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**3 (Sem-5/CBCS) STA HC 2**

**2023**

**STATISTICS**

(Honours Core)

Paper : STA-HC-5026

**( Statistical Computing  
using C/C++ Programming )**

Full Marks : 60

Time : Three hours

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

1. Answer the following questions:  $1 \times 7 = 7$

(a) Every programme statement in C must end with a dot. (State True or False)

(b) What is printf function ?

Contd.

(c) Which of the following is a data item displaced as a single character?

- (i) d
  - (ii) e
  - (iii) f
  - (iv) s
- (Choose the correct option)

(d) A C program contain the following statements:

```
#include <stdio.h>
```

```
int i, j, k;
```

Write an appropriate scanf statement to enter numerical values for i, j, k.

- (e) What is C-tokens?
- (f) What is the C-library function to find the exponentiation?
- (g) Which of the following is an assignment operator?

- (i) %
  - (ii) !=
  - (iii) =
  - (iv) \*
- (Choose the correct option)

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

(a) Write the output of the following program segment in C:

```
int x = 35;
float y = 4.5;
x = x * y;
y = x / y;
printf ( "%d: %f", x, y);
}
```

(b) Difference between machine level language and high level language.

(c) Write the following algebraic expression in C/C++ with the operator.

(i)  $ab^c + bc^d$

(ii)  $\frac{x+y+3}{m+n}$

(d) Write about declaration of variables in C.

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

(a) Write briefly on WHILE statement available in C.

(b) What are the Data types in C/C++?

(c) Explain the relational and logical operators in C.

(d) What is the purpose of scanf function?

How it is used within a C program? Compare with the getcher function.

(e) What is the purpose of the for statement? How does it differ from the while statement?

4.++ Answer **any three** questions (from the following):

(a) (i) Discuss initialization of one-dimensional array in C/C++. 5

(ii) Write a detail note on arithmetic operators in C. 5

(b) (i) Write a C/C++ program to find the regression equation of the lines of

Y on X and X on Y. 7

(ii) Define switch statement. 3

(c) (i) What is subscripts? How are they written? In what way does an array differ from an ordinary variable? 5

(ii) Write an interactive C/C++ program that reads in a student's name and three exam scores, and then calculates an average score. The data will be entered interactively. Each input data will be entered on a separate line. Once the data entered, the computer will compute the desired average and write out all the data. 5

(d) (i) Write a C/C++ program to determine the correlation coefficient of the pairs  $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ . 7

(ii) Write briefly on backslash character constants. 3

(e) (i) Write a C/C++ program to find the geometric mean of  $n$  observations. 6

(ii) Distinguish between the following pairs : 2+2=4

scanf and printf functions

%d and %f specifications

(f) (i) Write a C/C++ program to find the diagonal elements of a  $n \times n$  matrix A. 7

(ii) Explain briefly the 'IF-ELSE' statement. 3

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**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
- satisfy the problem constraints
  - optimise the objective function
  - satisfy the problem constraints and non-negativity restrictions
  - satisfy the non-negativity restrictions
- (Choose the correct option)
- (c) The general LPP is said to be in standard form if
- the constraints are strict equations
  - the constraints are inequalities of  $<$  type
  - the constraints are inequalities of  $\geq$  type
  - 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
- $mn$
  - $m + n$

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

- (e) A game is said to be fair, if
- both upper and lower values of the game are same and zero
  - upper and lower values of the game are not equal
  - upper value is more than lower value of the game
  - None of the above
- (Choose the correct option)
- (f) When maximin and minimax values of the game are same then
- there is a saddle point
  - solution does not exist
  - strategies are mixed
  - 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  $i^{th}$  origin and  $j^{th}$  destination respectively. 5

| $O_i$  | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|--------|-------|-------|-------|-------|--------|
| $O_1$  | 6     | 4     | 1     | 5     | 14     |
| $O_2$  | 8     | 9     | 2     | 7     | 16     |
| $O_3$  | 4     | 3     | 6     | 2     | 5      |
| Demand | 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



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3 (Sem-5/CBCS) STA HC 1

2023

## STATISTICS

(Honours Core)

Paper : STA-HC-5016

**(Stochastic Processes and Queuing Theory)**

Full Marks : 60

Time : Three hours

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

1. Answer the following questions as directed :

1×7=7

(a) Define a stationary process.

(b) What is absorbing barrier ?

(c) State one property of transition probability matrix.

Contd.

(d) The sum of two independent Poisson processes is also a Poisson process.

(State true or false)

(e) Mention two examples of stochastic process.

(f) In M/M/1 queuing model, the inter-arrival time as well as service time follows \_\_\_\_\_ distribution.

(Fill in the blank)

(g) What is the Markovian property of a stochastic process?

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

(a) State any two properties of Poisson process.

(b) Define bivariate probability generating function of a pair of random variables  $X$  and  $Y$ .

(c) Define stochastic matrix.

(d) State two characteristics of a Markov process.

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

(a) The transition probability matrix of a Markov chain  $\{X_n; n = 1, 2, \dots\}$  having three states 1, 2 and 3 is

$$P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$$

and the initial distribution is

$$\pi_0 = (0.7, 0.2, 0.1)$$

Find

(i)  $P_r \{X_2 = 3\}$

(ii)  $P_r \{X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 2\}$

(b) Write a note on 'order of Markov chain'.

(c) Obtain the mean number of units in M/M/1 queuing model with finite system capacity.

(d) Let  $X_n$  be a random variable representing the weather of a particular place in a given day. Let  $X_n = 0$  if the day is rainy and is equal to 1 if the day is sunny. Write the transition probability matrix. If today's weather is given what will be the weather at distant future?

(e) What are the operating characteristics of a queuing system?

4. Answer either (a) or (b):

(a) (i) Write a note on graphical representation of Markov chain. 4

(ii) Find the auto-correlation coefficient between  $N(t)$  and  $N(t+s)$ , where  $\{N(t)\}$  is a Poisson process. 6

(b) (i) Consider a two-state Markov chain arising from weather condition: Cloudy ( $E_1$ ) and clear ( $E_0$ ), with the one-step transition probability matrix

$$P = \begin{pmatrix} 0.6 & 0.4 \\ 0.3 & 0.7 \end{pmatrix}$$

What is the probability that it will be cloudy two days from now, given that it is clear to-day? 3

(ii) Classify the following two Markov chains with the transition probabilities: 3+4=7

(i) 
$$\begin{bmatrix} 0 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{4} & \frac{3}{4} & 0 \end{bmatrix}$$

(ii) 
$$\begin{bmatrix} \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{4} & \frac{1}{4} & \frac{2}{4} & 0 \\ 0 & 0 & \frac{1}{3} & \frac{2}{3} \end{bmatrix}$$

5. Answer **either (a) or (b)** :
- (a) Write a note on stochastic process explaining its applications in population studies, operation research, time series, physics and financial marketing. 10
- (b) (i) Derive Chapman-Kolmogorov equation. 5
- (ii) Show that the difference of two independent Poisson processes is not a Poisson process. 5

6. Answer **either (a) or (b)** :
- (a) A self-service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in same time. Assuming Poisson distribution for arrival rate and exponential for service time, find :
- (i) The traffic intensity. Also give its interpretation.
- (ii) Average number of customers in the queue.

- (iii) Average time a customer wait before being served.
- (iv) Probability that cashier is idle.
- (v) Probability that there are '3' customers in the system.

$$2+2+2+2+2=10$$

- (b) Analyse the M/M/1/K model in detail. Also find average waiting time in the system ( $w$ ) and average waiting time in the queue ( $w_q$ ). 10

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**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