on each sell. He specifies certain condition, the estate agent must sell property A first and this he must to do within 60 days. If and when A is sold the agent receives his 5% commission on that sale. He can than either back out at this stage or nominate and try to sell one of the remaining two properties within 60 days.

If he does not succeed in selling the nominated property in that period, he is not given the opportunity to sell the other. If he does sell it in the period, he is given the opportunity to sell the 3rd property in the same condition.

The following table summarises the prices, selling cost (incurred by the estate agent whenever a sale is made) and the estate agent estimated probability of making sale.

Property	Price of Property	Selling Cost	Probability of sale
A	Rs. 12000	Rs. 400	0.7
B	Rs. 25000	Rs. 225	0.6
C	Rs. 50000	Rs.450	0.5

- (a) Draw an appropriate decision tree for the estate agent.
- (b) What is the estate agent best strategy under EMV approach.

Q19. Alpha industry has to decide whether to set up large plant or a small plant for its new range of refrigerator. A large plant will cost the company Rs. 250 lakh. While a small plant cost Rs. 120 & expensive market survey and cost profit volume analysis carried by the company. Reveal the following estimate for sale over the next 10 years.

High Demand 0.5

Moderate Demand 0.3

Low Demand 0.2

1. A large plant with high demand will yield an annual profit of Rs. 100 lakh.
2. A large plant with moderate demand will yield an annual profit of Rs. 60 lakh.
3. A large plant with low demand will loss Rs. 20 lakh annual because of production inefficiency.
4. A small pilot plant with high demand would yield Rs.25 lakh annually taking in toaccount the cost of loss sale due to inability to meet demand.
5. A small plant with moderate demand will yield Rs.35 lakh annually.
6. A small plant with low demand will yield Rs. 45 lakh annually as the plant capacity and demand will match.

Q20. An oil company has recently acquired rights in a certain area to conduct surveys and test drillings to lead to lifting oil if it is found in commercial exploitable quantities. The area is considered to have good potential for finding oil in commercial quantities. At the outset the company has the choice to conduct further geological test or to carry out a drilling program immediately. On the known conditions, the company estimates that there is a 70:30 chance of further test showing a success.

Whether the test shows the possibility of ultimate success or not or even if no test are undertaken at all, the company could still pursue its drilling programme or alternatively consider selling its right to drill in the area. Thereafter, however, if it carries out the drilling programme, the likelihood of final success or failure is considered dependent on the foregoing stages. Thus:

1. If successful test have been carried out the expectation of success in drilling is given as 80:20.
2. If the test indicates failure then the expectation of success in drilling is given as 20:80.
3. If no test have been carried out the expectation of success in drilling is given as 55:45.

Cost and revenue have been estimated for all possible outcomes and the net present value of each is as follows:

Outcome	Net Present Value (Rs million)
Success:	
With prior test	100
Without prior test	120
Failure:	
With prior test	- 50
Without prior test	- 40
Sale of exploitation rights	
Prior test show success	65
Prior test show failure	15
Without prior test	45

- (a) Draw up a decision (probability) tree diagram to represent the above information.
- (b) Evaluate the tree in order to advise the management of the company on its best course of action.



Q.21 A manufacturing company has to select one of the two products A or B for manufacturing, Product A requires investment of Rs. 20,000 and Product B, Rs.40000. Market research survey shows high, medium and low demands with corresponding probabilities and return from sales, in Rs. Thousand, for the two products, in the following table:

Market	Probability		Return from sales	
	A	B	A	B
High	0.4	0.3	50	80
Medium	0.3	0.5	30	60
Low	0.3	0.2	10	50

Construct an appropriate decision tree. What decision the company should take?

Q.22 The coca cola associates deals with instant soft drink. They have two courses of action for selling their product in the market (a) Regional distribution through distributors and (b) Direct selling. The prior probabilities of high penetration and low penetration of regional distribution channel are 0.7 and 0.3 respectively. The prior probabilities of high penetration and low penetration of direct selling channel are 0.6 and 0.4 respectively. The pay-offs of high penetration and low penetrations of regional distribution channel are Rs.50 lakhs and Rs.10 lakhs respectively. The pay-offs of high penetration and low penetrations of direct selling channel, are Rs.30 lakhs and Rs.5 lakhs respectively. Draw the decision tree and determine the best selling channel i.e., Strategy.

Q23 A businessman has two independent investment A and B available to him, but he lacks the capital to undertake both of them simultaneously. He can choose to take A first and then stop, or if A is successful then take B or vice versa. The probability of success on A is 0.7 while for B is 0.4. Both investments require an initial capital outlay of Rs 2,000 and both return nothing if the venture is unsuccessful. Successful completion of A will return Rs 3,000 (overcost), successful completion of B will return Rs 5,000 (overcost). Draw the decision tree and determine the best strategy.

## UNIT - 5

### SIMULATION

Q1. A bakery keeps stock of popular brand of cake, previous experience shows the daily demand pattern as follows:-

Demand	5	6	7	8	9	10	11	12	Total
No of days	4	10	16	50	62	38	12	8	200

Simulate the demand for next 10 days. Using the following random numbers.

61, 74, 24, 3, 59, 16, 84, 92, 52 & 7.

Q2. A manufacturing company keep stock of a special product. Previous experience indicates the daily demand as given below:-

Daily Demand	5	10	15	20	25	30
Probability	0.01	0.20	0.15	0.50	0.12	.02

Simulate the demand for the next 10 days and also find the daily average demand for that product on the basis of given random number.

82, 96, 18, 96, 20, 84, 56, 11, 52 & 3.

