

SRI SAI RAGHAVENDRA (S.S.R.) DEGREE COLLEGE (AUTONOMOUS)

B.Sc. (CBCS) Statistics Syllabus (With Mathematics Combination only) with effect from Academic Year:2025-26 (First year)

Ye ar	Se m	Paper Code	Theory/ Practical	Paper Title	Cr ed its	H P W	IE Marks	SEE Marks	Total Marks
I	I	BS-101-T	Paper-I	Basic Statistics and Probability	4	4	30	70	100
		BS-101-P	Practical-I	Basic Statistical Analysis Lab using Excel & R	1	2	-	25	25
	II	BS-202-T	Paper-II	Probability Distributions	4	4	30	70	100
		BS-202-P	Practical-II	Probability Distributions Lab Using Excel & R	1	2	-	25	25
II	III	BS-303-T	Paper-III	Statistical Inference	4	4	30	70	100
		BS-303-P	Practical-III	Statistical Inference Lab using Excel & R	1	2	-	25	25
	IV	BS-404-T	Paper-IV	Analysis of Correlation, Regression and Basic Experimental Designs	4	4	30	70	100
		BS-404-P	Practical-IV	Analysis of Correlation, Regression and Basic Experimental Designs Lab	1	2	-	25	25
V	V	BS-505-T	Paper-V	Sampling Theory & Operation Research	4	4	30	70	100
		BS-505-P	Practical-V	Sampling Theory & Operation Research Lab	1	2	-	25	25
		BS-501-SEC	SEC-1	Skill Enhancement Course - I (University specified)	2	2	10	40	50
		BS-502-SEC	SEC-2	Skill Enhancement Course - 2 (Subject specified : Data Collection, Presentation and Interpretation)	2	2	10	40	50
		BS-501-MDC	MDC	Statistical Analysis	4	4	30	70	100
		BS-501-VAC	VAC	Value Added Course-I	3	3	25	50	75
VI	VI	BS-606-T	Paper-VI	Industrial Statistics	4	4	30	70	100
		BS-606-P	Practical-VI	Industrial Statistics	2	2	-	25	25
		BS-603-SEC	SEC-3	Skill Enhancement Course – 3 (University Specified)	2	2	10	40	50
		BS-604-SEC	SEC-4	Skill Enhancement Course - 4 (Subject specified : Data Scaling Techniques and ReportWriting)	2	2	10	40	50
		BS-602-VAC	VAC	Value Added Course-2	3	3	25	50	75
		BS-601	Internship	Data Analysis Project	4	8	30	70	100

- Note:**
1. No. of credits = No. of theory hours for teaching = twice the no. of credits for practical teaching
 2. Skill Enhancement Courses (SEC) are offered for Statistics students in Semester –V & VI with continuation (offered) for who are willing improve the practical skills in conducting of election forecasts/exit polls surveys
 3. Multi-disciplinary course and value added courses are offered in final year
 4. Optional paper course is offered if statistics students are willing to opt

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Course Objectives:

1. Able to compute and analyze the data sets (with different measurement of scales of variables in data sets, nominal, ordinal, interval, ratio scales) based descriptive statistics like: Central tendencies, Dispersions, Moments, Skewness and Kurtosis.
2. Able to familiar in to prepare the Basic descriptive statistical report using descriptive.
3. Strong foundations on the computation of the probability for the events and usage of addition, multiplication and Bayes theorems for probability computation, where ever the situation occurs.
4. Understanding the concept of one and two-dimensional random variable(s), probability mass/density distribution functions and their properties and transformation of one/ two dimensional random variables.
5. Understanding the procedure of evaluation Central and Non-central Moments for the random variables and also its evaluation from various generating functions.


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B.Sc. I.YEAR, I.SEMESTER SYLLABUS

BS-101-T: Paper-I: BASIC STATISTICS AND PROBABILITY

[4 HPW :: 4 Credits :: 100 Marks (SEE:70 &IE:30)]

UNIT.I

Basic Statistics: Definitions, Measures, Properties and Importance of Central tendencies, Dispersions, Absolute and Relative measures of dispersions, Central and Non-central moments, Skewness and kurtosis and their inter-relationships and computations to the raw and grouped data and data sets. Usage in the domains of image analysis, pattern recognitions, preparation of descriptive statistical analysis report based on the above descriptive statistics

UNIT.II

Probability: Basic concepts used for defining probability, Mathematical, Statistical and Axiomatic definitions of probability, their merits and demerits. Marginal, Joint and Conditional probabilities and independence of events, Multiplication & Addition theorems for 'n' events, Boole's inequality and Bayes' theorem, Problems on computation of Probability and including the usage of theorems

UNIT-III

Random Variables: Definition of random variable, discrete and continuous random variables, functions of random variables, probability mass, density and distribution functions with their properties and simple problems and illustrations. Notion of bivariate random variable, bivariate distribution, statements of its properties, Joint, marginal and conditional distributions, Independence of random variables. Transformation of one and two-dimensional random variable(s), simple problems on transformation of the random variable(s).


