70. STATISTICS

Part–A (50 Marks)

Analysis of Quantitative Data:- Univariate data – Measures of central tendency (Mean, Median and Mode with simple applications), Measures of Dispersion (definitions and simple examples), relative Dispersion and their areas of application. Importance of Moments. Central and Non-central Moments, Sheppard's corrections for moments for grouped data. Skewness and Kurtosis-their measures including those based on quartiles and moments with real life examples.

Probability and Random Experiment:- Definition of Probability, Classical and Relative frequency approach to Probability, merits and demerits of these approaches. Random experiment, sample point and sample space, definition of an event, operation of events. Properties of probability based on axiomatic approach, Addition theorem for 'n' events, conditional Probability, Multiplication rule of probability for 'n' events, Boole's inequality, Independence of events, Baye's theorem and its applications (with examples of real life).

Random Variables:- Notion of a Random variable, Distribution function and its properties. Discrete random variable, Probability Mass function, Continuous random variable, Probability Density function. Transformation of one dimensional random variable (simple1-1 functions only).

Mathematical Expectation:- Mathematical expectation of random variable and its properties. Moments-Raw and Central moments with examples – Definition of Moment generating function (m.g.f), Cumulant generating function (c.g.f). Probability generating function (p.g.f) and Characteristic function, statements of their properties with applications. Chebychev's inequality and its applications. Statement and applications of Weak law of Large numbers and Central limit theorem for i.i.d. random variables with finite variance.

Discrete Distributions:- Standard discrete distributions and their properties such as m.g.f, c.g.f, p.g.f., Characteristic function, moments up to fourth order of Uniform, Binomial, Poisson, Negative Binomial, Geometric and Hyper-Geometric distributions. Reproductive property wherever it exists. Binomial approximation to Hyper-Geometric, Poisson approximation to Binomial and Negative Binomial Distributions. Applications of these distributions in real life.

Continuous Distributions:- Normal distribution-Definition, properties and its importance in Statistics. Normal distribution as limiting case of Binomial and Poisson distributions. Definitions and properties such as m.g.f, c.g.f, Characteristic function, moments up to fourth order of Rectangular, Gamma, Exponential, and Cauchy distributions. Reproductive property wherever it exists. Application of these distributions in real life.

Bivariate date. Scattered diagram. Principle of Least squares, fitting of Straight line, Quadratic, Power and Exponential curves. Product moment Correlation coefficient and its properties, Partial and Multiple Correlation coefficients (only for three variables). Spearman's Rank correlation coefficient. Simple linear regression, Correlation and regression-comparison, Coefficient of Determination, Correlation ratio. Bivariate random variable – discrete and contiuous, joint, marginal and conditional distributions, distribution fuction of bivariate random variable, statement of its properties, simple illustrations. Mathematical expectation of bivariate random variable. Covariance, additive and multiplication theorems of mathematical expectation, correlation coefficient and lines of regression with illustrations.

Concept of Population, Parameter, Random Sample, Statistic. Sampling distribution of the sum of observations from Binomial, Poisson and Normal distribution, Standard error. Exact Sampling Distributions – Statements and Properties of x^2, t and F distributions and inter relations.

Theory of Estimation:- Point Estimate of parameter, concept of bias and mean square error of an estimate. Criteria of good estimator-Consistency, Unbiased ness, Efficiency and Sufficiency, Statement of Nyman's Factorization theorem, derivations of Sufficient statistics in Binomial, Poisson, Normal and Exponential cases (one parameter only). Estimation by the Method of Moments and Maximum Likelihood Method. Statements of asymptotic properties of Maximum Likelihood Estimators. Concept of Interval estimation, Confidence intervals of parameters of Normal population.

Statistical Tests:- Concepts of null hypothesis, alternative hypothesis, critical region, two types of errors, level of significance and power of a test. Neyman – Pearson lemma for testing a simple null hypothesis against a simple alternative and examples on the case of Binomial, Poisson, Exponential and Normal (for mean with known SD) distributions.

Part–B(50 Marks)

Analysis of Categorical Data:- Consistency of Categorical data. Independence and Association of Attributes, various measures of association for two-way data with real life examples.

Large Sample Tests:- Use of central limit theorem for testing and interval estimation of a single mean and a single proportion and difference of two means and two proportions. Fisher's Z-transformation and its uses.

Tests of significance based on t, χ^2 and F distributions, χ^2 test for goodness of fit, test for independence of attributes. Comparison of Parametric and Nonparametric tests, their advantages and disadvantages. **Nonparametric tests:-** One sample Run test. Sign test and Wilcoxon Signed Rank tests for one sample and two related samples. ***Tests for two independent samples:*** Median test, Wilcoxon Mann-Whitney U-test, Wald-Wolfowitz Runs test. (Small and Large samples).

Designs of Experiments:- Analysis of variance of one way and two way classifications. Expectation of various sums of squares. Importance and applications of designs of experiments, principal of Experimentation. Analysis of completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD) including one missing observation, comparison of their efficiencies, expectation of various sums of squares.

Designs of Sample Surveys:- Random Numbers, drawing random samples, Sample surveys versus census surveys. Planning and execution of large scale sample surveys, notion of non-sampling errors, sources and treatment of non-sampling errors. Estimation of population mean, population total, population proportion and variance of the estimators by

i) Simple Random sampling with and without replacements.
ii) Stratified Random sampling with proportional and Neyman's optimum allocation.
iii) Symmetric sampling with N = nk. Comparison of their efficiencies.

Time Series Analysis:- Components of Time Series, Determination of trend by graphical, semi-average, Least squares and moving average methods. Determination of Seasonal indices by Simple averages, Ratio to moving averages, Ratio to trend and Link relative methods.

Index Numbers:- Construction, uses and limitations of Index numbers. Simple and Weighted index numbers, consistency tests for an Index number, base shifting, splicing and deflation. Fixed and Chain base Index numbers. Cost of living Index numbers and Wholesale price Index numbers.

Demand Analysis:- Introduction, Demand and Supply, Price Elasticity's of Supply and Demand, Methods of determining Demand and Supply Curves: Time Series Data, Leontief's method of finding Demand Curve from time Series Data. Limitations of the method, Pigous's method from Time Series Data, Pareto's law of Income distribution, Curve of concentration.

Vital Statistics and Indian Official Statistics:- Rates and ratios, Standardized rates, Fertility and Reproduction rates, Construction and uses of complete and abridged life tables. Functions and organization of CSO and NSSO. Agricultural statistics, Area and Yield statistics. National Income and its computation. Utilities and difficulties in estimation of National Income.