

Total number of printed pages-7

3 (Sem-5/CBCS) STA HE 1

2023

**STATISTICS**

(Honours Elective)

Paper : STA-HE-5016

**(Operations Research)**

Full Marks : 60

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

1. Answer the following as directed:  $1 \times 7 = 7$
- (a) Operations research came into existence
- (i) in the year 1949
  - (ii) in the military context
  - (iii) during World War I
  - (iv) during World War II
- (Choose the correct option)

Contd.

- (b) A feasible solution of LPP should
- (i) satisfy the problem constraints
  - (ii) optimise the objective function
  - (iii) satisfy the problem constraints and non-negativity restrictions
  - (iv) satisfy the non-negativity restrictions
- (Choose the correct option)*

- (c) The general LPP is said to be in standard form if
- (i) the constraints are strict equations
  - (ii) the constraints are inequalities of  $\leq$  type
  - (iii) the constraints are inequalities of  $\geq$  type
  - (iv) the decision variables are unrestricted in sign
- (Choose the correct option)*

- (d) The number of non-negative variables in a basic feasible solution to a transportation problem with  $m$  sources and  $n$  destinations is
- (i)  $mn$
  - (ii)  $m + n$

- (iii)  $m + n - 1$
  - (iv)  $m - n + 1$
- (Choose the correct option)*

- (e) A game is said to be fair, if
- (i) both upper and lower values of the game are same and zero
  - (ii) upper and lower values of the game are not equal
  - (iii) upper value is more than lower value of the game
  - (iv) None of the above
- (Choose the correct option)*

- (f) When maximin and minimax values of the game are same then
- (i) there is a saddle point
  - (ii) solution does not exist
  - (iii) strategies are mixed
  - (iv) None of the above
- (Choose the correct option)*

(g) Define lead time.

2. Answer the following questions :  $2 \times 4 = 8$

- (a) For the system  $AX = b$  of  $m$  linear equations in  $n$  unknowns ( $n > m$ ) with  $\text{rank}(A) = m$ , define a basic solution. Hence define basic feasible solution.

(b) Define the following terms :

(i) Pure strategy

(ii) Mixed strategy

(c) Define Economic Lot Size Problem and Economic Order Quantity (EOQ).

(d) State the mathematical formulation of a transportation problem.

3. Answer **any three** from the following questions :  $5 \times 3 = 15$

(a) A manufacturer of furniture makes two products – chairs and tables. Processing of these product is done on two machines A and B. A chair requires 2 hours on machine A and 6 hours on machine B. A table requires 5 hours on machine A and no time on machine B. There are 16 hours of time per day available on machine A and 30 hours on machine B. Profit gained by manufacturer from a chair and a table is Re.1 and Rs.5 respectively. Formulate the above problem as a LPP.

(b) Define inventory. What are the different types of inventory in industries ? State the various types of costs associated with inventory control. Explain **any one** of them.  $1+1+1+2=5$

(c) Explain North-West corner rule for finding an initial basic feasible solution for a transportation problem.

(d) Find all basic solutions of the following system of equations

$$2x_1 + x_2 + 4x_3 = 11, \quad 3x_1 + x_2 + 5x_3 = 14$$

Are they degenerate ? Also find the basic feasible solutions.

(e) Explain the maximin and minimax strategies used in game theory.

Answer the following :

$10 \times 3 = 30$

4. Answer **either (a) or (b)** from the following :

(a) Solve the following LPP by simplex method :  $10$

Maximize  $Z = 5x_1 + 3x_2$   
subject to the constraints

$$x_1 + x_2 \leq 2$$

$$5x_1 + 2x_2 \leq 10$$

$$3x_1 + 8x_2 \leq 12$$

$$x_1, x_2 \geq 0$$

(b) (i) State the general linear programming problem.  $4$

(ii) Solve the following LPP graphically :

Maximize  $Z = x_1 + x_2$   
subject to the constraints

$$-2x_1 + x_2 \leq 1$$

$$x_1 \leq 2$$

$$x_1 + x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

6

5. Answer **either (a) or (b)** :

(a) (i) Explain Vogel's approximation method of finding an initial solution for a transportation problem. 5