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UNIT-IV

Mathematical Expectation: Mathematical Expectation, a random variable, function of a random variable, Computation of raw and central moments, covariance using mathematical expectation with examples, Addition and multiplication theorems of expectation. Generating function, Definitions of moment generating function (MGF), cumulant generating function (CGF), probability generating function (PGF) and characteristic function (CF), their basic properties, applications and computation of those for simple probability functions, Moment inequalities: Chebyshev's and Cauchy-Schwartz's inequalities and their applications.

Course Outcomes

1. Able to analyse the data sets by choosing appropriate statistical technique either manually or using Excel & R and preparing basic statistical reports
2. Able to compute the probability using counting methods/appropriate probability theorems.
3. Able to evaluate the distribution function from probability mass/density functions and vice versa and also evaluation of probability function for the transformations of random variables
4. Able to evaluate the Moments MGF, CGF, PGF and CF for the random variables and evaluation of Moments from the generating functions (MGF, CGF and CF)
5. Able to identify the realtime applications in various domains like Finance. Business, insurance, clinical, medical, health, biosciences, engineering and technology, etc.

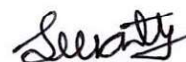
List of Reference Books:

1. V, K. Kapoor and S. C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Sanjay Arora and Bansilal : New Mathematical Statistics, Satya Prakashan New Delhi.
3. William Feller: Introduction to Probability theory and its applications, (Vol-I), Wiley.
4. S.P. Gupta: Statistical Methods, S Chand, New Delhi.


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B.Sc. I.YEAR, I.SEMESTER SYLLABUS

BS-101-P: Practical-I:

BASIC STATISTICAL USING EXCEL & R

[2HPW :: 1 Credits :: 25 Marks]

Basics of EXCEL : Excel- Data entry, editing and saving, establishing and copying formulae, creation of filters, sorting data, creation of databases usage of mathematical, statistical built in functions in excel. copy and paste and exporting to MS word document. Writing formulas for computation, drawing diagrams.

Basics of R-programming: Installation of R & R-studio, data importing / exporting, Basic Mathematical and statistical functions, writing simple programs and libraries/ usage packages.

1. Data Visualization Techniques (Histogram, Frequency curves & Polygon, Ogive curves, Bar (Simple, Component, Multiple, Percentage Bars) and Pie (Simple & multiple).
2. Computation of Central Tendencies, Dispersions, Moments (non-central and central).
3. Computation of coefficients of Skewness and Kurtosis.
4. Preparation of Statistical Analysis Report based on the descriptive statistics.

Note:

1. Each student has to spend minimum 15 weeks x 2 hours per week : 30 hours to practice on the system with the required software is mandatory.
2. Practice also be done on data sets available in web sources: www.kaggle.com, <https://iee-dataport.org> datasets, <https://data.world/datasets/link>, <https://archive.rcs.uci.edu>, Few selected data sets are : Fishers Iris data set, heart failure clinical records, cancer, Mental Health Dataset, Indian Food Dataset, water-quality-1, etc.).
3. Establishing formulae in Excel cells and deriving the results and also usage existing Excel statistical Functions in Excel.
4. Able to write an R-program for evaluation and also usage of libraries/ packages in R.
5. Maintaining the Practical records is mandatory and without records candidates are not allowed to attend practical examination.
6. Answer any two out of four choosing at least one from each section of Excel and R having two questions in each.

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B.Sc. I.YEAR, I.SEMESTER SYLLABUS

BS-201-T: Paper-II: PROBABILITY DISTRIBUTION

[4 HPW :: 4 Credits :: 100 Marks (SEE:70 & IE:30)]

Course Objectives:

1. Able to choose/ identify an appropriate standard probability distribution to fit the data.
2. Able to know and derive the properties of standard probability distributions (discrete and continuous) and knowing perfectly on the usage of each probability distribution in different domains.
3. Able to understand the concept of sampling distributions.
4. Able to understand the exact sampling distributions, their properties and applications.

