



**S. S. Jain Subodh P.G. College (Autonomous)
Jaipur**

DEPARTMENT OF STATISTICS

(Syllabus as per NEP-2020 and Choice Based Credit System)

Three-Year Undergraduate Programme in Arts/Science

**I & II Semester Examination 2023-24
III & IV Semester Examination 2024-25
V & VI Semester Examination 2025-26**

Medium of Instruction: Hindi/English

w.e.f. Academic Session 2023-24

CBCS Scheme for Bachelor of Science (B.Sc.) Pass Course

Semester	Subject1/Discipline1 (DSC/DSE) (credits)	Subject2 / Discipline 2 (DSC/DSE) (credits)	Subject3/ Discipline3 (DSC/DSE) (credits)	Generic/Elective (GE) (credits)	Ability Enhancement Course (ABCC) (credits)	Skill Enhancement Course (SEC) (credits)	Internship/ Apprenticeship/Project/Community outreach (4)	Value addition course (VAC) (credits)	Total Credits										
I	DSC-1 (2)	DSC - 3(2)	DSC - 5 (2)		English (2)			Choose one from a pool of courses (0)	20 credits										
	DSC-2 (2)	DSC - 4(2)	DSC - 6 (2)																
	DSCP (2)	DSCP (2)	DSCP (2)																
	DSC-7 (2)	DSC - 9(2)	DSC - 11(2)																
II	DSC-8 (2)	DSC - 10(2)	DSC - 12(2)		Hindi (2)			Choose one from a pool of courses (0)	20 credits										
	DSCP (2)	DSCP (2)	DSCP (2)																
Students on exit shall be awarded Undergraduate Certificate in Science after securing the requisite 40 credits in Semesters I and II																			
III	DSC-13 (2)	DSC - 15 (2)	DSC - 17(2)	Choose one from pool of courses, GE -1 (2)**		Computer Science (2)		Choose one from a pool of courses (0)	22 credits										
	DSC-14 (2)	DSC - 16(2)	DSC - 18 (2)																
	DSCP (2)	DSCP (2)	DSCP (2)																
	DSC-19 (2)	DSC - 21 (2)	DSC - 23(2)																
IV	DSC-20 (2)	DSC - 22 (2)	DSC - 24 (2)	Choose one from pool of courses GE - 2 (2)**		Env. Sc. and Sustainable Dev. (2)		Choose one from a pool of courses (0)	22 credits										
	DSCP (2)	DSCP (2)	DSCP (2)																
Students on exit shall be awarded Undergraduate Diploma in Science after securing the requisite 84 credits on completion of Semester IV																			
V	Choose two from pool of courses, DSE - 1 (2) DSE - 2 (2) DSEP (2)	Choose two from pool of courses, DSE - 3 (2) DSE - 4 (2) DSEP (2)	Choose two from pool of courses, DSE - 5 (2) DSE - 6 (2) DSEP (2)			Mental ability & reasoning (2)		Choose one from a pool of courses (0)	20 credits										
										Choose two from pool of courses, DSE - 7 (2) DSE - 8 (2) DSEP (2)	Choose two from pool of courses, DSE - 9 (2) DSE - 10 (2) DSEP (2)	Choose two from pool of courses, DSE - 11 (2) DSE - 12 (2) DSEP (2)							
VI	Choose two from pool of courses, DSE - 7 (2) DSE - 8 (2) DSEP (2)	Choose two from pool of courses, DSE - 9 (2) DSE - 10 (2) DSEP (2)	Choose two from pool of courses, DSE - 11 (2) DSE - 12 (2) DSEP (2)			Anandam - Joy of giving (2) or NCC/NSS/Rovers and Rangers/ Red Ribbon Club/ Sports/ Extra-curricular and co-curricular activities (2)		Choose one from a pool of courses (0)	20 credits										
										Students on exit shall be awarded Bachelor of Science (3 years) after securing the requisite 124 credits on completion of Semester VI									
										** Students may select Generic elective paper in Semester III and IV from the pool of courses given. The GE paper must be from the other faculty or discipline.									
										*Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing/exploring a real-life situation / difficult problem. A Project/Dissertation work would be of 2 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.									

Abbreviations Used

Course Category

DSC: Discipline Specific Core

DSCP: Discipline Specific Core Practical

DSE: Discipline Specific Elective

DSEP: Discipline Specific Elective Practical

GE : General Elective

AEC: Ability Enhancement Course

AECC: Ability Enhancement Compulsory Course

SEC: Skill Enhancement Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

Contact Hours

L: Lecture

T: Tutorial

P: Practical or Other

S: Self Study

The medium of instruction and examination shall be Hindi/English.

