

Karmaveer Bhaurao Patil University, Satara

Syllabus For

B. Sc. II STATISTICS

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2025-2026

SYLLABUS FOR BACHELOR OF SCIENCE PART-II: STATISTICS

1. TITLE: **Statistics**
2. YEAR OF IMPLEMENTATION: From **2025-26**
3. DURATION: **01 year**
4. PATTERN: **Semester**
5. MEDIUM OF INSTRUCTION: **English**
6. COURSE STRUCTURE: **As per NEP-2020 (2.0)**

As per NEP-2020 (2.0)

Class	Level	Sem	Major		Minor		VSC	SEC	AEC	VEC / IKS	OE	Total
			T	P	T	P	P	P	T	T	P	
B.Sc. II	5.0	III	4 (02 Courses)	2	4 (02 Courses)	2	2	2	2	2	2	22
		IV	4 (02 Courses)	2	4 (02 Courses)	2	2	2	2	2	2	22

VSC- Vocational Skill Courses, SEC- Skill Enhancement Courses, AEC- Ability Enhancement Courses, VEC- Value Education Courses, IKS- Indian Knowledge System, OE-Open Elective, T- Theory, P-Practical.

7. COURSE TITLES

B.Sc. II Semester III

Nature of the Course	Theory /Practical	Course Code	Name of the Course	No. of lectures/ Practical per week	Credits
Major	Theory	BST 231	Continuous Probability Distribution	2	2
		BST 232	Statistical Methods	2	2
	Practical	BSP 233	Statistics Major Practical-III	1	2
Minor	Theory	BST 234	Analysis of Continuous Distributions	2	2
		BST 235	Statistical Techniques	2	2
	Practical	BSP 236	Statistics Minor Practical – III	1	2
VSC	Practical	BSPVSC I	R Software-I	1	2
SEC	Practical	BSPSEC I	Introduction to Power BI	1	2
IKS	Theory	BSTIKS I	Indian Statistical Knowledge System	2	2

B.Sc. II Semester IV

Nature of the Course	Theory/ Practical	Course Code	Name of the Course	No. of lectures / Practical per week	Credits
Major	Theory	BST 241	Probability Distribution	2	2
		BST 242	Sampling Distributions and Statistical Tests	2	2
	Practical	BSP 243	Statistics Major Practical-IV	1	2
Minor	Theory	BST 244	Applications of Probability Distributions	2	2
		BST 245	Applied Statistical Methods	2	2
	Practical	BSP 246	Statistics Minor Practical – IV	1	2
VSC	Practical	BSPVSC II	R Software-II	1	2
SEC	Practical	BSPSEC II	Advanced Power BI	1	2
VEC	Theory	BSTVEC I	Environmental Awareness with Statistics	2	2

8. EVALUATION STRUCTURE

B.Sc. II NEP 2.0 (5.0)

Semester III (5.0)

Course	Course Category	Course Code	CCE	ESE	Total Marks	Credits
Major	T	BST 231	20	30	50	02
	T	BST 232	20	30	50	02
	P	BSP 233	20	30	50	02
Minor	T	BST 234	20	30	50	02
	T	BST 235	20	30	50	02
	P	BSP 236	20	30	50	02
OE	P	BSPOE 3 (For IDS Courses)	20	30	50	02
OE	T	BSTOE 3 (For Humanities)	20	30	50	02
VSC	P	BSPVSC I	20	30	50	02
SEC	P	BSPSEC I	20	30	50	02
AEC I	T	BSTAEC I	20	30	50	02
IKS II	T	BSTIKS II	20	30	50	02
Total					**550**	**22**

Semester IV

Course	Course Category	Course Code	CCE	ESE	Total Marks	Credits
Major	T	BST 231	20	30	50	02
	T	BST 232	20	30	50	02
	P	BSP 233	20	30	50	02
Minor	T	BST 234	20	30	50	02
	T	BST 235	20	30	50	02
	P	BSP 236	20	30	50	02
OE	P	BSPOE 3 (For IDS Courses)	20	30	50	02
OE	T	BSTOE 3 (For Humanities)	20	30	50	02
VSC	P	BSPVSC I	20	30	50	02
SEC	P	BSPSEC I	20	30	50	02
AEC II	T	BSTAEC II	20	30	50	02
VEC II	T	BSTVEC II	20	30	50	02
Total					**550**	**22**

