

**B.A./B.Sc. STATISTICS**  
**Syllabus (effective from session 2012 – 2013 onwards)**

**B.A. / B.Sc.I (effective from session 2012 - 2013)**

**Paper I: *Probability Theory***

**Paper II: *Descriptive Statistics***

**Paper III: *Numerical Methods and Programming in C***  
***Practical***

**B.A. / B.Sc. II (effective from session 2013 - 2014)**

**Paper I: *Statistical Methods***

**Paper II: *Distribution Theory***

**Paper III: *Sampling and Design of Experiments***  
***Practical***

**B.A. / B.Sc.III(effective from session 2014 - 2015)**

**Paper I: *Applied Statistics***

**Paper II: *Industrial Statistics and Operations Management***

**Paper III: *Linear Regression and Data Analysis***

**Paper IV: *Statistical Inference***  
***Practical***

## **B.A./B.Sc. Part I (Statistics) (effective from session 2012 - 2013)**

### **Paper I: *Probability Theory***

Random experiments : trial, sample point and sample space, event. Operations of events, concepts of mutually exclusive and exhaustive events.

Definition of Probability : Classical and relative frequency approach. Discrete probability space, Axiomatic approach to probability for the discrete case only . Properties of probability. Independence of events in probability for two and three events. Conditional probability, total and compound probability rules, Baye's theorem and its applications.

(2 questions)

Discrete and continuous random variables, Cumulative distribution function (cdf), Probability mass function(pmf) and probability density functions(pdf). Bivariate distribution, Marginal and conditional distributions.

(2 questions)

Expectation of a random variable and its properties. Independence of random variables. Moments, measures of location and dispersion of a rv. Theorems on the expectation of sums of random variables and product of independent random variables, Conditonal expectations, Probability generating function(pgf) and moment generating function(mgf), their properties and uses.

(2 questions)

Chebyshev inequality and applications. Repeated trials, Convergence in probability, Theorem of Bernoulli and Tchebycheff's ,Weak law of large numbers, Central limit theorem (without proof) and their applications.

*Discrete Distributions* : Bernoulli, Binomial, and Poisson.

*Continuous Distributions* : Uniform and Normal

(2 questions)

1.Kapoor,V.K& Gupta,S.C.:Fundamentals of Mathematical Statistic

2.Goon,Gupta &Dasgupta Vol-I,Fundamentals of Statistics

### **Paper II : *Descriptive Statistics* (effective from session 2012 - 2013)**

*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.

(1 questions)

*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.

(1 questions)

*Analysis of Quantitative Data* : Univariate data - Concepts of central tendency or location, dispersion and relative dispersion, skewness and kurtosis, and their measures including those based on quantiles and moments. Sheppard's correction for grouped data (without derivation).

(2 questions)

*Bivariate Data* : Scatter diagram. Product moment correlation coefficient and its properties. Coefficient of determination. Concepts of error in regression, linear Regression and related results, Correlation ratio.. Rank correlation -Spearman's and Kendall's measures. Intraclass correlation.

(2 questions)

*Multivariate Data* : Multiple regression, multiple correlation and partial correlation in three variables. Their measures and related results.

(1 questions)

*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. Odds ratio.

(1 questions)

1.Kapoor,V.K& Gupta,S.C.:Fundamentals of Mathematical Statistic

2.Goon,Gupta &Dasgupta Vol-I,Fundamentals of Statistics

### **Paper III : Numerical Methods and Programming with C (effective from session 2012 - 2013)**

Numerical methods :

Concept of function approximation, Principle of least squares. Fitting of curves reducible to polynomials by transformation. Calculus of finite differences, operators, separation of symbols, examples and problems. Interpolation formulas with remainder term. Newton's forward and backward formulae. Newton's divided difference formula for interpolation. Lagrange's interpolation formula.

Numerical Integration: Derivation of general quadrature formula for equidistant ordinates. Derivation of trapezoidal, Simpson's 1/3rd and 3/8th rules. Weddle's rule. Real roots of a numerical equation by bisection, Regula-Falsi, Newton-Raphson and iteration methods.

(3 questions)

*Programming with C:*

History and features of C language. Components of C language, Structure of a C Program.

Data type: Basic data types, Variable Declaration : Local, Global, Parametric Variables. Assignment of variables. Numeric, Character, real and string constants. Arithmetic, Relation and logical operators. Assignment operators. Increment and Decrement operators, conditional operators, Writing and interpreting expressions, using expressions in statements. Basic input/output.

