

DEPARTMENT OF STATISTICS

B.Sc. (H) Statistics

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1: DESCRIPTIVE STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Descriptive Statistics	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To tabulate statistical information given in descriptive form and to use graphical techniques to interpret
- To understand various measures of central tendency, dispersion, skewness and kurtosis. Moments and its properties.
- Familiarize with quantitative and qualitative data and available statistical tools to analyse them.
- Finding linear correlation between two variates using different measures and studying their properties. Least square method of fitting of curves, regression lines and their elementary properties.

Learning Outcomes:

The Learning Outcomes of this course are as follows:

- Understand concepts of sample vs. population and get acquainted with different types of data /scales. Distinguish between primary and secondary data. Tabulate and plot frequency distribution. Deals with numerical and graphical ways to describe and display data using histograms, stem and leaf plot and box plots.
- Calculate measures of central locations like mean, geometric mean, harmonic mean, median and mode and explain their properties
- Calculate measures of the spread: variance, standard deviation, range and inter-quartile range and explain their properties.
- Understand the meaning of probability and probabilistic experiment. Familiarize with the four approaches to probability theory and particularly, the axiomatic approach and use and manipulate the four axioms of probability comfortably to derive the results of other set

operations

- Understand and exploit Addition and Multiplicative laws of probability
- understand the meaning of conditional probability, conditioning, and reduced sample space, compute joint and conditional probabilities. independence, total probability, Bayes' rule and applications.
- Understand the concept of a random variable, differentiate between independent and uncorrelated random variables, distinguish between discrete, continuous, random variables and be able to represent them using probability mass, probability density, and cumulative distribution functions, Univariate transformation and its application.
- Understand expectation and its properties, Compute variance and covariance in terms of expectation. Solve problems based on expectation and its properties.

SYLLABUS OF DSC-1

Theory

Unit – 1 (02 Weeks)

Data Visualization

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Types of Data: Concepts of population and sample, quantitative and qualitative data, cross-sectional and time-series data, discrete and continuous data. Different types of scales: Nominal, ordinal, interval and ratio. Collection and Scrutiny of Data: Primary data. Secondary data – its major sources. Complete enumeration. Construction of tables with one or more factors of classification, frequency distributions and cumulative frequency distributions and their graphical representations (Histograms, frequency polygon), stem and leaf displays.

Unit – 2 (05 Weeks)

Data Summarization

Measures of Central Tendency: Mathematical and positional, partition values, Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, graphical representation of various measures of location and dispersion (Ogives, Histograms, Box Plot) Moments: Raw moments, Central moments, Absolute moments, Factorial moments, Sheppard's corrections, skewness and kurtosis, Types of frequency distributions.

Unit – 3 (02 Weeks)

Theory of Attributes

Theory of attributes: consistency and independence of data with special reference to attributes, Association of attributes: concept, Yules coefficient of Colligation and Coefficient of Colligation.

Unit – 4 (05 Weeks)

Correlation and Regression

Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation. Spearman's rank correlation coefficient (Introductory with interpretation). Principle of least squares and fitting of polynomials and exponential curves, lines of regression, properties of regression coefficients, angle between two regression lines, and residual variance.

Practical

List of Practicals:

1. Graphical representation of data- frequency polygon, histogram and ogive.
2. Practical based on arithmetic mean and to find missing frequencies given arithmetic mean.
3. Practical based on median and partition vales using formulae and to find them graphically also.
4. Practical based on mode by using formula, graphically, method of grouping.
5. Practical based on combined mean and combined variance.
6. Practical based on quartile deviation using formula and graphically.
7. Practical based on mean deviation and standard deviation.
8. Practical based on coefficient of variation.
9. Practical based on moments about origin and moments about any arbitrary point.
10. Practical on skewness based on mean, median, mode and standard deviation.
11. Practical based on central moments, skewness and kurtosis.
12. Practical based on fitting of polynomials.
13. Practical based on fitting of exponential curves, power curves.
14. Practical based on association and independence of attributes.
15. Practical based on fundamental set of class frequencies in attributes (find missing frequencies given fundamental set of class frequencies).
16. Practical based on Karl Pearson correlation coefficient.
17. Practical based on correlation coefficient for a bivariate frequency distribution.
18. Practical based on lines of regression, angle between lines and estimated values of variables.
19. Practical based on rank correlation with ties.
20. Practical based on rank correlation without ties.

