B.A./B.SC. (CBCS) (STATISTICS) SYLLABUS

(With Mathematics Combination only)

With effect from the Academic Year: 2024-25 (of first year)

Year	Sem	Paper code	Theory/ Practical	Paper Title	Credits	Work Load (Hours / Week)	Total Marks
I	I	BS-101-T	Paper-I	Descriptive Statistics and Probability	4	4	100
		BS-101-P	Practical -I	Basic Statistical Analysis Lab using Excel & R	1	2	25
	II	BS-202-T	Paper-II	Probability Distributions	4	4	100
		BS-202-P	Practical -II	Probability Distributions Lab using Excel & R	1	2	25
II	III	BS-303-T	Paper-III	Statistical Inference	4	4	100
		BS-303-P	Practical-III	Statistical Inference lab using Excel & R	1	2	25
		BS-303-SE	SEC-2	Subject specified	2	2	50
	IV	BS-404-T	Paper-IV	Analysis of Correlation, Regression and Basic Experimental Designs	4	4	100
		BS-404-P	Practical-IV	Analysis of Correlation, Regression and Basic Experimental Designs Lab	1	2	25
		BS-404-SE	SEC-4	Subject specified	2	2	50
III	V	BS-505-T	Paper-V	Sampling Theory & Operation Research	4	4	100
		BS-505-P	Practical-5	Sampling Theory & Operation Research Lab	1	2	25
		BS-505-GE	Generic Elective	Statistical Analysis	4	4	100
	VI	BS-606-T	Paper-VI	Industrial Statistics	4	4	100
		BS-606-P	Paper-VI	Industrial Statistics	1	2	25
		BS-606-O	Optional	Data Analysis Project	4	4	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 Sem-III & IV with continuation (offered for who are willing improve the practical skills in conducting of election forecasts / exit poll surveys.
3. Generic Elective (GE) course is offered for *other than Statistics Course students.*
4. Optional paper course is offered if statistics students are willing to opt.

B.SC. FIRST YEAR I-SEMESTER SYLLABUS

BS-101T: PAPER-I (Theory): BASIC STATISTICS AND PROBABILITY

[4 HPW :: 4 Credits :: 100 Marks (External:80 & Internal:20)]

Course Objectives:

1. Able to compute and analyse 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 descriptives.
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.

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 & 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).

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 (Ch.F), 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 Outcome:

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 real time applications 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 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. FIRST YEAR I-SEMESTER SYLLABUS

BS-101-P: PAPER-I (Lab):

BASIC STATISTICAL ANALYSIS USING EXCEL & R

(2 HPW:: 1 Credit :: 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://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. FIRST YEAR II-SEMESTER SYLLABUS

BS-202-T: PAPER-II (Theory): PROBABILITY DISTRIBUTIONS

[4 HPW:: 4 Credits :: 100 Marks (External: 80, Internal: 20)]

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, M.G.F, C.G.F., P.G.F., Ch. F. 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 M.G.F, C.G.F., Ch. F. 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, M.G.F, C.G.F., Ch. F., 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, Ch. f. and its special properties and its statistical significance.

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 Outcome:

1. Able to evaluate the probability analyse 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 Ch. F. 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 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.

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B.SC. FIRST YEAR II-SEMESTER SYLLABUS

BS-202-P: PAPER-II (Lab):

PROBABILITY DISTRIBUTIONS USING MS-EXCEL & R

(2 HPW :: 1 Credit :: 25 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. 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.

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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.