

**SHRIMATHI DEVKUNVAR NANALAL BHATT
VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI - 600044.**

Re accredited with A+ Grade by NAAC

BACHELOR OF SCIENCE

Under the faculty of Science

DEPARTMENT OF STATISTICS



CHOICE BASED CREDIT SYSTEM (CBCS)

**OUTCOME BASED EDUCATION
(OBE)**

(Effective from the Academic Year 2020-21)

15. PROGRAMME SPECIFIC OUTCOMES (PSOs)

The Undergraduate students of B.Sc.(Statistics) will be able to:

PSO1: Acquire fundamental/systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications.

PSO2: Demonstrate the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems

PSO3: Identify and apply appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

PSO4: Plan and execute Statistical experiments or investigations, analyse and interpret data/information collected using appropriate methods, by using appropriate statistical software.

PSO5: Recognize the importance of statistical modeling & computing and the role of approximation & mathematical approaches to analyse the real problems using various statistical tools.

PSO6: Demonstrate relevant generic skills and global competencies such as problem-solving skills, investigative skills, analytical skills, ICT skills, interpersonal skills and communication skills.

DEPARTMENT OF STATISTICS
Assessment Model (from 2020-21 onwards)

TOTAL CREDITS: 140

SEMESTER-I							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-I	Language	Tamil-I/Hindi-I/Sanskrit-I/ French-I	20ULTFC1001 20ULHFC1001 20ULSFC1001 20ULFFC1001			6	3
Part-II	English	General English-I	20UGEFC1001			6	3
Part-III	Core Paper-I	Descriptive Statistics	20USTCT1001	4	2	6	3
	Core Paper-II	Probability and Random Variables	20USTCT1002			6	4
	Allied Paper-I	Mathematics-I	20USTAT1001			6	5
Part-IV	Soft Skill	Essentials of Language and Communication Skills	18USSLC1001			-	3
	Value Education	Environmental Studies	18UESVE1001			-	2
						30	23
SEMESTER-II							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-I	Language	Tamil-II/Hindi-II/Sanskrit-II/ French-II	20ULTFC2002 20ULHFC2002 20ULSFC2002 20ULFFC2002			6	3
Part-II	English	General English-II	20UGEFC2002			6	3
Part-III	Core Paper-III	Distribution Theory-I	20USTCT2003			6	4
	Core Paper-IV	Matrix Algebra	20USTCT2004	4	2	6	3
	Core Practical-I (Calculator based)	Core Practical-I	20USTCP2001		(2+2)	-	2
	Allied Paper-II	Mathematics-II	20USTAT2002			6	5
Part-IV	Soft Skill	Essentials of Spoken and Presentation Skills	18USSSP2002			-	3
	Value Education	Yoga and Wellness		-	-	-	2
						30	25

SEMESTER-III							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-I	Language	Tamil-III/Hindi-III/Sanskrit-III/ French-III				6	3
Part-II	English	General English-III				6	3
Part-III	Core Paper-V	Distribution Theory-II		4	1	5	3
	Core Paper-VI	Applied Statistics		4	1	5	3
	Allied Paper-III	Programming in C++		4	2	6	3
	Allied Practical-I (Lab based)	Programming in C++			2	-	2
Part-IV	NME	Data Analysis				2	2
						30	19
SEMESTER-IV							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-I	Language	Tamil-IV/Hindi-IV/Sanskrit-IV/ French-IV				6	3
Part-II	English	General English-IV				6	3
Part-III	Core Paper-VII	Statistical Inference-I		4	1	5	3
	Core Paper-VIII	Operations Research				5	4
	Core Practical-II (Calculator based)	Core Practical-II			3	-	2
	Allied Paper-IV	Numerical Methods				6	5
Part-IV	NME	Data Analysis				2	2
						30	22
SEMESTER-V							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-III	Core Paper-IX	Statistical Inference-II		5	1	6	4
	Core Paper-X	Design of Experiments		5	1	6	4

	Core Paper-XI	Regression Analysis		5	1	6	4
	Core Paper-XII	Stochastic Processes				6	4
	Core Elective-I (Lab based practical)	Data Analysis using R				6	5
	Core Practical-III (Calculator based)	Core Practical-III			3	-	2
Part-IV	Skill based Elective	SWYAM-MOOC Course relevant to the subject				-	3
						30	26
SEMESTER-VI							
PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
Part-III	Core Paper-XIII	Sampling Methods		5	1	6	3
	Core Paper-XIV	Statistical Quality Control		5	1	6	3
	Core Paper-XV	Demography		5	1	6	3
	Core Elective-II	Project				6	5
	Core Elective-III (Lab based practical)	Data Analysis using SPSS and MS-EXCEL				6	5
	Core Practical-IV (Calculator based)	Core Practical-IV			3	-	2
Part-IV	Computing Skills	SWYAM-MOOC Course relevant to the subject				-	3
						30	24

	No. of Courses	Total No. of credits
Part I (language)	4	12
Part II (English)	4	12
Part III		
CORE THEORY	15	52
CORE ELECTIVE	3	15
CORE PRACTICAL	4	8
ALLIED (THEORY & PRACTICAL)	4	20
PART IV (SKILL BASED)	4	12
NME/VALUE EDUCATION	4	8
OTHER ACTIVITY (Compulsory Sports)	-	1
TOTAL	38	140

**SDNB VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI-600044**

DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER I

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
20USTCT1001	Core Paper-I	Descriptive Statistics	4	3	40	60	100
20USTCT1002	Core Paper-II	Probability and Random Variables	6	4	40	60	100
	Core Practical-I	Core Practical-I	2	-	-	-	-
20USTAT1001	Allied Paper-I	Mathematics-I	6	5	40	60	100

SEMESTER I
CORE PAPER I - DESCRIPTIVE STATISTICS

TOTAL HOURS: 60

SUB CODE: 20USTCT1001

CREDIT: 3

L-T-H: 4-2-6

COURSE OBJECTIVES:

1. To provide an insight about the origin and application of statistics in various fields along with its limitations.
2. To provide in depth knowledge about types of data, data collection methods, organising data and presentation of data.
3. To explain various descriptive measures for extracting meaningful information from the data and their interpretation.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Explain various sources of Collecting data and discuss applications, scope & limitations of statistics.
CO2	Organize data in frequency distribution tables and compare different data sets using appropriate diagrams and graphs.
CO3	Explain, compare and interpret various measures of central tendency, dispersion, skewness and kurtosis.
CO4	Define correlation coefficient between two variables and prove its properties. Derive regression lines and prove the properties of regression coefficients
CO5	Explain association between attributes using various measures of association.

SYLLABUS

UNIT 1

(Total number of hours: 10)

Definition- scope of statistical methods and their limitations - Collection of data - Primary and secondary sources –measurement scales: nominal, ordinal, ratio and interval scale

UNIT 2

(Total number of hours: 10)

Classification and Tabulation – Diagrammatic and graphical representation - Bar diagrams – Pie diagram – Histogram – Ogives, Lorenz curves.

UNIT 3

(Total number of hours: 15)

Measures of location, dispersion, moments and measure of skewness and kurtosis for both grouped and ungrouped data.

UNIT 4

(Total number of hours: 15)

Simple correlation and regression : Introduction – Scatter diagram – Karl Pearson’s coefficient of correlation – Properties of correlation coefficients - Spearman’s rank correlation – Simple regression – Properties of regression coefficients

UNIT 5

(Total number of hours: 10)

Fundamental set of frequencies, consistency of data, conditions for consistency, contingency table, association of attributes - measures of associations – Yule’s coefficient of association – coefficient of colligation.

Note: Simple numerical problems from Units 3, 4 & 5 may be asked in sections A & B only.

TEXT BOOKS:

1. Freund, J.E. (2002): Mathematical Statistics with applications, Pearson Education.
2. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
3. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
4. Pillai, R.S.N and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd. New Delhi.
5. Sharma, J.K. (2009): Business Statistics , 2nd edition, Pearson Education.

BOOKS FOR REFERENCE:

1. Kapoor, J.N. and Saxena, H.C. (2002): Mathematical Statistics, S. Chand & Sons Pvt. Ltd., New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund’s Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

E-LEARNING RESOURCES:

1. <https://conjointly.com/kb/descriptive-statistics/>
2. <https://towardsdatascience.com/descriptive-statistics-f2beeaf7a8df>
3. <https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355/association-in-case-of-attributes>
4. <https://royalsocietypublishing.org/doi/pdf/10.1098/rspl.1899.0067>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	1	2	0	0
CO2	2	2	1	2	0	1
CO3	3	3	1	1	1	1
CO4	3	2	2	3	1	1
CO5	2	1	2	1	1	1
Average	3	2	1	2	1	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER I

CORE PAPER II – PROBABILITY AND RANDOM VARIABLES

TOTAL HOURS: 90

SUB CODE: 20USTCT1002

CREDIT: 4

L-T-H:6-0-6

COURSE OBJECTIVES:

1. To introduce the basic concepts in probability.
2. To develop the logical basis of probability theory
3. To demonstrate the skills necessary to solve practical problems in probability and random variables

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Apply fundamental concepts of probability of events, prove basic theorems and calculate probabilities by applying probability laws.
CO2	Understand and apply Conditional probability and proving its theorem based on conditional probability. To solve real life problems using these concepts.
CO3	Understand the concept of random variable and its types. Finding characteristics of the probability function corresponding to these types.
CO4	Understanding the concept of mathematical expectation and proving its properties. Introduce Chebychev's inequality when central limit theorem fails and to find actual probabilities.
CO5	Compute moments of probability distribution using different generating functions. Distinguish between various types of convergences and understand the basics.

SYLLABUS

UNIT 1

(Total number of hours: 18)

Random experiment, sample point, sample space, Classical and relative frequency approach to probability, Axiomatic approach to probability. Addition theorem of probability – simple problems. Boole's inequality.

UNIT 2

(Total number of hours:16)

Conditional probability, independence of events, multiplication theorem. Baye's theorem and its applications - simple problems.

UNIT 3

(Total number of hours:20)

Random variable - discrete and continuous, distribution functions, probability mass function, probability density function and their properties. Measures of location, dispersion, skewness and kurtosis for discrete and continuous variables. Joint – marginal and conditional distributions -stochastic independence - simple problems.

UNIT 4

(Total number of hours:18)

Mathematical Expectation - addition theorem and multiplication theorem - Properties of expectation - Variance of a random variable and its properties – correlation coefficient- Chebychev's inequality - conditional expectation - conditional variance –simple problems.

UNIT 5

(Total number of hours:18)

Moment generating function, characteristic function, Cumulant generating function – their properties – simple problems. Statement of uniqueness theorem - Definition of convergence in probability, convergence in distribution, and Weak Law of Large Numbers – Statement and meaning of Central Limit theorem.

TEXT BOOKS:

1. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
3. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
4. Lipshutz, S, Lipson, M & Jain, K. (2017): Schaum's Outlines Series on Probability.

BOOKS FOR REFERENCE:

1. Rohatgi, V.K. and Saleh, A.K.Md.E. (2002): An introduction to probability and Statistics, John Wiley and Sons.
2. Meyer, P.L.(1970) : Introduction to Probability and Statistical Applications, 2nd edition, Addison-Wesley.
3. Irwin Miller and Marylees Miller (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia
4. Sanjay Arora & Bansilal (1989): New Mathematical statistics, Meerat Publications, New Delhi.

E-LEARNING RESOURCES:

- <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>
- https://www.stat.pitt.edu/stoffer/tsa4/intro_prob.pdf
- <https://www.econometrics-with-r.org/2-1-random-variables-and-probability-distributions.html>
- <https://www.mathsisfun.com/data/random-variables.html>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	3	1	3	1
CO2	3	2	3	3	2	1
CO3	2	1	2	1	1	1
CO4	2	3	1	3	2	3
CO5	1	1	1	1	1	1
Average	2	2	2	2	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

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DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER II

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
20USTCT2003	Core Paper-III	Distribution Theory-I	6	4	40	60	100
20USTCT2004	Core Paper-IV	Matrix Algebra	4	3	40	60	100
20USTCP2001	Core Practical –I (Calculator Based)	Core Practical-I	(2+2)*	2	40	60	100
	Allied Paper-II	Mathematics-II	6	5	40	60	100

SEMESTER II
CORE PAPER III – DISTRIBUTION THEORY - I

TOTALHOURS: 90

SUB CODE: 20USTCT2003

CREDIT: 4

L-T-H: 6-0-6

COURSE OBJECTIVES:

1. To introduce basic discrete as well as continuous probability distributions and notions of probability models for data.
2. To apply the knowledge of probability and random variables course to study the properties of these probability distributions.
3. To familiarise students with genesis & applications of these basic probability distributions.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Identify suitable probability distribution of a random variable from its description
CO2	Write down the probability function, support and parameter space of the basic distributions.
CO3	Derive & compute moments of basic probability distributions.
CO4	Derive generating functions for basic probability distributions and derive moments using generating functions.
CO5	Prove various properties relating to basic probability distributions

SYLLABUS

UNIT 1

(Total number of hours: 18)

Discrete Uniform distribution – mean – Variance – First Four Moment – m.g.f – p.g.f; Bernoulli & Binomial distributions – Mean – Variance – Mode -m.g.f – p.g.f- cgf; Characteristic Function- Recurrence formula – additive property.