Control Construct -I : Control Statements, conditional statements, if ...else, Nesting of if...else, elseif ladder, switch statements. Loops in C : for, while, do....while loops.

Control Construct -II: break, continue, exit(), goto and label declarations.

(2 questions)

One dimensional, and two dimensional arrays., reading/writing of arrays.

Functions, classification of functions, functions definition and declaration, assessing a function, return statement

Preprocessors : Introduction to preprocessors, Macro Substitution, Simple Macro Substitution, Macro with arguments.

Standard header files, Library functions, String functions, Mathematical functions, Date and Time functions, variables argument list function, utility functions, character class test functions.

Programmes for simple statistical and numerical problems.

(3 questions)

1. Sexena, H.C.: Numerical Analysis
2. Kunz, K.S.: Numerical Analysis
3. Balaguru swamy, E.: Programming in C

#### **Practicals based on Papers I, II and III**

(An outline only)

1. Presentation of data by Frequency tables
2. Presentation of data by Histogram, Frequency Polygon, Frequency curve, Stem-leaf and Boxplots
3. Calculation of A.M., G.M. and H.M.
4. Determination of Median, Mode, quartiles, deciles and percentiles
5. Calculation of measures of dispersion.
6. Calculation of moments, measures of skewness and measure of Kurtosis.
7. Calculation of coefficient of correlation ( Grouped and ungrouped data).
8. Calculation of correlation ratio, Rank correlation and Intra-class correlation coefficients.
9. Regression of two variables.
10. Spearman's Rank correlation and Kendall's tau.
11. Fitting of various polynomial curves by the method of least squares.
12. Problems on multiple and partial correlation and linear regression upto three variables.
11. Construction of forward difference tables and divided difference tables.
12. Interpolation by Newton's forward/backward difference formula for equal intervals.
13. Interpolation by Newton's divided difference formula for unequal intervals.
14. Interpolation by Lagrange's formula for unequal intervals.
15. Approximate integration (Trapezoidal rule, Simpson's 1/3, Simpson's 3/8 and Weddle's rules).
16. Real roots of numerical equation by bisection, false position, iteration and Newton-Raphson methods.
17. C programs for
  - (i) fitting of straight line and exponential curve to the given data.
  - (ii) Numerical integration for equal intervals;
  - (iii) interpolation using Newton and Lagrange methods;
  - (iv) roots of nonlinear equations using bisection, iteration and Newton-Raphson methods.
  - (v) calculation of mean, variance and correlation coefficient.

18. Working with Software Packages (Descriptive Statistics only) : MS-Word, MS-Excel, MINITAB, SYSTAT or SPSS.

## **B.A./B.Sc. Part II (Statistics) (effective from session 2013 - 2014)**

### **Paper I : *Statistical Methods***

Parametric models, parameters; definition of random sample and its likelihood; concept of derived distributions of a function of random variables, concept of statistic and its sampling distribution; problems of inference.

*Properties of Estimators:* Requirements of good estimator, Unbiasedness, Consistency Efficiency and sufficiency, Minimum variance properties and Cramer-Rao inequality for unbiased estimators. Application of these concepts to standard distributions.

(3 question)

*Method of estimation:* General descriptions of the method of moments, method of maximum likelihood, Method of least square and method of minimum  $\chi^2$ . Properties of maximum likelihood estimators (without proof) Minimum variance unbiased estimator (MVUE) and its determination.

(1 questions)

*Theory of testing of hypothesis:* Simple and composite hypotheses, Null and alternative hypotheses, Test of significance and critical regions, Two kinds of errors, Level of significance, p-value and power of test. Best critical region, Most powerful(MP) and uniformly most powerful(UMP) tests, Neyman - Pearson Lemma for simple hypothesis against simple alternative, Its application to normal population.

(2 questions)

Large Sample tests. Small sample tests based on normal, t,  $\chi^2$  and F distributions, Fisher's Z transformation and its applications. Fitting of binomial, Poisson and normal distribution to the observed data, Goodness of fit test

(2 questions)

- 1.Kapoor,V.K& Gupta,S.C.:Fundamentals of Mathematical Statistic
- 2.Rohatgi,V.k. &Ehsanes Saleh,A.K.Md.:An Interoduction to probability and statistics
- 3.Goon,Gupta &Dasgupta :An outline of Statistical Theory

### **Paper II : *Distribution Theory***

*Transformation of Random Variables:* Discrete and Continuous type of one and two variables, One-to - One and not One - to - One transformations.

