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

<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Course Title</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>Non-parametric Methods and Regression Analysis</td>
<td>50</td>
</tr>
<tr>
<td>302</td>
<td>Applied Statistics</td>
<td>50</td>
</tr>
<tr>
<td>303</td>
<td>Operations Research</td>
<td>50</td>
</tr>
<tr>
<td>304</td>
<td>Practical (Based on Paper 301, 302, 303)</td>
<td>50</td>
</tr>
</tbody>
</table>
B.Sc. (STATISTICS)
FIRST YEAR DETAILED SYLLABUS

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:

B.Sc. (STATISTICS)
FIRST YEAR DETAILED SYLLABUS

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

UNIT – III

UNIT – IV
REFERENCES


3. Freeman : Finite Differences.


7. Saxena, H.C : Calculus of Finite Differences (S. Chand & Co.).
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

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:

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.
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 $Z = \frac{X - E(X)}{\text{standard deviation of } X}$. Sampling distribution of $t$, $f$, and chi-square without derivations. Simple properties of these distributions and their interrelationship.

UNIT – II


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

B.Sc. (STATISTICS)
SECOND YEAR DETAILED SYLLABUS

PAPER – 202

Survey Sampling

UNIT – I

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

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
5. Das & Giri : Design and Analysis of Experiments (Wiley Eastern).
B.Sc. (STATISTICS)
SECOND YEAR DETAILED SYLLABUS

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 x 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).
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.
13. Stratified random sampling for population means (proportional and optimum allocation).


15. Factorial Experiment Practical.
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, \( r^{\text{th}} \) and maximum order statistic. Joint distribution of \( r^{\text{th}} \) and \( s^{\text{th}} \) order statistics (in continuous case) Distribution of sample range & sample median, for uniform and exponential distributions.

UNIT – III

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, KarlPearson’s and Tschuprow’s coefficient of association.

REFERENCE:

2. Gibbons, J.D. : Non-parametric statistical inference
5. Johnston : Econometric Methods
6. Anderson : Introduction to Multivariate Statistical Analysis, Chaps 1,2 & 3
B.Sc. (STATISTICS)
THIRD YEAR DETAILED SYLLABUS

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 sessional 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

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 :**


2. Draper & Smith : Applied Regression Analysis


4. Wetherill and Brown : Statistical Quality Control


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


UNIT – III


UNIT – IV

REFERENCES:

B.Sc. (STATISTICS)
THIRD YEAR DETAILED SYLLABUS

PAPER – 304

PRACTICAL