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. I, 8th Ed. The World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edn., S. Chand and Sons. Delhi.
- Bernstein, S. and Bernstein, R. (2020). Schaums: Outline of Elements of Statistics I Descriptive Statistics and Probability. McGraw Hill.
- Heumann, C., Schomaker, M. and Shalabh (2016). Introduction to Statistics and Data Analysis with Exercises, Solutions and Applications in R. Springer.

Suggestive Readings

- Tukey, J.W. (1977). Exploratory Data Analysis, Addison-Wesley Pub. Co. N.Y.
- Myatt, G, J. and Johnson, W.P. (2014). Making sense of data: A practical guide to exploratory data analysis and data mining. 2nd Edn, John Wiley & Sons, Inc. N. J.
- Agresti, A., Christine Franklin, C. and Klingenberg, B. (2017). Statistics: the art and science of learning from data. Pearson. Boston.
- Dudewicz, E. and Mishra, S. N. (1988). Modern Mathematical Statistics. Wiley.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: INTRODUCTION TO PROBABILITY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Probability	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Familiarize students with the mathematical basis of probability theory.
- Prepare students with important tools for statistical analyses at the undergraduate level.
- Promote understanding through real-world statistical applications.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- Understand the meaning of probability and probabilistic experiment. Familiarize with the four approaches to probability theory and particularly, the axiomatic approach, use and manipulate the four axioms of probability comfortably to derive the results of other set operations.
- Understand and use addition and multiplicative laws of probability, understand the meaning of conditional probability, conditioning, and reduced sample space, compute joint and conditional probabilities. independence, total probability, Bayes' rule and applications.
- Understand the concept of a random variable, differentiate between independent and uncorrelated random variables, distinguish between discrete and continuous, random variables and be able to represent them using probability mass, probability density, and

cumulative distribution functions. Acquaint with Univariate transformation and its application.

- Understand expectation and its properties, Compute variance and covariance in terms of expectation. Solve problems based on expectation and its properties.

SYLLABUS OF DSC - 2

Theory

Unit – 1

(03 Weeks)

Elements of Probability

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – Classical, Statistical. Limitations of Classical definition. Probability of union and intersection of events, Probability of occurrence of exactly m and at least m events out of n events, Examples based on classical approach and repeated trials, Kolmogorov's Axiomatic definition and problems based on it, Matching problems.

Unit – 2

(03 Weeks)

Laws of Probability

Conditional Probability, laws of addition and multiplication, theorem of total probability, Examples based on conditional probability and laws of addition and multiplication, independent events – Pairwise mutual independence, Bayes' theorem and its applications, Geometric probability.

Unit – 3

(05 Weeks)

Random variables

Distribution function and properties, Discrete random variables - p.m.f., discrete distribution function, Continuous random variables - p.d.f, illustrations and properties of random variables. Measures of central tendency, dispersion, skewness and kurtosis for continuous probability distributions, Examples based on random variables, Continuous distribution functions and their properties, Univariate transformation of random variables, Examples based on univariate transformations.

Unit – 4

(03 Weeks)

Mathematical Expectation

Expectation of random variable and its properties (addition and multiplication theorem of expectation), Variance and Covariance in terms of expectation and their properties, Examples based on Expectation and its properties.

Practical

List of Practicals:

1. Problem based long run relative frequency to establish statistical definition of probability
2. Problem based on geometric probability.

3. Problem based on permutations and combinations when all objects are distinguishable.
4. Problem based on permutations and combinations when not all objects are different.
5. Computation of probability related to occurrence of exactly m and at least m events out of n events.
6. Computation of probabilities related to matching problems
7. Computation of conditional probabilities using addition and multiplication laws.
8. Problem related to application of Bayes Theorem.
9. Computation of distribution function of discrete and continuous random variables and calculations of probabilities of events thereof.
10. Graphical representation of probability function and distribution function of discrete/continuous arbitrary random variables.
11. Finding expectation, variance and covariances of discrete as well as continuous random variables
12. Finding expectation, variance and covariances of linear function of discrete as well as continuous random variables.
13. Constructing sample space for two-dimensional random variable.