(1 question)

*Discrete Distributions :* Negative binomial, Hypergeomatic, Geometric and Multinomial.

*Continuous Distributions :* Beta and Gamma , Exponential, Log-normal, Cauchy, Laplace, Pareto and Weibull distributions and their properties. Bivariate normal distribution and its properties.

(4 questions)

*Sampling distributions:* Statistics, Sampling distribution and Standard error, Chi-square distribution, distribution of sample mean and variance. Student 's and Fisher's 't' - distributions, Snedecor F-distribution and their properties.

(2 question)

*Order Statistics:* Order statistics, Distribution of order statistics, Range and median from uniform and Exponential parents

(1 question)

1. Hogg,R.V&Craig,A.T.:Introduction to Mathematical Statistics
- 2.Mood,A.M.,Grayball,F.A.&Boes,D.C.:Introduction to the theory of Statistics
3. Kapoor,V.K& Gupta,S.C.:Fundamentals of Mathematical Statistic

### **Paper III : *Sample Surveys and Design of Experiments***

*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 surveys. Scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross validation.

(1 question)

Sample Surveys, Concept of population and sample, need for sampling, Census and Sample survey, basic concepts in sampling; requirements of a good sample, Random and non-random methods of sampling, Concept of sampling and non-sampling errors. The planning and execution of sample surveys, sample selection and sample size.

*Simple random sampling (SRS)*: with and without replacement, Use of random number tables for selection of sample, Estimation of the population mean and totals and their standard errors. Sampling for population and percentage .

*Stratified Random sampling* : Estimation of population mean and total, their variances, Allocation among strata, Proportional and Neyman optimum allocations, Gain due to stratification.

(4 questions)

*Analysis of Variance*: Analysis of variance for one way and two way classifications with interaction (excluding unequal number of observation in the cells).

(1 questions)

*Design of Experiments*: Need for design of experiments, Fundamental principles of a design: Randomization, Replication and local control. Basic designs : Completely randomized design(CRD), Randomized block design(RBD) and Latin square design(LSD).

(2questions)

**1.Cockran,W.G.:SamplingTechniques,J.wiley&Sons**

**2.Sukhatme&Sukhatme:SamplingTheoryofSsurveyswithApplication,IOWR Statistics Uni. Press USA**

**3.Parimal Mikhopadhyay:Survay Sampling,New age India Ltd**

**4.Goon,Gupta,&Dasgupta:FundamentalofStatistics,Vol-I,II,WorldPressPvt.Ltd**

**5.Kapoor&Gupta:FundamentalofAppliedStatistics**

## **B.A./B.Sc. Part II : Practicals based on paper I, II and III.**

(An outline only)

1. Fitting of a binomial, Poisson and normal distributions to observed data and testing of goodness of fit.
2. Testing of independence of attributes in  $m \times n$  contingency table and calculation of measures of association.
3. Testing of hypothesis for  $H_0 : \sigma^2 = \sigma_0^2$
4. t - test for
  - (i)  $H_0 : \mu = \mu_0$ , (ii)  $H_0 : \mu_1 = \mu_2$  and (iii)  $H_0 : \rho = 0$
5. F - test for  $H_0 : \sigma_1^2 = \sigma_2^2$
6. Fisher's Z-transformation and its uses in testing.
  - (i)  $H_0 : \rho = \rho_0$ , (ii)  $H_0 : \rho_1 = \rho_2$  and (iii)  $H_0 : \rho_1 = \rho_2 = \dots = \rho_k$
7. Large sample test for various hypothesis.
8. Analysis of variance in one-way and two-way classification.
9. Analysis of CRD
10. Analysis of RBD
11. Analysis of Latin square design
12. The selection of a sample.
13. Problem on simple random sampling
14. Problems on a stratified sampling with proportional and optimum allocation.
15. Problems on sampling in attributes
16. Working with Software Packages : MS-Word, MS-Excel, MINITAB, SYSTAT or SPSS.(In accordance with prescribed syllabi)

## **B.A./B.Sc. Part III (Statistics) (effective from session 2014 - 2015)**

### **Paper I : *Applied Statistics***

*Demographic Methods:* Measurement of mortality and life table : Crude, standardised and age-specific death rate, infant mortality rates, rate by cause. Complete and abridged life table and its main features, uses of life table. Measurement of fertility : Crude birth rate, general fertility rate, age-specific birth rate, total fertility rate (TFR), gross reproduction rate (GRR) and net reproduction rate (NRR).