UNIT 2

(Total number of hours:18)

Poisson distribution – Mean – Variance – Mode – m.g.f – p.g.f- cgf; characteristic function – Recurrence formula – Additive Property – approximation of Binomial distribution to Poisson.

UNIT 3

(Total number of hours:19)

Geometric Distribution – Mean – Variance –Recurrence Formula – Memory less property – m.g.f – p.g.f; Negative Binomial distribution – Mean – Variance – m.g.f – Recurrence Formula – p.g.f – Reproductive Property.

UNIT 4

(Total number of hours:16)

Hyper-geometric distribution – Mean – Variance – approximation to binomial distribution - Multinomial Distribution –m.g.f.- correlation.

UNIT 5

(Total number of hours:19)

Continuous Uniform distribution - Mean – Variance – m.g.f – characteristic function – Normal Distribution – Mean – Variance – First Four Moments – Mode – Skewness – Kurtosis – m.g.f – c.g.f. - characteristic function – Linear Combination of Normal Variates – Reproductive Property.

BOOKS FOR STUDY:

1. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

BOOKS FOR REFERENCE:

1. Rohatgi, V.K. and Saleh, A.K. Md.E. (2002): An introduction to probability and Statistics, John Wiley and Sons.
2. Meyer, P.L.(1970) : Introduction to Probability and Statistical Applications, 2nd edition, Addison-Wesley.

E-LEARNING RESOURCES:

- <https://www.statisticshowto.com/discrete-probability-distribution/>
- <https://corporatefinanceinstitute.com/resources/knowledge/other/discrete-distribution/>
- https://saylordotorg.github.io/text_introductory-statistics/s08-02-probability-distributions-for-.html
- <https://sites.nicholas.duke.edu/statsreview/continuous-probability-distributions/>
- <https://www.statisticshowto.com/continuous-probability-distribution/>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	1	3	1	2	1
CO2	1	1	3	1	2	1
CO3	1	1	3	1	2	1
CO4	1	2	2	1	3	1
CO5	2	2	2	3	3	2
Average	1	1	3	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Graphic Visualisation of Probability models with changing parameter values using ONLINE probability function calculators
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts – using KAGGLE or MOODLE.

SEMESTER II
CORE PAPER IV – MATRIX ALGEBRA

TOTAL HOURS: 60

SUB CODE: 20USTCT2004

CREDIT: 3

L-T-H: 4-2-6

COURSE OBJECTIVES:

1. To introduce basic concepts of matrices and mathematical operations on matrices.
2. To solve the system of linear equations using matrices.
3. To familiarise with quadratic forms and its reduction to canonical forms.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Identify the types of matrices and perform the various matrix operations .
CO2	Compute rank of matrices using Elementary Transformations .
CO3	Solve linear systems of equations using matrices.
CO4	Determine Eigen values and Eigen vectors from characteristic equations.
CO5	Determine index and signature of quadratic forms by reducing QF to canonical form.

SYLLABUS

UNIT 1

(Total number of hours: 15)

Matrices – Operations on Matrices-Addition and its properties, Multiplication and its properties. Various types of Matrices- Basic types, Idempotent matrix, Periodic Matrix, Nil Potent matrix, Involutory matrix. Comparable matrices and Equal matrices- Symmetric and Skew symmetric matrix-Hermitian and Skew Hermitian Matrix. Orthogonal matrix and unitary matrix. Trace of square matrix- Transpose of a matrix.

UNIT 2

(Total number of hours: 15)

Determinant – properties-Singular & Non – singular Matrices. Invertible matrix -Inverse of a Matrix and its properties. Rank of a Matrix – Determinant method, canonical method, Echelon form and its Properties. Method of Matrix inversion.

UNIT 3

(Total number of hours: 12)

Linear Equations –Types- Non-homogeneous and homogeneous –consistency and condition for consistency – solution by Cramer’s rule and matrix method

UNIT 4

(Total number of hours: 12)

Characteristic equation, Eigen roots & vector – Properties. Cayley – Hamilton Theorem., Matrix inversion by Cayley-Hamilton Theorem.

UNIT 5

(Total number of hours: 6)

Quadratic forms: Definition– Types – linear transformations - Reduction of QFs to canonical forms – Index and Signature of QFs.

TEXT BOOKS:

1. Shanthi Naryanan (1993), A Text Book Matrices, S. Chand Publishing, New Delhi.
2. Vashishta A.R. (2014): Matrices, Krishna Prakashan Media (P) Ltd., Meerut, UP.
3. Gilbert, J et. al. (2010): Linear Algebra and Matrix Theory, Elsevier India.
4. Seymour Lipschutz, Marc Lipson et al(2017): Schaum's Outline of Linear Algebra, Sixth Edition, McGraw Hill.

BOOKS FOR REFERENCE:

1. Biswas, S. (2012): Textbook of Matrix Algebra, 3rd edition, Prentice Hall India Learning Private Limited.
2. Aggarwal, R.S. (1987): A text book on Matrices, 4th edition, S. Chand & Company (pvt) Ltd.
3. Spence, L.E, Insel, A.J. and Friedberg, S.H. (2019): Elementary Linear Algebra : A Matrix Approach, Second Edition, Pearson Publications.

E-LEARNING RESOURCES:

- <https://www.statisticshowto.com/matrices-and-matrix-algebra/>
- <https://sites.stat.washington.edu/adobra/classes/536/Files/week1/matrixfull.pdf>
- <https://ecampusontario.pressbooks.pub/linearalgebrautm/chapter/chapter-2-matrix-algebra/>
- <http://faculty.cas.usf.edu/mbrannick/regression/matalg.html>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	1	1	1	2	0
CO2	1	2	1	1	3	0
CO3	2	1	1	2	2	1
CO4	1	3	1	1	3	1
CO5	1	1	2	0	3	1
Average	1	2	1	1	3	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER I

CORE PRACTICAL (Calculator Based): CORE PRACTICAL – I

TOTALHOURS: 60

SUBCODE: 20USTCP2001

CREDIT: 2

L-T-H: 0-4-4

COURSE OBJECTIVES

1. To present the data in a consolidated form
2. To describe the univariate and Bivariate characteristics of the data set.
3. To perform matrix operations and arriving solutions to system of linear equations.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Construct frequency distribution and represent the data in diagrammatic and graphical form
CO2	Analyze the univariate data using various descriptive measures
CO3	Analyze the bivariate data and establish relationship between them
CO4	Analyze the qualitative data finding its association.
CO5	Identify the types of matrix find the solution to system of linear equations and its rank.

SYLLABUS

(Based on Descriptive Statistics, matrix Algebra & Distribution Theory – I)

1. Construction of univariate and bivariate distributions with samples of size not exceeding 200.
2. Diagrammatic and graphical representation of data and frequency distribution.
3. Cumulative frequency distribution – Ogives – Lorenz curve.
4. Measure of location and dispersion. (Absolute and relative)
5. Curve fitting by the method of least squares.
(i) $y=ax + b$ (ii) $y=ax^2 + bx + c$ (iii) $y=ae^{bx}$
6. Computation of correlation coefficient and regression lines for raw and grouped data. Rank correlation coefficient.
7. Construction of contingency table and testing the consistency of data.
8. Computation of various measures of associations of attributes.
9. Rank of a matrix of order $p \times q$ ($p, q < 4$).
10. Inverse of a non singular matrix – by
 - i. Sweepout method
 - ii. Cayley Hamilton theorem
11. Solution to system of linear equations.
12. Determination of characteristic roots and characteristic vectors of second and third order square matrices.
13. Drawing a Random sample from (i) Normal (ii) Binomial (iii) Poisson

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	1	2	2	2
CO2	3	3	2	2	2	2
CO3	3	2	2	2	1	1
CO4	2	2	2	2	1	1
CO5	2	1	2	2	1	2
Average	3	2	2	2	1	2

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DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER III

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Core Paper-V	Distribution Theory-II	4	3	40	60	100
	Core Paper-VI	Applied Statistics	4	3	40	60	100
	Allied Paper-III	Programming in C++	4	3	40	60	100
	Core Practical-II (calculator Based)	Core Practical-II	(1+1)	-	-	-	-
	Allied Practical-I (Lab Based Practical)	Programming in C++	2	2	40	60	100
	Part-IV NME	Data Analysis	2	2	40	60	100

SEMESTER III

CORE PAPER V – DISTRIBUTION THEORY - II

TOTAL HOURS: 60

SUB CODE:

CREDIT: 3

L-T-H: 4-1-5

COURSE OBJECTIVES

1. To introduce important continuous probability distributions and their properties.
2. To provide an understanding of transformation of random variables and derive probability distributions of transformed random variables.
3. To familiarise students with genesis, properties & applications of sampling distributions of chi-square, t and F.
4. To introduce the concept of Order Statistics & their functions and their pdfs and cdfs.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Identify various continuous probability distributions and their probability density function, support and parameter space
CO2	Derive & compute moments of various continuous probability distributions using pdfs and generating functions.
CO3	handle transformed random variables and derive associated distributions
CO4	Understand the concept of Sampling Distribution of a statistic and derive the three important sampling distributions along with their properties and applications
CO5	Define Order Statistics & derive the pdfs & cdfs of order statistics (their functions) from basic continuous distributions

SYLLABUS

UNIT 1:

(Total number of hours: 12)

Beta, Gamma, Exponential, Cauchy– Mean – Variance – M.G.F – distribution function – Properties (Both one & two Parameter).

UNIT 2:

(Total number of hours: 12)

Weibull, Log normal, Logistic distributions: Definition, Mean, variance, M.G.F – properties.

UNIT 3:

(Total number of hours: 12)

Sampling distributions – Sampling distributions of Chi-Square– derivation of its pdf,mgf – first four moments- properties – applications. Distribution of sample mean and variance from normal population.

UNIT 4:

(Total number of hours: 12)

Sampling distributions – Definition of t statistic - derivation of its pdf - first four moments – applications. Definition of F statistic - derivation of its pdf – mean and variance – applications. Inter relationship between t, F and Chi-square, Properties and applications.

UNIT 5:

(Total number of hours: 12)

Order statistics – distribution of first, n^{th} and i^{th} order statistics – joint distribution of r^{th} and s^{th} order statistics - distribution of median and range –simple problems.

BOOKS FOR STUDY:

1. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

BOOKS FOR REFERENCE:

3. Rohatgi, V.K. and Saleh, A.K.Md.E. (2002): An introduction to probability and Statistics, John Wiley and Sons.
4. Meyer, P.L.(1970) : Introduction to Probability and Statistical Applications, 2nd edition, Addison-Wesley.

E-LEARNING RESOURCES:

- https://personal.utdallas.edu/~d.sul/Econo1/Lec1_AppB.pdf
- <https://www2.stat.duke.edu/courses/Spring12/sta104.1/Lectures/Lec15.pdf>
- <http://www.math.sci.hokudai.ac.jp/~s.settepanella/teachingfile/Calculus/Calculus2/pagine/IntGB.pdf>
- https://web.williams.edu/Mathematics/sjmiller/public_html/372Fa15/handouts/GammaFnChapter_Miller.pdf

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	2	1	2	1
CO2	3	3	2	1	2	1
CO3	3	3	2	1	2	1
CO4	3	3	2	1	2	1
CO5	3	3	2	1	2	1
Average	3	3	2	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures/Online Lectures
- Chalk and Talk/ Google Jam Boards/ One Note or Microsoft Whiteboards
- Graphic Visualization of Probability models with changing parameter values using ONLINE probability function calculators
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts – using Google forms/Quizzizes/Kaggle.

SEMESTER III
CORE PAPER XI – APPLIED STATISTICS

TOTAL HOURS: 60

SUB CODE:

CREDIT: 3

L-T-H: 4-1-5

COURSE OBJECTIVES

1. To equip students with various forecasting techniques and knowledge on various statistical methods for analyzing time series data
2. Understanding and constructing various indices.
3. To know the statistical system of India.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO STATEMENT
CO1	Understanding of various components of time series and forecasting univariate variate time series data
CO2	Apply different methods of computing time series fitting models
CO3	Understanding various important concepts in forecasting and different approaches for modeling trend, seasonality and persistence.
CO4	Interpret and use a range of index numbers commonly used in the business sector and understand the basic structure of the consumer price index(CPI) and its construction.
CO5	Familiarize on the function of various statistical system.

SYLLABUS

UNIT 1: **(Total number of hours: 10)**

Time series – Concept – Components of time Series – Additive and multiplicative models – Measurement of trend – Moving average method – Least square method.

UNIT 2: **(Total number of hours: 15)**

Measurement of seasonal variations – Simple average method – Ratio to trend method – Ratio to moving average method – Link relative method – Variate Difference method

UNIT 3: **(Total number of hours: 10)**

Business forecasting – role of forecasting in Business – steps in forecasting – methods of forecasting – exponential smoothing, regression with time series data. Box-Jenkins methodology – steps only.

UNIT 4: **(Total number of hours: 15)**

Index Numbers – uses, classification of index numbers – Problems in the construction of index numbers – Methods of constructing index numbers – Unweighted index numbers – weighted index numbers, quantity index numbers and cost of living index numbers.

Fixed and chain base index numbers- base shifting, splicing and deflating of index numbers – Optimum test for index numbers – Time reversal test – factor reversal test.