UNIT.I

Discrete distributions: Discrete Uniform and Bernoulli distributions: definitions, mean, variance and simple examples. Binomial, Poisson, Negative-Binomial and Geometric distributions: Physical conditions. derivation of probability mass functions, central and moments up to fourth order, Median, mode, MGF, CGF, PGF, CF. nature of the curve and, reproductive property (wherever exists) special properties if any and real-life applications in various domains and probability problems related to these distributions. Poisson approximation to Binomial distribution, Poisson approximation to Negative binomial distribution'

UNIT-II

Hyper-geometric distribution: definition, real life applications, derivation of probability function, mean, variance. Binomial approximation to Hypergeometric distribution.

Continuous distributions: Rectangular and Normal distributions - definition, properties such as MGF, CGF, CF. and moments up to fourth order, reproductive property, wherever exists and their real-life applications. Normal distribution as a limiting case of Binomial and Poisson distributions.

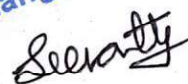
UNIT.III

Exponential, single and two parameter Gamma distributions: Definition, Moments up to fourth order, MGF, CGF, CF, reproductive property (wherever exists), nature of the curves and their real-life applications special properties (if any) and problems. Beta distribution of two kinds: Definitions, mean and variance, nature of the curve, special properties (if any) & applications. **Cauchy** distribution :Definition, nature of the curve, derivation of density, CF. and its special properties and its statistical significance


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UNIT-IV

Exact Sampling Distributions: Concepts of Population, Parameter, sample, Statistic, Sampling distribution and Standard error. Standard errors for various statistics. Exact sampling distributions: χ^2 , t and F, Definitions, curves and properties of distributions and their interrelationships. independence of sample mean and variance in random sampling from normal distributions.

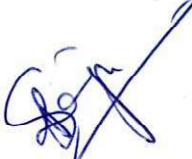
Course Outcomes

1. Able to evaluate the probability analyses the datasets by choosing appropriate statistical tool and preparing basic statistical report
2. Able to compute the probability using the counting methods. appropriate probability theorems
3. Able to evaluate the distribution function from probability mass /density functions and vice versa and also evaluation of probability function for the transformation of random variables
4. Able to evaluate the Moments, MGF, CGF, PGF and CF for any probability function
5. Able to identify the real time applications for each distribution in various domains like Finance, business, Insurance, clinical, medical, health , bio sciences, engineering and technology etc.

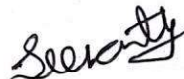
List of Reference books:

1. V.K. Kapoor and S.C. Gupta : Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
2. Sanjay Arora and Bansilal : New Mathematics Statistics, Satyaprakasan, New Delhi
3. William Feller; Introduction to probability theory and its applications (Vol-I) Wiley
4. Goon, A.M. Gupta and M.K. Das Gupta B; Fundamentals of Statistics, (Vol-I) The World Press Pvt Ltd., Kolkata


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B.Sc. I.YEAR, I.SEMESTER SYLLABUS

BS-202-P: Paper-II(Practical)

PROBABILITY DISTRIBUTION USING MS-EXCEL & R

[2HPW :1 Credits :25 Marks]

Topics to be Covered

1. Fitting of Binomial distribution (Direct and Recurrence Relation methods)
2. Fitting of Poisson distribution (Direct and Recurrence Relation methods)
3. Fitting of Negative Binomial (Direct and Recurrence Relation methods)
4. Fitting a Geometric Distribution
5. Fitting of Normal Distribution (Areas and ordinates method)
6. Fitting of Exponential distribution
7. Fitting of Cauchy distribution
8. Generation of random samples from Uniform (0,1) and Uniform (a, b) distributions
9. Generation of random samples from Binomial, Poisson, Negative Binomial Distributions
10. Generation of random samples from Normal and Exponential distributions

Note:

1. Each student has spend minimum 15 weeks x 2Hrs per week = 90 Hours to practice on the system with the required software is mandatory
2. Establishing Formulae in excel cells and deriving the results and also usage existing statistical functions in Excel
3. Writing R-program for evaluation and usage of libraries in R
4. Maintaining the practical records is mandatory and without records candidates are not allowed to attend practical examination
5. Answer any two out of four questions selecting at least one from each section of Excel and R having two questions in each


