UNIVERSITY OF DELHI

DEPARTMENT: Statistics

COURSE NAME: B.Sc. (Hons)

(SEMESTER – 1)

based on
Undergraduate Curriculum Framework 2022 (UGCF)
(Effective from Academic Year 2022-23)

University of Delhi

List of DSC Papers

Course Title	Nature of the Course	Total Credits	Components			Contents of the course and reference is in
			Lecture	Tutorial	Practical	
Descriptive Statistics	DSC-101	4	3	0	1	**Annexure-I**
Introduction to Probability	DSC-102	4	3	0	1	**Annexure-II**
Calculus	DSC-103	4	3	0	1	**Annexure-III**

List of GE Papers

Course Title	Nature of the Course	Total Credits	Components			Contents of the course and reference is in
			Lecture	Tutorial	Practical	
Introduction to Statistics	GE-01	4	3	0	1	**Annexure-IV**
Time Series Analysis & Index Numbers	GE-02	4	3	0	1	**Annexure-V**

Annexure-I

STAT-DSC-101-Descriptive Statistics

Objective of the Course:

- 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:

After taking this course, the student should be able to:

- 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.
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- 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.

Lecture: 3-hour Credit:3

Practical: 2-hour Credit :1

Note: Practical in Batches as per Strength

Proposed Syllabus for B.Sc. (H) Statistics under UGCF – 2022

❖ DSC and DSE papers for B.Sc (H) Statistics under UGCF - 2022

Semester I

STAT-DSC-101: Descriptive Statistics

UNIT I

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 II

Measures of Central Tendency: Mathematical and positional, pwartition 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 III

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 IV

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.

SUGGESTED READINGS:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). *Fundamentals of Statistics*, Vol. I, 8th Ed. The World Press, Kolkata.
2. Gupta, S. C. and Kapoor, V. K. (2020). *Fundamentals of Mathematical Statistics*, 12th Edn., S. Chand and Sons. Delhi.
3. Tukey, J.W. (1977). *Exploratory Data Analysis*, Addison-Wesley Pub. Co. N.Y.
4. Bernstein, S. and Bernstein, R. (2020). *Schaums: Outline of Elements of Statistics I Descriptive Statistics and Probability.* McGraw Hill.
5. 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.

6. Agresti, A., Christine Franklin, C. and Klingenberg, B. (2017). *Statistics: the art and science of learning from data.* Pearson. Boston.
7. Heumann, C., Schomaker, M. and Shalabh (2016). *Introduction to Statistics and Data Analysis with Exercises, Solutions and Applications in R.* Springer.

PRACTICAL / LAB WORK

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.

STAT- DSC2-INTRODUCTION TO PROBABILITY

Objective of the Course:

- 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:

After taking this paper, the student should be able to:

•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.

Lecture: 3-hour Credit:3

Practical: 2-hour Credit :1

Note: Practical in Batches as per Strength

STAT-DSC-102: Introduction to Probability

UNIT I

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 II

Unit 2 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 III

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 IV

Mathematical Expectation: Expectation of random variables 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.

SUGGESTED READINGS:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). *Fundamentals of Statistics*, Vol. I, 8th Ed. The World Press, Kolkata.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017). An *Outline of statistical theory*, Vol. I, The World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V. K. (2020). *Fundamentals of Mathematical Statistics*, 12th Edn., S. Chand and Sons. Delhi.
4. Chung, K.L. (2000). *A Course in Probability Theory*, 3rd Edn. Academic Press.
5. Parzen, E. (1960). *Modern probability theory and its applications.* John Wiley.
6. Feller, W. *(1968) An introduction to probability theory and its applications. Vol. I,* 3rd Edn. John Wiley & Sons Inc., New York.
7. Ross, S.M. (2002). *A first course in Probability,* 6th Ed., Pearson.

PRACTICAL / LAB WORK

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.

Annexure-III

Syllabus
B.Sc. (Hons) Statistics, Semester I
Paper DSC 3: Calculus

Credits: 04

Max. Marks: 100
Theory Marks: 75
IA: 25

Course Objectives:

The objective of this course is

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

Expected Learning Outcomes:

On completion of this course students are expected

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

Credit of the Course: 3 Lectures + 2 Practicals*

Content

UNIT I: 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 II: 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 III: 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.

REFFERENCES

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

Suggested Readings:

1) Prasad, G. (2017). Differential Calculus, 19th Ed. (Revised), Pothishala Pvt. Ltd., Allahabad.
2) Prasad, G. (2017). Integral Calculus, 17th Ed. (Revised), Pothishala Pvt. Ltd., Allahabad.
3) Ahsan, Z. (2004). Differential Equations and their Applications, 2nd Ed., PHI, Pvt. Ltd., New Delhi.
4) Shanti Narayan and P K Mittal (2018). Differential Calculus. 15th Ed (Revised)., S Chand Publication, New Delhi
5) Shanti Narayan and P K Mittal (2016). Integral Calculus. 11th Ed (Revised), S Chand Publication, New Delhi.
6) Business Mathematics Theory and Applications, V. K. Kapoor (2012), Sultan Chand &Sons.

PRACTICAL/LAB WORK

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

Pattern of Paper

1) There will be an end-semester ***Theory & Practical*** examinations in this paper.
2) Theory paper will consist of **two** sections, Section A based on the Unit I and Unit II (Equal weightage should be given to both the units) consisting of **five** questions and Section B based on Unit III consisting of **three** questions. Weightage of the marks for
   Unit I 25 Marks
   Unit II 25 Marks
   Unit III 25 Marks
3) Students will have to attempt six questions in all by selecting **four** questions from Section A and **two** questions from Section B
4) Evaluation for practical will be done through continuous evaluation (25 marks) and end semester practical examination (25 marks).
5) Continuous evaluation shall be comprised of 15 marks for practical file and 10 marks on the basis of performance of the student in the practical classes.
6) Practical examination will be of 02 hrs. duration.
7) Practical paper will consist of five questions in all covering the topics from all the Units on the basis of its practical applications, out of which four questions are to be attempted.

*** There will be batch of 15 students per practical class.**

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