UNIT 5: **(Total number of hours: 10)**

Official Statistics: Statistical System in India CSO, NSSO and National Statistical Commission (NSC) and its functions – Present structure of the Indian statistical system – Functions of a statistical system – Agricultural statistics – Industrial statistics – Trade statistics – Labour statistics – transport and Communication statistics.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, S.P (1999): Statistical Methods, Sultan Chand, New Delhi.
2. Kapoor, V.K and Gupta, S. C (2008): Fundamentals of Applied statistics, Sultan Chand & Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Agarwal, B.L. (1988): Basic Statistics, Wiley Eastern Ltd. New Delhi.
2. Croxton, F.E and Cowden, D.J (1984): Applied general statistics, Prentice Hall of India.
3. Hanke, J.E. and Wichern, D.W. (2007): Business Forecasting, eighth edition, Pearson education, Asia.

E-LEARNING RESOURCES:

- www.mospi.nic.in
- https://cmapskm.ihmc.us/rid=1052458821502_1749267941_6906/components.pdf
- <https://itfeature.com/time-series-analysis-and-forecasting/components-of-time-series>
- https://nios.ac.in/media/documents/SrSec318NEW/318_Economics_Eng/318_Economics_Eng_Lesson11.pdf

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	1	2	1	1	1
CO2	2	1	3	1	2	1
CO3	2	3	3	2	2	1
CO4	2	2	3	2	3	3
CO5	1	1	2	1	1	1
Average	2	2	3	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER III

ALLIED PAPER III – PROGRAMMING IN C++

TOTAL HOURS: 60

SUB CODE:

CREDIT: 3

L-T-H:4-2-6

COURSE OBJECTIVES

1. To provide an insight about the object oriented programming and structure of C++ language.
2. To provide in depth knowledge about identifiers, operators and built in functions.
3. To explain declaration and definition of functions, classes and objects, operator and function overloading and inheritance

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Understanding the basic concepts object oriented programming, features and components related to C++ programming language, and structure of C++ program.
CO2	Defining the Declaration and initialization of variables .various operators used like Arithmetic, Relational, Logical,& Assignment operators in C++ program
CO3	Using Control statements, conditional statements, branching and looping statements, arrays, etc. in C++ program,.Define and declaring a function and overloading a function
CO4	General form of declaring a class and objects, Member function inside and outside a class .Creation of objects, constructor and destructor.
CO5	Explain operator overloading and various types of inheritance.

SYLLABUS

UNIT 1:

(Total number of hours: 12)

Object-Oriented programming – advantages of OOP over procedure oriented programming – OOP language. What is C++? – features and applications of C++ - Source code and object code – C++ compilers – Features of iostream.h – Comments – Input/output using cin/cout, gets/puts , getchar/putchar and getc/putc.

UNIT2:

(Total number of hours: 12)

Character set – Tokens - Keywords – Variables (identifiers) - Declaration and initialization of variables – Reference variables – Constants (string, numeric, character and symbolic constants). Arithmetic operators – Relational operator – Logical operator – Assignment operator – Increment and decrement operators – mathematical functions.

UNIT3:

(Total number of hours: 12)

If statement – if...else statement – switch statement – while statement – do...while statement – for statement – break statement – continue statement – simple programs. Arrays – one dimensional array – Two dimensional arrays – strings – simple problems. Defining a function – Advantages of using a function – main function – return statement – Function overloading. Concept of structures and name space.

UNIT 4:

(Total number of hours: 12)

Class- General form of a class declaration – Creating objects – Accessing class members – Defining member functions outside/inside the class – Arrays within a class – Memory allocation for objects – Arrays of objects. Constructors and Destructors.

UNIT 5:

(Total number of hours: 12)

Operator Overloading and Type conversions .Inheritance - Single Inheritance - Multilevel Inheritance - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance. Exception handling - basics

NOTE: Students should be trained in writing Statistical Programs (mean , Median , variance , skewness , kurtosis , correlation , regression – only for Raw data .Matrix manipulation – addition, multiplication, trace and transpose). Programs can be asked in section C from the above list.

BOOKS FOR STUDY:

1. Balaguruswamy, E. (2001): Programming in C++, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Venugopal, K.R., Rajkumar Buyya and Ravishankar, T. (2006): Mastering C++, Tata McGraw Hill Publishing Company Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Hubbard, J. (1996): Programming with C++, Schaum's Outline series, McGraw Hill.

E-LEARNING RESOURCES:

- <http://www.cplusplus.com/>
- <http://www.learncpp.com/>
- <https://www.tutorialspoint.com/cplusplus/index.htm>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	1	1	1	2	1
CO2	2	2	1	2	1	1
CO3	3	3	3	3	3	2
CO4	2	3	3	3	3	2
CO5	3	1	2	1	1	1
Average	2	2	2	2	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Hands on training in understanding the syntax and simple programs.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER III

ALLIED PRACTICAL (Lab Based Practical) – PROGRAMMING IN C++

TOTALHOURS:30

SUB CODE:

CREDIT: 3

L-T-H: 0-2-2

COURSE OBJECTIVES

1. To train the students to have an exposure in writing a programming language.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Code and execute programs for univariate analysis for raw data
CO2	Code and execute programs to establish relationship between two variables
CO3	Code and execute programs using in built string and mathematical functions.
CO4	Code and execute basic operations on matrix and fitting of binomial and poisson distribution.

SYLLABUS

1. Find the Mean and Median of ungrouped data.
2. Find the Mean and Standard Deviation of ungrouped data.
3. Form the frequency distribution with k classes given N observations (k known).
4. Find the Skewness and Kurtosis of an empirical distribution.
5. Regression and correlation coefficients.
6. Counting number of characters (vowels/consonants) in a given word.
7. Checking if a given word is a palindrome.
8. Generation of Fibonacci series.
9. Matrix addition and subtractions.
10. Matrix Multiplication.
11. Inverse of a square matrix.
12. Fitting of binomial and Poisson distribution for the given frequency distribution and test the goodness of fit.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	2	1
CO2	3	2	3	3	1	2
CO3	1	2	1	3	2	2
CO4	2	2	2	2	2	1
Average	2	2	2	3	2	2

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CHENNAI-600044**

DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER IV

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Core Paper-VII	Statistical Inference-I	4	3	40	60	100
	Core Paper-VIII	Operations Research	5	4	40	60	100
	Core Practical-II (calculator Based)	Core Practical-II	(2+1)	2	40	60	100
	Allied Paper-IV	Numerical Methods	6	5	40	60	100
	Part-IV NME	Data Analysis	2	2	40	60	100

SEMESTER IV
CORE PAPER VII – STATISTICAL INFERENCE -I

TOTAL HOURS: 60

SUB CODE:

CREDIT: 3

L-T-H: 4-1-5

COURSE OBJECTIVES:

1. Identify the parameter of population and estimate the parameter various methods.
2. To obtain the Best estimator for decision making.
3. To understand the logic and framework of the inference of hypothesis testing.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Introduce the basic theory behind the development and assessment of statistical estimation techniques in areas of point estimation.
CO2	Obtain estimator with minimum variance and bound estimator using Cramer – Rao Inequality, Rao Blackwell theorem.
CO3	Understand and apply the various methods of estimation techniques and solving problem based on these techniques
CO4	Understand the concept of interval estimation and fixing the confidence interval of parameter of various distributions.
CO5	Understand the concept of test of significance and carryout test procedure for real life situation problem.

SYLLABUS

UNIT 1:

(Total number of hours: 14)

Point Estimation – Problem of Point Estimation – Properties of estimators – Consistency and Efficiency of an estimator. Sufficiency of a statistic – Neyman factorization theorem – simple problems.

UNIT 2:

(Total number of hours: 12)

Unbiasedness – Properties, MVUE, BLUE, Rao-Blackwell theorem – Sufficiency, Cramer Rao inequality – Theorem & proof - simple problems.

UNIT 3:

(Total number of hours: 10)

Methods of estimation: Method of moments, Method of Maximum Likelihood, Method of Minimum chi square, Method of modified minimum chi-square, Method of minimum variance – properties of estimators obtained by these methods - simple problems.

UNIT 4:

(Total number of hours: 11)

Interval Estimation – Confidence Interval for proportions, mean(s), variance and variance ratio based on chi square, student's t, F and Normal distributions.

UNIT 5:

(Total number of hours: 13)

Tests of significance: concepts, tests based on normal, t & F distributions – Proportion(s), Mean(s), Variance(s), paired data - mean, correlation and Chi square test - Association and Goodness of fit.

Note: No numerical problems should be asked from units 4 & 5.

BOOKS FOR STUDY:

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkatta.
2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.
4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.
5. M. Rajagopalan, P. Dhanavanthan(2012). Statistical Inference, PHI Learning Pvt. Ltd.,

BOOKS FOR REFERENCE:

1. Rohatgi, V.K. and Saleh, A.K.Md.E.(2002): An Introduction to Probability and Statistics, Wiley Eastern.
2. Speigal, M.R.(1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill.
3. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.
4. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

E-LEARNING RESOURCES:

1. <https://www.britannica.com/science/point-estimation>
2. <https://corporatefinanceinstitute.com/resources/knowledge/other/point-estimators/>
3. <https://www.statisticshowto.com/interval-estimate/>
4. https://nptel.ac.in/content/syllabus_pdf/111102112.pdf

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	1	1	1	1	1
CO2	2	2	1	1	1	1
CO3	3	3	1	1	2	2
CO4	2	3	2	3	3	3
CO5	1	2	2	3	3	3
Average	2	2	1	2	2	2

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

CORE PAPER VIII – OPERATIONS RESEARCH

TOTAL HOURS: 75

SUB CODE:

CREDIT: 4

L-T-H: 5-0-5

COURSE OBJECTIVES:

1. Identify and develop operational Research models from the verbal description of the real system
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Ability to understand and analyze managerial problems in industry to use the recourses more effectively.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Formulate Linear Programming Problem and solving them using graphical procedure and Simplex algorithm.
CO2	Acquire a skill on Transportation of goods to the various location with optimum cost and time.
CO3	Acquire a skill on the allocation of resources to activity to optimize cost and profit.
CO4	Give solutions to Games using Maximin- Minimax principles for pure and mixed strategies.
CO5	Design a project using a Network diagram & construct an optimum project completion time using CPM & PERT.

SYLLABUS

UNIT 1:

(Total number of hours: 15)

Introduction to OR- Linear programming problem – Formulation of LPP – Solving the LPP by graphical method – Solving the LPP by simplex method (degeneracy), Big M - Simple problems.

UNIT 2:

(Total number of hours: 15)

Transportation problem - obtaining initial basic feasible solutions by North west corner rule, least cost method, Vogel's approximation method - optimal solution by MODI method, degeneracy (concept only), maximization in transportation - Unbalanced transportation problem

UNIT 3:

(Total number of hours: 15)

Assignment problem – - balanced & unbalanced assignment problem- optimal solution by Hungarian method – maximization in assignment - prohibited assignments -Traveling salesman problem.

UNIT 4:

Game Theory – Two person zero sum games, the maximin & minimax principle, Mixed strategies, Graphical solution of $2 \times n$ and $n \times 2$ games, Dominance property.
Sequencing Problem –Introduction - 'n' jobs through 2 machines, 'n' jobs through 3 machines, 'n' jobs on m machines, two jobs on 'm' machines

UNIT 5:

(Total number of hours: 15)

Network analysis by CPM / PERT: Basic concepts – constraints in Network – construction of the network – Time calculations – Concepts of slack and float in network – Finding optimum project duration and minimum project cost

Note: Question paper can have 60% numerical problems and 40% theory questions.

BOOKS FOR STUDY:

1. Kanthi Swarup, Gupta, P.K. and Manmohan (2003): Operations Research . Sultan Chand & Sons
2. Sharma, J.K. (2008). Operations Research: Theory and Application, Third edition , McGraw-Hill
3. M. S. Bazara, H. D. Sherali, C. M. Shetty: Nonlinear Programming-Theory and Algorithms. Wiley, 3rd Edition, 2006.
4. A. Antoniou, Wu-Sheng Lu: Practical Optimization- Algorithms and Engineering Applications, Springer, 2007.

BOOKS FOR REFERENCE:

1. Taha, H.A. (2006): Operations Research, 7th edition, Collier MacMillan.
2. Hillier, F.S. and Liberman, G.J. (1980): Introduction to operations research, 3rd ed Sundaresan, V., Ganapathy Subramanian, K.S. and Ganesan, K. (2000): Resource Management Techniques, A.R. Publications, Tamil Nadu.
3. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition,2010.
4. Wayne L. Winston and M. Venkataramanan: Introduction to Mathematical Programming: Applications and Algorithms, 4th edition, Duxbury Press, 2002.