(3 questions)

*Statistical Process and Product Control :* Quality of a product, need for quality control, basic concepts of Process control, Process capability and Product Control. General theory of control charts, Causes of variation in quality. Control, specification and tolerance limits, subgrouping, summary of out of control criteria. Control chart for the attributes- p-chart, np-chart, c-chart, u-chart. Charts for variables: chart for average, range and standard deviation, CUSUM charts, Application and interpretation of control charts.

(2 questions)

*Principles of acceptance sampling :* Problem of lot acceptance, good and bad lots, consumer and producer risks. Single and double sampling plans for attributes and their OC functions. Concepts of AQL, LTPD, AOQL, ATI, and ASN functions.

(1 questions)

*Index Number :* Price relatives and quantity or volume relatives. Link and chain relatives, computation of index numbers, Laspeyre's, Paasche's, Marshal-Edgeworth's and Fisher's index numbers, Chain base index number, consumer price index numbers, Tests for index numbers :Time and factor reversal test.

(1 questions)

*Time Series :* Economic time series, different components, illustrations, additive and multiplicative models, Determination of trend, growth curves, analysis of seasonal fluctuations, construction of seasonal indices.

(1 questions)

1.Kapoor,V.K& Gupta,S.C.:Fundamentals of Applied Statistic

2.Goon,Gupta &Dasgupta Vol-I,II,Fundamentals of Statistics ,World Press Pvt Ltd

### **Paper II : *Industrial Statistics and Operations Management***

#### ***Reliability Theory***

Definition of Reliability and relationship with survival function, maintainability and availability, Life distribution failure rate and bath tub. Failure rate curve. Hazard function, hazard rate of non-negative random variable. Parametric distributions - Weibull, gamma, lognormal and exponential as life time distributions. Concept of aging, IFR, IFRA classes of distributions and their dual, coherent system as binary function : minimal cut and path sets(vectors), representation of structure function of series, parallel and k out of n: G systems of independent components. Using minimal cut and path structure functions, dual of a coherent structure, derivation of reliabilities of above structures.

(4 questions)

#### ***Operations Research***

*Convex sets and functions:* Convex sets, Vertex of a convex set (relationship), Convex cone, Convex hull of a set, Simplex, Separating and supporting hyperplanes, Convex and concave functions. Epigraphs of a convex function- local and global.

*Linear Programming :* The structure and formation of linear programming problem. Feasible and basic feasible solutions. Graphical methods. Simplex method. Dual of LPP and Duality theorem and the solution thereof. Two phase and Big -M method with artificial variables.

*Transportation :* Mathematical formulation, Method for initial basic feasible solution. North West corner rule. Lowest cost entry. Vogel's approximation, Optimal solution. (non-degenerate and balanced case only)

*Assignment :* Mathematical formulation. Reduction theorem. Hungarian method.

(4 questions)

1.Zacks,S.:Reliability Theory ,Springer

2.Sinha,S.K.:Reliability and life testing

3.Johnson &Johnson :Survival Analysis,John wiley &Sons

O.R.

1.Taha,Kantiswarep,P.K.Gupta &Man Mohan ,Operation Research ,Sultan Chand & Sons

### **Paper III : *Linear Regression and Data Analysis***

Multivariate normal distributions, marginal and conditional distribution, Moment Generating and Characteristics functions, Distribution of linear combination of components of multivariate normal, marginal and conditional distributions, random sample from multivariate normal distribution, Maximum likelihood estimation of mean vector and co-variance matrix.

Linear regression model of full rank, Least squares theory. Estimation of parameters-OLSE and MLE of parameters, variances and covariances of least squares estimates, estimation of error variance, test of hypotheses for parameters.  $R^2$  and adjusted  $R^2$ . ANOVA table for regression.

(4 questions)

Explanatory data analysis, empirical distribution function and their properties. quantile function, confidence interval of quantiles of order  $p$ , tolerance and convergence. density estimation with smoothing kernels.

Stochastic simulation: Inversion theorem, generating random variables, simulating standard univariate distributions using inverse method, Monte Carlo integration.

Non-parametric methods – Tests for randomness and test for goodness of fit. One sample tests : sign test, Wilcoxon signed rank tests. Two sample tests : run test, Kolmogorov – Smirnov's test. Median test and Mann-Whitney U test. Mood tests and Sukhatme test for scale parameter, Spearman's rank correlation test, Kurskall-Wallis Test.

