SYLLABUS

STATISTICS PAPER – 1

Unit 1: Descriptive Statistics

Collection, compilation and presentation of data, charts, diagrams and histogram. Frequency distribution. Measures of location, dispersion, skewness and kurtosis. Bivariate and multivariate data. Association and contingency. Curve fitting and orthogonal polynomials. Bivariate normal distribution. Karl Pearson's and Spearman's correlation coefficients, Partial and multiple correlation, Intra-class correlation, Correlation ratio. Regression-linear and polynomial.

Unit 2: Probability

Classical and axiomatic approaches of Probability. Laws of probability, Conditional probability, Bayes' theorem and applications. Discrete and continuous random variables. Distribution functions and their properties. Random vectors, Joint and marginal distributions, conditional distributions, Distributions of functions of random variables. Modes of convergences of sequences of random variables - in distribution, in probability, with probability one and in mean square. Mathematical expectation and conditional expectation. Characteristic function, moment and probability generating functions, Inversion, uniqueness and continuity theorems. Borel 0-1 law, Kolmogorov's 0-1 law. Tchebycheff's and Kolmogorov's inequalities. Laws of large numbers and central limit theorems for independent variables.

Unit 3: Probability Distributions and Sampling Distributions

Probability Distributions: Standard discrete and continuous probability distributions - Bernoulli, Uniform, Binomial, Poisson, Geometric, Negative binomial, Hyper geometric, Multinomial, Rectangular, Exponential, Normal, Cauchy, Laplace, Beta, Gamma and Lognormal. Sampling Distributions: Standard error and sampling distribution, large sample tests. Sampling distributions of sample mean, sample variance, t, chi-square and F; tests of significance based on them.

Unit 4: Statistical Inference

Characteristics of good estimator. Estimation methods of maximum likelihood, minimum chi-square, moments and least squares. Optimal properties of maximum likelihood estimators. Minimum variance unbiased estimators. Minimum variance 2 bound estimators. Cramer-Rao inequality. Bhattacharya bounds. Sufficient estimator. factorization theorem. Complete statistics. Rao-Blackwell theorem. Confidence interval estimation. Optimum confidence bounds. Resampling, Bootstrap and Jacknife. Hypothesis testing. Simple and composite hypotheses. Two kinds of error. Critical region. Different types of critical regions and similar regions. Power function. Most powerful and uniformly most powerful tests. Neyman-Pearson fundamental lemma. Unbiased test. Randomized test. Likelihood ratio test. Wald's SPRT, OC and ASN functions. Elements of decision theory. Non-parametric tests- sign, median, run, Wilcoxon, Mann-Whitney, Wald Wolfowitz and Kolmogorov-Smirnov tests. Order statistics-minimum, maximum, range and median. Concept of Asymptotic relative efficiency.

Unit 5: Design and Analysis of Experiments

Analysis of variance for one way and two way classifications, need for design of experiments, basic principle of experimental design (randomization, replication and local control), complete analysis and layout of completely randomized design, randomized block design and Latin square design, Missing plot technique. Split Plot Design and Strip Plot Design. Factorial experiments and confounding in 2n and 3n experiments. Analysis of covariance. Analysis of non-orthogonal data. Analysis of missing data.

Unit 6: Sampling Techniques

Concept of population and sample, need for sampling, complete enumeration versus sampling, basic concepts in sampling, sampling and Non-sampling error. Subjective or purposive sampling, probability sampling or random sampling, simple random sampling with and without replacement, estimation of population mean, population proportions and their standard errors. Stratified random sampling, proportional and optimum allocation, comparison with simple random sampling for fixed sample size. Systematic sampling (when population size (N) is an integer multiple of sampling size (n)). Estimation of population mean and standard error of this estimate, comparison with simple random sampling. Sampling with probability proportional to size (with and without replacement method), Ratio, product and regression methods of estimation, estimation of population mean, evaluation of Bias and Variance to the first order of approximation, comparison with simple random sampling, Sampling with probability proportional to size (with and without replacement method), Des Raj and Das estimators for n=2, Horvitz-Thomson's estimator. Cluster sampling: estimators of population mean and total and their standard errors, comparison of cluster sampling with SRS. Concept of multistage sampling and its application, two-stage sampling with equal number of second stage units, estimation of population mean and total. Double sampling in ratio and regression methods of estimation. Concept of Interpenetrating sub-sampling.