E-LEARNING RESOURCES:

1. www.openintro.org/stat/down/OpenIntroStatFirst.pdf
2. https://nptel.ac.in/content/syllabus_pdf/110106062.pdf

Mapping of CO with PSO:

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CO3	1	2	2	1	1	1
CO4	2	3	2	1	2	1
CO5	1	3	3	2	2	3
Average	2	3	2	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Solving problems based on the concept.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

ALLIED PAPER IV – NUMERICAL METHODS

TOTAL HOURS: 90

SUB CODE:

CREDIT: 5

L-T-H: 6-0-6

COURSE OBJECTIVES

1. To demonstrate knowledge of different numerical methods and to predict interpolation & extrapolation.
2. Be in a position to recall solutions to the system of linear and transcendental equations.
3. To investigate numerical integration using Trapezoidal and Simpson's rule.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Identify finite & divided differences with equal and unequal intervals & their properties.
CO2	Examine Newton's forward, backward, divided differences formula & Lagrange's formula & its inverse.
CO3	Examine Central difference interpolation using Gauss forward & backward, Stirling's, Bessel's, Everett's central difference formula.
CO4	Solve transcendental equations & linear equations using its various method.
CO5	Examine Numerical integration using the trapezoidal rule, Simpson's one third and three eighth rule.

SYLLABUS

UNIT 1

(Total number of hours: 20)

Finite differences – forward and backward differences operators E and delta, and their basic properties – interpolation with equal intervals – Newton’s forward and backward differences formulae - simple problems.

UNIT 2

(Total number of hours: 18)

Interpolation with unequal intervals – divided differences and their properties – Newton’s divided differences formula – Lagrange’s formula- simple problems.

UNIT 3

(Total number of hours: 17)

Central difference interpolation formula – Gauss forward and backward differences formulae – Stirling’s, Bessel’s, Everett’s central difference formula.

UNIT 4

(Total number of hours: 20)

Inverse interpolation – Lagrange’s method – simple problems – Solution to transcendental equations – bisection and Newton Raphson’s method. Solution to system of linear equations – Gauss elimination, Gauss Seidel method (up to four iterations only).

UNIT 5

(Total number of hours: 15)

Numerical integration – trapezoidal rule – Simpson’s one third and three eighth rule – simple problems.

BOOKS FOR STUDY:

1. Balasubramanian: Numerical Mathematics, Vol. I and II
2. Hilderbrand, F.B. (1987). Introduction to Numerical Analysis, Second Edition, Dover Publications.
3. Sastry, S.S. (2007): Introductory method of numerical analysis, 4th edition, Prentice Hall of India.

BOOKS FOR REFERENCE:

1. Gupta, P.P. and Malik, G.S. (2006): Calculus of finite differences and numerical analysis, 34th edition, Krishna publishers.
2. Kandasamy, P. (2009): Numerical Methods, 4th edition S. Chand & Sons.

E-LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/111/107/111107105/>
2. <https://www.math.ust.hk/~machas/numerical-methods.pdf>
3. http://www.scholarpedia.org/article/Numerical_analysis

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	1	1	1
CO2	2	3	3	1	2	1
CO3	2	3	3	1	3	1
CO4	2	3	2	1	3	1
CO5	1	2	2	1	3	1
Average	2	3	2	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem-solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

CORE PRACTICAL (Calculator Based): CORE PRACTICAL - II

TOTAL HOURS:45

SUB CODE:

CREDIT:2

L-T-H: 0-3-3

COURSE OBJECTIVES:

To provide hands on practical training on application of

- Statistical Inference Techniques to real world problems.
- Time Series Analysis & Index Numbers

COURSE OUTCOMES:

On successful completion of the course the students will be able to

	CO Statement
CO1	Fit appropriate probability distribution to the given observed dataset
CO2	Compute MLE & MoM estimates and Confidence Intervals for parameters of basic distributions
CO3	Apply appropriate tests of significance to a given problem and draw Inferences.
CO4	Measure various components of a Time Series for forecasting
CO5	Construct various types of Index Numbers for Comparison of prices between different time periods.

SYLLABUS

BASED ON CORE PAPERS

(Distribution Theory –I & II and Statistical Inference – I, Applied Statistics)

1. Estimation of parameters by method of moments (discrete and continuous distributions).
2. Estimation of parameters by method of maximum likelihood (discrete and continuous distributions).
3. Confidence intervals based on Normal, t, F and chi-square statistic.
4. Asymptotic and exact tests of significance with regard to population proportion(s), mean(s), variance, ratio of variances and coefficient of correlation, regression coefficients.
5. Independence tests by contingency tables of order $p \times q$ ($p, q=5$)
6. Chi-square test for Goodness of Fit (Fitting & testing) of distribution (i) Normal (ii) Binomial (iii) Poisson
7. Fitting of trend polynomials by method of least squares – linear, quadratic, exponential.
8. Methods of measuring trend – semi averages, moving average.
9. Measurement of seasonal variation – simple average, ratio to trend , ratio to moving average and link relative methods.
10. Measurement of random component – variate difference method.
11. Construction of Index numbers - Laspeyre's, Paasche's, Bowley's, Fisher's and Marshall-Edgeworth index numbers.
12. Fixed and Chain base index numbers, Cost of living numbers.
13. Base shifting, splicing and deflating of index numbers.

NOTE:

Candidates are required to answer any three questions out of five questions (Internal Marks: 20 Marks and External examination : 30 marks.)

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	3	2	2	2
CO5	3	3	3	2	2	2
Average	3	3	3	2	2	2

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DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER V

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Core Paper-IX	Statistical Inference-II	5	4	40	60	100
	Core Paper-X	Design of Experiments	5	4	40	60	100
	Core Paper-XI	Regression Analysis	5	4	40	60	100
	Core Paper-XII	Stochastic Process	6	4	40	60	100
	Core Elective-I (Lab Based Practical)	Data Analysis using R	6	5	40	60	100
	Core Practical-III (Calculator based)	Core Practical-III	(1+1+1)	2	40	60	100

SEMESTER V
CORE PAPER IX – STATISTICAL INFERENCE - II

TOTALHOURS: 75

SUB CODE:

CREDIT:4

L-T-H: 5-1-6

COURSE OBJECTIVES

1. To provide theoretical understanding of Statistical Inference procedures.
2. To carry out the test procedures and obtain the best test with minimum possible errors for any given null and alternative hypothesis.
3. Introduce main ideas and principles behind the non-parametric inference procedures.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO NO.	CO STATEMENT
CO1	Understand the basic concepts of testing of hypothesis and hypothesis testing when null and alternative is simple using N.P. Lemma.
CO2	Find UMPT when alternative is composite for various distributions. Identify one parameter exponential families of distributions and find monotone likelihood property.
CO3	Find best test using Likelihood Ratio Test when null and alternative may be simple or composite for mean and variance of Normal distribution.
CO4	Carryout the test procedure corresponding to distribution free tests with respect to Mean, Median, and Goodness of fit and one way ANOVA.
CO5	Understand Decision theory, Prior distributions – Baye’s risk. For fixed α and β fixing the sample size n fixing sample size n using Sequential Probability Ratio Test. Finding OC and ASN function for various distribution.

SYLLABUS

UNIT 1:

(Total number of hours: 12)

Testing of Hypothesis – Statistical Hypothesis – Simple and composite hypothesis, Null and alternative Hypothesis, Two types of errors, critical region, power of a test, Most powerful test – Neymann-Pearson lemma – Simple problems based on Binomial, Poisson, Uniform, Normal & exponential distributions.

UNIT 2:

(Total number of hours: 15)

Uniformly Most Powerful Tests – Power function and power curve – one parameter exponential family, Kerlin and Rubin theorem, Monotone likelihood Ratio property, UMP tests for the parameters of univariate Normal and Exponential distributions.

UNIT 3:

(Total number of hours: 18)

Likelihood Ratio Test (LRT) : Definition of LRT - Properties of LRT tests (Statements only) – LRT for the mean and LRT of the variance of univariate normal population – Test for equality of means of 2 independent univariate normal populations with common unknown variance – Test for equality of variances of 2 independent univariate normal populations.

UNIT 4:

(Total number of hours: 18)

Non-Parametric tests – sign test, Wilcoxon signed rank test, Median test, Mann-Whitney U test, Runs test- for randomness, Kolmogorov-Smirnov one sample and two sample tests and Kruskal-Wallis test.

UNIT 5:

(Total number of hours: 12)

Basic ideas on decision theory – Loss functions – Risk functions–Prior distributions – Bayes' Risk - simple problems based on Bayes' estimation.

Sequential Probability Ratio Test – Definition and properties of SPRT without proof, OC and ASN for Binomial, Poisson & Normal distributions – simple problems.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Daniel, W.W. (2005): A foundation for Analysis in health Sciences, John Wiley and Sons.
2. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
3. Hogg, R.V. and Craig, A.T. (1972): Introduction to Mathematical Statistics, third edition, Academic Press, USA.
4. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson EducationInc.
5. Rohatagi, V.K. (1976): An Introduction to Probability and Statistics, John Wiley & Sons. (for unit 5- Section 8.8 only)
6. M. Rajagopalan, P. Dhanavanthan(2012). Statistical Inference, PHI Learning Pvt. Ltd.,

BOOKS FOR REFERENCE:

1. Beaumont, G.P. (1980): Intermediate mathematical Statistics, Chapman and Hall, New York.
2. Gibbons, J. D. (1971): Nonparametric Statistical inference, McGraw- Hill Kogakusha ltd., New Delhi.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B.(1980): An outline of Statistical theory, Volume I, 6th revised edition, World Press limited, Calcutta.
4. Mood, A.M., Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of statistics, International student edition, McGraw Hill.

E-LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/111/105/111105043/>
2. <https://nptel.ac.in/courses/111/102/111102143/>
3. <https://web.stanford.edu/class/archive/stats/stats200/stats200.1172/Lecture01.pdf>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	2	1	1	2	1
CO2	3	3	3	1	3	2
CO3	2	2	3	1	1	1
CO4	3	3	3	2	2	1
CO5	1	2	1	1	2	1
Average	2	2	2	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER V
CORE PAPER X– DESIGN OF EXPERIMENT

TOTAL HOURS: 75

SUB CODE:

CREDIT: 4

L-T-H: 5-1-6

COURSE OBJECTIVES

1. To introduce basic concepts & Principles of designing of experiments.
2. To impart sound knowledge of Analysis for Variance Technique.
3. To impart sound knowledge on appropriate use of various experimental designs (CRD, RBD & LSD), draw statistical inferences and interpretation of results obtained.
4. To familiarise basic concepts of Factorial experiments its analysis using ANOVA technique.
5. To introduce analysis of covariance technique and Split plot designs.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Understand the Principles of Experimentation and Explain the methods of determination of experimental unit.
CO2	Identify type of classification of data and apply suitable Analysis of variance and perform post-hoc multiple comparison tests.
CO3	Use appropriate experimental designs (CRD, RBD & LSD) and carry out its analysis. Apply Missing plot technique and its estimation using Least square method.
CO4	Apply analysis of covariance technique in CRD and RBD with least square estimate. Analyse Split-Plot design in RBD layout.
CO5	Understand analysis of Factorial experiments using ANOVA technique and principles of confounding used in factorial experiments.

SYLLABUS

UNIT 1:

(Total number of hours: 15)

Principles of Experimentation: Replication, Randomization and Local Control; Size of experimental unit; Methods of determination of experimental units – Maximum curvature methods - Fairfield Smith's variance law.

UNIT2:

(Total number of hours: 15)

Analysis of Variance – Cochran's Theorem (Statement only), one-way, two-way classification (without interaction); Multiple range tests – Newman-Keuls test, Least significance difference test, Duncan's multiple range test & Tukey's test; Transformations – square root, angular, logarithmic.

UNIT3:

(Total number of hours: 15)

Completely Randomized design (CRD) and its analysis; Randomized Block Design (RBD) and its analysis; analysis of RBD with more than one but equal number of observations per cell; Latin Square Design (LSD) and its analysis.

UNIT 4:

(Total number of hours: 15)

Missing plot technique – Meaning, Least square method of estimating one missing observations in RBD and LSD; Analysis of covariance technique in CRD and in RBD with least square estimates only. Split plot design in RBD layout and its analysis.

UNIT 5:

(Total number of hours: 15)

Factorial experiments – Definition of 2^2 , 2^3 and 3^2 factorial experiments and their analysis; Principles of confounding – Partial and Complete confounding in 2^3 design;

NOTE: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Dass, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8th Edn. World Press, Kolkata.

BOOK FOR REFERENCE:

1. Federer, W.T. (1955): Experimental Design, Oxford & IBH publishing Co., New Delhi
2. Montgomery, D.C. (2005): Design and Analysis of Experiments, 5th edition, John Wiley and Sons inc.
3. Mukhopadhyay, P. (2005): Applied Statistics, Books and allied pvt ltd., Kolkata.
4. Snedecor, G.W. and Cochran, W.G. (1989): Statistical Methods, 8th edition, Iowa State University Press.

E-LEARNING RESOURCES:

- <https://nptel.ac.in/courses/111/104/111104075/>
- <http://www.stat.tugraz.at/courses/files/DoE.pdf>
- <https://statweb.stanford.edu/~owen/courses/363/lecture1.pdf>
- <https://faculty.franklin.uga.edu/dhall/sites/faculty.franklin.uga.edu.dhall/files/STAT8200-Fall13-lec1.pdf>
- <http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
Average	3	3	3	3	3	2

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER V

CORE PAPER XI – REGRESSION ANALYSIS

TOTALHOURS: 75

SUB CODE:

CREDIT:4

L-T-H:5-1-6

COURSE OBJECTIVES

1. Modeling any real life data
2. Obtaining best model
3. Predict and interpret models

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO STATEMENT
CO1	To know about partial and multiple correlation coefficients and also the inter relationship among simple, partial and multiple correlation coefficients.
CO2	To acquire sound knowledge about simple linear regression model (SLRM) with parameter estimation and tests for regression coefficients. Get an idea of analysis of residuals.
CO3	To learn about regression diagnostics, model adequacy checking, transformation of variables to achieve linearity and stabilize the variance and weighted least squares.
CO4	To study the multiple linear regression model (MLRM) and parameter estimation and testing also to know about generalized least squares.
CO5	Get an idea of general linear model (GLM) and test of hypothesis. Testing equality of regression coefficients and subsets of regression coefficients.