(ii) Determine an initial basic feasible solution to the following transportation problem using North-West corner rule where  $O_i$  and  $D_j$  represent  $i^{\text{th}}$  origin and  $j^{\text{th}}$  destination respectively. 5

	$D_1$	$D_2$	$D_3$	$D_4$	Supply
$O_1$	6	4	1	5	14
$O_2$	8	9	2	7	16
$O_3$	4	3	6	2	5
Demard	6	10	15	4	35

(b) Obtain the EOQ of an inventory model where production is instantaneous, shortages are not allowed and rate of demand is different in different production cycles. 10

6. Answer **either (a) or (b)** :

(a) (i) What is saddle point ? Explain the method for detecting a saddle point. 5

(ii) Explain zero-sum two person game giving suitable example. 5

(b) (i) A manufacturer has to supply his customer with 600 units of his product per year. Shortages are not allowed and the storage cost amounts to Rs.0.60 per unit per year. The set up cost per run is Rs.80.00. Find the optimum run size and minimum average yearly cost. 4

(ii) Explain ABC analysis. 6

Total number of printed pages—4

3 (Sem-5/CBCS) STA HE 2

2023

**STATISTICS**

(Honours Elective)

Paper : STA-HE-5026

**(Time Series Analysis)**

Full Marks : 60

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

1. Answer the following as directed :  $1 \times 7 = 7$

(a) Time series enables us to study the past behaviour of the phenomenon under consideration. (State True or False)

(b) Least square method can be used to fit modified exponential curve, Gompertz curve and logistic curve.

(State True or False)

(c) Moving average method can be used for forecasting or predicting future trend. (State True or False)

Contd.

- (d) The consistent increase in production of cereals constitutes the component of a time series :
- (i) Secular trend
  - (ii) Seasonal variation
  - (iii) Cyclical variation
  - (iv) All of the above

(Choose the correct option)

- (e) Given the trend equation  $\hat{Y} = 108 + 2.88X$  with 1980 as origin and yearly data from 1980 to 1992, the estimated value for 1985 is \_\_\_\_.

(Fill in the blank)

- (f) A time series is a set of values arranged in \_\_\_\_ order. (Fill in the blank)

- (g) If the annual trend equation with 1984 as origin is  $\hat{Y} = 112.8 + 6.48X$ , the monthly trend equation is \_\_\_\_.

(Fill in the blank)

2. Answer the following questions :  $2 \times 4 = 8$

- (a) State *one* merit and *one* demerit of the graphical method of determining trend.

- (b) Which component of the time series is mainly applicable in the following cases ?

(i) A strike in steel industry delaying production for 10 days.

(ii) Quarterly fluctuations observed in a time series.

(iii) An increase in employment during harvest time.

(iv) A need for increased wheat production due to constant increase in population.

- (c) Define time series with examples.

- (d) Explain semi average method of determining trend.

3. Answer *any three* of the following questions :

$5 \times 3 = 15$

- (a) Explain the models commonly used for decomposition of a time series.

- (b) Describe various components of a time series.

- (c) Explain simple average method of determining seasonal variation. Also discuss its merits and demerits.

- (d) Discuss the uses of time series.

- (e) Give the equation of an exponential curve and method for its fitting.

4. Answer *either (a) or (b)* from the following questions :

- (a) What is meant by trend of a time series? Describe the method of moving averages for estimating the trend in a time series. Discuss its merits and demerits.

$2 + 6 + 2 = 10$

(b) What do you understand by seasonal variation? Describe the method of ratio to trend method with merits and demerits.  $2+6+2=10$

5. Answer **either (a) or (b)** :

(a) Describe the method of link relatives for finding seasonal indices. Also mention the merits and demerits of this method.  $6+2+2=10$

(b) Define random component of a time series. Describe variate difference method.  $2+8=10$

6. Answer **either (a) or (b)** :

(a) Discuss the method of least squares for determining trend in a time series. Also discuss the merits and demerits of this method.  $6+2+2=10$

(b) Write short notes on : **(any two)**  
 $5 \times 2 = 10$

(i) Deseasonalisation of data

(ii) Growth curves

(iii) Exponential smoothing