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B.Sc. II -YEAR, III - SEMESTER SYLLABUS BS-303 -T: Paper-III (Theory): STATISTICAL INFERENCE [4 HPW:: 4 Credits :: 100 Marks (External:70, Internal:30)]

Course Objectives:

1. Able to evaluate and familiar to estimate the parameter (if exists) for the any standard probability distribution(s) using methods of maximum likelihood and method of moments, and estimation of parameters using method of least squares.
2. Able to examine the estimator satisfies the criteria of good estimation (Consistency, unbiasedness, sufficiency) for standard distributions.
3. Able to evaluate and familiar the confidence interval estimates for the parameter using pivot method.
4. Framing statistical hypothesis and knowing the statistical test procedure.
5. Identifying the suitable large/ small sample parametric/ non parametric tests among the basic statistical tests.

UNIT-I

Point and Interval Estimation: Review on Sampling distributions; exponential family of distributions Point estimation of a parameter, concept of bias and mean square error of an estimate. Criteria of a good estimator. Consistency (Definition, necessary conditions, problems); Unbiasedness (Definition, Median modal unbiasedness necessary conditions, problems).

UNIT-II

Sufficiency: Definition, properties, Statement of Neyman's Factorization theorem, one parameter exponential family, computation of sufficient statistics in case of Binomial, Poisson, Normal and Exponential (one parameter only) distributions. **Methods of Estimation:** Method of Moments and Method of Maximum likelihood estimation (MLE); their properties and computation for standard probability distributions (if exists), statements of asymptotic properties of MLE. Method of least squares, Concept of interval estimation. Confidence intervals of the parameters of normal population by Pivot method.

UNIT-III

Testing of Hypothesis: Concepts of statistical hypotheses, Statement and Proof of Neyman-Pearson's fundamental lemma for Randomized tests. Examples in case of Binomial, Poisson, Exponential and Normal distributions and their power of the test functions. **Large sample tests:** Tests for single sample mean, difference of means, single sample proportion, difference of proportions and difference of standard deviations. **Order statistics:** Definition, statements of their distributions and applications.

UNIT-IV

Small sample Tests: Tests for single sample mean, variance, difference of means (independent and related samples), equality of variances, Test for goodness of fit and independence of attributes.

Non-parametric tests: Advantages and disadvantages, comparison with parametric tests. Use of Central Limit Theorem for normal approximations. Single sample Sign test and Runs test, Wilcoxon-signed rank


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test (single and paired samples). Two independent sample tests: Median test, Wilcoxon –Mann-Whitney U test, Wald Wolfowitz's runs test.

Course Outcome:

1. Familiar to estimate the parameter (if exists) for the any standard probability distribution(s) using methods of maximum likelihood and method of moments, and estimation of parameters using method of least squares.
2. Examine the estimator satisfies the criteria of good estimation (Consistency, unbiasedness, sufficiency) for standard distributions.
3. Evaluate and familiar the confidence interval estimates for the parameter using pivot method.
4. Framing statistical hypothesis and knowing the statistical test procedure.
5. Identifying the suitable large/small sample parametric/non-parametric tests among the basic statistical tests.

List of Reference Books:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons,
2. Goon AM, Gupta MK, Das Gupta B: Outlines of Statistics, Vol-II, the World Press Pvt. Ltd.
3. V.K.Rohatgi: An introduction to probability and statistics. Wiley series.
4. Sanjay Arora and Bansilal : New Mathematical Statistics Satya Prakashan, New Delhi
5. Siegal, S., and Sidney: Non-parametric statistics for Behavioral Science. McGraw Hill.
6. Hogg, Tanis, Rao. Probability and Statistical Inference .7th edition. Pearson Publication.


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B.Sc. II -YEAR, III-SEMESTER SYLLABUS
BS-303-P: Paper-III (Practical):
STATISTICAL INFERENCE USING MS-EXCEL & R
(2 HPW :: 1 Credit ::50 Marks)

Topics to be covered:

1. Large sample tests for mean(s), proportion(s), Standard deviation(s).
2. Small sample tests for single sample mean and difference of means (related & independent).
3. Small sample test for single sample variance and equality of variances.
4. Test for goodness of fit and independence of attributes.
5. Non parametric tests for two independent samples (Median test, Wilcoxon Mann Whitney – U test, Wald - Wolfowitz's runs test)

Note:

1. Practice can also be done on data sets available in web sources: www.kaggle.com., <https://ieee-dataport.org/datasets>, <https://data.world/datasets/link>, <https://archive.ics.uci.edu>, (Few selected data sets are: Fishers Iris data set, heart_failure_clinical_records, cancer, Mental Health Dataset, Indian Food Dataset, water-quality-1,etc.)
2. Establishing formulae in Excel cells and deriving the results and also usage existing Excel statistical functions in Excel.
3. Writing R-program for evaluation and usage of libraries in R.
4. Maintaining the Practical records is mandatory.
5. Answer any two out of four choosing at least one each section of Excel and R having two questions in each.