SYLLABUS

UNIT 1:

(Total number of hours: 15)

Partial and multiple correlation coefficients, relationships among simple, multiple and partial correlation coefficients – biserial correlation coefficients.

UNIT 2:

(Total number of hours: 20)

Simple linear regression model: Description of the data model – estimation of parameters by least square method and test of hypothesis – index of fit – predicted values and standard errors – evaluation of fit – analysis of residuals.

UNIT 3:

(Total number of hours: 10)

Effect of outliers in simple regression – model, adequacy and residual plots – deletion of data points – transformation of variables – transformation to achieve linearity – transformation to stabilize variance – removal of heterogeneity – principles of weighted least squares.

UNIT 4:

(Total number of hours: 20)

Multiple linear regression: Description of the Data model – properties of least squares estimators – predicted values and standard errors in multiple regression – generalized least squares.

UNIT 5:

(Total number of hours: 10)

Inference on GLM: Test of hypothesis on the linear model – Assumption about the explanatory variable – testing a subset of regression coefficient equals to zero – testing of equality of regression coefficients.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Kapoor, V.K. & Gupta, S.C. (2007): Fundamentals of mathematical statistics, Sultan Chand and Sons
2. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to linear regression analysis, third edition, John Wiley and Sons, Inc.

BOOKS FOR REFERENCE:

1. Draper, N.R. and Smith, H. (2003): Applied Regression Analysis, third edition, John Wiley and Sons, Inc.
2. Johnston, J. (1984): Econometric methods, third edition, McGraw-Hill International.

E-LEARNING RESOURCES:

- <http://home.iitk.ac.in/~shalab/regression/Chapter2-Regression-SimpleLinearRegressionAnalysis.pdf>
- http://educ.jmu.edu/~drakepp/FIN360/readings/Regression_notes.pdf
- <https://nptel.ac.in/courses/111/105/111105042/>
- <https://nptel.ac.in/content/storage2/courses/111104074/Module2/Lecture2.pdf>
- <https://nptel.ac.in/content/storage2/courses/111104074/Module3/Lecture8.pdf>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
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CO2	3	3	3	3	3	2
CO3	2	3	3	2	3	2
CO4	3	3	3	3	3	2
CO5	1	1	1	1	2	1
Average	2	2	2	2	3	2

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER V
CORE PAPER XII – STOCHASTIC PROCESSES

TOTAL HOURS: 90

SUB CODE:

CREDIT:4

L-T-P: 6-0-6

COURSE OBJECTIVES

1. Stochastic Processes & its classification through several examples
2. Markov Chains including the notion of transition probabilities
3. Various other stochastic processes such as Poisson process, birth and death processes, queuing process

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Identify a stochastic process & its classification and also identify the nature of dependence relation between members of the stochastic process
CO2	Obtain the transition probabilities (one step & higher order) of Markov chains and represent it using Markov Graphs.
CO3	Derive Poisson Process and prove the associated properties and apply them to solving problems.
CO4	Differentiate between Pure Birth & Birth-death Processes and Derive some special cases of each.
CO5	Understand elements of a queuing system & operating characteristics of a queuing system and derive & apply solutions of basic Queuing Models as an extension of Birth-Death process.

SYLLABUS

UNIT 1:

(Total number of hours: 20)

Definition of stochastic process, classification of stochastic process according to time parameter space and state space-examples of stochastic process. Concept of Stationary and independent increment process, definitions of strict sense and wide sense stationary processes - examples.

UNIT2:

(Total number of hours: 18)

Markov chain – definitions and examples – Markov Graphs - higher transition probabilities – Chapman – Kolmogorov equations (discrete) - classification of states of Markov Chains (definitions only), simple problems only.

UNIT3:

(Total number of hours: 15)

Poisson Process – Postulates – Properties – Related distributions – exponential, uniform, geometric and negative binomial distributions.

UNIT 4:

(Total number of hours: 17)

Pure Birth Process – Yule-Fury process – Birth and Death Process – Linear Growth process.

UNIT 5:

(Total number of hours: 20)

Queuing Theory – Introduction – elements of a queuing system –operating characteristics of a queuing system- classification of queuing models – definitions of transient state and steady state. Poisson models – M/M/1:∞/FIFO, and M/M/1:N/FIFO. (steady state solutions only)

BOOKS FOR STUDY:

1. Medhi, J. (2009): Stochastic Process, New age International, 3rd edition chapter1(1.5) Chapter 2(2.1, 2.2), chapter 3(3.1, 3.2, 3.3.3, 3.4), chapter10(10.1,10.2).
2. Veerarajan, T. (2003): Probability, Statistics and Random Processes, Second edition,Tata McGraw-Hill Publishing Company Ltd. , New Delhi.

BOOKS FOR REFERENCE:

1. Feller, W (1972), **Introduction to Probability Theory and its Applications, Volume I**, Wiley Eastern Ltd, New York.
2. Karlin, S. and Taylor, H.M. (1975): A First course in Stochastic Processes, Academic Press, New York.
3. Ross, S.M. (1983): Stochastic Processes, John Wiley and Sons, New York.

E-LEARNING RESOURCES:

- <https://www.stat.auckland.ac.nz/~fewster/325/notes/325book.pdf>
- <http://sarantsev.faculty.pstat.ucsb.edu/mydocs/notes.pdf>
- <http://ramanujan.math.trinity.edu/polofsson/teach/Book.pdf>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	1	2	1
CO2	3	3	3	1	2	1
CO3	3	3	3	1	2	1
CO4	3	3	3	1	2	1
CO5	3	3	3	1	2	1
Average	3	3	3	1	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures/Online Lectures
- Chalk and Talk/ Google Jam Boards/ One Note or Microsoft Whiteboards
- Graphic Visualization of Probability models with changing parameter values using ONLINE probability function calculators
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts – using Google forms/Quizzizes/Kaggle.

SEMESTER V

CORE ELECTIVE- I (Lab Based Practical): DATA ANALYSIS USING R

TOTALHOURS:90

SUB CODE:

CREDIT:5

L-T-H: 0-6-6

COURSE OBJECTIVES

1. To impart programming skills using R Language.
2. Apply the programming skills to the real life data and arrive solutions.
3. Arriving conclusions from the results.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Preparing data visualization in terms of various diagrams, graphs and tables.
CO2	Univariate measures – Measures of location, dispersion, Skewness and Kurtosis.
CO3	Bivariate and multivariate data and its analysis – correlation, regression and multiple linear regression and predictions
CO4	Test of significance for mean, variance, goodness of fit, test for associations and ANOVA
CO5	Explain Non parametric tests for mean, median test, test for randomness, Kolmogorov Smirnov and Kruskal Wallis test.

SYLLABUS

UNIT I

R language Essentials: Expressions and objects, Assignments, creating vectors, vectorized arithmetic, creating matrices, operations on matrices, lists, data frames – creation, indexing, sorting and conditional selection ; examples.

Unit II

R Programming: conditional statements – if and if else; loops – for, while, do-while; functions – built-in and user defined; Data entry – reading from text file, data editor; examples.

Unit III

Descriptive Statistics and Graphics: Obtaining summary statistics; generating tables; Bar plots, Pie charts, Box plots, Histogram; exercises.

Unit IV

Correlation: Pearson, Spearman and correlation; Regression – fitting, obtaining residuals and fitted values; one and two sample tests for mean and variance, association of attributes – one way and two way ANOVA.

BOOKS FOR STUDY

1. Michael J.Crawley (2007), The R Book, John Wiley and Sons Ltd.
2. Peter Dalgaard (2008), Introductory Statistics with R, 2 nd edition, Springer.
3. Sudha G. Purohit, Sharad D. Gore and Shilaja R. Desmukh (2009), Statistics Using R Language, Narosa, Chennai.
4. Brian S Everitt, Torsten Hothorn (2009), A Handbook of Statistical Analyses Using R, Chapman & Hall/CRC, Second edition, England.
5. John Verzani (2009), Using R for Introductory Statistics, Chapman & Hall/CRC, Ebook/pdf., UK.

Candidates are to answer any 4 out of 6 questions and all questions carry equal marks.

1. Diagrams – Simple bar, Pie diagram, Multiple bar diagram(clustered), Subdivided (stacked bar).
2. Frequency distribution – Univariate (categorical data, quantitative data), Bivariate (cross tabulation).
3. Graphs – Histogram, Box- Whiskers plot.
4. Measures of location, dispersion, skewness and kurtosis
5. Correlation coefficient - Scatter diagram, Karl-Pearson’s and Spearman’s rank correlation.
6. Simple Linear Regression
7. Multiple Linear Regression
8. Parametric tests – mean(s) and variance(s) (upto two populations)
9. Chi-square test for goodness of fit
10. Chi-square test for independent samples
11. ANOVA – one way and two way.
12. Nonparametric tests for one sample and Paired data - Sign test & Wilcoxon signed rank test
13. Nonparametric tests for two independent samples - Median test and Wilcoxon Mann Whitney test
14. Test for Randomness
15. Kolmogorov Smirnov one sample and two sample test
16. Kruskal Wallis test

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	1	1
CO2	2	3	3	2	1	1
CO3	3	3	3	2	2	1
CO4	3	3	3	2	2	1
CO5	2	2	3	2	1	1
Average						

PEDAGOGY (TEACHING METHODOLOGY):

- Power point presentation
- Formal face-to-face lectures/Online Lectures
- Chalk and Talk/ Google Jam Boards/ One Note or Microsoft Whiteboards
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.

SEMESTER V

CORE PRACTICAL (Calculator based): CORE PRACTICAL - III

TOTALHOURS:45

SUB CODE:

CREDIT:2

L-T-P: 0-3-3

COURSE OBJECTIVE:

1. To provide hands on practical training on application of
2. Statistical Inference Techniques to real world problems.
3. Analysis of Variance Techniques to draw inferences from data obtained from Designed experiments.
4. To provide hands on training to estimate the inference on partial and multiple correlation coefficients and fitting regression models.

COURSE OUTCOMES:

On successful completion of the course the students will be able to

	CO Statement
CO1	Identify the problem on hand and apply appropriate Parametric/ Non parametric tests for making meaningful inferences.
CO2	Compute size & power of a test and draw power curves
CO3	Analyse data from various designs viz. CRD, RBD, LSD & Factorial, using appropriate ANOVA technique.
CO4	Study the concept of coefficient of determination and inference on partial and multiple correlation coefficients and fitting regression models.

SYLLABUS

NOTE:

Five Questions are to be set without omitting any topic

Candidates are to answer any three questions without omitting any topic.

All questions carry equal marks.

Statistical Inference II:

1. Type I and Type II errors calculations – Binomial, Poisson & Normal distributions.
2. Most Powerful tests – Bernoulli, Poisson & Normal distributions.
3. Power Curves – Binomial, Poisson & Normal distributions.
4. Nonparametric tests – sign test, Wilcoxon signed rank test, median test, Mann-Whitney test, run test, Kolmogorov-Smirnov one sample and two sample tests and Kruskal-Wallis test.

Design of Experiments:

1. ANOVA – one & two way classification,
2. Analysis of CRD, RBD, LSD, their efficiencies, Missing plot techniques in RBD & LSD.
3. Analysis of covariance - one way classification with one concomitant variable.
4. Analysis of factorial experiments – 2^2 , 2^3 , with and without confounding and 3^2 factorial experiments.

Regression Analysis:

1. Multiple and Partial correlation coefficient.
2. Simple Linear regression model.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	2	2
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CO3	3	3	3	2	2	2
CO4	3	3	3	2	2	2
Average	3	3	3	2	2	2

**SDNB VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI-600044**

DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER VI

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Core Paper-XIII	Sampling Methods	5	3	40	60	100
	Core Paper-XIV	Statistical Quality Control	5	3	40	60	100
	Core Paper-XV	Demography	5	3	40	60	100
	Core Elective-II	Project	6	5	40	60	100
	Core Elective-III (Lab Based Practical)	Data Analysis using SPSS and MS-EXCEL	6	5	40	60	100
	Core Practical-IV (Calculator based)	Core Practical-IV	(1+1+1)	2	40	60	100

SEMESTER VI
CORE PAPER XIII – SAMPLING METHODS

TOTALHOURS: 75

SUB CODE:

CREDIT:3

L-T-H: 5-1-6

COURSE OBJECTIVES

1. Introduce to various statistical sampling schemes such as simple, stratified, systematic, and probability proportional to size (pps) sampling.
2. To provide an outline of conducting the sample surveys.
3. To synthesize appropriate sampling technique & sample size for a survey.
4. To classify and compare different sampling techniques.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Discuss, organize and execute the sample survey.
CO2	Identify a sample size & estimate the parameters of the population using simple random sampling with & without replacement.
CO3	Identify a sample size & estimate the parameters of the population using stratified random sampling and classify optimum and proportional allocations.
CO4	Identify a sample size & estimate the parameters of the population using Systematic sampling and compare simple & stratified with systematic random sampling
CO5	Inspect Ratio estimators & Regression estimator and discuss PPS sampling.