Department of Statistics

B.A./B.Sc. (Pass Course) Semester I-VI (2023-2026)
Credit Template : CBCS

S.No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per Week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
Semester- I									
1	STAT101	Probability Theory	DSC	2	2	-	-	3	-
2	STAT102	Descriptive Statistics	DSC	2	2	-	-	3	-
3	STAT103	Practical Paper-I	DSCP	2	-	-	4	-	4
Semester- II									
4	STAT201	Statistical Analysis of Bivariate Data	DSC	2	2	-	-	3	-
5	STAT202	Univariate Distribution	DSC	2	2	-	-	3	-
6	STAT203	Practical Paper-II	DSCP	2	-	-	4	-	4
Semester-III									
7	STAT301	Applied Statistics-(I)	DSC	2	2	-	-	3	-
8	STAT302	Applied Statistics-(II)	DSC	2	2	-	-	3	-
9	STAT303	Practical Paper-III	DSC	2	-	-	4	-	4
Semester-IV									
10	STAT401	Statistical Inference	DSC	2	2	-	-	3	-
11	STAT402	Sampling Distribution	DSC	2	2	-	-	3	-
12	STAT403	Practical Paper-IV	DSCP	2	-	-	4	-	4
Semester-V(Any 2 Theory Paper)									
13	STAT501	Sample Survey-(I)	DSE-1	2	2	-	-	3	-
14	STAT502	Design of Experiment-(I)	DSE-2	2	2	-	-	3	-
15	STAT503	Econometrics	DSE-3	2	-	-	-	3	-
16	STAT504	Practical Paper-V	DSCP	2	-	-	4	-	4
Semester-VI(Any 2 Theory Paper)									
17	STAT601	Sample Survey-(II)	DSE-1	2	2	-	-	3	-
18	STAT602	Design of Experiment – (II)	DSE-2	2	2	-	-	3	-
19	STAT603	Project	DSE-3	2	2	-	-	3	-
20	STAT604	Practical Paper-VI	DSCP	2	-	-	4	-	4

Program outcomes

1. To imbibe a strong foundation of statistics in students.
2. To familiarize students with basic to high-level statistical concepts.
3. To update students with mathematical tools that aid in statistical theory.
4. To promote application-oriented pedagogy by exposing students to real world data.
5. To make students do projects, which prepare them for jobs/markets.

Programme Specific outcome

- This course exposes the students to the beautiful world of Statistics and how it affects each and every aspect of our daily life.
- The course is designed to equip students with all the major concepts of Statistics along with the tools required to implement them.
- Introduction to computer software helps them in the analysis of data by making optimum usage of time and resources. This software give them the necessary support and an edge when progressing to their professional careers.
- Exposure to the plethora of real-life data helps in honing their analytical skills.
- Having a practical component with every paper invokes their exploratory side and the interpretation abilities. Such a pedagogy goes a long way in giving them the required impetus and confidence fine-tunes for consultancy startups/jobs in near future.
- The structure of the course also motivates/helps the students to pursue careers in related disciplines, especially the data sciences, financial statistics and actuarial sciences.

Scheme of Examination for Science & Arts

For Theory Paper: -

- The ESE will be of 3 hours duration for each theory Paper.
- There will be two parts of the end-semester theory paper.

Part A- Question 1 is compulsory and comprises ten very short answer questions.

Candidate has to attempt any seven questions. Each question carry 1 marks.

$7 \times 1 = 7$ Marks.

Part B- The paper will consist of four questions with internal choice. Each question will carry 7 marks.

$7 \times 4 = 28$ Marks.

Total of End Semester Exam- 35

Internal Assessment – 15

Maximum Marks – 50

Minimum Marks – 20

For Practical Paper: -

- The ESE will be of 4 hours duration for each Practical Paper.

Total of End Semester Exam- 30

Internal Assessment – 20

Maximum Marks – 50

Minimum Marks – 20

Written Paper - 15 Marks

Class performance & Viva-Voce - 6 (3 + 3)

Record work and Viva-Voce - 9 (5 + 4)

Note: - Hardcopy of practical file has to be maintained by the students for each practical paper and submitted at the time of End Semester Exam.

Department of Statistics

Semester I

Paper-STAT101: Probability Theory

Credit : 02(2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To understand the concepts of probability and its applications.
- To understand the concept of random variables, expectation and generating function.

Course Learning Outcomes:

- After completing this course, students should have developed a clear understanding of:
- Probability theory and its applications.
- The fundamental concepts of Mathematical Statistics.
- Basic concept of random variable and its types.
- Properties of random variables like expectation, moment generating function, cumulative generating function etc.
- Marginal and conditional probability distributions.

Unit I

Important concept of probability theory: Random experiment: Trial, Events and their types. Definitions of probability. Sample point and sample space. Axiomatic approach of probability. Special cases with mathematical probability and statistical probability. Addition and Multiplication theorems of probability. Conditional probability. Bayes theorems and its application (Simple problems only).