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B.Sc. II -YEAR, IV - SEMESTER SYLLABUS

BS-404 -T: Paper-IV (Theory):

ANALYSIS OF CORRELATION, REGRESSION AND DESIGN OF EXPERIMENTS

[4 HPW:: 4 Credits :: 100 Marks (External:70, Internal:30)

Course Objectives:

1. Able to understand and conducting experiment for the given task i.e. designing an experiment and carrying out its analysis.
2. Identifying the suitable complete block experimental design for the given data.
3. Identifying and carryout the complete analysis for the simple & multiple linear regression for the given data set.
4. Identifying the suitable measure of association/ correlation for the given data set.

UNIT-I

Correlation Analysis: Concept of Correlation Different Correlation Measures: Scatters diagram, Karl Pearsons coefficient (raw & grouped data), Spearman's Rank Correlation, Correlation ratio. Concepts of Partial and Multiple correlation coefficients (only for three variables). Analysis of categorical data, their independence, Association and partial association of attributes. Various measures of association: (Yule's) for two-way data and coefficient of contingency (Pearson and Tcherprow) and coefficient of colligation.

UNIT-II

Regression Analysis: Simple linear regression, Principle of least squares for estimation of Regression coefficients (linear, quadratic and power curves), properties of regression coefficients, Simple linear Regression Analysis and extending to Multiple linear Regression Analysis including Estimation of parameters and Computation of R^2 , Adjusted R^2 , MSE, lack of fit of the model, testing significance of regression coefficient(s).

Fisher's Z-transformation for population correlation coefficient(s) and testing the same in case of one sample and two samples.

UNIT -III

Analysis of Variance: Concept of Gauss-Markoff linear model with examples, statement of Cochran's theorem, Concept of Analysis of Variance (ANOVA), statistical models analysis for single factor and two factor (with one / m-observations per cell), Expectation of various sums of squares, Statistical analysis, Importance and applications of design of experiments. Concept of Critical difference, Post-hoc tests (DMR & LSD).

UNIT -IV

Design and Analysis of Experiments: Definition, Principles of experimental designs, Statistical planning for the experimentation Statistical linear models, estimation of parameters and Analysis of Completely Randomized Design (C.R.D), Randomized Block Design (R.B.D) and Latin Square Design (L.S.D). Expectation of various sum of squares. Comparison of the efficiencies of above designs. Estimation one missing observation in RBD & LSD and their analysis.

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Course Outcomes:

1. Able to designing an experiment for the given task and carrying out its analysis.
2. Able to identify the suitable complete block experimental design and carrying out its analysis for the given data.
3. Able to identify the suitable model and carryout the complete analysis for the simple & multiple linear regression for the given data set.
4. Able to identify and compute the suitable measure of association/ correlation for the given data set

List of Reference Books:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand& Sons, Delhi.
2. V.K.Kapoor and S.C.Gupta: Applied Statistics, Sultan Chand & Sons, New Delhi.
3. Sanjay Arora and Bansilal: New Mathematical Statistics Satya Prakashan, New Delhi.


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B.Sc. II -YEAR, IV-SEMESTER SYLLABUS

BS-404-P: Paper-IV (Practical):

ANALYSIS OF CORRELATION, REGRESSION AND DESIGN OF EXPERIMENTS USING R (2 HPW :: 1 Credit :: 50 Marks)

Topics to be covered:

1. Analysis of single, two factor models and two factor model with m-per cell and computation of Critical Difference, post-hoc tests (DMR& LSD).
2. Analysis of CRD, RBD and LSD and computing the efficiencies one over other (RBD over CRD, LSD over RBD & CRD)
3. Estimation of missing observation in RBD & LSD and their Analysis.
4. Analysis of LSD with one missing observation and computation of Critical Difference.
5. Drawing of Scatter diagram.
6. Computation of Karl Pearsons, Spearman's correlation for grouped & ungrouped datasets.
7. Computation of correlation ratio.
8. Computation of multiple and partial correlation coefficients.
9. Fitting of simple Linear and Quadratic Regression models.
10. Fitting of log-linear regression models ($y=ax^b$, $y=ab^x$ & $y = ae^{bx}$)
11. Analysis of Simple linear Regression model.
12. Analysis of Multiple linear regression model.
13. Computation of Yule's coefficient of association.
14. Computation of Pearson's, Tcherprows coefficient of contingency.

