

# STATISTICS ( CODE NO. 08 )

## PAPER – I

### PART - I

#### 1. Descriptive Statistics

**Types of data** - Concepts of a Statistical population and sample from a population ; qualitative and quantitative data ; nominal and ordinal data ; cross sectional and time series data; discrete and continuous data; frequency and non-frequency data. different types of scales – nominal, ordinal , ratio and interval. Collection and Scrutiny of data ; Primary data – designing a questionnaire and a schedule; checking their consistency. Secondary data – its major sources including some government publications. Complete enumeration, controlled experiments, observational studies and sample survey. Scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross- validation. Presentation of Data ; construction of tables with one or more factors of classification. Diagrammatic and graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representation, histogram, frequency polygon and ogives. Stem and leaf chart. Box plot. Analysis of Quantitative Data; Univariate data- Concepts of central tendency, dispersion and relative dispersion, skewness and kurtosis and their measures Sheppard's corrections for moments for grouped data (without derivations). Bivariate Data ; Scatter diagram. Product moment correlation coefficient and its properties. coefficient of determination. Correlation ratio. Concepts of error in regression. Principle of least squares. Fitting of linear regression and related results. fitting of curves reducible to polynomials by transformation. Rank correlation - Spearman's and Kendall's measures. Multivariate data; Multiple regression, multiple correlation and partial correlation in three variables, their measures and related results. Analysis of Categorical Data; Consistency of categorical data. Independence and association of attributes. Various measures of association for two-way and three-way classified data.

## **2. Probability Theory**

**Important Concepts in Probability** - Definition of probability – classical and relative frequency approach to probability, Richard von Mises, Cramer and Kolmogorov's approaches to probability, merits and demerits of these approaches . Random Experiment : Trial, sample point and sample space, definition of an event, operation of events, mutually exclusive and exhaustive events. Discrete sample space, properties of probability based on axiomatic approach, conditional probability, independence of events, Bayes theorem and its applications. Random Variables ; Definition of discrete random variables, probability mass function, idea of continuous random variable and its properties – moments, measures of location , dispersion, skewness and kurtosis, moment generating function, their properties and uses. Standard univariate discrete distributions and their properties : Discrete Uniform, Binomial, Poisson, Hypergeometric, Negative Binomial and Geometric distributions. Continuous univariate distributions- Uniform, normal , Cauchy, Laplace, Exponential, Chi-square, Gamma and Beta distributions. Bivariate normal distribution ( including marginal and conditional distributions) Chebyshev's inequality and applications, Statements and applications of weak law of large numbers and central limit theorems ( Lindeberg Leby, Liapounov and De-Moiver's )

## **PART - II**

### **1. Statistical Methods**

Sampling from a distribution ; Definition of a random sample, simulating random sample from standard distributions (Uniform, Exponential & Normal) . Concept of derived distributions of functions of random variables. Concept of a statistic and its sampling distribution . Point estimate of a parameter, Concept of bias and standard error of an estimate, Standard errors of sample mean and sample proportion, Sampling distributions of sum of binomial and Poisson distributions. Sampling distribution of mean of normal distribution.

Independence of sample mean and variance in random sampling from a normal distribution ( without derivation ), Statistical Tests and interval Estimation ; Null and alternative hypotheses, Types of errors, p-values . Statement of chi-square, t, and F statistics. Testing for the mean and variance of univariate normal distribution, testing of equality of two means and testing of equality of two variances of two univariate normal distributions.

Related confidence intervals. Testing for the significance of sample correlation coefficient in sampling from bivariate normal distribution and for the equality of means and equality of variances in sampling from bivariate normal distribution. Large sample tests. Use of central limit theorem for testing and its applications to interval estimation of a single mean, a single proportion, difference of two means and two proportions. Fisher's Z-transformation and its uses . Pearson's chi-square test for goodness of fit. Contingency table and test of independence in a contingency table. Definition of order statistics and their distributions ( Without derivations ), Non-parametric tests; Sign test for univariate and bivariate distributions, Wilcoxon-Mann-Whitney test, Run test, Median test, and Spearman's rank correlation coefficient test.

### **Statistics (CODE NO. 08)**

#### **PAPER - II**

#### **PART - I**

##### **1. Sample Surveys**

Sample Surveys. Concepts of population and sample., need for sampling. Census and sample survey, basic concepts in sampling , organizational aspects of survey sampling, sample selection and sample size . Some basic sampling methods- simple random sampling (SRS) with and without replacement. Stratified random sampling. systematic sampling, ratio and regression methods of estimation under SRS. Non sampling errors, acquaintance with the working (questionnaires, sampling design, methods followed in field

investigation, principal findings etc.) of NSSO, and other agencies undertaking sample surveys.

## **2. Design of Experiments**

Analysis of variance for one way and two-way classifications ( with one observation per cell ) . Need for design of experiments, fundamental principles of design, basic designs – C.R.D., R.B.D. ,L.S.D. and their analysis. Factorial designs –  $2^n$  (  $n \leq 4$  ) designs, illustrations, main effects and interaction effects and confounding in  $2^3$  design.

## **PART - II**

### **1. Measurement of mortality and life table**

Crude death rate, infant mortality rates, death rate by casuse, standardized death rate, complete life table-its main features, mortality rate and probability of dying, use of survival tables. Measurement of fertility : crude birth rate, general fertility rate, total fertility rate, gross reproduction rate, net reproduction rate.

### **2. Economic Statistics**

Index number-its definition, applications of index numbers, price relatives and quantity or volume relatives of index numbers, use of averages, simple aggregative and weighted aggregative methods, Laspeyre's Paache's and Fisher's index numbers, time and factor reversal tests of index numbers. Consumer Price Index.

### **3. Time Series Analysis**

Economic time series, its different components. Illustrations , additive and multiplicative models, detemination of trend, growth curves, analysis of seasonal fluctuations, construction of seasonal indices.

### **4. Statistical Quality Control**

Importance of statistical methods in industrial research and practice, specification of items and lot qualities corresponding to visual gauging, count and measurements, types of inspection, detemination of tolerance limits. General theory of control charts, causes of variation in quality, control limits, sub-grouping, summary of out-of control criteria, charts for attributes, np-chart, p-chart, c-chart, U-chart.

Charts for variables ;  $\bar{X}$  and R charts, design of  $\bar{X}$  and R Charts versus p-charts, process capability studies. Principle of acceptance sampling - problems of lot acceptance, stipulation of good and bad lots, producer's and consumers risks, single and double sampling plans, their OC functions, concepts of AQL, LTPD, AOQL, average amount of inspection and ASN functions, rectifying inspection plans, Sampling inspection plans, Indian Standards Tables Part I ( including applications ).