

**2023**  
**B.A./B.Sc.**  
**Sixth Semester**  
CORE – 14  
**STATISTICS**  
*Course Code: STC 6.21*  
(Multivariate Analysis & Index Numbers)

*Total Mark: 70*  
*Time: 3 hours*

*Pass Mark: 28*

*Answer five questions, taking one from each unit.*

**UNIT-I**

1. (a) Derive the bivariate normal distribution stating the assumptions.  
Hence write down the form of the distribution if the parameters are  $(0, 0, 1, 1, \rho)$ . 5+2=7  
(b) Show that if  $X_1$  and  $X_2$  are independent normal variates with correlation coefficient  $\rho$  between them, then the correlation coefficient between  $X_1^2$  and  $X_2^2$  is given by  $\rho^2$ . 7
2. (a) Obtain the marginal distribution of the random variable  $X$  of bivariate normal distribution. 7  
(b) Let  $X_1$  and  $X_2$  be two independent standard normal variates and let the random variables  $Y_1$  and  $Y_2$  be defined by  
$$Y_1 = 2X_1 + X_2, Y_2 = 2X_2 - X_1$$
Find  $E(Y_1), E(Y_2), Cov(Y_1, Y_2)$  and the joint p.d.f. of  $Y_1, Y_2$  i.e.  $f(y_1, y_2)$ . 7

**UNIT-II**

3. (a) Define and derive the multivariate normal distribution. 2+6=8  
(b) Obtain the moment generating function of multivariate normal distribution. 6
4. (a) Give Rao's definition of multivariate normal distribution. 2

- (b) Determine the value of the constant  $k$  of the multivariate normal distribution. 6
- (c) If  $X$  have a multivariate normal distribution with covariance matrix

$$\sum \begin{bmatrix} 1 & p & p^2 \\ p & 1 & 0 \\ p^2 & 0 & 1 \end{bmatrix} \text{ then show that the conditional distribution of}$$

$(X_1, X_2)$  given  $X_3 = x_3$  is also multivariate normal with mean

$$\mu = \begin{bmatrix} \mu_1 + p^2(x_3 - \mu_3) \\ \mu_2 \end{bmatrix} \text{ and covariance matrix } \begin{bmatrix} 1 - p^4 & p \\ p & 1 \end{bmatrix}. \quad 6$$

### UNIT-III

5. (a) Define  $\sigma$ -scores and standard scores. What are the advantages of  $\sigma$ -scores? 2+2+1=5
- (b) Define reliability of test scores. Describe the methods of Test-Retest and split-half for assessing the reliability of a test. 2+2+2=6
- (c) Describe the index of reliability. 3
6. (a) Define normalized scores. Explain clearly the method of converting raw test scores into  $T$ -scores. 2+4=6
- (b) What do you understand by validity of test scores? Discuss the different types of validity of test scores. 2+4=6
- (c) What are parallel tests? 2

### UNIT-IV

7. (a) What is meant by index numbers? Mention the uses of index numbers. 2+3=5
- (b) Why is Fisher's index called ideal index? Show that Fisher's index number satisfies both the time reversal test and factor reversal test. 2+4=6
- (c) If  $L(p), L(q)$  and  $P(p), P(q)$  represents respectively the Laspeyre's and Paasche's index numbers for prices and quantities, show that

$$\frac{L(p)}{L(q)} = \frac{P(p)}{P(q)} \quad 3$$

8. (a) Mention different types of index numbers. Explain the various characteristics of index numbers. 2+3=5
- (b) What are time reversal test and factor reversal test? Examine whether Laspeyre's and Paasche's index numbers satisfy these tests or not. 3+3=6
- (c) Write a note on implicit weights and explicit weights. 3

### UNIT-V

9. (a) Give the concept of cost of living index number. Mention the uses of cost of living index number. 2+4=6
- (b) Discuss the steps to be followed in the construction of cost of living index numbers. 8
10. (a) Describe the methods of construction of cost of living index numbers. 7
- (b) Write notes on any two of the following: 3½×2=7
- (i) Index numbers of industrial production
  - (ii) Index number of agricultural production
  - (iii) Wholesale price index number.
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