Unit II

Random Variable: Definition with illustrations, Types of Random Variable. Probability Mass Function. Probability Density Function. Definition and its properties. Joint Probability Distribution, Marginal and Conditional Probability Distribution and density functions (Continuous and Discrete Cases).

Unit III

Mathematical Expectation: Expectation of a random Variable and its simple properties. Addition and Multiplication Theorems of Expectation. Definition of Variance and Covariance and properties. Raw and Central Moments. Chebychev's inequality and its application.

Unit IV

Generating Function: Moments and cumulants, Moment generating function, Cumulants generating function Characteristic function with properties and numerical. Inversion Theorem (Statement only).

Department of Statistics

Semester I

Paper-STAT102: Descriptive Statistics

Credit : 02(2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- Introduction to Statistics.
- To summarize the data and to obtain its salient features from the vast mass of original data.
- Graphical representation of data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- The fundamental concepts of statistical population and sample.
- Handling various types of data and their graphical representation.
- Measures of location and dispersion.

Unit I

Statistical Methods & Types of Data: Definition and scope of Statistics, merits and demerits of statistics, Concepts of a statistical population and sample. Nature of data. Categories of data Primary Data and Secondary Data. Method of collection of data. Classification of data: Qualitative and Quantitative data, Geographical & Chronological Data.

Unit II

Presentation of Data: Diagrammatic Presentation of Data, Tabular presentation of data, Construction of tables, Types of tables. Frequency distribution- Discrete, grouped, continuous and cumulative. Graphical presentation of data- Histogram, frequency polygon, frequency curve and ogives.

Unit III

Statistical analysis of Quantitative Data: Different types of scales- nominal, ordinal, intervals and ratio. Univariate Data- Measures of central tendency (Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean)

Unit IV

Measures of Dispersion: Definition and Properties of a Good Measure of Dispersion, Range, Quartile Deviation, Mean Deviation. Standard Deviation, Partition values, Coefficient of Variation. Moments: Definition and relationship, Absolute and relative measure of Skewness and Kurtosis based on quantiles and moments. Sheppard's Correction for moments (without proof) , Box-plot and its interpretation.

Department of Statistics

Semester I

Practical Paper- STAT 103

Credit: 02(4 hours/week)

Maximum Marks = 50

Course Objective:-

This paper is designed to acquaint the students with the fundamental statistical techniques, to understand the role of statistics in analyzing and interpreting data meaningfully, and to develop problem-solving skills in probability.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of the skill to select appropriate methods to present data and gain the skills to calculate probabilities for various types of events.

Syllabus:

1. Problems related to Probability, Conditional Probability and Bayes Theorem.
2. Problems of Mathematical Expectation.
3. Problems based on Marginal and Conditional Probability Distribution.
4. Construction of frequency distribution table.
5. Construction of Relative frequency table.
6. Construction of less than and more than cumulative frequency distribution.
7. Practical based on Diagrammatic Presentation of data: (i) One-dimensional Diagrams (ii) Two-dimensional (iii) Three-dimensional (iv) Pictograms (v) Cartograms
8. Graphical representation by (i) Histogram (equal class intervals and unequal class intervals) (ii) Frequency curve (iii) Frequency Polygon (iv) Ogives
9. Measure of central tendency: Mean, Median and Mode (for unorganised and organised data).
10. Missing value problems based on Mean, Median, and mode.
11. Measure of dispersion: (i) Mean deviation (ii) Quartile deviation (iii) Standard deviation (iv) coefficient of variation.
12. Problems based on comparison of two data sets.
13. Computation of mean and variance of combined series.
14. Computation of various measures of skewness and kurtosis based on moment.
15. Computation of Moments (Raw and Central).
16. Computation of Sheppard's Correction for moments.

Reference:

- Kapoor V.K. & Gupta S.C(2020): Fundamental of Mathematical Statistics, Sultan Chand and Sons, New Delhi
- Goon A.N., Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol.I & II, World Press, Calcutta.
- Gupta S. P.: Statistical Methods, Sultan Chand and Sons, N. Delhi.
- Elhance D.N.: Fundamental of Statistics
- Bhatt B.R. Srivenkatramanna T and Rao Mashaya K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (p) Ltd., New Delhi.
- Croxton F.E., Crowden D.J. and Kellin S (1973): Applied General Statistics, Prentice Hall of India, New Delhi.

Department of Statistics

Semester II

Paper- STAT 201: Statistical Analysis of Bivariate Data

Credit : 02(2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To know about official statistical system in India and functions of different agencies.
- To understand the nature of data with the help of various statistical tools.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- To know about official statistical system in India and functions of different agencies.
- Statistical Organisation in India
- Bivariate data. Significance of various coefficients of correlation.
- Fitting of linear and nonlinear curve.
- Theory of Attributes.

Unit I

Statistical Organisation in India: Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry, agriculture and finance.

Unit II

Theory of Attributes: Class frequency, order of a class frequency, ultimate class frequency, consistency of data, independence, association of attributes and their interrelationship, Measures of association.

