U.G. 6th Semester Examination - 2021

STATISTICS

[HONOURS]

Course Code : STAT-H-CC-T-14

(Multivariate Analysis and Nonparametric Methods)

Full Marks : 50(40+10) Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Notations and symbols have their usual meanings.

1. Answer any **five** questions: 2×5=10

   a) Give an example of a bivariate situation where the marginal distributions are normal but the joint distribution is not bivariate normal.

   b) Mention any two properties of multivariate normal distribution.

   c) Explain the use of partial and multiple correlation coefficients.

   d) State the general expressions for the mean vector and covariance matrix under linear transformations of a random vector.

   e) Explain the dimensionality reduction role played by Principal Components.

   f) State the postulates on the 'common factors' and the 'specific factors' in the orthogonal factor model.

   g) In what situations do we use nonparametric tests?

   h) Write a note on one-sample sign test.

2. Answer any **two** questions: 5×2=10

   a) Derive the moment generating function of a p-variate normal distribution.

   b) Explain the problem of classification into two classes.

   c) Establish the relationship of principal components to the eigenvalues and eigenvectors of the covariance matrix of the underlying random vector.

   d) Describe the median test procedure.

3. Answer any **two** questions: 10×2=20

   a) Write down the sampling distributions of $\bar{\mathbf{X}}$ and $\mathbf{S}$, the sample mean vector and covariance matrix, based on a sample of size n from a multivariate normal population with mean vector μ and covariance matrix $\Sigma\mu$. Show that $\bar{\mathbf{X}}$ is an unbiased estimator of $\boldsymbol{\mu}$ but $\mathbf{S}$ is a biased estimator of $\boldsymbol{\Sigma}$. Suggest an unbiased estimator of $\boldsymbol{\Sigma}$.

b) Find an expression for the multiple correlation coefficient between X_1 and $X_2, X_3, \ldots, X_p$. Prove that the conditional variance of X_1 given the rest of the variables cannot be greater than unconditional variance of X_1 .

c) Present the ‘Orthogonal Factor Model’ and develop the ideas of ‘Communality’ and ‘Specific Variance’.

d) Describe the Kolmogorov-Smirnov one-sample and two-sample tests.

[*Internal Assessment : 10*]

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