SYLLABUS

UNIT 1

(Total number of hours: 15)

Design – Organization and execution of sample surveys – principal steps in sample survey – Pilot survey – principles of sample survey – sampling and non-sampling errors – advantages of sampling over complete census – limitations of sampling.

UNIT 2

(Total number of hours: 15)

Sampling from finite population – simple random sampling with and without replacement – unbiased estimate of the mean, variance of the estimate of the mean, finite population correction – estimation of standard error from a sample – determination of sample size

UNIT 3

(Total number of hours: 15)

Stratified random sampling – properties of the estimates - unbiased estimates of the mean and variance of the estimates of the mean-optimum and proportional allocations – relative precision of a stratified sampling and simple random sampling – estimation of gain in precision in stratified sampling.

UNIT 4

(Total number of hours: 15)

Systematic sampling – estimate of mean and variance of the estimated mean – comparison of simple and stratified with systematic random sampling

UNIT 5

(Total number of hours: 15)

Ratio estimators: Definition – bias – variance of the ratio estimator – Comparison with mean per unit. Difference estimator – Regression estimator: Comparison with mean per unit. PPS sampling – concept only – cumulative method and Lahiri method.

BOOKS FOR STUDY:

1. Cochran, W.G. (1984): Sampling techniques, Wiley Eastern Ltd.
2. Daroga Singh, & Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs, Wiley Eastern.
3. Mukhopadhyay, P. (2005): Theory and methods of Survey Sampling, Prentice - Hall of India, New Delhi.

BOOKS FOR REFERENCES:

1. Des Raj (1976): Sampling theory, Tata McGraw Hill. Kapoor, V.K. & Gupta, S.C. (2008): Fundamentals of Applied Statistics, Sultan Chand and Sons.
2. Murthy, M.N. (1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.
3. Sampath, S. (2000): Sampling theory and methods, Narosa Publishing House
4. Sukhatme, P.V. *et al* (1984): Sample survey methods and its applications, Indian Society of Agricultural Statistics, New Delhi.
5. Kish, L. (1995): Survey Sampling, Wiley Classics Library edition

E-LEARNING RESOURCES:

- <https://www.sjsu.edu/people/fred.prochaska/courses/ScWk240/s1/Week-6-Slides---Sampling.pdf>
- https://www.researchgate.net/publication/319998246_Sampling_Methods_in_Research_Methodology_How_to_Choose_a_Sampling_Technique_for_Research
- <https://www.healthknowledge.org.uk/public-health-textbook/research-methods/1a-epidemiology/methods-of-sampling-population>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
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Average	3	2	3	2	1	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER VI

CORE PAPER XIV – STATISTICAL QUALITY CONTROL

TOTALHOURS:75

SUB CODE:

CREDIT:3

L-T-H: 5-1-6

COURSE OBJECTIVES

1. Use control charts to analyze for improving the process quality
2. Demonstrate the approaches and techniques to assess and improve quality in process and product control.
3. Illustrate the basic concept and techniques of modern reliability engineering tools

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Introduce the principles and techniques of Statistical Quality Control and their practical uses in product and process design and monitoring.
CO2	Draw different types of control charts for variables and attributes.
CO3	Understand the practical applicability of single and double sampling inspection plans.
CO4	Understand variable and sequential sampling inspection plans and to draw OC and ASN functions.
CO5	Get an idea of reliability and hazard function and how to discriminate among the important lifetime distributions based on hazard function.

SYLLABUS

UNIT 1:

(Total number of hours: 10)

Need for Statistical Quality Control techniques in Industry – Causes of Quality variation – seven dimensions of quality - control charts – Use of the Shewhart – control chart
– Specification and tolerance limits – 3sigma limits – warning limits –application of theory of runs in quality control – **Introduction to 6σ concepts.**

UNIT 2:

(Total number of hours: 20)

Control chart for variables – X bar chart, R chart, σ chart - purpose of the charts - Basis of sub grouping - plotting X bar and R results - determining the control limits - Interpretation of control charts X and R.

UNIT 3:

(Total number of hours: 20)

Control chart for attributes - purpose of the chart - p chart - np chart - construction of p and np chart - choice between chart for P and chart for np - construction of c-chart.

UNIT 4:

(Total number of hours: 15)

Acceptance sampling plans for attributes: Producer's risk and consumer's risk – concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN –single sampling plan and double sampling plans – OC, ASN, AOQ, ATI curves for single and double sampling plans

UNIT 5:

(Total number of hours: 10)

Variable sampling plans- Sigma known and sigma unknown - determination of n and k for one-sided specification – OC curve. Sequential sampling plan – Sequential Probability Ratio Test – OC, ASN function-working rule – binomial population only.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOKS FOR STUDY:

1. Gupta, R.C. (2003): Statistical Quality Control, Khanna Publication, New Delhi.
2. Kapoor, V.K. and Gupta, S.C. (2007): Fundamentals of applied statistics, Sultan
3. Mahajan, M. (1994): Statistical Quality Control.
4. Veerarajan T.(2003): Probability, Statistics and Random Processes, Second edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

BOOKS FOR REFERENCE:

1. Grant, E.L. and Leavenworth, R.S.(1988): Statistical Quality Control, 6th edition, McGraw Hill.
2. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, Wiley Eastern.

E-LEARNING RESOURCES:

- http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
- <http://www.gdcboysang.ac.in/About/droid/uploads/contents%20of%20UNIT%20iii-part%20%20A.pdf>
- <http://www.egyankosh.ac.in/bitstream/123456789/20753/1/Unit-1.pdf>
- https://endustri.eskisehir.edu.tr/ipoyraz/TKY302/icerik/text%20book_montgomery_6th%20edition.pdf
- <https://www.ets.org/Media/Research/pdf/RM-18-01.pdf>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	1	1	1	1
CO2	2	3	3	3	2	2
CO3	2	3	3	3	3	2
CO4	2	2	2	3	2	2
CO5	1	1	1	2	2	1
Average	2	2	2	2	2	2

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER VI
CORE PAPER XV - DEMOGRAPHY

TOTALHOURS: 75

SUB CODE:

CREDIT: 3

L-T-H: 5-1-6

COURSE OBJECTIVES

1. To examine measures of demographic data using fertility, mortality, and fecundity rates.
2. To inspect, construct and analyze the parameters of a complete and abridged life table.
3. To describe demographic data and explain its various registration system.
4. Compare and identify Population growth curves, population estimates, and projections.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Knowledge of determining and measuring population change, age & sex structure, and demographic cycle.
CO2	Inspect mortality, fertility & fecundity rates & to solve its different measures.
CO3	Acquire knowledge of Life Tables&Abridged Life Table – construction and examine different life table parameters.
CO4	Acquire knowledge of demographic data and relate it to Census, Civil Registration System, Sample Registration system & National Family Health Survey.
CO5	Knowledge of Population estimation and discuss its different mathematical measures of population estimation &component method.

SYLLABUS

UNIT 1

(Total number of hours: 15)

Demography: Definition and Meaning, Demographic determinants of population change: births, deaths, migrants, marriages – measures of population change: arithmetic, geometric and logistic measures – Age and sex structure - population pyramid –demographic cycle

Data Sources: Salient features - Census, Civil Registration System, Sample Registration system, National Family Health Survey – Errors in demographic data

UNIT 2

(Total number of hours: 15)

Mortality: Need to study mortality - measures of mortality: Crude Death Rate, Age-specific Death Rate, Cause Specific Death Rate- Direct and Indirect Standardization of Rates - merits and demerits-Mortality at Birth - Infant Mortality Rate - Different approaches to estimating Infant Mortality Rate- neonatal mortality rate- perinatal mortality rate- Simple problems with these rates

UNIT 3

(Total number of hours: 15)

Life Tables: Life Tables – Meaning, Significance, Structure and Components, Construction – relationships between the functions of a life table- force of mortality - central mortality rate- current and cohort life tables- structure and components of Abridged Life Tables

UNIT 4

(Total number of hours: 15)

Fertility and Reproduction: Need to study Fertility - Approaches to measure Fertility - Cohort Fertility and Period fertility, Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate

Fecundity: Meaning - Measures of Reproduction – Gross Reproduction Rate, Net Reproduction Rate - Simple problems with these rates.

UNIT 5

(Total number of hours: 15)

Population estimation and projection: intercensal estimates, postcensal estimates and projection - mathematical method: Linear, exponential, logarithmic and logistic, Gompertz curves - component method.

BOOKS FOR STUDY:

1. Gupta, S.C and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
2. RamKumar, R. (1986): Technical Demography, Wiley Eastern Limited.
3. Pathak, K.B. and Ram, F. (1992): Techniques of Demographic Analysis, Himalaya publishing House.

BOOKS FOR REFERENCE:

1. Gupta, S.C and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi.
2. RamKumar, R. (1986): Technical Demography, Wiley Eastern Limited.
3. Pathak, K.B. and Ram, F. (1992): Techniques of Demographic Analysis, Himalaya publishing House.

E-LEARNING RESOURCES:

1. www.censusindia.gov.in
2. www.rchiips.org

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	1	1	1	1
CO2	2	3	3	2	2	1
CO3	3	3	3	2	2	3
CO4	2	3	3	2	2	1
CO5	3	1	2	1	1	1
Average	3	2	2	2	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER VI
CORE ELECTIVE -II - PROJECT

TOTALHOURS: 75

CREDIT:5

SUB CODE:

L-T-H: 0-6-6

COURSE OBJECTIVES

1. To provide in depth knowledge about types of data, data collection methods, organising data and presentation of data.
2. To explain various descriptive and inferencial measures for extracting meaningful information from the data and their interpretation.
3. To use any of the software or programming language to analyse the collected data.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Use various sources of Collecting data and discuss applications, scope & limitations.
CO2	Organize data in frequency distribution tables and compare different data sets using data visualization methods.
CO3	Explain, various descriptive and inferencial measures for extracting meaningful information from the data and their interpretation.
CO4	Prepare a project report and sugest future work with respect to the topic chosen.

SEMESTER VI

CORE ELECTIVE III (Lab based Practical): DATA ANALYSIS USING SPSS & MS EXCEL

TOTALHOURS: 90

SUB CODE:

CREDIT: 5

L-T-P: 0-6-6

COURSE OBJECTIVES

1. To familiarize with Statistical Software SPSS and Ms-Excel
2. To orient the students to do data analysis using SPSS and Ms-Excel
3. Arriving conclusions from the results.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Preparing data visuvalization in terms of various diagrams, graphs and tables.
CO2	Univariate measures – Measures of location, dispersion, Skewness and Kurtosis.
CO3	Bivariate and multivariate data and its analysis – correlation, regression and multiple linear regression and predictions.
CO4	Test of significance for mean, variance, goodness of fit, test for associations and ANOVA. Explain Non parametric tests for mean, median test, test for randomness, Kolmogorov Smirnov and Kruskal Wallis test.
CO5	Perform basic operations on matrix, testing of hypothesis and Compute numerical integration using excel.

SYLLABUS

UNIT-I

1. Diagrams – Simple bar, Pie diagram, Multiple bar diagram(clustered), Subdivided (stacked bar).
2. Frequency distribution – Univariate (categorical data, quantitative data), Bivariate (cross tabulation).
3. Graphs – Histogram, Box- Whiskers plot.
4. Measures of location, dispersion, skewness and kurtosis
5. Correlation coefficient - Scatter diagram, Karl-Pearson's and Spearman's rank correlation.
6. Simple Linear Regression
7. Multiple Linear Regression
8. Parametric tests – mean(s) and variance(s) (upto two populations)
9. Chi-square test for goodness of fit
10. Chi-square test for independent samples
11. ANOVA – one way and two way.
12. Nonparametric tests for one sample and Paired data - Sign test & Wilcoxon signed rank test
13. Nonparametric tests for two independent samples - Median test and Wilcoxon Mann Whitney test
14. Test for Randomness
15. Kolmogorov Smirnov one sample and two sample test
16. Kruskal Wallis test

UNIT: 2

17. Matrix addition, subtractions and Multiplication.
18. Inverse of a square matrix
19. Fitting of Binomial and Poisson distribution for the given frequency distribution and test the goodness of fit.
20. Single and two sample 't' test, paired 't' test given a set of n observations.
21. F-test for testing the equality of two population variances given a set of n observations.
22. Numerical integration by Trapezoidal, Simpson's 1/3 and 3/8th rule
23. Solution of polynomial equations by Newton Raphson method.

BOOKS FOR STUDY:

1. George, D. and Mallery, P. (2006): SPSS for windows step by step 6th edition. Version 13.0, Pearson Education.
2. Pal, N. and Sarkar, S. (2005): Statistics- Concepts and applications, Prentice Hall India.

