B.Sc. (Statistics) Syllabus

(Common Core Syllabus under CBCS)

(With Mathematics Combinations only)

With effect from the academic year 2025-2026 onwards

Accredited with 'A^{+}' grade by NAAC

DEPARTMENT OF STATISTICS
KAKATIYA UNIVERSITY
WARANGAL – 506 009 (TG)

KAKATIYA UNIVERSITY-WARANGAL

Annexure – I (Credits)

Approved CBCS Structure from 2025-26 for Under Graduate Courses

Courses		Papers	Total Credits	Credits for each paper / Semester					
				B.Sc.					
				I	II	III	IV	V	VI
Core Courses (DSC)	Major-1	6	30	5	5	5	5	5	5
	Major-2	6	30	5	5	5	5	5	5
	Minor-1	4	20	5	5	5	5	--	--
MIL /AEC (First Language)	English	4	20	5	5	5	5	--	--
Second Language (Telugu, Hindi, Urdu etc.)		4	20	5	5	5	5	--	--
Multi-Disciplinary Course	MDC-1	1	4	--	--	--	--	4	--
SEC 1, 2		2	4	--	--	--	--	2	2
SEC 3, 4		2	4	--	--	--	--	2	2
Value added course (VAC)	VAC1, 2	2	6	--	--	--	--	3	3
Internships	Internship / Project	1	4	--	--	--	--	--	4
Total Credits in each semester		--	142	25	25	25	25	21	21
Total Credits in UG		--	142						
Credits under Non-CGPA (Community engagement and service)		NSS/ NCC/ Sports/ Extra curricular	6	Upto 6 (2 in each year)					
		IKS	4	Upto 4 (2 in each, after I & II years)					

DSC : Discipline Specific Course
AEC : Ability Enhancement Course
MDC : Multi- Disciplinary Course
SEC : Skill Enhancement Course
VAC : Value Added Course

Note: Under the proposed CBCS structure for Undergraduate Programmes (2025-26), students will pursue two Majors and one Minor, collectively referred to as Discipline Specific Core (DSC). Both Major and Minor courses will remain integrated up to the fourth semester, after which students will have the option to drop one Minor course in both the fifth and sixth semesters. The syllabus and credits for Major and Minor courses will remain consistent up to the fourth semester, with the Major continuing through the fifth and sixth semesters.

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KAKATIYA UNIVERSITY-WARANGAL
B.Sc. (Statistics) Syllabus
Scheme of Instructions under CBCS (w.e.f. 2025-26 academic year onwards)

Year	Semester	Theory Paper/ *Practical*	Paper Title	Work Load (hrs/ week)	No. of Credits	Marks distribution		
						Internal	End Exam	Total Marks
I	I	**DSC-1/ Paper-1**	**Basic Statistics and Probability**	4	4	20	80	100
		Practical-1	*Basic Statistical Analysis Lab*	2	1	---	25	25
	II	**DSC-2/ Paper-2**	**Probability Distributions**	4	4	20	80	100
		Practical-2	*Probability Distributions Lab*	2	1	---	25	25
II	III	**DSC-3/ Paper-3**	**Statistical Inference**	4	4	20	80	100
		Practical-3	*Statistical Inference lab*	2	1	---	25	25
	IV	**DSC-4/ Paper-4**	**Analysis of Correlation, Regression and Basic Experimental Designs**	4	4	20	80	100
		Practical-4	*Analysis of Correlation, Regression and Basic Experimental Designs Lab*	2	1	---	25	25
III	V	**DSC-5/ Paper-5**	**Sampling Theory & Operation Research**	4	4	20	80	100
		Practical-5	*Sampling Theory & Operation Research Lab*	2	1	---	25	25
		MDC-1	**Statistical Analysis**	4	4	20	80	100
		SEC-1	Skill Enhancement Course-1	2	2	10	40	50
		SEC-2	Skill Enhancement Course-2	2	2	10	40	50
		VAC-1	Value added Course-1	3	3	15	60	75
	VI	**DSC-6/ Paper-6**	**Industrial Statistics**	4	4	20	80	100
		Practical-6	*Industrial Statistics Lab*	2	1	---	25	25
		SEC-3	Skill Enhancement Course-3	2	2	10	40	50
		SEC-4	Skill Enhancement Course-4	2	2	10	40	50
		VAC-2	Value added Course-2	3	3	15	60	75
		Project work / Internship		4	4	----	----	100