➢ CONTINOUS COMPRHENSIVE EVALUATION (CCE)STRUCTURE

- Continuous Comprehensive Evaluation (CCE) of theory papers shall carry a weightage of 40%.
- **Activity:** For the internal evaluation of theory papers following activities will be adopted for CCE I & CCE II: class test/ open book test/ online course/ Industrial review/ Industrial Visit/ e learning video creation/ assignment/seminar/ case study/ fieldwork/ project.
- CCE III shall consist of multiple-choice questions.
- Each CCE will carry 10 marks for 2-credit theory papers and 20 marks for 4-credit theory papers, and the best two scores will be considered for final score.
- Internal evaluation of practical papers shall carry a weightage of 40%.
- For practical examinations, internal evaluation will be based on student performance, attendance, journal records, and viva voce.

9. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

1. Specific equipment's in laboratory:

   70 Computers, LCD Projector, Visualizer, 02 Smart board etc.

2. Laboratory Software's:

   1. R-Software. 2. SPSS 3. MATLAB

   4. MINITAB 5. Python

Bachelor of Science (B. Sc.) Part II,

Semester-III Statistics

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Major	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: CONTINUOUS PROBABILITY DISTRIBUTIONS (BST 231)

Course Objectives: Students should…

1) Develop an understanding of continuous random variables and their probability distributions.
2) Interpret the characteristics and applications of important continuous probability distributions, including Uniform, Exponential, and Normal distributions.
3) Analyse continuous probability models to describe random phenomena and quantify uncertainty.
4) Apply transformation techniques to derive probability distributions of functions of univariate and bivariate continuous random variables.

Course Outcomes: Students will be able to…

1) Define probability density function (p.d.f.) And cumulative distribution function (c.d.f.) And their properties.
2) Fit the normal distribution for real life data and test its properties.
3) Apply the properties of continuous uniform and exponential distributions to solve real-world problems.
4) Analyze transformations of continuous random variables and their resulting distributions.

Module	Title and Contents	Hrs.
Module -1:	**Continuous Univariate Distributions** 1.1 Definition of the continuous sample space with illustrations, Definition of a continuous random variable (r.v.), probability density function (p.d.f.), cumulative distribution function (c.d.f.), and its properties. 1.2 Expectation of r.v., the expectation of a function of r.v., mean, median, mode, quartiles, variance, harmonic mean, raw and central moments, Cumulants, skewness and kurtosis, examples 1.3 Moments generating function (m.g.f.): definition and properties (i) Standardization Property $M_X(0) = 1$, (ii) Effect of change of origin and scale, (iii) Uniqueness property of m.g.f., (statement only). Generation of raw and central moments. 1.4 Cumulant generating function (c.g.f.): definition, relations between cumulants and central moments (up to order four). Examples. 1.5 Mode, partition values: quartiles (Q_1, Q_2, Q_3), deciles, percentiles Probability distribution of a function of r. v. Y=g(X): using i) Jacobian of g(.) transformation for monotonic function and one-to-one, on to functions, ii) Distribution function for $Y=X^2$,$Y=\|X\|$ etc., iii) M.G.F. of g(X).	08

