

Statistics (Subject Code -23)

PAPER - I

1. Probability:

Sample space and events, probability measure and probability space, Statistical Independence, Random variable as a measurable function, Discrete and continuous random variables, Probability density and distribution functions, marginal and conditional distribution functions of random variables and their distributions, expectations and moments, conditional expectation, correlation coefficient; convergence in probability in LP almost everywhere, Markov, Chebychev and Kolmogorov inequalities, Borel Cantelli Lemma, weak and strong law of large numbers probability generating and characteristic functions. Uniqueness and continuity theorems, Determination of distribution by moments. Lindeberg-Levy Central limit theorem. Standard discrete and continuous probability distributions, their interrelations including limiting cases.

II. Statistical Inference :

Properties of estimates, consistency, unbiasedness, efficiency, sufficiency and completeness. Cramer-Rao bound, Minimum variance unbiased estimation, Rao-Blackwell and Lehmann-Scheffe's theorem methods of estimation by moments maximum likelihood, minimum Chi-square. Properties of maximum likelihood estimators confidence intervals for parameters of standard distribution.

Simple and composite hypotheses, statistical tests and critical region, two kinds of error, power function unbiased tests, most powerful and uniformly most powerful tests Neyman-Person Lemma, optimal tests for simple hypotheses concerning one parameter, monotone likelihood ratio property and its use in constructing UMP tests, likelihood ratio criterion and its asymptotic distribution, Chi-square and Kolmogorov tests for goodness of fit. Run test for randomness Sign test for Location, Wilcoxon Mann-Whitney test and Kolmogor-Smirnov test for the two sample problem. Distribution free confidence intervals for quantities and confidence band for distribution function.

Notions of a sequential test, Walds SPRT, its C_c and ASN function.

III. Linear Inference and Multivariate Analysis:

Theory of least squares and Analysis of variance, Gauss-Markoff theory, normal equations, least squares estimates and their precision. Tests of significance and intervals estimates based on least square theory in one way, two way and three way classified data. Regression Analysis, linear regression, estimates and test about

correlation and regression, estimates and tests about correlation and regression coefficient curve linear regression and orthogonal polynomials, test for linearity of regression Multivariate normal distribution, multiple regression, Multiple and partial correlation, Mahalanobis D^2 and Hotelling T^2 -statistics and their applications (derivations of distribution of D^2 and T^2 excluded) Fisher's discriminant analysis.

PAPER - II

I. Sampling Theory and Design of Experiments.

Nature and scope of Sampling, simple random sampling, sampling from finite populations with and without replacement, estimation of the standard errors sampling with equal probabilities and PPS Sampling. Stratified random and systematic sampling two stage and multistage sampling. Multiphase and cluster sampling schemes.

Estimation of population total and mean, use of biased and unbiased estimates auxiliary variables, double sampling standard errors of estimates cost and variance functions ratio and regression estimates and their relative efficiency. Planning and organization of sample surveys with special reference to recent large scale surveys conducted in India.

Principles of experimental designs, CRD, RED, LSD, missing plot technique factorial experiments $2n$ and $3n$ design general theory of total and partial confounding and fractional replication. Analysis of split plot, BIB and simple lattice designs.

II. Engineering Statistics :

Concepts of quality and meaning of control. Different types of control charts like \bar{X} -R charts, P charts np charts and cumulative sum control chart.

Sampling inspection Vs 100 percent inspections. Single, double, multiple and sequential sampling plans for attributes inspection, CC, ASN, and ATI, curves, Concept of producer's risk and consumer's risk. AQL, AQLL, LTPD etc. Variable sampling plans.

Definition of Reliability, maintainability and availability. Life distribution failure rate and both-tub, failure curve exponential and Weibull model. Reliability of series and Parallel systems and other simple configurations. Different types of redundancy like hot and cold and use of redundancy in reliability improvement problem in life testing, censored and truncated experiments for exponential model.

III. Operational Research :

Scope and definition of OR different types of models, their construction and obtaining solution.

Homogenous discrete time Markov chains, transition probability matrix, classification of states and ergodic theorems. Homogenous continuous time Markov chains. Elements of queuing theory, M/M/1 and M/M/K queues, the problem of machine interference and GI/M/1 and M/GI queues.

Concept of Scientific inventory management and analytical structure of inventory problems Simple models with deterministic and stochastic demand with and without leadtime. Storage models with particular reference to dam type.

The structure and formation of a Linear programming problem.

The simplex procedure two phase methods and Charnes – Method with artificial variables. The quality theory of linear programming and its economic interpretation Sensitivity analysis.

Transportation and Assignment problems.

Replacement of items that fail and those that deteriorate group and individual replacement policies.

Introduction to computers and elements of Fortran IV programming formats for input and output statements specification and logical statements and sub-routines. Application to some simple statistical problems.

IV. Quantitative Economics :

Concept of time series, additive and multiplicative models, resolution into four components, determination of trend by freehand drawing, moving averages, and fitting of mathematical curves, seasonal indices and estimate of the variance of the random components.

Definition, construction, interpretation, and limitations of index numbers, Laspeyres, Paasche, Edgeworth, Marshall and Fisher index numbers their comparison tests for index numbers and construction of cost of living index.

Theory and analysis of consumer demand – specification and estimation of demand function. Demand elasticities. Theory of production, supply functions and elasticities, input demand functions. Estimation of parameters in single equation model, classical least squares, generalized least squares, heteroscedasticity, serial correlation,

multicollinearity, errors in variables model, simultaneous equation models-identification, rank and order conditions.

Indirect least squares and two; stage least squares. Short-term economic forecasting.

V. Demography and Psychometry :

Sources of demographic data : census registration : NSS and other demographic surveys. Limitation and uses of demographic data.

Vital rates and ratios : Definition, construction and uses.

Life tables, complete and abridged : construction of life tables from vital statistics and census returns, Uses of life tables.

Logistic and other population growth curves.

Measure of fertility, Gross and net reproduction rates.

Stable population theory, Uses of stable, and quasistable population techniques in estimation of demographic parameters.

Morbidity and its measurement standard classification by cause of death. Health surveys and use of hospital statistics.

Educational and psychological statistics methods of Standardisation of scales tests, IQ tests, reliability of test and T and Z scores.