Statistics

PAPER-I

UNIT-I (Probability Theory)

Classical definition and axiomatic approach. Sample space. Laws of total and compound probability. Probability of m events out of n. Conditional probability. Bayes' theorem. Random variable – discrete and continuous. Distribution function. Mathematical expectation, moments and cumulants, Characteristic function and probability generating function. Inversion, uniqueness and continuity theorems. Markov, Holder, Jenson, Liapnov and Chebyshev's inequalities.

UNIT-II (Probability Theory and Distributions)

Standard probability distributions – Bernoulli, uniform, binomial, Poisson, geometric, rectangular, Exponential, normal, Cauchy, hyper-geometric, multinomial, negative binomial, beta, gamma and lognormal, Convergence in distribution, in probability, in r-th mean, and almost surely, and their relationships. Laws of large numbers and central limit theorems for i.i.d. random variables.

UNIT-III (Statistical Methods)

Collection, compilation and presentation of data, charts, diagrams and histogram. Frequency distribution. Measures of location, dispersion land skewness. Bivariate and multivariate data. Association and contingency. Curve fitting and orthogonal polynomials. Bivariate distributions. Bivariate normal distribution. Bivariate normal distribution. Simple correlation and regression. Distribution of the sample correlation coefficient.

UNIT-IV (Statistical Methods)

Partial and multiple correlations and regressions. Intraclass correlation. Correlation ratio. Standard errors, and large sample and small sample tests. Sampling distributions of sample mean, sample variance, t, F and chi-square; and tests of significance bases on them.

UNIT-V (Theory of Estimation)

Characteristics of a good estimator, Estimations based on the method of maximum likelihood, minimum chi-square, moments, and least squares. Optimal properties of maximum likelihood estimators. Minimum variance unbiased and minimum variance bound estimators, Cramer-Rao inequality. Bhattacharya bounds. Sufficient estimator. Factorization theorem. Complete statistics. Rao-Blackwell theorem. Confidence interval estimation.

UNIT-VI (Hypothesis Testing)

Simple and composite hypothesis, kinds of error. Critical region. Different types of critical regions and similar regions. Power function. Most powerful and uniformly most powerful tets. Neyman-Pearson fundamental lemma. Unbiased tests. Likelihood ratio test. Non-parametric tests- sign, median, run, Wilcoxon, Mann-Whitney, Wald-Wolfowitz.

PAPER-II

UNIT-I (Multivariate Analysis)

Multivariate normal distribution – marginal and conditional distributions, distribution of quadratic forms. Maximum likelihood estimators of parameters, distributions of sample mean vector and matrix of corrected sum of squares and cross products. Sampling distributions of sample partial and multiple correlation coefficients (null case only). Hotelling's T^2 statistic – properties, distribution and uses, Mahalanobis- D^2 statistic and its use. The problem of discrimination, Fisher's dicsriminant function.

UNIT-II (Sampling Techniques)

Census versus sample survey. Pilot and large-sale sample surveys. Simple random sampling with and without replacement. Stratified sampling and sample allocations, Cost and variance functions. Ratio and regression methods of estimation. Sampling with probability proportional to size. Cluster, multi-phase, multi-stage and systematic sampling.

UNIT-III (Demography and Vital Statistics)

The life table, its constitution and properties. Makehams and Gompertz curves. Abridged life table. U.N. model life tables. Stable and stationary populations. Different birth rates. Total fertility rate. Gross and net reproduction rates. Different mortality rates. Standardized death rate. Internal and international migration: net migration. International and post censual estimates. Projection methods including logistic curve fitting. Decennial population census in India.

UNIT-IV (Time Series Analysis and Econometrics)

Time series – components and methods of their determination, variate difference method, Yule-Slutsky effect. Correlogram. Autoregressive models of first and second order. Periodogram analysis. Two variable and k-variable linear models – assumptions, OLS estimators and their properties. Multicollinearity – detection, consequences and remedial measures. Heteroscedasticity – nature, OLS estimators in the presence of heteroscedasticity, detection, consequences and remedial measures. Generalized least squares GLS estimators.

UNIT-V (Design and Analysis of Experiments)

Principles of designs of experiments. Layout and analysis of completely randomized, randomized block and Latin square designs. Factorial experiments and confounding in 2^η, 3^2 and 3^3 experiments. Split plot and strip-plot designs. Construction and analysis of balanced and partially balanced incomplete block designs. Analysis of covariance. Analysis of non-orthogonal data. Analysis of missing plot data.

UNIT-VI (Statistical Quality Control and Operations Research)

Different types of control charts for variables and attributes. Acceptance sampling by attributes-single, double, multiple and sequential sampling plans. OC and ASN