BOOKS FOR REFERENCE:

1. Clifford E. Lunneborg (2000): Data analysis by Resampling: concepts and applications, Duxbury Thompson learning, Australia.
2. Jeremy J. Foster (2001): Data Analysis using SPSS for Windows. New Edition. Versions 8-10. Sage publications. London.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	2	2	1
CO2	2	3	3	2	2	1
CO3	3	3	3	2	2	3
CO4	2	3	3	2	2	1
CO5	3	2	2	1	1	1
Average	3	3	3	2	2	1

SEMESTER VI

CORE PRACTICAL (Calculator Based): CORE PRACTICAL IV

TOTALHOURS: 45

SUB CODE:

CREDIT:2

L-T-P: 0-3-3

COURSE OBJECTIVE:

- 1.To provide hands on practical training on application of Statistical quality control to real world problems.
- 2.To provide practical knowledge of various sampling techniques
- 3.To provide practical knowledge of demography for population

COURSE OUTCOMES:

On successful completion of the course the students will be able to

CO	CO Statement
CO1	Get an idea of conducting the sample surveys and selecting appropriate sampling Techniques and knowledge about comparing various sampling techniques.
CO2	Identify various statistical sampling schemes such as simple, stratified, systematic and probability proportional to size (pps) sampling
CO3	Understand to draw different types of control charts for variables and attributes
CO4	Understand the practical applicability of using single sampling inspection plans and to draw OC, AOQ, ATI curves.
CO5	Compute Vital Statistics of a given Population and construct population pyramids. Fit appropriate Growth-Curves for predicting population growth.

SYLLABUS

NOTE:

- Five Questions are to be set without omitting any topic
- Candidates are to answer any three questions without omitting any topic.
- All questions carry equal marks.

SAMPLING:

1. Drawing random samples of size not exceeding 25 from Binomial, Poisson, Uniform, Cauchy, Normal and Exponential distribution with known mean and variance using random number tables.
2. Simple random sampling with and without replacement-estimation of population mean and variance.
3. Stratified random sampling-estimation of mean and variance under proportional allocation and optimum allocation, gain due to stratification.
4. Systematic sampling-estimation of mean and variance.
5. Ratio estimation-estimation for population mean and total based on simple random sampling only.
6. Regression method of estimation-estimation for population mean and total (simple random sampling only)
7. Probability proportional to size sampling-cumulative total method, Lahiri's method.

STATISTICAL QUALITY CONTROL:

1. Control charts for attributes and variables- \bar{x} -chart, R-chart, p, np, and C- charts.
2. OC, AOQ, ATI curves for single sampling plan.

DEMOGRAPHY:

1. Construction of population pyramid
2. Computation of Mortality and fertility rates.
3. Construction of life tables.
4. Fitting of growth curves- logistic, Gompertz.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	3	2	2	2
CO5	3	3	3	2	2	2
Average	3	3	3	2	2	2

SEMESTER – III and IV

Non Major Elective - DATA ANALYSIS

TOTAL HOURS: 30

SUB CODE:

CREDIT: 2 Credits

Hours for L-T-H:2-0-2

COURSE EDUCATION OBJECTIVES:

1. To provide an insight about the origin and application of statistics in various fields along with its limitations.
2. To provide in depth knowledge about types of data, data collection methods, organizing data and presentation of data.
3. To frame a questionnaire for the required project that suits the objective of the survey.

COURSE OUTCOMES: On successful completion of the course the students will be able to:

	CO Statement
CO1	Understand the application of statistics in various fields.
CO2	Understand the types of data and various methods of collecting the data.
CO3	Classify data and Visualize data through diagrams and graphs.
CO4	Prepare frequency distribution tables and compute basic measures of central value and dispersion.
CO5	Construct a questionnaire for primary data collection and perform exploratory data analysis.

SYLLABUS

UNIT 1

(Total number of hours: 6)

Definition of statistics, application of Statistics in various fields and limitations of Statistics. Types of measurement Scales- Nominal, Ordinal, Interval & Ratio

UNIT 2

(Total number of hours: 6)

Collection of data – Primary and secondary data. Methods of collecting primary data – direct and indirect interview method, mailed questionnaire method. Methods of collecting secondary data – Published and Unpublished sources.

UNIT 3

(Total number of hours: 6)

Classification of data – types – chronological, geographical, qualitative and quantitative. Presentation of data , Tabulation of data – rules of tabulation, types and parts of table. Diagrams – Types of diagrams – Simple Bar chart – Multiple bar charts – Pie diagram.

UNIT 4

(Total number of hours: 6)

Basic descriptive measures of Central Tendency- mean, median, mode and measures of dispersion- range, quartile deviation, standard deviation, concept of scatter plots, correlation – regression – only properties of these measures

UNIT 5

(Total number of hours: 6)

Questionnaire preparation (with a maximum of ten questions and a minimum sample size of 30) and exploratory data analysis on data from the questionnaire.

BOOKS FOR STUDY:

Sharma, J.K. (2009): Business Statistics , 2nd edition, Pearson Education.

BOOKS FOR REFERENCES:

Pillai, R.S.N and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd. New Delhi.

Mapping of Course Outcomes with Under Graduate Program Outcomes:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	3	2	1
CO2	3	2	3	3	2	1
CO3	3	2	3	3	2	1
CO4	3	2	3	3	2	1
CO5	3	2	3	3	2	1
Average	3	3	3	3	2	1

PEDAGOGY (Teaching methodology to be adopted for the classroom instructional hours)

- Formal face-to-face lectures
- Chalk and Talk/Online Mode
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

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DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER III & IV

ALLIED FOR B.Sc MATHEMATICS

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Allied	Mathematical Statistics -I	4	4	40	60	100
	Allied	Mathematical Statistics -II	4	4	40	60	100
	Allied Practical (Calculator based)	Mathematical Statistics-Practicals	(2+2)	2	40	60	100

SEMESTER III
ALLIED PAPER MATHEMATICAL
STATISTICS –I

TOTAL HOURS: 60

CREDIT: 4

SUB CODE:

L-T-H: 4-2-6

COURSE OBJECTIVES

1. To introduce the basic concepts in probability.
2. To develop the logical basis of probability theory.
3. To familiarise students with genesis & applications of these basic probability distributions

CO	CO Statement
CO1	Apply fundamental concepts of probability of events, prove basic theorems and calculate probabilities by applying probability laws. Simultaneously, to understand the conditional probability including the concept of Bayes' Theorem
CO2	Identify discrete & continuous random variables and their probability distributions and prove the associated properties.
CO3	Understand the knowledge related to concept of discrete random variable and its probability distribution including expectation and moments. Derive generating functions for basic probability distributions and derive moments using generating functions.
CO4	Define and Prove various properties relating to basic probability discrete distribution such as Uniform, Binomial, and Poisson.
CO5	Define and Prove various properties relating to basic probability continuous distributions normal, beta and gamma distributions.

SYLLABUS

UNIT 1:

(Total number of hours: 12)

Concept of sample space – Events, definition of Probability (classical, statistical & axiomatic) – addition and multiplication law of probability (for two events only) –independence – conditional probability – Bayes’ theorem - simple problems.

UNIT 2:

(Total number of hours: 13)

Random variables – discrete and continuous – distribution function – joint probability function – marginal and conditional distributions – independent random variables - simple problems.

UNIT 3:

(Total number of hours: 10)

Mathematical Expectation – addition and multiplication theorem – moments – Moment generating function – their properties. Chebychev’s inequality - simple problems.

UNIT 4:

(Total number of hours: 12)

Standard Distributions – Binomial, Poisson– mean, variance, mgf and recurrence formula; Normal – mgf- first four moments- properties(statement only).

UNIT 5:

(Total number of hours: 13)

Standard Distributions – Uniform; Gamma– mgf , mean, variance; Beta – I & II kind, mean, variance; Distribution of sum & ratio of gamma variates.

BOOK FOR STUDY:

1. Gupta, S.C. and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Arora, S. and Bansilal, (1989): New mathematical Statistics , Meerat Publications, Satya Prakashan , New Delhi
2. Hogg, R.V., McKean, J.W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

E-LEARNING RESOURCES:

- <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>
- https://www.stat.pitt.edu/stoffer/tsa4/intro_prob.pdf
- <https://www.econometrics-with-r.org/2-1-random-variables-and-probability-distributions.html>
- <https://www.mathsisfun.com/data/random-variables.html>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	3	1	3	1
CO2	3	2	3	3	2	1
CO3	2	1	2	1	1	1
CO4	2	3	1	3	2	3
CO5	1	1	1	1	1	1
Average	2	2	2	2	2	1

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV
ALLIED PAPER
MATHEMATICAL STATISTICS –II

TOTAL HOURS: 60

SUB CODE:

CREDIT: 4

L-T-H: 4-2-6

COURSE OBJECTIVES

1. To familiarise students with genesis, properties & applications of sampling distributions of chi-square, t and F.
2. Identify the parameter of population and estimate the parameter various methods.
3. To obtain the Best estimator for decision making.
4. To understand the logic and framework of the inference of hypothesis testing.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO	CO Statement
CO1	Understand the concept of Sampling Distribution of a statistic and derive the three important sampling distributions along with their properties and applications
CO2	knowledge of point and interval estimation procedures and different methods of point estimation and to understand the Cramer-Rao Inequality, Rao Blackwell theorem and their applications in obtaining Minimum Variance Unbiased and Minimum Variance Bound estimators.
CO3	Understand the concept of interval estimation and fixing the confidence interval of parameter of various distributions.
CO4	Understand the concept of test of significance and carryout test procedure for real life situation problem.
CO5	Applying the real life problems to demonstrate the small sample test and goodness of fit.

SYLLABUS

UNIT 1:

Exact sampling distribution: Chi square – definition – derivation of pdf, mgf, additive property. t and F – definition – derivation of pdf's – mean and variance.

UNIT 2:

Point estimation – properties of estimators – Neyman Fisher Factorization theorem, Rao-Blackwell theorem – Cramer-Rao inequality.

UNIT 3:

Methods of estimation – maximum likelihood, moments. Interval estimation – Confidence Interval for mean(s) , variance and ratio of variance based on Normal, t , Chi-square and F.

UNIT 4:

Test of significance – null and alternative hypothesis – type I and type II errors, power of the test, critical region - Standard Error – Large sample tests – proportion(s), mean(s)

UNIT 5:

Exact test based on t, Chi-square and F distribution with respect to population mean(s) and variance(s). Test of independence of attributes based on contingency table – Goodness of fit tests based on Chi-square.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

BOOK FOR STUDY:

1. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand and Sons Pvt. Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Arora, S. and Bansilal (1989): New mathematical Statistics, Meerat Publications, Satya Prakashan , New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.

E-LEARNING RESOURCES:

1. <https://www.britannica.com/science/point-estimation>
2. <https://corporatefinanceinstitute.com/resources/knowledge/other/point-estimators/>
3. <https://www.statisticshowto.com/interval-estimate/>
4. https://nptel.ac.in/content/syllabus_pdf/111102112.pdf

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	3	1	1	1	1
CO2	2	3	1	1	1	1
CO3	3	3	1	1	2	2
CO4	2	3	2	3	3	3
CO5	1	2	2	3	3	3
Average	2	3	1	2	2	2

PEDAGOGY (TEACHING METHODOLOGY):

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem-solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

ALLIED PRACTICAL (CALCULATOR BASED) : MATHEMATICAL STATISTICS-

PRACTICALS TOTALHOURS:30

SUB CODE:

CREDIT: 2

L-T-P: 0-2-2

COURSE OBJECTIVE:

1. To enhance computing skills by analyzing data using various statistical techniques.
2. Statistical Inference Techniques to real world problems.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO NO.	CO Statement
CO 1	Able to construct frequency distribution and represent the data in diagrammatic and graphical form.
CO 2	Analyze the data using various descriptive measures.
CO 3	Analyze the Correlation & regression lines
CO 4	Fit the appropriate distribution and testing its goodness of fit.
CO 5	Executing the test procedure for large & small sample and infer the data.

SYLLABUS:

1. Graphical representation - histogram(&mode), frequency curve and ogives (& median)
2. Measures of location- Mean, Median & Mode for raw and grouped continuous data
3. Measures of Dispersion – Range, Quartile Deviation & Standard Deviation for grouped continuous data
4. Measures of Skewness – Karl Pearson's & Bowley's.
5. Measures of Skewness & Kurtosis - moments for grouped continuous data
6. Correlation & regression lines – Univariate data
7. Fitting of Binomial, Poisson and Normal distributions and tests of goodness of fit.
8. Asymptotic and exact tests of significance (two tailed only) with regard to population proportion(s),mean(s), variance and ratio of variances.
9. Confidence Interval for population proportion(s), mean(s), variance and ratio of variances.
10. Test for independence of attributes based on contingency tables

Mapping of CO with PSO:

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CO 1	2	3	3	3	3	1
CO 2	2	2	3	3	3	1
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CO 4	3	3	3	2	2	2
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Average	3	3	3	2	2	2

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DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER III & IV

ALLIED FOR B.Sc COMPUTER SCIENCE

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Allied	Statistical Methods and its applications-I	4	4	40	60	100
	Allied	Statistical Methods and its applications -II	4	4	40	60	100
	Allied Practical-I (Calculator Practical)	Statistical Methods and its applications-practicals	(2+2)	2	40	60	100

SEMESTER III

ALLIED PAPER

STATISTICAL METHODS AND ITS APPLICATIONS - I

TOTALHOURS: 60

SUBCODE:

CREDIT: 4

L-T-P: 4-2-6

COURSE OBJECTIVES:

1. To provide an insight into the origin and application of statistics in various fields along with its limitations.
2. To provide in-depth knowledge about types of data, data collection methods, organizing data, and presentation of data.
3. To explain depth knowledge about the computation of conditional probabilities and probabilities based on Bayes theorem

COURSE OUTCOMES: On completion of the course the students will be able to

CO No.	CO Statement
CO1	Knowledge about various sources of Collecting data and discuss applications, scope & limitations of statistics.
CO2	Organize data in frequency distribution tables and compare different data sets using appropriate diagrams and graphs.
CO3	Examine, compare and interpret various measures of central tendency, dispersion, skewness and kurtosis.
CO4	Knowledge to conceptualize the probabilities of events & calculate the probability by applying probability law.
CO5	Knowledge related to the concept of random variables such & characteristics of basic distribution such as Binomial, Poisson, and Normal.