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. I, 8th Ed. The World Press, Kolkata.
- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017). An Outline of statistical theory, Vol. I, The World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edn., S. Chand and Sons. Delhi.
- Ross, S.M. (2002). A first course in Probability, 6th Ed., Pearson.
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.

Suggestive Readings

- Chung, K.L. (2000). A Course in Probability Theory, 3rd Edn. Academic Press.
- Parzen, E. (1960). Modern probability theory and its applications. John Wiley.
- Feller, W. (1968) An introduction to probability theory and its applications. Vol. I, 3rd Edn. John Wiley & Sons Inc., New York.
- Blake, I. F. (1987). Introduction to Applied Probability. Krieger Publishing Co.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 3: CALCULUS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Calculus	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize students with the basic mathematical tools.
- It helps students to understand the other statistical concepts.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- Understand to solve applied problems using differentiation and integration.
- Understand to solve applied problems under integral sign and changes of order of integration.

SYLLABUS OF DSC – 3

Theory

Unit – 1

(04 Weeks)

Differential Calculus

Review of limits, continuity and differentiability, partial differentiation and total differentiation. Indeterminate forms: L-Hospital's rule, Leibnitz rule for successive differentiation. Euler's theorem on homogeneous functions.

Unit – 2

(04 Weeks)

Integral Calculus

Review of integration and definite integral. Differentiation under integral sign, double integral, changes of order of integration. Beta and Gamma functions: Properties and relationship between them.

Unit – 3

(06 Weeks)

Differential Equations

Exact differential equations. Differential equations of first order and first degree. Higher Order Differential Equations: Linear differential equations of order n, Homogeneous and non-

homogeneous linear differential equations of order n with constant coefficients, Different forms of particular integrals. The Cauchy-Euler's equation of order n . Formation and solution of a partial differential equations. Equations easily integrable. Linear partial differential equations of first order. Homogeneous linear partial differential equations with constant coefficients. Different cases for complimentary functions and particular integrals.

Practical

List of Practicals:

- 1) Verification of Euler's Theorem.
- 2) Applications of differentiation
 - a. Calculate income and price elasticity of demand.
 - b. Determination of price and quantity for which total revenue is maximum.
 - c. Find the level of output for which the average cost is minimum.
 - d. Solve profit maximization problems.
 - e. Evaluate first and second order partial derivatives of functions of the form $Z = f(x, y)$.
 - f. Examine a function of two variables for relative maxima and relative minima.
 - g. Find the nature of the commodities by using the concept of partial marginal demand functions.
 - h. Find four partial elasticities for a demand function of two variables.
- 3) Applications of Integration
 - a) Derive total cost function from given marginal cost function.
 - b) Derive total revenue function and demand function form a given marginal revenue function.
 - c) Calculate the maximum profit if marginal revenue and marginal cost are given.
 - d) Find the demand function when the price elasticity of demand is given.
- 4) Applications of Differential Equations
 - a) Application on growth and decay.
 - b) Application of the form $\frac{d^2y}{dx^2} = f(x)$ and $\frac{d^2y}{dx^2} = f(y)$ to physical problems.
 - c) Application on coordinate geometry.
- 5) Verify that the area under the curve is unity under the given p.d.f. and also calculate
 - a) Arithmetic Mean
 - b) Median
 - c) Mode
 - d) Standard Deviation

Essential Reading

- Prasad, G. (2017). Differential Calculus, 19th Ed. (Revised), Pothishala Pvt. Ltd., Allahabad.
- Prasad, G. (2017). Integral Calculus, 17th Ed. (Revised), Pothishala Pvt. Ltd., Allahabad.
- Ahsan, Z. (2004). Differential Equations and their Applications, 2nd Ed., PHI, Pvt. Ltd., New Delhi.
- Shanti Narayan and P K Mittal (2018). Differential Calculus. 15th Ed (Revised), S Chand Publication, New Delhi
- Shanti Narayan and P K Mittal (2016). Integral Calculus. 11th Ed (Revised), S Chand Publication, New Delhi.

