



BACHELOR OF SCIENCE (B.Sc.)

(THREE YEAR DEGREE COURSE)

SUBJECT

STATISTICS

B.Sc. (STATISTICS)

COURSE STRUCTURE

FIRST YEAR

PAPER – 101: Probability	50 MARKS
PAPER – 102: Probability distributions and Numerical Analysis	50 MARKS
PAPER – 103: Statistical Methods	50 MARKS
PAPER – 104: PRACTICAL (Based on Paper 101, 102, 103)	50 MARKS

SECOND YEAR

PAPER – 201: Statistical Inference	50 MARKS
PAPER – 202: Survey Sampling	50 MARKS
PAPER – 203: Analysis of Variance and Design of Experiment	50 MARKS
PAPER – 204: PRACTICAL (Based on Paper 201, 202, 203)	50 MARKS

THIRD YEAR

PAPER – 301: Non-parametric Methods and Regression Analysis 50 MARKS

PAPER – 302: Applied Statistics 50 MARKS

PAPER – 303: Operations Research 50 MARKS

PAPER – 304 : PRACTICAL (Based on Paper 301, 302, 303) 50 MARKS

B.Sc. (STATISTICS)

FIRST YEAR DETAILED SYLLBUS

PAPER – 101

Probability

UNIT – I

Random experiment, trial, sample point and sample space, events, operations of events, concepts of equally likely, mutually exclusive and exhaustive events.

Definition of probability: Classical, relative frequency and axiomatic approaches. Discrete probability space, properties of probability under set theoretic approach. Independence of events, Conditional probability, total and compound probability theorems, Bayes theorem and its applications.

UNIT – II

Random variables – discrete and continuous, probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, marginal and conditional distributions. Independence of random variables.

UNIT – III

Expectation of a random variable (rv) and its properties., expectation of sum of random variables and product of independent random variables, conditional expectation and related problems.

UNIT – IV

Moments, moment generating function (m.g.f.) & their properties, continuity theorem for m.g.f. (without proof).Chebyshev's inequality. Weak law of large numbers for a sequence of independently and identically distributed random variables and their applications. (Statement Only)

REFERENCE:

1. Parzen, E.S. : Modern Probability Theory and its Applications.
2. Meyer, P. : Introductory Probability and Statistical Applications.
3. Stirzeker David (1994) : Elementry Probabilityu, Cambridge University Press.
4. Mood A.M., Graybill F.A. and Boes D.C. (1974) : Introduction to the theory of Statistics, McGraw Hill.
5. Mukhopadhyay, P : Mathmatical Statistics, new central book agency.

B.Sc. (STATISTICS)

FIRST YEAR DETAILED SYALLBUS

PAPER – 102

Probability distributions and Numerical Analysis

UNIT – I

Discrete Probability Distribution: Binomial distribution, Poisson distribution (as limiting case of Binomial distribution), Hypergeometric, Geometric and Negative Binomial, Uniform and Multinomial distributions, fitting of Binomial, Poisson and Uniform distributions.

UNIT – II

Continuous Probability Distributions: Normal distribution and its properties, Standard Normal variate, Exponential, Gamma, Beta distributions. Cauchy, Laplace, Pareto, Weibull, Log normal distributions. Normal distributions as limiting case of Binomial distribution, fitting of Normal distribution.

UNIT – III

Calculus of finite differences, operators, separation of symbols, examples and problems. Interpolation formulas with remainder term. Newton's forward and backward formulae. Central difference formulae, Newton's divided difference formulae for interpolation. Lagrange's interpolation formulae.

UNIT – IV

Numerical Integration: Derivation of general quadrature formula for equidistant ordinates. Derivation of trapezoidal, Simpson's $1/3^{\text{rd}}$ and $3/8^{\text{th}}$ rules. Weddle's rule. Numerical differentiation using Newton's forward and backward formulae.

REFERENCES

1. Parzen, E.S. : Modern Probability Theory and Its Applications.
2. Meyer, P.: Introductory Probability and Statistical Applications.
3. Freeman : Finite Differences.
4. Scarborough: Numerical Analysis.
5. S.S. Sastry : Introductory Methods of Numerical Analysis; Prentice Hall of India Pvt. Limited.
6. Jain, M.K., Iyengar, SRK and Jain R.K.: Numerical Methods For Scientific And Engineering Computations; NEW AGE International (P) Limited.
7. Saxena, H.C : Calculus of Finite Differences (S. Chand & Co.).