Note:

1. Practice on the following tests should be on small and large data sets available in www.kaggle.com.
2. Writing R-program for evaluation and usage of libraries in R.
3. Maintaining the Practical records is mandatory.
4. Answer any two out of four questions.


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B.Sc. (CBCS) (STATISTICS) SYLLABUS

(With Mathematics Combination only)

With effect from the Academic Year: 2026-27 (First year)

Ye ar	Se m	Paper Code	Theory/ Practical	Paper Title	Credi ts	Work Load (Hours / Week)
I	I	BS-101-T	Paper-I	Basic Statistics and Probability	4	4
		BS-101-P	Practical -I	Basic Statistical Analysis Lab using Excel & R	1	2
	II	BS-202-T	Paper-II	Probability & Multivariate Distributions	4	4
		BS-202-P	Practical -II	Probability Distributions Lab using Excel & R	1	2
II	III	BS-303-T	Paper-III		4	4
		BS-303-P	Practical-III		1	2
	IV	BS-404-T	Paper-IV		4	4
		BS-404-P	Practical-IV		1	2
III	V	BS-505-T	Paper-V		4	4
		BS-505-P	Practical-5		1	2
		BS-501-SEC	SEC-1		2	2
		BS-502-SEC	SEC-2		2	2
		BS-501-MDC	MDC		4	4
		BS-501-VAC	VAC		3	3
	VI	BS-606-T	Paper-VI		4	4
		BS-606-P	Paper-VI		1	2
		BS-603-SEC	SEC-3		2	2
		BS-604-SEC	SEC-4		2	2
		BS-602-VAC	VAC		3	3
		BS-601	Project/ Internship		4	8

Note:

1. No of credits – No of theory hours for teaching = twice the no. of credits for practical teaching.
2. Skill Enhancement Courses (SEC) are offered for Statistics students in Semester-V & VI with continuation (offered for who are willing improve the practical skills in conducting of election forecasts / exit poll surveys.
3. Multi-disciplinary course and Value added courses are offered in final year.
4. Optional paper course is offered if statistics students are willing to opt.

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B.Sc. I-YEAR, I-SEMESTER SYLLABUS

BS-101-T: Paper-I: BASIC STATISTICS AND PROBABILITY

[4 HPW:: 4 Credits :: 100 Marks (External:70, Internal:30)]

Course Objectives:

1. Able to compute and analysis the data sets (with different measurement of scales of variables in data sets, nominal, ordinal, interval, ratio scales) based descriptive statistics like: Central tendencies, Dispersions, Moments, Skewness and Kurtosis.
2. Able to familiar in to prepare the Basic descriptive statistical report using descriptive.
3. Strong foundations on the computation of the probability for the events and usage of addition, multiplication and Bayes theorems for probability computation, where ever the situation occurs.
4. Understanding the concept of one and two-dimensional random variable(s), probability mass/ density/ distribution functions and their properties and transformation of one/ two dimensional random variables.
5. Understanding the procedure of evaluation Central and Non-central Moments for the random variables and also its evaluation from various generating functions.

Course Outcomes:

After completing this course, the student should have developed a clear understanding about:

1. Able to analyse the data sets by choosing appropriate statistical technique either manually or using Excel & R and preparing basic statistical report.
2. Able to compute the probability using counting methods/ appropriate probability theorems.
3. Able to evaluate the distribution function from probability mass/ density functions and vice-versa and also evaluation of probability function for the transformations of random variables.
4. Able to evaluate the Moments, MGF, CGF, PGF and ChF for the random variables and evaluation Moments from the generating functions (MGF, CGF and ChF).
5. Able to identify the realtime applications in various domains like Finance, business, insurance, clinical, medical, health, bio sciences, engineering and technology etc.

UNIT-I

Basic Statistics: Definitions, Measures, Properties and Importance of Central tendencies, Dispersions, Absolute and Relative measures of dispersions, Central and Non-central moments, Skewness and kurtosis and their inter-relationships and computations to the raw and grouped data and data sets. Usage in the domains of image analysis, pattern recognitions, preparation of descriptive statistical analysis report based on the above descriptive statistics.