SYLLABUS

UNIT 1

(Total number of hours: 12)

Nature and scope of statistical methods and their limitations – Classification, tabulation and diagrammatic representation of various type of statistical data – Bar chart, Pie Chart and Histogram.

UNIT 2

(Total number of hours: 12)

Measures of location – arithmetic mean, median, mode – merits and demerits - simple problems. Frequency curve and Ogives – graphical determination of median and mode.

UNIT 3

(Total number of hours: 11)

Measures of dispersion-Range, mean deviation, quartile deviation, standard deviation, coefficient of variation, skewness and kurtosis - simple problems. Box and whisker plot, stem and leaf plot.

UNIT 4

(Total number of hours: 12)

Probability of an event – addition and multiplication theorem for two events – Independence of events – conditional probability – Bayes' theorem - simple problems.

UNIT 5

(Total number of hours: 13)

Concept of random variable – mathematical expectation – mean and variance – Moment generating function. Standard distributions: Binomial, Poisson – mean and variance, Normal distribution – properties only - simple problems.

Text books:

1. Gupta, S.P. (2005): Statistical Methods, Sultan Chand and Sons.
2. Pillai, R.S.N. and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd., New Delhi.

References:

1. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory Vol. I, 6th revised edition, World Press.

E-LEARNING RESOURCES:

1. <https://conjointly.com/kb/descriptive-statistics/>
2. <https://towardsdatascience.com/descriptive-statistics-f2beeaf7a8df>
3. <https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355/association-in-case-of-attributes>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	1	2	0	0
CO 2	1	2	1	2	0	2
CO 3	3	2	1	1	1	1
CO 4	2	2	3	1	0	3
CO 5	3	1	3	2	3	0
Average	2	2	2	2	1	1

PEDAGOGY

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

ALLIED PAPER

STATISTICAL METHODS AND ITS APPLICATIONS - II

TOTALHOURS: 60

SUBCODE:

CREDIT: 4

L-T-P: 4-2-6

COURSE OBJECTIVES:

1. To provide insight about bivariate data and its interpretation with prediction.
2. To understand the basic concepts of hypothesis testing and sampling distribution.
3. To carry out different test procedures.
4. To provide the knowledge about experimental designs to analyze the experimental data.

COURSE OUTCOMES: On completion of the course the students will be able to:

CO NO.	CO Statement
CO1	Knowledge about bivariate data - its graphical representation, quantifying its relationship & prediction.
CO2	Understand the basic concepts of Hypothesis testing and test procedure for large sampling.
CO3	Understanding the different test procedures and choosing the appropriate test & drawing a reasonable conclusion.
CO4	Knowledge to understand the basics of experimental data& to design the experiments using RBD, CRD & LSD.

SYLLABUS

UNIT 1

(Total number of hours: 12)

Correlation – Scatter diagram – Rank correlation coefficient – Regression lines – linear prediction – simple problems.

UNIT 2

(Total number of hours: 10)

Concept of Sampling Distribution – Standard error – type I and type II errors- level of significance -critical region. student-t, F, Chi square – definition – properties .

UNIT 3

(Total number of hours: 10)

Large sample tests – mean(s), proportion(s) and variance(s) - simple problems.

UNIT 4

(Total number of hours: 13)

Test of significance based on t, Chi-square and F distributions with respect to mean(s) and variance(s) – Test of independence in contingency table – Test of goodness of fit - simple problems.

UNIT 5

(Total number of hours: 15)

Non parametric test – K-S test. Principle of scientific experiments – Randomization, replication and local control. Basic designs –CRD,RBD, LSD (layout and ANOVA table).

Text books:

3. Gupta, S.P. (2005): Statistical Methods, Sultan Chand and Sons.
4. Pillai, R.S.N. and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd., New Delhi.

References:

3. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): An outline of Statistical theory Vol. I, 6th revised edition, World Press.
5. Montgomery, D.C. (2017). Design and analysis of Experiments, 9th Edition. John Wiley & Sons.

E-LEARNINGRESOURCES:

1. <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>https://www.stat.pitt.edu/stoffer/tsa4/intro_prob.pdf
2. https://nptel.ac.in/content/syllabus_pdf/111102112.pdf

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	2	2	3	1	1
CO 2	3	3	3	1	1	0
CO 3	2	1	3	0	0	0
CO 4	3	2	3	0	2	1
CO 5	3	2	3	3	3	2
Average	3	2	3	1	1	1

PEDAGOGY (Teaching methodology to be adopted for the classroom instructional hours)

- Formal face-to-face lectures
- Chalk and Talk
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes to assess the understanding of the concepts.

SEMESTER IV

ALLIED PRACTICAL (CALCULATOR BASED): STATISTICAL METHODS AND ITS APPLICATIONS - PRACTICALS

TOTAL HOURS: 30

SUB CODE:

CREDIT: 2

L-T-H: 0-2-2

COURSE OBJECTIVE:

1. To enhance computing skills by analyzing data using various statistical techniques.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO NO.	CO Statement
CO 1	Able to construct frequency distribution and represent the data in diagrammatic and graphical form.
CO 2	Analyze the univariate data using various descriptive measures.
CO 3	Fit the appropriate distribution and testing its goodness of fit.
CO 4	Executing the test procedure for large & small sample and infer the data.
CO 5	Analyze & interpret the experimental data using various design of experiment methods.

Syllabus:

1. Construction of univariate and bivariate frequency distributions with samples of size not exceeding 200.
2. Diagrammatic and graphical representation of various statistical data and frequency distributions.
3. Cumulative frequency distribution – Ogives.
4. Computation of various measures of location, dispersion (absolute and relative), moments, skewness and kurtosis.
5. Computation of correlation coefficient and regression lines for raw and grouped data. Rank correlation coefficient.
6. Fitting of Binomial, Poisson and Normal distributions and tests of goodness of fit.
7. Large sample tests - mean(s), proportion(s) and variance(s)
8. Exact tests of significance based on t, Chi-square and F distributions with regard to population proportion(s), mean(s), variance and coefficient of correlation.
9. Analysis of CRD, RBD and LSD.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	3	3	3	3	1
CO 2	2	2	3	3	3	1
CO 4	3	3	3	2	2	2
CO 5	2	2	3	1	1	2
CO 6	3	3	3	2	2	1
Average	2	3	3	2	2	1

**SDNB VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI-600044**

DEPARTMENT OF STATISTICS

COURSE FRAME WORK

SEMESTER IV

ALLIED FOR B.Sc Computer Science (with COGNITIVE SYSTEMS)

COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS	CREDITS	CA	SE	T
	Allied	Statistical Methods	4	4	40	60	100
	Allied Practical (Calculator based)	Statistical Methods - practicals	2	2	40	60	100

SEMESTER IV
ALLIED PAPER
STATISTICAL METHODS

TOTALHOURS: 60

CREDIT: 3

SUBCODE:

L-T-P: 4-0-4

COURSE OBJECTIVES:

1. To learn the fundamental concepts of statistical methods.
2. To solve in the different methods for numerical analysis.
3. To examine the past data and use mathematical equations.

COURSE OUTCOMES:

CO	CO STATEMENT
CO 1	Organize data in frequency distribution tables and compare different data sets using appropriate diagrams and graphs.
CO 2	Explain compare and interpret various measures of central tendency, Dispersion, Skewness and Kurtosis
CO 3	Define correlation coefficient between two variables and prove its properties. Derive regression lines and prove the properties of regression coefficient.
CO 4	An idea of conducting the sample surveys and selecting appropriate sampling techniques.
CO 5	Carry out one way and two way Analysis of Variance.

SYLLABUS

Unit- 1

[Total number of hours: 12]

Nature and scope of statistical methods and their limitations- classification, tabulation and diagrammatic representation of various types of statistical data- bar chart & pie chart-

UNIT-2

[Total number of hours: 12]

Measures of location- arithmetic mean, median and mode- merits and demerits- simple problem. Frequency curves and Ogives- graphical determination of median and mode.

Measures of dispersion – Range, mean deviation, quartile deviation, standard deviation, coefficient of variation, skewness and kurtosis- simple problem. Box plot

UNIT-3

[Total number of hours: 10]

Correlation scatter diagram- Rank correlation coefficient- Regression lines- linear prediction-simple problem.

UNIT-4

[Total number of hours: 12]

Concepts of sampling distribution- standard error-type I and type II errors- level of significance- critical region-test based mean and variance for large and small samples.

UNIT-5

[Total number of hours: 13]

Analysis of variance (ANOVA)- One way ANOVA and Two way ANOVA parameter estimation and ANOVA table.

Note: Numerical problems should not be asked in the question paper as this paper has a practical component.

TEXT BOOKS:

1. Freund, J.E. (2002): Mathematical Statistics with applications, Pearson Education.
2. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi
3. Gupta, S.P. (2005): Statistical Methods, Sultan Chand & Sons Pvt. Ltd. New Delhi.
4. Pillai, R.S.N and Bagavathi, V. (2003): Statistics, S. Chand and Company Ltd. New Delhi.
5. Sharma, J.K. (2009): Business Statistics , 2nd edition, Pearson Education.

1. BOOKS FOR REFERENCE:

1. Dr.P.R.Vittal, Allied Mathematics, Margham Publications, 2012.
2. P.Kandasamy, K.Thilagavathy, Gunavathy K, Numerical Methods, S CHAND & Co, 2015.
3. Ken Black- Applied Business Statistics –Wiley 2012.
- 4.Elements Of Mathematical Statistics, S.C.Gupta & V.K. Kapoor, Sultan Chand Publications Edition, 2014.

E-LEARNING RESOURCE

1. <http://data36.com/statistical-average-mean-median-mode>
2. <http://www.mathsisfun.com/data/standard-deviation.html/>
3. <http://www.randomservices.org/random>

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	1	2	0	0
CO2	3	3	1	1	1	1
CO3	3	2	2	3	1	1
CO4	1	2	1	2	0	0
CO5	3	3	3	3	3	2
Average	2	2	2	2	1	1

SEMESTER IV

ALLIED PRACTICAL (CALCULATOR BASED) : STATISTICAL METHODS -PRACTICALS

TOTAL HOURS: 30
CREDIT: 2

SUB CODE:
L-T-H: 0-2-2

COURSE OBJECTIVE:

1. To enhance computing skills by analyzing data using various statistical techniques.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO NO.	CO Statement
CO 1	Able to construct frequency distribution and represent the data in diagrammatic and graphical form.
CO 2	Analyze the univariate data using various descriptive measures.
CO 3	Understand bivariate data and obtain relationship and find prediction.
CO 4	Executing the test procedure for large & small sample and infer the data.
CO 5	Analyze & interpret the experimental data using one-way and two-way analysis.

Syllabus:

1. Construction of univariate and bivariate frequency distributions with samples of size not exceeding 100.
2. Diagrammatic and graphical representation of various statistical data and frequency distributions.
3. Cumulative frequency distribution – Ogives.
4. Computation of various measures of location, dispersion (absolute and relative), moments, skewness and kurtosis.
5. Computation of correlation coefficient and regression lines for raw data. Rank correlation coefficient.
6. Large and small sample tests - mean(s) and variance(s)
7. Analysis of Variance technique – One-way and two-way analysis.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	3	3	3	3	1
CO 2	2	2	3	3	3	1
CO 4	3	3	3	2	2	2
CO 5	2	2	3	1	1	2
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Average	2	3	3	2	2	1

Shrimathi DevkunvarNanalal Bhatt Vaishnav College for Women (Autonomous)
Re-accredited with “A+” Grade by NAAC

Amendments in the regulations from 2020 – 2021 onwards

UG -

Changes in Part-IV

Semester – I

Title	Internal Marks	External Marks	Credits
Soft Skills – Essentials of Communication Skills	50	-	3
Environmental Studies – For Day Students	50	-	2

Semester – II

Title	Internal Marks	External Marks	Credits
Soft Skills – Essentials of Spoken and Presentation Skills	50	-	3
Environmental Studies – For Self-Supporting Students	50	-	2
Yoga and wellness	50	-	2

Semester – III

Title	Internal Marks	External Marks	Credits
NME – Offered to other department students	50	-	2

Semester – IV

Title	Internal Marks	External Marks	Credits
NME – Offered to other department students	50	-	2

Semester – V

Title	Internal Marks	External Marks	Credits
Skill Enhancement course	50	-	3

Semester – VI

Title	Internal Marks	External Marks	Credits
Skill based Elective – Offered to students of same department SWAYAM – MOOC or other (For Non-Commerce Students) ArthaVidhya (For Commerce Students)	50	-	3