B.Sc. (STATISTICS)

FIRST YEAR DETAILED SYLLBUS

PAPER – 103

Statistical Methods

UNIT-I

Concept of statistical population, Attributes and variables (discrete and Continuous). Different types of scales – nominal, ordinal, ratio and interval. Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency. Secondary data. scrutiny of data for internal consistency and detection of errors of recording. Presentation of data : classification, tabulation, diagrammatic & graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representations, histogram, frequency polygon and ogives. Stem and Leaf plot. Box Plot.

UNIT-II

Measure of central tendency and dispersion, merits and demerits of these measures. Moments and factorial moments. Shephard's correction for moments. Skewness and Kurtosis and their Measures. Measures based on quartiles.

UNIT-III

Bivariate data, Principles of least squares, most plausible values, scatter diagrams, meaning of curve fitting, fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares.

Bi-Variate frequency table, correlation, types of relationships, scatter diagram Karl-Person's correlation coefficient and its properties.

UNIT-IV

Rank correlation, rank correlation – coefficient (Spearman and Kendall Measures), Regression analysis through both types of regression equations for X and Y variables. Regression coefficients and their properties relationship between correlation coefficients and regression coefficients.

Multiple and partial correlations and Multiple Regression for three variables only.

REFERENCES:

1. Goon, Gupta & Dasgupta: Fundamentals of statistics. Vol. I. The world press Private Ltd., Calcutta.
2. Yule, G.U. and Kendall, M.G.: An Introduction to the theory of statistics. Charles Griffin & Company Ltd.
3. C. E. Weatherburn: Mathematical Statistics.

B.Sc. (STATISTICS)

FIRST YEAR DETAILED SYLLBUS

PAPER – 104

PRACTICAL

The practical examination will be based on papers I, II & III and will cover the following experiments.

List of Practical Experiments

1. Graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives. Stem and Leaf Plot, Box Plot.
2. Calculation of measures of location.
3. Calculation of measures of dispersion.
4. Calculation of moments, measures of skewness and measures of Kurtosis.
5. Fitting of curves by method of least squares.
6. Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.
7. Calculation of multiple and partial correlation coefficients for three variables
8. Construction of forward difference tables and divided difference tables.
9. Interpolation by Newton's forward difference formula for equal intervals and calculation of error.
10. Interpolation by Newton's divided difference formula for unequal intervals.
11. Interpolation by Lagrange's formula for unequal intervals.
12. Approximate integration (Trapezoidal rule, Simpson's one-third rules, Simpson's three-eighth rule), Weddle's rule.

B.Sc. (STATISTICS)

SECOND YEAR DETAILED SYALLBUS

PAPER – 201

Statistical Inference

UNIT – I

Sampling Distributions: The concept of sampling distribution, parameters, statistics and standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution, central limit theorem, sampling distribution of $Z = [X - E(X)] / \text{standard deviation of } X$. Sampling distribution of t, f, and chi-square without derivations. Simple properties of these distributions and their interrelationship.

UNIT – II

Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Method of maximum likelihood and properties of maximum likelihood estimators (without proof). Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters. Problems and examples. Interval estimation.

UNIT – III

Statistical Hypothesis (simple and composite). Testing of hypothesis. Types –I and Types – II errors, significance level, p-values, power of a test. Definitions of most powerful (MP), Uniformly most Powerful (UMP) and Uniformly Most Powerfull Unbiased (UMPU) tests.

UNIT-IV

Test of significance : Large sample test for (Attributes and Variables) properties and means (i) single (ii) two independent samples (iii) correlation coefficient in case of (a) $p=p_0$ (b) $p_1=p_2$ small sample test based on t,f, and chi-square distributions.

REFERENCE

1. Hogg & Craig : Mathematical Statistics.
2. Mood, Graybill and Boes : Introduction to the theory of Statistics.
3. Goon, Gupta and Dasgupta : Fundamentals of Statistics Vol.1 & II
4. Ferund J.E (2001) : Mathmatical Statistics, Prentice Hall of India.