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Basics of R-programming: Installation of R & R-studio, data importing/ exporting, Basic Mathematical and statistical functions, writing simple programs and libraries/ usage packages.

UNIT-II

Probability: Basic concepts used for defining probability, Mathematical, Statistical and Axiomatic definitions of probability, their merits and demerits. Marginal, Joint and Conditional probabilities and independence of events, Multiplication & Addition theorems for 'n' events, Boole's inequality and Bayes' theorem, Problems on computation of Probability and including the usage of theorems.

UNIT-III

Random Variables: Definition of random variable, discrete and continuous random variables, functions of random variables, probability mass, density and distribution functions with their properties and simple problems and illustrations. Notion of bivariate random variable, bivariate distribution, statements of its properties, Joint, marginal and conditional distributions, Independence of random variables. Transformation of one and two-dimensional random variable(s), simple problems on transformation of the random variable(s).

UNIT-IV

Mathematical Expectation: Mathematical expectation of a random variable, function of a random variable, Computation of raw and central moments, covariance using mathematical expectation with examples, Addition and multiplication theorems of expectation. Generating function, Definitions of moment generating function (MGF), cumulant generating function (CGF), probability generating function (PGF) and characteristic function (CF), their basic properties, applications and computation of those for simple probability functions, Moment inequalities: Chebyshev's and Cauchy-Schwartz's inequalities and their applications.

List of Reference Books:

1. V. K. Kapoor and S. C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Sanjay Arora and Bansilal: New Mathematical Statistics, Satya Prakashan, New Delhi.
3. William Feller: Introduction to Probability theory and its applications, (Vol-I), Wiley.
4. S.P. Gupta: Statistical Methods, S Chand, New Delhi.
5. Dr. Dharmendra Patel, Dr. Sanskruti Patel and Dr. Atul Patel: Fundamentals of R Programming: A Practical Way.


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B.Sc. I-YEAR, I-SEMESTER SYLLABUS
BS-101-P: Paper-I (Practical):
BASIC STATISTICAL ANALYSIS USING EXCEL & R
(2 HPW :: 1 Credit :: 50 Marks)

Basics of EXCEL: Excel- Data entry, editing and saving, establishing and copying formulae, creation of filters, sorting data, creation of databases usage of mathematical, statistical built in functions in excel, copy and paste and exporting to MS word document. Writing formulas for computation, drawing diagrams.

Using R-programming:

1. Data Visualization Techniques (Histogram, Frequency curves & Polygon, Ogive curves, Bar (Simple, Component, Multiple, Percentage Bars) and Pie (Simple & multiple).
2. Computation of Central Tendencies, Dispersions, Moments (non-central and central).
3. Computation of coefficients of Skewness and Kurtosis.
4. Preparation of Statistical Analysis Report based on the descriptive statistics.

Note:

1. Each student has to spend minimum 15 weeks x 2 hours per week = 30 hours to practice on the system with the required software is mandatory.
2. Practice also be done on data sets available in web sources: www.kaggle.com, <https://ieee-dataport.org/datasets>, <https://data.world/datasets/link>, <https://archive.ics.uci.edu>, (Few selected data sets are: Fishers Iris data set, heart_failure_clinical_records, cancer, Mental Health Dataset, Indian Food Dataset, water-quality-1, etc.).
3. Establishing formulae in Excel cells and deriving the results and also usage existing Excel statistical Functions in Excel.
4. Able to write an R-program for evaluation and also usage of libraries/ packages in R.
5. Maintaining the Practical records is mandatory and without records candidates are not allowed to attend practical examination.
6. Answer any two out of four choosing at least one from each section of Excel and R having two questions in each.


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B.Sc. I-YEAR, II-SEMESTER SYLLABUS

BS-202-T: Paper-II:

PROBABILITY AND MULTIVARIATE DISTRIBUTIONS

[4 HPW:: 4 Credits :: 100 Marks (External:70, Internal:30)

Course Objectives:

1. Able to choose/ identify an appropriate standard probability distribution to fit the data.
2. Able to know and derive the properties of standard probability distributions (discrete and continuous) and knowing perfectly on the usage of each probability distribution in different domains.
3. Able to understand the concept of sampling distributions.
4. Able to understand the exact sampling distributions, their properties and applications.