- Business Mathematics Theory and Applications, V. K. Kapoor (2012), Sultan Chand & Sons.

Suggestive Reading

- R. S. Soni (2000) Business Mathematics with applications in Business and Economics, 3rd ed., Pitamber Publishing Company (P) Ltd.
- Brahma Nand, B. S. Tyagi and B. D. Sharma, Integral Calculus, Kedar Nath Ram Nath.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

B.Sc. (Program) with Statistics as Major

Category II

DISCIPLINE SPECIFIC CORE COURSE – 1: DESCRIPTIVE STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Descriptive Statistics	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To motivate students towards intrinsic interest in statistical thinking.
- To analyze and interpret data.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basic concepts of Statistics.
- Able to employ different types of data.
- Employ the graphical methods of displaying data.
- Use measures of locations.

SYLLABUS OF DSC - 1

Theory

Unit – 1

(04 Weeks)

Data Representation

Introduction: Definition, importance, scope and limitations of Statistics. Population and Sample Concept of statistical population with illustrations, concept of sample with illustrations. Raw data, Attributes and variables, discrete and continuous variables, classification and construction of frequency distribution. Graphical Representation: Histogram, Frequency polygon, Frequency curve, Ogive curves and their uses. Examples and Problems.

Unit – 2

(05 Weeks)

Measures of central tendency

Concept of central tendency, Criteria for good measures of central tendency. Arithmetic mean: Definition, computation for ungrouped and grouped data, combined mean, weighted mean,

merits and demerits. Median: Definition, computation for ungrouped and grouped data, graphical method, merits and demerits. Mode: Definition, computation for ungrouped and grouped data, graphical method, merits and demerits. Quartiles: Definition, computation for ungrouped and grouped data graphical method. Numerical problems.

Unit – 3

(05 Weeks)

Measures of Dispersion

Concept of dispersion and measures of dispersion, absolute and relative measures of dispersion. Range and Quartile Deviation: definition for ungrouped and grouped data, and their coefficients, merits and demerits. Mean Deviation: Definition for ungrouped and grouped data, minimal property (statement only). Standard deviation and Variance: definition for ungrouped and grouped data, coefficient of variation, combined variance and standard deviation for two groups, merits and demerits. Numerical problems.

Practical

List of Practicals:

1. Problems based on graphical representation of data: Histograms, Frequency polygon, Ogive curve for equal class intervals.
2. Problems based on graphical representation of data: Histograms, Frequency polygon, Ogive curve for unequal class intervals.
3. Problems based on measures of central tendency using raw data, grouped data.
4. Problems based on change of origin and scale.
5. Problems based on measures of dispersion using raw data, grouped data.
6. Problems based on measures of dispersion for change of origin and scale.
7. Problems based on combined mean.
8. Problems based on combined variance.
9. Problems based on coefficient of variation.
10. Problems based on standard deviation of two groups

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I, 8th Ed. The World Press, Kolkata.
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.
- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Ed., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

Suggestive Reading

- Gupta, S.P. (2022) Statistical Methods 46th ed, S. Chand and Sons
- Gupta, S. C. and Kapoor V. K. (). Fundamentals of Mathematical Statistics, S. Chand and Sons

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: STATISTICAL METHODS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Statistical Methods	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- Acquainting the students with various statistical methods.
- Students should be able to understand and compute various statistical measures of correlation, fitting of curve and regression.

Learning Outcomes

Upon successful completion of this course students will demonstrate knowledge of:

- Correlation and regression.
- Theory of attributes.

SYLLABUS OF DSC - 2

Theory

Unit – 1 (05 Weeks)

Correlation

Introduction and meaning of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation, limits for correlation coefficient, correlation coefficient for bivariate distribution, rank correlation: tied and repeated rank, correlation ratio, measure of correlation ratio, Intra class correlation, multiple and partial correlation.