B.Sc. (STATISTICS)

SECOND YEAR DETAILED SYALLBUS

PAPER – 202

Survey Sampling

UNIT – I

Sampling vs. complete enumeration : sampling units and frame. Precision and efficiency of estimators. Simple Random sampling with and without replacement. Use of random number tables in selection of simple random sample. Estimation of population mean and proportion. Derivation of expression for variance of these estimators. Estimation of variances. Sample size determination.

UNIT-II

Stratified random sampling. Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard errors of the usual estimators when these allocations are used. Gain in precision due to stratification. Role of sampling cost in the sample allocation. Minimization of variance for fixed cost.

UNIT-III

Systematic Sampling: Estimation of populations mean and population total, standard errors of these estimators. Two stage sampling with equal first stage units: estimator of population mean and its variance. Non – sampling errors.

UNIT-IV

Regression and ratio methods of estimation in simple random sampling. Cluster sampling with equal clusters. Estimators of population mean and their mean square errors.

REFERENCES

1. Cochran, W.G.: Sampling Techniques
2. Sukhatme, Sukhatme, Sukhatme & Asok: Sampling Theory of Surveys with applications.
3. Murthy, M. N.: Sampling theory.

B.Sc. (STATISTICS)

SECOND YEAR DETAILED SYALLBUS

PAPER – 203

Analysis of Variance and Design of Experiment

UNIT-I

Analysis of Variance, One way classification, Assumptions regarding model. Two way classification with equal number of observations per cell. Duncan's multiple comparison tests.

UNIT-II

Principles of Design of experiments: Randomization, Replication and local control. Choice of size and type of a plot using uniformity trials. CRD, Randomized block design. Concept and definition of efficiency of design. Comparison of efficiency between CRD and RBD.

UNIT – III

Latin square Design, Lay-out, ANOVA table. Comparison of efficiencies between LSD and RBD; LSD and CRD. Missing plot technique: estimation of missing plots by minimizing error sum of squares in RBD and LSD with one or two missing observations.

UNIT-IV

Factorial Experiments : general description of factorial experiments; 2^2 , 2^3 and 2^n factorial experiments arranged in RBD and LSD. Definition of main effects and interactions in 2^2 and 2^3 factorial experiments. Preparation of ANOVA by Yates procedure. Estimates and tests for main and interaction effects (Analysis without confounding).

REFERENCES

1. Cochran and Cox : Experimental Design
2. Kempthorne : Design of Experiments
3. Federer : Experimental Designs
4. Goon, Gupta and Dasgupta : Fundamentals of Statistics, Vol. II
5. Das & Giri : Design and Analysis of Experiments (Wiley Eastern).

B.Sc. (STATISTICS)

SECOND YEAR DETAILED SYLLBUS

PAPER – 204

Practical

The practical examination will be based on papers I, II and III and will cover the following experiments:

List of Practical Experiments

1. Fitting of 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. t – test for (i) $\mu = \mu_0$ (ii) $\mu_1 = \mu_2$ (iii) $\alpha = \alpha_0$ (iv) $\beta = \beta_0$ (v) $\rho = 0$
4. F-test for $\sigma_1^2 = \sigma_2^2$
5. Fisher's Z-transformation and its use in testing (i) $\rho_1 = \rho_2$ (ii) $\rho = \rho_0$
6. Calculation of power curve for the test of $\mu = \mu_0$ against $\mu \neq \mu_0$ for a normal distribution with known variance.
7. Large sample tests.
8. Analysis of variance in one-way and two-way classification (with and without interaction terms).
9. Analysis of a Latin square design.
10. Analysis of variance in RBD and LS design with one or two missing observations.
11. Drawing a simple random sample with the help of table of random numbers.
12. Estimation of population means and variance in simple random sampling.

13. Stratified random sampling for population means (proportional and optimum allocation).
14. Ratio and regression estimation of population mean and total.
15. Factorial Experiment Practical.

B.Sc. (STATISTICS)

THIRD YEAR DETAILED SYALLBUS

PAPER – 301

Non-parametric Methods and Regression Analysis

UNIT – I

Multivariate normal distributions, marginal and conditional distribution, Moment Generating and Characteristics functions, Maximum likelihood estimation of mean vector and co-variance matrix, independence and joint sufficiency of these estimates. Distribution of linear combination of components of multi normal variate.