Q3. An automobile production line turns out a about 100 cars a day. But deviation occurs due to many causes. The production is more accurately describe by the probability distribution given below

Production per day	95	96	97	98	99	100	101	102	103	104	105
Probability	0.03	0.05	0.07	0.10	0.15	0.20	0.15	0.10	0.07	0.05	0.03

Finished cars are transported across the bay at the end of each day by ferry. If the ferry has a space for only 101 cars then simulate the production for next 15 days and What will be the average no of cars waiting to be transported and what will be the average no of empty space on the ship.

Random Nos- 97, 02, 80,66, 96,55,50,29,58,51,04,86,24,39,49

Q5. Doctor amit is a dentist he gives appointment to patient every half hour. Some of the patient take more or less than 30 minutes depending upon the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time actually needed to complete the work.

Nature of Illness	Probability	Time taken for treatment
Filling	0.40	45
Crowning	0.15	60
Cleaning	0.15	15
Extraction	0.10	45
Check-up	0.20	15

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly at scheduled arrival time starting at 8:00 AM. Use the following Random numbers for handing the above problem: 40,82,11,34,25,66,17,79.

Q6. The occurrence of a rain in a city on a day is dependent upon whether it rained on the previous day. If it rained on the previous day, the rain distribution is given by:

Event	Probability
No rain	0.50
1 cm rain	0.25
2 cm rain	0.15
3 cm rain	0.05
4 cm rain	0.03
5 cm rain	0.02

It did not rain the previous day, the rain distribution is given by:

Event	Probability
No rain	0.75
1 cm rain	0.15
2 cm rain	0.06
3 cm rain	0.04

Simulates the city weather for 10 days and determine by simulation the total days without rain as well as the total rainfall during the period. Using the following random numbers

67. 63, 39, 55, 29, 78, 70, 06, 78, 76

For simulation. Assume that for the first day of the simulation it had not rained the day before.

Q7. A company manufactures 30 units per day. The sale of these items depend upon demand which has the following distribution.

Sales (Units)	Probability
27	0.10
28	0.15
29	0.20
30	0.35
31	0.15
32	0.05

The production cost and sale price of each unit are Rs. 40 & Rs. 50 respectively. Any unsold product is to be disposed off at a loss of Rs. 15 per unit. There is a penalty of Rs. 5 per unit if the demand is not met.

Using the following random numbers, estimate the total profit/loss for the company for the next 10 days.

10, 99, 65, 99, 95, 01, 79, 11, 16, 20

If the company decides to produce 29 units per day, what is the advantage or disadvantage of the company?

Q8. The tit - fit scientific laboratories is engaged in producing different types of high class equipments for use in science laboratories. The company has two different assembly lines to produce its most popular product 'Pressure X'. The processing time for each of the assembly line is regarded as a random variable and is described by the following distributions.

Process Time (minutes)	Assembly A <sub>1</sub>	Assembly A <sub>2</sub>
10	0.10	0.20
11	0.15	0.40
12	0.40	0.20
13	0.25	0.15
14	0.10	0.05

Using the following random numbers, generate data on the process time for 15 units of the item and compute the expected process time for the product. For the purpose read the number

vertically ranking on the first two digits for the processing time on assembly A<sub>1</sub> and the last two digits for processing time on assembly A<sub>2</sub>.

4134, 8343, 3602, 7505, 7428

7476, 1183, 9445, 0089, 3424

4943, 1915, 5415, 0880, 9309

Q9. At a small store of readymade garments, there is only one clerk at the counter who is to check the bills, receive payments and placed the packed garments into bags etc. The customer arrive at the counter is a random phenomenon and the time between the arrivals varies from one minute to five minutes, the frequency distribution for which is given in table below. The service time (time taken by the counter clerk) varies from one minute to three minute.

The managers of stores feels that the counter clerk is not sufficient loaded with the work and wants to assign to him some additional work. But before taking the decision he likes to know the percentage waiting time for counter clerk and the percentage waiting time for customer.

Frequency distribution of inter arrival time

Time between arrivals (minutes)	Frequency (%)	Cumulative frequency (%)	Random No Range
1	35	35	00 – 34
2	25	60	35 – 59
3	20	80	60 – 79
4	12	92	80 – 91
5	8	100	92 - 99

Frequency distribution of service time

Service time (minutes)	Frequency (%)	Cumulative frequency (%)	Random No Range
1.0	20	20	00 – 19
1.5	35	55	20 – 54
2.0	25	80	55 – 79
2.5	15	95	80 – 94
3.0	5	100	95 – 99

Use the following random no. For-

Arrival- 48,51,06,22,79,56,06,91,51,13

Service- 22,62,25,31,23,07,93,44,12,26

Q10. The management of ABC Company is considering the question of marketing a new product. The fixed cost required in the project is Rs. 4,000. Three factors are uncertain viz. The selling price, variable cost and the annual sales volume. The product has a life of only one year. The management has the data on these three factors are as under:

Selling Price (Rs)	Probability	Variable Cost (Rs.)	Probability	Sales Volume (units)	Probability
3	0.2	1	0.3	2000	0.3
4	0.5	2	0.6	3000	0.3
5	0.3	3	0.1	5000	0.4

Consider the following sequence of thirty random numbers:

81 32 60 : 04 46 31 : 67 25 24 : 10 40 02 : 39 68 08  
 59 66 90 : 12 64 79 : 31 86 68 : 82 89 25 : 11 98 16

Using the sequence (first three random numbers for the first trial etc). Simulate the average profit for the above project on the basis of 10 trials.