Unit – 2 (05 Weeks)

Regression

Introduction to Linear regression, regression coefficient, properties of regression coefficients, angle between two lines of regression, regression curve, curvilinear regression. Principle of least-squares and fitting of polynomials and exponential curves.

Unit – 3 (04 Weeks)

Theory of Attributes

Theory of attributes: Notion and terminology, class frequencies, ultimate class frequencies, Contingency table, consistency, association of attributes, independence, measure of association for 2x2 table, Yule's coefficient of association.

Practical

List of Practicals:

1. Problems based on Karl Pearson correlation coefficient.
2. Problems based on Karl Pearson correlation coefficient with change of scale and origin.
3. Problem based on multiple correlation
4. Problem based on partial correlation
5. Problems based on lines of regression.
6. Problems based on angle between two lines of regression.
7. Problems based on Spearman rank correlation.
8. Problems based on fitting of polynomials and exponential curves.
9. Problems based on association and independence of attributes.
10. Problems based on fundamental set of class frequencies in attributes (find missing frequencies given fundamental set of class frequencies)

Essential Readings

- Goon, A. M., Gupta, M. K. and Dasgupta, B. (2003). An Outline of Statistical Theory (4th ed., Vol. I). World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2007). Fundamentals of Mathematical Statistics (11th ed.). Sultan Chand and Sons.
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.

Suggestive Readings

- Gupta, S.P. (2022) *Statistical Methods 46th ed, S. Chand and Sons*
- Hogg, R. V., Craig, A. T. and Mckean, J. W. (2005). Introduction to Mathematical Statistics (6th ed.). Pearson Education

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

B.Sc. (Program) with Statistics as Minor

Category III

DISCIPLINE SPECIFIC CORE COURSE: DESCRIPTIVE STATISTICS AND PROBABILITY THEORY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Descriptive Statistics and probability theory	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- Introduction to Statistics.
- Graphical representation of data.
- Understanding the concept of Probability.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Apply the fundamental concepts of statistics.
- Understand handling various types of data and their graphical representation.
- Employ measures of location and dispersion.
- Bivariate data. Significance of various coefficients of correlation.
- Employ fitting of linear curve.
- Use probability theory and its applications.

SYLLABUS OF DSC

Theory

Unit – 1

(05 Weeks)

Basic Statistics

Fundamentals of statistics. Diagrammatic representation of data. Measures of central tendency: location and positional. Partition values, Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Moments: raw and central, Measures of skewness and kurtosis.

Unit – 2

(04 Weeks)

Correlation and Regression

Bivariate data: definition, scatter diagram. Correlation and regression: Karl Pearsons coefficient of correlation, Spearman's rank correlation coefficient, lines of regression, properties of regression coefficients, angle between two regression lines. Principle of least-square and fitting of linear curve.

Unit – 3

(05 Weeks)

Probability

Probability: Introduction, Random experiment, sample point and sample space, event, algebra of events, Definition of Probability - classical, relative frequency and axiomatic approaches to probability, merits and demerits of these approaches (only general ideas to be given). Theorems on probability, conditional probability, independent events: pairwise and mutually independent. Bayes theorem and its applications.

Practical

List of Practicals:

1. Problems based on graphical representation of data. Histograms (equal class intervals and unequal class intervals), frequency polygon, ogive curve.
2. Problems based on mean using raw data, grouped data for change of origin and scale.
3. Problems based on arithmetic mean and to find missing frequencies given arithmetic mean.
4. Problems based on median and partition vales using formulae and to find them graphically also.
5. Problems based on mode by using formula, graphically, method of grouping.
6. Problems based on mean deviation and standard deviation.
7. Problems based on combined mean and variance.
8. Problems based on coefficient of variation.
9. Comparison of data using consistency approach.
10. Problems on skewness based on mean, median, mode and standard deviation.
11. Problems based on central moments.
12. Relationships between moments about origin and central moments.
13. Problems based on skewness and kurtosis.
14. Problems based on Karl Pearson correlation coefficient.
15. Problems based on Spearman's rank correlation with ties.
16. Problems based on Spearman's rank correlation without ties.
17. Problems based on lines of regression and estimated values of variables.
18. Problems on regression coefficients.