UNIT – II

Order Statistics. Distributions of minimum, r^{th} and maximum order statistic. Joint distribution of r^{th} and s^{th} order statistics (in continuous case) Distribution of sample range & sample median, for uniform and exponential distributions.

UNIT – III

Non-parametric tests – 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.

UNIT – IV

Attributes – Notion and terminology, contingency table, class frequencies and ultimate class frequencies, consistency. Association of attributes, independence, measures of association for 2X2 table. Chi-square, Karl Pearson's and Tschuprow's coefficient of association.

REFERENCE :

1. Mood, A.M., Graybill F and Boes D.C. : Introduction to the theory of Statistics.
2. Gibbons, J.D. : Non-parametric statistical inference
3. Conover, W.J. : Practical Non-parametric Statistics
4. David, H.A. : Order Statistics
5. Johnston : Econometric Methods
6. Anderson : Introduction to Multivariate Statistical Analysis, Chaps 1,2 & 3

B.Sc. (STATISTICS)

THIRD YEAR DETAILED SYALLBUS

PAPER – 302

Applied Statistics

UNIT – I

Introduction & definition of time series, its different components, illustrations, additive and multiplicative models, determinations of trend, free hand curve, semi average methods, moving averages, methods of least squares, analysis of seasonal ratio to trend, link relative methods.

UNIT – II

Index number – its definition, application of index number, price relative and quantity or volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre's, Paasche's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index.

UNIT – III

Demographic methods: Sources of demographic data – census, register, ad-hoc survey, hospital records, demographic profiles of Indian Censuses. Measurement of mortality, crude death rates, age specific death rates, infant mortality rates, death rate by cause. Measurement of fertility – crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate, standardized death rates, age pyramid of sex composition, other measures of fertility. Logistic curve fitting and its use in population projection. Complete life table, its main features and construction.

UNIT – IV

Introduction, Process control, tool of statistical quality control + 3 control limits, principle underlying the construction of control charts, control charts for variables, X and R charts, construction and interpretation, control charts for attributes p and c charts construction and interpretation, application of c charts.

REFERENCE :

1. Montgomery D.C. (1985) : Introduction to Statistical Quality Control (Wiley).
2. Draper & Smith : Applied Regression Analysis
3. Burr: Industrial Quality Control.
4. Wetherill and Brown : Statistical Quality Control
5. Croxton F.E. and Cowden D.J. : Applied General Statistics
6. Goon, Gupta and Dasgupta : Fundamentals of Statistics, Vol. I & II Siya Ram:
Applied Statistics.

B.Sc. (STATISTICS)

THIRD YEAR DETAILED SYALLBUS

PAPER – 303

Operations Research

UNIT – I

History and background of OR, General linear programming problems and their formulations. Method for solving LPP : Graphical Method, Simplex method, Big – M method, Two phase Method, Degeneracy and Duality in LPP.

UNIT – II

Transportation problem: North-west corner rule, Least cost method, Vogel's approximation method. Optimum solution: Stepping stone method, Method of Multipliers. Assignment Problem: Hungarian Algorithm.

UNIT – III

Replacement problems (individual and group). Job sequencing : n jobs – 2 machines, n jobs – k machines, 2 jobs – n machines, Dynamic Programming.

UNIT – IV

Introduction to Computer: Generation of Computer, Basic Structure of Computer, Digital computer and its peripherals, number systems (Binary, Octal, Hexadecimal Systems). Flow chart for sample statistical problems, Programming in C: Introduction, historical development of C, character set, Constants, Variables and Key words.

REFERENCES :

1. Swarup Kanti, Gupta P.K. and Man Mohan : Operations Research, Sultan Chand & Sons.
2. Taha, H.A. : Operations Research, Mac Millan publishing.
3. Sinha P.K. Fundamentals of Computer, BPB Publications.

B.Sc. (STATISTICS)
THIRD YEAR DETAILED SYALLBUS

PAPER – 304

PRACTICAL

Based on Paper - 301, Paper - 302 and Paper - 303.