Unit III

Correlation: Correlation, Scatter diagram, Karl-Pearson's coefficient of correlation and its properties, Spearman's Rank correlation coefficient. Correlation Coefficient for a bivariate frequency distribution.

Unit IV

Curve fitting and Regression: Principle of least square, fitting of straight line, Parabola and curves reducible to straight line (exponential and power curve). Regression analysis -Fitting of regression lines, regression coefficients and their properties.

Department of Statistics

Semester II

Paper- STAT 202: Univariate Distribution

Credit : 02(2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To familiar with basic concepts of Mathematical Statistics.
- To understand the nature of data with the help of various statistical tools.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of - Various discrete and continuous probability distributions like Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Normal, Uniform, Exponential, Cauchy, Beta and Gamma distributions.

Unit I

Discrete Distributions: Bernoulli distribution.-Mean, Variance and Moments. Mean, Variance, Moments, Cumulants, Mode, Moment generating function, Characteristic function, Additive property, Probability generating function, Recurrence relation for the Moments and Probabilities for Binomial and Poisson Distribution. Recurrence relation for cumulants of Binomial Distribution.

Unit II

Discrete Distributions: Geometric Distribution: Mean, Variance, Moments, Moment generating function and Lack of memory. Hyper-geometric and Negative Binomial Distribution and their properties.

Unit III

Continuous Distributions: Normal and Rectangular Distribution: Mean, Mode, Median, Moments, Moment Generating Function, Cumulant Generating Function, Mean deviation., Additive property. Introduction to standard normal distribution.

Unit IV

Continuous Distribution: Exponential, Cauchy, Beta first and second kind and Gamma Distribution with their properties: Mean, Variance, Moments, Moment generating function .

Department of Statistics

Semester II

Practical Paper- STAT 203

Credit: 02 (4 hours/week)

Maximum Marks = 50

Course Objectives:

This paper aims to familiarize the students with the handling of bivariate data and various probability distributions which are useful in day to day life.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of analyzing the behavior of the data by fitting discrete and continuous distributions. Students are able to measure simple correlation, regression and Attributes.

Syllabus:

1. Computation of Karl Pearson's Coefficient of Correlation and its interpretation.
2. Computation of Spearman's Rank Correlation Coefficient and its interpretation.
3. Computation of Correlation Coefficient for a Bivariate Frequency Distribution.
4. Computation of various order class frequencies (Order I and II).
5. Problems of Independence of Attributes and its interpretation.
6. Problems of Yule's Coefficient of Association and Coefficient of Colligation.
7. Fitting of Regression lines.
8. Computation of Regression lines for a Bivariate Frequency Distribution.
9. Fitting of a straight line.
10. Fitting of a parabola.
11. Fitting of a Power Curve.
12. Fitting of an Exponential Curve.
13. Fitting of Binomial.
14. Fitting of Poisson Distribution.
15. Fitting of Normal Distribution.

Reference:

- Kapoor V.K. & Gupta S.C.: Fundamental of Mathematical Statistics, Sultan Chand and Sons, New Delhi
- Kapoor V.K. & Gupta S.C (2020):. Fundamental of Applied Statistics, Sultan Chand and Sons, New Delhi
- Goon A.N., Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Val. I & II, World Press, Calcutta.
- Croxton F.E. Cowden D.J. (1969): Applied General Statistics, Prentice Hall of India.
- Rohatgi V.K. (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons.
- Kapoor V.K. & Gupta S.C.: Fundamental of Mathematical Statistics, Sultan Chand and Sons, New Delhi

Department of Statistics

Semester III

Paper-STAT301: Applied Statistics (I)

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- Understand the concept of time series, its components and their estimation.
- Application of time series.
- Demand Function.
- Price and income elasticity of demand.
- To learn techniques and approach of SQC.

Course Learning Outcomes:

After completing this course, students will possess the ability to appreciate, formulate solutions, analyze use of time series, Demand Analysis to real world problems and understanding of Statistical Quality Control by Control charts for variables and attributes.

Unit I

Time Series Analysis: Definition and its different components, illustrations, additive and multiplicative models. Different Methods for determination of trend. Idea of seasonal and cyclic variation along with their merits and demerits.

Unit II

Demand Analysis: Demand function, price and income elasticity of demand, Partial and cross Elasticity of demand, nature of commodities, laws of supply and demand. Pareto – curves of concentration.

Unit III

Statistical Quality Control: Concept of SQC, Process control and product control, Causes of variation in quality, Shewhartz Control Charts technique of rational sub groups, Control limits, Specification limits, tolerance limits, Summary of out-of-control criteria. Construction of Mean, Range and Standard Deviation charts.

Unit IV

Control Charts for variables: Concept of defects and defectives. Control charts for attributes: Construction of np-chart, p- chart, c-chart.