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005). Fundamentals of Statistics, Vol. I, 8th Ed., World Press, Kolkatta.
- Gupta, S.C. and Kapoor, V.K. (2014). Fundamentals of Mathematical Statistics, 11th Ed., Sultan Chand and Sons.

- Hogg, R. V., McKean, J., and Craig, A. T. (2005). Introduction to mathematical statistics. Pearson Education.
- Freund, J.E. (2009). Mathematical Statistics with Applications, 7th Ed., Pearson Education.

Suggestive Readings

- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw Hill Publication
- Miller, Irwin and Miller, Marylees (2006): John E Freund's Mathematical Statistics with Applications, (7th ed.) Pearson Education, Asia.
- Nagar and Das (1997) Basic Statistics. 2nd ed., Oxford University Press

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

B.A. (Prog.) Multidisciplinary Studies with Statistics

DISCIPLINE SPECIFIC CORE COURSE: DESCRIPTIVE STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Descriptive Statistics	4	3	0	1	Class XII pass with Mathematics	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To motivate students towards intrinsic interest in statistical thinking.
- To analyze and interpret data.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand the basic concepts of Statistics.
- Able to employ different types of data.
- Employ the graphical methods of displaying data.
- Use measures of locations.

SYLLABUS OF DSC

Theory

Unit – 1

(04 Weeks)

Basics of Statistics

Introduction: Definition, importance, scope and limitations of Statistics. Population and Sample Concept of statistical population with illustrations, concept of sample with illustrations. Raw data, Attributes and variables, discrete and continuous variables, classification and construction of frequency distribution. Graphical Representation: Histogram, Frequency polygon, Frequency curve, Ogive curves and their uses. Examples and Problems.

Unit – 2

(05 Weeks)

Measures of Central Tendency

Concept of central tendency, Criteria for good measures of central tendency. Arithmetic mean: Definition, computation for ungrouped and grouped data, combined mean, weighted mean, merits and demerits. Median: Definition, computation for ungrouped and grouped data, graphical method, merits and demerits. Mode: Definition, computation for ungrouped and grouped data,

graphical method, merits and demerits. Quartiles: Definition, computation for ungrouped and grouped data graphical method. Numerical problems.

Unit – 3

(05 Weeks)

Measures of Dispersion

Concept of dispersion, absolute and relative measures of dispersion. Range and Quartile Deviation: definition for ungrouped and grouped data, and their coefficients, merits and demerits. Mean Deviation: Definition for ungrouped and grouped data, minimal property (statement only). Standard deviation and Variance: definition for ungrouped and grouped data, coefficient of variation, combined variance and standard deviation for two groups, merits and demerits. Numerical problems.

Practical

List of Practicals:

1. Problems based on graphical representation of data: Histograms, Frequency polygon, Ogive curve for equal class intervals.
2. Problems based on graphical representation of data: Histograms, Frequency polygon, Ogive curve for unequal class intervals.
3. Problems based on measures of central tendency using raw data, grouped data.
4. Problems based on change of origin and scale.
5. Problems based on measures of dispersion using raw data, grouped data.
6. Problems based on measures of dispersion for change of origin and scale.
7. Problems based on combined mean.
8. Problems based on combined variance.
9. Problems based on coefficient of variation.
10. Problems based on standard deviation of two groups

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002). Fundamentals of Statistics, Vol. I, 8th Ed. The World Press, Kolkata.
- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Ed., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
- Gupta, S.C., and Kapoor, V.K. (2014). Fundamental of Mathematical Statistics, 11th Ed., Sultan Chand

Suggestive Reading

- **Gupta, S.P. (2022) Statistical Methods 46th ed, S. Chand and Sons**
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

**COMMON POOL OF GENERIC ELECTIVES (GE) COURSES
OFFERED BY DEPARTMENT OF STATISTICS
CATEGORY-IV**

GENERIC ELECTIVES: INTRODUCTION TO STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Introduction to Statistics	4	3	0	1	Class XII pass with Mathematics	NIL	Statistics

Learning Objectives

The Learning Objectives of this course is as follows:

- Acquainting the students with descriptive data analysis.
- To introduce students to different measurement scales, qualitative and quantitative and discrete and continuous data.
- To help students to organise data into frequency distribution graphs, including bar graphs, histograms, polygons and ogives.
- Students should be able to understand the purpose for measuring central tendency, dispersion, skewness and kurtosis and should be able to compute them as well.
- Students should be able to understand theory of attributes, independence and association of attributes.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- Introduction to Statistics, definitions and data classification
- Employ graphical displays of data, frequency distributions, analysing graphs.
- Apply numerical descriptions of data, measures of center tendency, measures of dispersion, skewness and kurtosis.
- Understand theory of attributes.