(4questions)

1. Anderson,T.W.:An Introduction to multivariate Statistical Analysis, J.wiely &sons
- 2.Draper,N.R. and Simth,H.(1998):Applied Regression Analysis,John wiley
- 3.Rao,C.R.:Linear statistical Inferences and its Application,wiley Eastern
- 4.Gibbons: Non-parametric,wiley
- 5.Goon,Gupta,DAsgupta:An Outline of Statistical Theory Vol-I,II,World Press Pvt Ltd

#### **Paper IV : *Statistical Inference***

Introduction to Parametric Models and Problems of Statistical Inference.

Completeness and bounded completeness, Score function, Statistic(s), Sufficient statistics, factorization theorem (proof for discrete case only), Likelihood function and statistics, minimal sufficient statistics, Lehman-Scheffe criterion for obtaining minimal sufficient statistics, Completeness of sufficient statistics, Cramer Rao inequality for biased and unbiased estimators, Minimum variance unbiased estimation, necessary and sufficient condition, Rao-Blackwell and Lehman - Scheffe theorem, Small sample properties of M.L.estimators. ML estimation vis a vis method of moments estimation.

(4 questions)

*Testing hypothesis* : Notion of hypothesis testing, critical function, size and power of a test, MP and UMP tests, Randomised and Non-randomised tests, Neyman-Pearson Lemma, Optimal test for simple hypothesis concerning one parameter. MLR property. Testing one sided compoite in MLR models.

(2 questions)

*Confidence Estimation*: Interval estimation for single unknown parameter, Confidence regions, Confidence bounds, Uniformly most accurate confidence intervals and uniformly most accurate unbiased confidence intervals, Correspondence between testing of hypothesis and confidence Interval estimation.

(1 questions)

*Sequential Analysis*: Concept of O.C. and A.S.N. functions. Wald's sequential probability ratio test. Wald's Identity. Wald's fundamental Lemma.

(1 question)

- 1.Zacks,S.Parametric Statistical Inference,Pargamon press
- 2.Kale,B.K.(1999):A first course on parametric inference ,Narosa Publication House,New Delhi
- 3.Rohategi,V.K.(1988):An Introduction to probability &Mathematical statistical ,wiley Eastern
- 4.Wald,A.:Sequential Analysis
- 5.Goon,Gupta,&Dasgupta :Anoutline of statistical Theory Vol-I,II,World press Pvt Ltd
- 6.Mood,A.M.,Graybill,F.A.&Boes,D.C.:Introduction to the theory of Statistics,Tata McGraw Hill



### **B.A./B.Sc. Part III : *Statistics Practical based on Paper I, II, III & IV***

(An outline only)

1. Computing measures of mortality and fertility.
2. Construction of complete life tables using age specific mortality rates.
3. Fitting of Gompertz, Makeham and Logistic Curves. Population Projection.
4. Drawing of Control charts : average, range, p-chart , np-chart, c-chart, u-chart and CUMSUM charts.
5. Single and double sampling plans. OC, ASN, AOQ and ATI curves.
6. Setting of confidence limits for the parameters of the Binomial, Poisson distributions based on Chi-square and F-distributions.
8. Sequential test for binomial parameter  $p = p_0$  against  $p = p_1 (p_1 > p_0)$  A.S.N. and O.C. curves.
9. Sequential test for Normal Distribution (a)  $\mu = \mu_0$  against  $\mu = \mu_1 (\mu_1 > \mu_0)$  A.S.N. and O.C. curves.  
(b)  $\sigma^2 = \sigma_0^2$  against  $\sigma^2 = \sigma_1^2 (\sigma_1^2 > \sigma_0^2)$  A.S.N. and O.C. curves.
10. Sequential test for  $\lambda = \lambda_0$  against  $\lambda = \lambda_1$  in Poisson  $P(\lambda)$
11. Problems on randomised and non-randomised tests.
12. Calculation of power curve for the test of  $H_0 : \mu = \mu_0$  against  $H_1 : \mu \neq \mu_0$  for a normal distribution with known variance.
13. Problems on
  - (i) Wald-Wolfowitz run test.
  - (ii) Sign and Wilcoxon test
  - (iii) Wilcoxon - signed rank test.
  - (iv) Mann-Whitney and Kolmogorov – Smirnov test for two samples .
14. Linear programming problem, transportation and assignment problems.
15. Parameter estimation and test for hypothesis in linear regression model of full rank.
16. Sample generation from univariate distributions
17. Construction of index numbers.
18. Construction of chain base index number.
19. Problems on time reversal and factor reversal test.
20. Determination of trend and seasonal components of a time series.
21. Application of Software Packages : MS-Word, MS-Excel, MINITAB, SYSTAT or SPSS (In accordance with prescribed syllabi)