Department of Statistics

Semester III

Paper-STAT302: Applied Statistics (II)

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To collect valid Demographic data using different methods.
- To learn basic measures of Mortality, Fertility and Population Growth.
- To construct life tables
- To Understand the concept, formulation and application of index numbers.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Distinction between Vital Statistics and Demography.
- Sources of data collection on Vital Statistics and errors therein.
- Measurement of Population.
- Basic measures of Mortality.
- Concepts of Stable and Stationary Populations.
- Concept of Life Tables, their construction and uses.
- Basic measures of Fertility.
- Measures of Population Growth.
- Index numbers: Definition, Applications uses.
- Construction of Index numbers

Unit I

Demographic Method: Sources of demographic data census, register, ad-hoc survey, hospital records. Measurement of mortality: Crude death rate, Specified death rates, Infant mortality rates, Standardized death rate. Measurement of Fertility: Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Total Fertility Rate.

Unit II

Life Table: Meaning of life table, Relation between different columns of life table, uses of life table and its limitations. Complete life table: Construction and its main features, Measurement of Population Growth: Gross Reproduction Rate, Net Reproduction Rate.

Unit III

Index Numbers: Definition, Meaning and uses of Index Numbers, problem in the construction of index numbers, price relatives, quantity and value relatives. Fixed base and chain base index numbers, use of averages.

Unit IV

Tests and Methods of constructing Index Numbers: Weighted and unweighted index numbers- Laspeyers, Paasche's, Marshall-Edgeworth and Fisher's ideal index numbers, Dorbish, Kelly's fixed base index numbers. Test for index numbers- Unit Test, Time reversal test, Factor test and Circular Test. Consumer Price Index numbers, Construction of cost of living index and Whole-sale price index.

Department of Statistics

Semester III

Practical Paper- STAT 303

Credit: 02 (4 hours/week)

Maximum Marks = 50

Course Objectives:

This paper is focused on the study of vital statistics, index numbers, demand analysis and time series. Vital Statistic deals with laws of human mortality, morbidity and fertility. Role of index number is in formulation of executive decisions. In time series analysis, we will study about different components and various methods useful in analyzing them.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of specialized averages under the domain of Index numbers, be aware of the concept of Time Series and are familiar with simple measures of trend and seasonal variation. Perform basic demographic analyses using various techniques and ensure their comparability across populations.

Syllabus:

1. Determination of trend by (i) Graphic Method (ii) Method of Semi-Averages (iii) Method of Curve fitting by Principal of Least Squares (iv) Method of Moving average.
2. Construction of X-bar, R Chart.
3. Construction of p, d and c-charts.
4. Computation of mortality.
5. Computation of fertility rates
6. Construction of life tables.
7. Construction of index numbers by Laspeyre's, Paasche's, Fisher's,
8. Computation of Chain Base Indices.
9. Computation of Consumer price index.
10. Computation of Test for index numbers.
11. Application of Factor Reversal test on various Index numbers.
12. Application of Time Reversal test on various Index numbers.
13. Problems based on conversion of Chain based Index Number to Fixed base Index Number and vice-versa.

Reference:

- Kapoor V.K. & Gupta S.C (2020).: Fundamental of Applied Statistics, Sultan Chand and Sons, New Delhi
- Goon A.N., Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Val. I & II, World Press, Calcutta.
- Croxton F.E. Cowden D.J. (1969): Applied General Statistics, Prentice Hall of India.
- Montgomery, D.C. (2001): Introduction to Statistical Quality Control, John Wiley and Sons, Third Edition.

Department of Statistics

Semester IV

Paper- STAT 401: Statistical Inference

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To understand the process of hypothesis testing and estimation theory.
- To analyze and interpret the data vis-à-vis statistical inference.
- To understand the Concept of small sample and large sample tests.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Basic concepts of hypothesis testing, including framing of null and alternative hypothesis.
- Developing/ constructing best/most powerful statistical tests to test hypotheses regarding unknown population parameters (Using Neyman-Pearson Lemma).
- Characteristics of a good estimator, different methods of estimation.
- Demonstrate use of these techniques in data analysis.

Unit I

Theory of Estimation: Point Estimation- problems for point estimation; Criterion of a good estimation (Unbiasedness, Consistency, Efficiency, Sufficiency). Minimum Variance Unbiased Estimation. Method of estimation: Methods of maximum likelihood estimation

Unit II

Interval Estimation: Definition of Confidence interval and confidence coefficient. Confidence interval for mean, variance, difference of means and ratio of variances for normal populations

Unit III

Testing of Hypothesis: Definition of random sample, parameter & statistic, simple, Composite null and Alternative hypothesis, types of error, level of significance, power of the test, critical region. BCR (Best critical region). Neyman Person's Lemma and its application. BCR in case of Binomial, Poisson and Normal Distribution.