SYLLABUS OF GE

Theory

Unit – 1

(04 Weeks)

Introduction to Statistics and Data

Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement -nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.

Unit – 2

(06 Weeks)

Descriptive Statistics

Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean, harmonic mean, partition values. Measures of Dispersion: Range, quartile deviation, mean deviation, standard deviation, variance, coefficient of dispersion: coefficient of variation. Moments, Measure of skewness and kurtosis.

Unit – 3

(04 Weeks)

Theory of Attributes

Theory of Attributes: Consistency of data, independence of attributes, association of attributes, Yule's coefficient of association, coefficient of colligation.

Practical

List of Practicals:

1. Tabular representation of data
2. Graphical representation of data using histogram
3. Graphical representation of data using ogives
4. Problems based on arithmetic mean
5. Problems based on geometric mean
6. Problems based on harmonic mean
7. Problems based on median
8. Problems based on mode
9. Problems based on partition values
10. Verifying the relationship between arithmetic mean, geometric mean and harmonic mean
11. Problems based on range and quartile deviation.
12. Problems based on mean deviation
13. Problems based on standard deviation and variance
14. Problems based on combined mean and combined variance
15. Problems based on coefficient of variation.
16. Problems based on moments,
17. Problems based on skewness
18. Problems based on kurtosis
19. Checking consistency of data.
20. Checking the independence of attributes

21. Measuring the association between the attributes

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002). Fundamentals of Statistics, 8th Ed. Vol. I & II, The World Press, Kolkata.
- Mood, A.M. Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Ed., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
- Gupta, S.C., and Kapoor, V.K. (2014). Fundamental of Mathematical Statistics, 11th Ed., Sultan Chand.

Suggestive Reading

- Miller, I. and Miller, M. (2006). John E. Freund’s Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.
- Ross, Sheldon M. (2010): Introductory Statistics, 3rd Edition, Academic Press

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES: TIME SERIES ANALYSIS AND INDEX NUMBERS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Time Series Analysis and Index Numbers	4	3	0	1	Class XII pass with Mathematics	NIL	Statistics

Learning Objectives

The Learning Objectives of this course are as follows:

- Introduce the concept of time series, its components, and their estimation.
- Introduce the application of time series.
- Introduce the concept, formulation, and application of index numbers.

Learning outcomes

After completion of this course, the students will be able to:

- Understand the concepts of time series and index numbers.

- Formulate, solve, and analyze the use of time series and index numbers for real-world problems.

SYLLABUS OF GE

Theory

Unit - 1 (04 Weeks)

Components of Time Series

Introduction to Time Series, Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series, Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear, quadratic and exponential).

Unit - 2 (04 Weeks)

Trend and Seasonality

Fitting of modified exponential, Gompertz and logistic curve, Moving average method, Measurement of seasonal variations by method of simple averages, ratio to trend method, and ratio to moving average method.

Unit - 3 (06 Weeks)

Index Numbers

Introduction to Index numbers, Problems in the construction of index numbers, Construction of price and quantity index numbers: simple aggregate, weighted aggregate (Laspeyres, Paasche's, Drobish-Bowley, Marshall-Edgeworth's, Walsch and Fisher's Formula), simple and weighted average of price relatives, and chain base method, Criteria for a good index number, Errors in the measurement of price and quantity index numbers, Consumer price index number, its construction and uses, Uses and limitations of index numbers.