Course Outcomes:

1. Able to evaluate the probability analyses the data sets by choosing appropriate statistical tool and preparing basic statistical report.
2. Able to compute the probability using counting methods/ appropriate probability theorems.
3. Able to evaluate the distribution function from probability mass / density functions and vice-versa and also evaluation of probability function for the transformations of random variables.
4. Able to evaluate the Moments, MGF, CGF, PGF and CF for any probability function.
5. Able to identify the real-time applications for each distribution in various domains like Finance, business, insurance, clinical, medical, health, bio sciences, engineering and technology etc.

UNIT-I

Discrete distributions: Discrete *Uniform* and *Bernoulli* distributions: definitions, mean, variance and simple examples. *Binomial*, *Poisson*, *Negative-Binomial* and *Geometric* distributions: Physical conditions. derivation of probability mass functions, central and moments up to fourth order, median, mode, MGF, CGF, PGF, CF. nature of the curve and, reproductive property (wherever exists) special properties if any and real-life applications in various domains and probability problems related to these distributions. Poisson approximation to Binomial distribution, Poisson approximation to Negative binomial distribution.

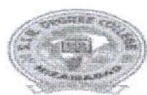
UNIT-II

Hyper-geometric distribution: definition, real life applications, derivation of probability function, mean, variance. Binomial approximation to Hyper-geometric distribution.

Continuous distributions: *Rectangular* and *Normal* distributions - definition, properties such as MGF, CGF, CF. and moments up to fourth order, reproductive property, wherever exists and their real-life applications. Normal distribution as a limiting case of Binomial and Poisson distributions.


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UNIT-III

Exponential, single and two parameter *Gamma* distributions: Definition, Moments up to fourth order, MGF, CGF, CF, reproductive property (wherever exists), nature of the curves and their real-life applications special properties (if any) and problems. *Beta* distribution of two kinds: Definitions, mean and variance, nature of the curve, special properties (if any) & applications. *Cauchy* distribution: Definition, nature of the curve, derivation of density, CF. and its special properties and its statistical significance.

UNIT-IV

Multivariate Distributions and Multivariate Analysis Techniques: Introduction to multivariate distributions and the concept of analyzing multiple variables simultaneously. Definitions, properties and applications of **Multinomial Distribution** and **Multivariate Normal Distribution** with suitable real-life examples. Introduction to multivariate statistical techniques including **Principal Component Analysis (PCA)**, **Factor Analysis** and **Cluster Analysis**. Definitions, important properties, and applications of these techniques in real-world data analysis.

List of reference books:

1. V. K. Kapoor and S. C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Sanjay Arora and Bansilal: New Mathematical Statistics, Satya Prakashan, New Delhi.
3. William Feller: Introduction to Probability theory and its applications, (Vol-I), Wiley.
4. Goon A M, Gupta M K, Das Gupta B: Fundamentals of Statistics, (Vol-I), The World Press (Pvt) Ltd., Kolkata.
5. Johnson, R. A. and Wichern, D. W.: Applied Multivariate Statistical Analysis, Pearson Education.
6. Anderson, T. W.: An Introduction to Multivariate Statistical Analysis, Wiley.

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B.Sc. I-YEAR, II-SEMESTER SYLLABUS
BS-202-P: Paper-II (Practical):
PROBABILITY DISTRIBUTIONS USING MS-EXCEL & R
(2 HPW :: 1 Credit :: 50 Marks)

Topics to be covered:

1. Fitting of Binomial distribution (Direct & Recurrence relation Methods).
2. Fitting of Poisson distribution (Direct & Recurrence relation Methods).
3. Fitting of Negative Binomial (Direct & Recurrence relation Methods).
4. Fitting of Geometric distribution.
5. Fitting of Normal distribution (Areas & Ordinates method)
6. Fitting of Exponential distribution.
7. Fitting of Cauchy distribution.
8. Extraction of probability density function from large datasets.
9. Generation of random samples from Uniform (0, 1) and Uniform (a, b) distributions.
10. Generation of random samples from Binomial, Poisson, Negative Binomial Distributions.
11. Generation of random samples from Normal and Exponential Distributions.

Note:

1. Each student has to spend minimum 15 weeks X 2 hours per week = 30 hours to practice on the system with the required software is mandatory.
2. Establishing formulae in Excel cells and deriving the results and also usage existing Excel statistical functions in Excel.
3. Writing R-program for evaluation and usage of libraries in R
4. Maintaining the Practical records is mandatory and without records candidates are not allowed to attend practical examination.
5. Answer any two out of four choosing at least one from each section of Excel and R having two questions in each.

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