Unit IV

Large Sample Test: Testing of single mean, Proportion, testing of difference of means and proportion. Non-Parametric Tests- Definition, Merits and Limitation. Sign test (for one sample and two sample cases) Run test, Median test.

Department of Statistics

Semester IV

Paper- STAT 402: Sampling Distribution

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To understand the concept of sampling distributions and their applications in statistics.
- To have a clear understanding of when to apply various tests of hypothesis about population parameters using sample statistics and draw appropriate conclusions from the analysis.
- To understand the nature of data with the help of various statistical tools.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Parameter, statistic, standard error, sampling distribution of a statistic.
- Sampling distributions of chi-square, t and F and their applications.

Unit I

Sampling distribution: Concept of statistic and its sampling distribution, sampling distribution of Binomial, Poisson, and mean of Normal Distribution.. Fisher's transformation and its uses.

Unit II

Chi-square Distribution: Definition, Derivation, Moments, Moment Generating Function, Cumulant Generating Function, Mode, Skewness. Limiting and Additive property of Chi-square variates. Distribution of ratio of chi-square variates. Applications of Chi-square: Chi-square test for testing normal population variance, Test for goodness of fit, Test for independence of attributes, Yates correction for 2x2 contingency table.

Unit III

t-Distribution: Definition, Mean, Variance of Student's-t and Fisher's-t statistics and derivation of their distributions. Limiting property of t-distribution. Applications: Testing of single mean, Difference of two means, paired t-test, test of sample correlation coefficient and their confidence interval.

Unit IV

F-distribution: Definition, Mean, Variance and mode of Snedecor's F-distribution and its derivation. Applications- Testing of equality of two variance. Relationship between 't', 'F' and chi-square statistics.

Department of Statistics

Semester IV

Practical Paper- STAT 403

Credit: 02 (4 hours/week)

Maximum Marks = 50

Course Objectives:

This paper is designed to familiarize the students with concept of statistical inference (which include estimation theory and Testing of Hypothesis) and Sampling distribution.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of the concept of 'Testing of Hypothesis' and in particular for 'Test of hypothesis for Large Samples' and Estimation Theory.

Syllabus:

1. Problems based on Non- parametric tests: Sign test, Run test, and Median test (for large samples)
2. Problems-based on test of significance:
 - (a) Chi-square test for population variance,
 - (b) Goodness of fit.
 - (c) Independence of Attributes.
 - (d) t-test for single mean
 - (e) t-test for difference of means (paired and unpaired cases)
 - (f) t-test for observed sample Correlation Coefficient.
 - (g) F-test for equality of population variances.
 - (h) Use of Z-transformation.
3. Test of significance for single mean in Large sample.
4. Test of significance for difference of mean in Large sample.
5. Test of significance for single proportions in Large sample.
6. Test of significance for difference of proportions in Large sample.

References:

- Kapoor V.K. & Gupta S.C.: Fundamental of Mathematical Statistics, Sultan Chand and Sons, New Delhi
- Croxton F. E. Cowden D.J. (1969); Applied General Statistics, Prentice Hall of India.
- Goon A.M. Gupta M.K. Das Gupta B. (1986) Fundamentals of Statistics, Vol. II, World Press Calcutta.
- Gupta S.C. & Kapoor V.K.: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Department of Statistics

Semester V

Paper- STAT 501: Sample Survey (I)

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To learn about sample surveys, its need and objectives.
- To learn to draw appropriate sample and interpret the result.
- To analyze and interpret the data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- The fundamental concepts of population and sample. (or the basic concepts of survey)
- The principles of sample survey and the steps involved in selecting a sample.
- Simple random sampling.
- Stratified random sampling.
- Systematic sampling.

Unit I

Concepts of population: Definition of population, sample, parameter, estimate, estimator and statistic, need for sampling over complete enumerations, Principles steps in a sample survey, Principles of sample survey, sampling and non-sampling error. Methods of drawing a random sample from finite population, accuracy and precision of an estimator.

Unit II

Simple Random Sampling: Simple random sampling (srswr and srswor): definition and procedures of selecting a sample, properties of simple random sample, estimation of mean and sampling variance of sample mean, comparison of srswr and srswor. advantages and disadvantages Simple random sampling for attributes and its characteristics(without proof).

Unit III

Stratified random Sampling: Stratified random sampling, Estimation of the population mean and its variance. Optimum and proportional allocation and their comparison with SRS WOR. Advantages and disadvantages of Stratified random Sampling.

Unit IV

Systematic Sampling: Definition and sample selection procedures, advantages and disadvantages, variance of the estimated mean, Comparison of systematic sampling with SRSWOR and Stratified random sampling.