Practical

List of Practicals:

1. Fitting of linear trend
2. Fitting of quadratic trend
3. Fitting of an exponential curve
4. Fitting of modified exponential curve by the method of
 - a. Three selected points
 - b. Partial sums
5. Fitting of Gompertz curve by the method of
 - a. Three selected points
 - b. Partial sums
6. Fitting of logistic curve by the method of three selected points
7. Fitting of trend by moving average method (for n even and odd)
8. Measurement of seasonal indices by
 - a. Method of simple averages

- b. Ratio-to-trend method
- c. Ratio-to-moving-average method
- 9. Construction of price and quantity index numbers by simple aggregate method.
- 10. Construction of price and quantity index numbers by Laspeyres, Paasche's, Drobish-Bowley, Marshall-Edgeworth, Walsch and Fisher's Formula.
- 11. Construction of price and quantity index numbers by simple and weighted average of price relatives.
- 12. Construction of index number by Chain base method.
- 13. Construction of consumer price index number by
 - a. Family budget method
 - b. Aggregate expenditure method
- 14. Time Reversal Test and Factor Reversal Test

Essential Readings

- Croxton, Fredrick E, Cowden, Dudley J. and Klein, S. (1973): Applied General Statistics, 3rd edition, Prentice Hall of India Pvt. Ltd.
- Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008). Fundamentals of Statistics, Vol. II, 9th Ed., World Press, Kolkata.
- Gupta, S.C. and Kapoor, V.K. (2014). Applied Statistics, 11th Ed., Sultan Chand.

Suggestive Reading

- Allen R.G.D. (1975): Index Numbers in Theory and Practice, Macmillan
- Mukhopadhyay, P. (1999). Applied Statistics, New Central Book Agency, Calcutta.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVES: BASIC STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Basic Statistics	4	3	0	1	Class XII pass with Mathematics	NIL	Statistics

Learning Objectives

The Learning Objectives of this course are as follows:

- To summarize the data and to obtain its salient features from the vast mass of original data.
- To understand the concepts of probability and its applications.
- To understand the concept of random variables, probability distributions and expectation..

Learning outcomes

After completion of this course, the students will be able to:

- Apply the concepts of statistical population and sample, variables and attributes.
- Present tabular and graphical representation of data based on variables.
- Measures of central tendency, Dispersion, Skewness and Kurtosis.
- Employ moments and their use in studying various characteristics of data.
- Employ correlation and regression analysis of bivariate data.

SYLLABUS OF GE

Theory

Unit - 1

(04 Weeks)

Elementary Statistics

Concepts of a statistical population and sample from a population, quantitative and qualitative data, nominal, ordinal and time-series data, discrete and continuous data. Presentation of data by tables and by diagrams, frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods).

Unit - 2

(05 Weeks)

Descriptive Statistics

Measures of location (or central tendency) and dispersion, moments, measures of skewness and kurtosis, cumulants. Bi-variate data: Scatter diagram, principle of least-squares and fitting of polynomials and exponential curves.

Unit - 3

(05 Weeks)

Correlation and Regression

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Practical

List of Practicals:

1. Problems based on graphical representation of data.
2. Problems based on measures of central tendency using raw data, grouped data and for change of origin and scale.

3. Problems based on measures of dispersion using raw data, grouped data and for change of origin and scale.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on Moments using raw data, grouped data and for change of origin and scale.
6. Problems based on relationships between moments about origin and central moments.
7. Problems based on Skewness and kurtosis.
8. Problems based on Karl Pearson correlation coefficient (with/without change of scale and origin).
9. Problems based on Lines of regression, angle between two lines of regression
10. Problems based on Spearman rank correlation.
11. Fitting of polynomials and exponential curves.

Essential Readings

- Goon, A. M., Gupta, M. K. and Dasgupta, B. (2003). An Outline of Statistical Theory (4th ed., Vol. I). World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2021). Fundamentals of Mathematical Statistics (60th ed.). Sultan Chand and Sons.
- Hogg, R. V., Craig, A. T. and Mckean, J. W. (2005). Introduction to Mathematical Statistics (6th ed.). Pearson Education.

Suggestive Reading

- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia
- Elhance, D. N. , Elhance, V. and Agrawal, B. M. (2021), Kitab Mahal

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