### **The List of books “Recommended” for B.A./B.Sc. Part I, II and III (Statistics) with effect from 2012 onwards**

#### **B.A./B.Sc. Part I (Statistics) (effective from session 2012 - 2013)**

##### **Paper I: *Probability Theory***

1. Kapoor, V.K & Gupta, S.C.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. Goon, Gupta & Dasgupta Vol-I : Fundamentals of Statistics, World Press Pvt. Ltd

##### **Paper II : *Descriptive Statistics***

1. Kapoor, V.K & Gupta, S.C.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons. New
2. Goon, Gupta & Dasgupta Vol-I, Fundamentals of Statistics, World Press Pvt. Ltd

### **Paper III : *Numerical Methods and Programming with C***

1. Sexena, H.C.: Numerical Analysis, S. Chand & Co.
2. Kunz, K.S.: Numerical Analysis, Addison Wesley
3. Balaguru swamy, E.: Programming in C

### **B.A./B.Sc. Part II (Statistics) (effective from session 2013 - 2014)**

#### **Paper I : *Statistical Methods***

1. Kapoor, V.K & Gupta, S.C.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons. New Delhi
2. Rohatgi, V.K. & Ehsanes Saleh, A.K.Md.: An Introduction to probability and statistics, Wiley Eastern Ltd
3. Goon, Gupta & Dasgupta : An outline of Statistical Theory, , World Press Pvt. Ltd

#### **Paper II : *Distribution Theory***

1. Hogg, R.V & Craig, A.T.: Introduction to Mathematical Statistics, Macmillan
2. Mood, A.M., Graybill, F.A. & Boes, D.C.: Introduction to the theory of Statistics, TMH
3. Kapoor, V.K & Gupta, S.C.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi

#### **Paper III : *Sample Surveys and Design of Experiments***

1. Cochran, W.G.: Sampling Techniques, John. Wiley & Sons, New York
2. Sukhatme & Sukhatme: Sampling Theory of Surveys with Applications, IOWA State Uni. Press
3. Parimal Mikhopadhyay: Survey Sampling, New age International Ltd
4. Goon, Gupta, & Dasgupta: Fundamentals of Statistics, Vol-I, II, World Press Pvt Ltd
5. Kapoor & Gupta: Fundamentals of Applied Statistics, Sultan Chand & Sons. New Delhi

### **B.A./B.Sc. Part III (Statistics) (effective from session 2014 - 2015)**

#### **Paper I : *Applied Statistics***

1. Kapoor, V.K & Gupta, S.C.: Fundamentals of Applied Statistics, Sultan Chand & Sons. New Delhi
2. Goon, Gupta & Dasgupta Vol-I, II, Fundamentals of Statistics, World Press Pvt Ltd

#### **Paper II : *Industrial Statistics and Operations Management***

1. Zacks, S.: Reliability Theory, Springer
2. Sinha, S.K.: Reliability and life testing, Wiley Eastern Ltd.
3. Johnson & Johnson : Survival Analysis, John Wiley & Sons
1. Taha, Operations Research, TMH
2. Kantiswarp, P.K. Gupta & Man Mohan, Operation Research, Sultan Chand & Sons

#### **Paper III : *Linear Regression and Data Analysis***

1. Anderson, T.W.: An Introduction to multivariate Statistical Analysis, J. Wiley & Sons, New York
2. Draper, N.R. and Smith, H. (1998): Applied Regression Analysis, John Wiley & Sons
3. Rao, C.R.: Linear statistical Inferences and its Application, Wiley Eastern Ltd.
4. Gibbons: Non-parametric, John Wiley & Sons, New York
5. Goon, Gupta, Dasgupta: An Outline of Statistical Theory Vol-I, II, World Press Pvt Ltd

#### **Paper IV : *Statistical Inference***

1. Zacks, S. Parametric Statistical Inference, Pergamon press, New York
2. Kale, B.K. (1999): A first course on parametric inference, Narosa Publication House, New Delhi
3. Rohatgi, V.K. (1988): An Introduction to probability & Mathematical statistics, Wiley Eastern
4. Wald, A.: Sequential Analysis, John Wiley & Sons, New York

5. Goon, Gupta, & Dasgupta : An outline of statistical Theory Vol-I, II, World Press Pvt Ltd

6. Mood, A.M., Graybill, F.A. & Boes, D.C.: Introduction to the theory of Statistics, Tata McGraw Hill