Reference:

- Des Raj (2001): Sample Survey Theory. Narosa Publishing House.
- Singh, Daroga & Chaudhary, F.S. (1989): Theory and analysis of sample surveys Designs. Wiley Eastern Ltd.
- Gupta S.C., Kapoor V.K.: Fundamental of Applied Statistics, Sultan Chand & Sons, New Delhi.
- Sukhatme et al. (1984): Sampling Theory and Methods, Statistical Publishing seems Surveys Designs. Wiley Eastern Ltd.

Department of Statistics

Semester V

Paper- STAT 502: Design of Experiment (II)

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To learn to design and conduct experiments.
- To analyze and interpret the data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- One-way and two-way analysis of variance.
- Basic concepts of design of experiments.
- Completely randomized design.
- Randomized design.
- Latin square design

Unit I

Analysis of Variance: Linear model & its different types, Analysis of Variance technique. ANOVA for one-way and two-way classified data (with one observation per cell & fixed effect model); Expectation of Sum of squares, Critical difference. Effects of violations of basic assumptions of ANOVA, Types of Transformations.

Unit II

Design of Experiments: Need for design of experiments, fundamental principles of design of experiments. Uniformity Trials, Choice of size and shape of plots, Experimental error, Efficiency of design.

Unit III

Completely randomized design (CRD), Randomised block design (RBD)-

Their advantages & disadvantage, usage. Analysis, least square estimates, Expectation of sum of square of CRD and RBD. Efficiency of RBD over CRD.

Unit IV

Latin square design (LSD): Analysis, least square estimates; expectation of sum of squares; efficiency of LSD over CRD & RBD.

Reference:

- Des Raj (2001): Sample Survey Theory. Narosa Publishing House.
- Singh, Daroga & Chaudhary, F.S. (1989): Theory and analysis of sample surveys Designs. Wiley Eastern Ltd.
- Gupta S.C., Kapoor V.K.: Fundamental of Applied Statistics, Sultan Chand & Sons, New Delhi.
- Sukhatme et al. (1984): Sampling Theory and Methods, Statistical Publishing seems Surveys Designs. Wiley Eastern Ltd.

Department of Statistics
Semester V
Paper- STAT 503: Econometrics

Credit : 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- A broad knowledge of regression analysis relevant for analysing economic data.
- Interpretation and critical evaluation of the outcomes of empirical analysis.
- Distinguish the results of violating the assumptions of classical regression model.
- To judge the validity of the economic theories and carry out their evaluation in numerical terms.
- To extract useful information about important economic policy issues from the available data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- The fundamental concepts of econometrics.
- Specification of the model.
- Multiple Linear Regression.
- Multicollinearity.
- Heteroscedasticity.
- Autocorrelation.
- Autoregressive and Lag models.

UNIT I

Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics. General linear model (GLM). Estimation under linear restrictions.

UNIT II

Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity.

UNIT III

Autocorrelation: Generalized least squares estimation, Aitken estimators. concept, consequences of autocorrelated disturbances, detection and solution of autocorrelation.

UNIT IV

Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Autoregressive and Lag models.

Reference:

- Gujarati, D. and Guneshker, S. (2007). Basic Econometrics, 4th Ed., McGraw Hill Companies.
- Johnston, J. (1972). Econometric Methods, 2nd Ed., McGraw Hill International. 3. Koutsoyiannis, A. (2004). Theory of Econometrics, 2 Ed., Palgrave Macmillan Limited.
- Maddala, G.S. and Lahiri, K. (2009). Introduction to Econometrics, 4 Ed., John Wiley & Sons.

Department of Statistics
Semester V
Practical Paper – STAT 504

Credit: 02 (4 hours/week)

Maximum Marks = 50

I. Based on Paper STAT-501: Sample Survey (I)

Course Objectives:

This paper is aimed at teaching the students various sampling techniques.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of various sampling techniques & apply these techniques in real life situations.

Syllabus:

1. Simple random sampling WR and WOR.
2. Stratified sampling.
3. Systematic sampling.
4. Estimation of gain in precision in stratified sampling.

II. Practical Based on Paper STAT-502: Design of Experiment (II)

Course Objectives:

The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of various Designs & apply these techniques in real life situations.

Syllabus:

1. Analysis of one-way ANOVA.
2. Analysis of two-way ANOVA.
3. Analysis of CRD.
4. Analysis of RBD.
5. Analysis of LSD.
6. Efficiency of RBD over CRD
7. Efficiency of LSD over CRD & RBD
8. Analysis of CRD with missing case.
9. Analysis of RBD with missing case.

(III) Practical Based on Paper STAT-502: Econometrics

Course Objectives:

This course is meant for training the students in econometric methods and their applications.

Course Learning Outcomes:

This course would enable the students in understanding the economic phenomena through statistical tools and economics principles.

Syllabus:

1. Problems related to consequences of Multicollinearity.
2. Diagnostics of Multicollinearity.
3. Problems related to consequences of Autocorrelation.
4. Diagnostics of Autocorrelation.
5. Problems related to consequences of Heteroscedasticity.
6. Problems on Autoregressive.