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KAKATIYA UNIVERSITY-WARANGAL

Under Graduate Courses (Under CBCS AY: 2025-2026 onwards)

B.Sc. STATISTICS

I Year:: Semester-I

Paper-1: BASIC STATISTICS AND PROBABILIT

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

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, Addition & Multiplication 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: Chebychev'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.

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Under Graduate Courses (Under CBCS AY: 2025-2026 onwards)

B.Sc. STATISTICS

I Year:: Semester-I

Practical-1: ***Basic Statistical Analysis Lab***

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

Practical (Using Calculator, MS- Excel and R-Software)

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.

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B.Sc. STATISTICS

I Year:: Semester-II

Paper-2: PROBABILITY DISTRIBUTIONS

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

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.

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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Under Graduate Courses (Under CBCS AY: 2025-2026 onwards)

B.Sc. STATISTICS

I Year:: Semester-II

Practical-2: ***Probability Distributions Lab***

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

Practical (Using Calculator, MS- Excel and R-Software)

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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Under Graduate Courses (Under CBCS AY: 2025-2026 onwards)

B.Sc. STATISTICS

II Year:: Semester-III

Paper-3: STATISTICAL INFERENCE

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

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

List of Reference Books:

1. V.K. Kapoor and S.C. Gupta: Fundamentals of Mathematical Statistics, S. Chand & Sons,
2. Goon A.M., Gupta M.K, Das Gupta B: Outlines of Statistics, Vol-II, the World Press .
3. V.K. Rohatgi: An introduction to probability and Statistics, Wiley series.
4. Sanjay Arora and Bansal: 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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Under Graduate Courses (Under CBCS AY: 2025-2026 onwards)

B.Sc. STATISTICS

II Year:: Semester-III

Practical-3: ***Statistical Inference lab***

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

Practical (Using Calculator, MS- Excel and R-Software)

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. Nonparametric tests for two independent samples (Median test, Wilcoxon Mann Whitney - U test, Wald - Wolfowitz's runs test)

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B.Sc. STATISTICS

II Year:: Semester-IV

Paper-4: ANALYSIS OF CORRELATION, REGRESSION AND BASIC EXPERIMENTAL DESIGNS

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

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

List of Reference Books:

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

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B.Sc. STATISTICS

II Year:: Semester-IV

Practical-4: Analysis of Correlation, Regression and Basic Experimental Designs Lab

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

Practical (Using Calculator, MS- Excel and R-Software)

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

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KAKATIYA UNIVERSITY-WARANGAL
SCHEME OF QUESTION PAPER
Code No.:
FACULTY OF SCIENCE
B.Sc. (I/II/III/IV Semester) Examination
Subject: STATISTICS
Paper: I/II/III/IV
Paper title:_____

Time: 3 Hours] **[Max. Marks: 80**

Section A – Short answer questions (Marks: 8 × 4 = 32)
Answer any **eight** questions.

1. Unit-I
2. Unit-I
3. Unit-I (Problem)
4. Unit-II
5. Unit-II
6. Unit-II (Problem)
7. Unit-III
8. Unit-III
9. Unit-III (Problem)
10. Unit-IV
11. Unit-IV
12. Unit-IV (Problem)

Section B – Essay type questions (Marks: 4 × 12 = 48)
Answer **all** questions.

Q13. (a) Unit-I
(Or)
(b) Unit-I

Q14. (a) Unit-II
(Or)
(b) Unit-II

Q15. (a) Unit-III
(Or)
(b) Unit-III

Q16. (a) Unit-IV
(Or)
(b) Unit-IV

[Note: If required each question can be divided into sub parts]

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