Department of Statistics

Semester VI

Paper- STAT 601: Sample Survey-II

Credit : 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To provide tools and techniques for selecting a sample of elements from a target population keeping in mind the objectives to be fulfilled and nature of population.
- To obtain estimator of the population parameter on the basis of selected sample and study its properties.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Cluster Sampling.
- Ratio Sampling.
- Regression
- Two Stage Sampling

Unit I

Cluster Sampling: Cluster sampling (equal size): Meaning, advantages and disadvantages, estimation of population mean and its variance, Relative efficiency of cluster sampling with SRS in terms of intra-class correlation.

Unit II

Ratio sampling: Ratio Method of estimation (first approximation only) Meaning, bias of ratio estimators, variance efficiency of ratio estimate with SRSWOR and ratio estimators.

Unit III

Regression Method: Regression Method of estimation (first approximation only) Meaning, Simple Regression Estimate, Expected value and variance of simple regression estimate. Comparison with SRSWOR and ratio estimators.

Unit IV

Two Stage Sampling: Definition of Two stage sampling, Estimation of Population mean and its Variance. Comparison with SRS.

References:

- Das M.N. & Giri N.E. (1986): Design and Analysis of Experiments, Springer Varlag.
- Gupta S. C. Kapoor V.K.: Fundamentals of Applied Statistics. Sultan Chand & Sons. New Delhi.
- Goon A. M., Gupta M.K. Das Gupta B (1986): Fundamental of Statistics. Vol. II, World Press Kolkutta.
- Nagpal D. P.: Computer Fundamentals, Wheeler Publishing, New Delhi.
- Stallings: Operating Systems. PHI

Department of Statistics

Semester VI

Paper- STAT 602: Design of Experiment (II)

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The learning objectives include:

- To learn to design and conduct experiments.
- To analyse and interpret the data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Missing plot techniques.
- Factorial experiments.
- Confounding
- BIBD

Unit I

Missing Plot Technique: Define missing plot technique, Estimation of single missing value in RBD & LSD and their analysis.

Unit II

Factorial Experiments: 2^2 & 2^3 experiments. Illustrations, main effects. Interaction effects & their analysis of factorial experiments.

Unit III

Confounding: Total and partial confounding. Construction of confounded factorial experiments belonging to 2^3 .

Unit IV

BIBD: Define BIBD and relation between its parameter. Balanced incomplete block design (intra - block analysis)

References:

- Das M.N. & Giri N.E. (1986): Design and Analysis of Experiments, Springer Verlag.
- Gupta S. C. Kapoor V.K.: Fundamentals of Applied Statistics. Sultan Chand & Sons. New Delhi.
- Goon A. M., Gupta M.K. Das Gupta B (1986): Fundamental of Statistics. Vol. II, World Press 4.
- Cochran, W.G. (1997): Sampling Techniques III ed, John Wiley Pub. New York.
- Murthy, MN. (1977) Sampling Theory and Methods, 2nd Ed. Statistical Publ. Soc., Calcutta.

Department of Statistics

Semester VI

Paper- STAT 603: Project

Credit: 02 (2 hours/week)

Maximum Marks = 50

Course Objectives:

The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of human interest. The project work will provide hands on training to the students to deal with data emanating from some real life situation and propel them to dwell on some theory or relate it to some theoretical concepts.

Course Learning Outcomes:

The project work will provide hands on training to the students to deal with data and relate it to some theoretical concepts.

Additional Resources:

- Journal of Statistical Theory and Practice.
- Communication in Statistics- Theory and Methods.
- Journal of Statistical Theory and Applications.
- Journal of Medical Statistics.

Department of Statistics

Semester VI

Practical Paper – STAT 604

Credit: 02 (4 hours/week)

Maximum Marks = 50

I. Practical Based on Paper STAT-601: Sample Survey (II)

Course Objectives:

This paper is designed so that the student gets familiar with techniques for solving the statistical problems based on advanced sampling.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of Regression method of estimation, Ratio methods of estimation, Cluster sampling. Students will be able to Estimate the mean and variance in Regression , Ratio methods of estimation, and Cluster sampling.

Syllabus:

1. Regression method of estimation.
2. Ratio methods of estimation.
3. Cluster sampling.

II. Practical Based on Paper STAT-602: Design of Experiment (II)

Course Objectives:

This paper is designed so that the student gets familiar with techniques for solving the statistical problems based on the Advanced Design of experiment.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of Missing Plot Technique, Factorial Experiment, BIBD , Partial & Total confounding. Students will be able to develop the skills and knowledge required to design and analyze various experiments.

Syllabus:

1. Analysis of 2^2 factorial design.
2. Analysis of 2^3 factorial design.
3. Missing Plot Technique for one missing observation in R.B.D. and L.S.D.
4. Analysis of BIBD.
5. Partial and Total confounding in 2^3 .