Module -2:	**Continuous Uniform and Exponential Distribution** 2.1 Uniform distribution: Definition of Uniform distribution over (a, b) c.d.f., m.g.f., mean, variance, moments. Symmetry of Uniform Distribution, U(0, θ) as Scale Family of distributions. 2.2 Distribution of (i) (X-a) / (b-a), ii) (b-X) / (b-a), (iii) Y = F(x) where F(x) is c.d.f. of any continuous r.v. 2.3 Exponential distribution: p.d.f. (one parameter), c.d.f., m.g.f., c.g.f., mean, variance, C.V., moments, Cumulants, Skewness 2.4 Kurtosis, median, quartiles, lack of memory property, distribution of – (1/ θ) logX where X~U (0, 1)	**07**
Module -3:	**Normal Distribution** 3.1 Normal distribution with parameters μ & σ^2, Definition of standard normal distribution, properties of normal curve, m.g.f., c.g.f., mean, variance, median, mode, mean deviation, moments. 3.2 Cumulants, measures of skewness & kurtosis, distribution of linear combination of variates. Normal family as a location and scale family. 3.3 Probability distribution of $\bar{X}$ the mean of n . r. v s., computations of normal probabilities using normal probability integral tables. Central limit theorem (CLT) for i.i.d. random variables with finite positive variance (statement only), its illustration for Poisson and Binomial distributions	**07**
Module -4:	**Continuous Bivariate Distribution** 4.1 Definition of a bivariate continuous random variable (X, Y), Joint p.d.f., c.d.f with properties, marginal and conditional distribution, independence of random variables, evaluation of probabilities of various regions bounded by straight lines. 4.2 Expectation of function of r.v.s means, variances, covariance, correlation coefficient, conditional expectation, regression as conditional expectation if it is a linear function of other variable and conditional variance, proof of i) E (X± Y) = E(X) ± E(Y) ii) E [E(X/Y)] = E(X). 4.3 If X and Y are independent r.v.s. then i) E (XY) = E(X) E(Y) ii) Mx+y (t)=Mx(t)My (t) 4.4 Probability distribution of transformation of bivariate r. v. U=$\emptyset_1(X, Y)$ and V=$\emptyset_2(X, Y)$, Examples.	08

Reference Books :

1) Hogg, Robert V., Joseph W. McKean, and Allen T. Craig. Introduction to Mathematical Statistics. 9th ed. Pearson, 2021.
2) Evans, Merran, Nicholas Hastings, and Brian Peacock. Statistical Distributions. 4th ed. Wiley, 2020.
3) Wasserman, Larry. All of Statistics: A Concise Course in Statistical Inference. Springer, 2020.
4) Goon, A. M., M. K. Gupta, and B. Dasgupta. Fundamentals of Statistics. Vols. I and II. Kolkata: The World Press Pvt. Ltd, 2016.
5) Gupta, S. C., and V. K. Kapoor. Applied Statistics. New Delhi: Sultan Chand & Sons, 2018.

6) Gupta, S. C., and V. K. Kapoor. Fundamentals of Mathematical Statistics. New Delhi: Sultan Chand & Sons, 2014.
7) Hogg, Robert V., and Allen T. Craig. Introduction to Mathematical Statistics. 7th ed. New York: Macmillan Publishing Company, 2013.
8) Mukhopadhyay, Parimal. An Introduction to the Theory of Probability. Singapore: World Scientific Publishing, 2011.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Major	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: STATISTICAL METHODS (BST 232)

Course Objectives: Students should…

1) Understand the concepts, components, and forecasting techniques of time series analysis.
2) Compute and interpret demographic measures and construct life tables.
3) Analyze reliability of binary systems using coherent system models and reliability functions.
4) Apply statistical methods to solve practical problems in forecasting, demography, and reliability analysis.

Course Outcomes: Students will be able to…

1) Analyze time series data using trend, smoothing, seasonal variation, and forecasting techniques.
2) Calculate and interpret demographic indicators, including mortality, fertility, reproduction rates, and life tables.
3) Evaluate the reliability of coherent binary systems and compute system reliability for different configurations.
4) Explain ageing properties and apply hazard, survival, IFR, and DFR concepts in reliability analysis.

Module	Title and Contents	Hrs.
Module -1:	**Time Series** 1.1 Meaning and need of time series analysis, components of times (i) Secular trend (ii) Seasonal Variation (iii) Cyclical Variation (iv) Irregular Variation, Additive and Multiplicative model, Utility of time series. 1.2 Measurement of trend: (i) Moving averages method (ii) Progressive average method (iii) Least square method. (iv) Linear, parabolic, exponential, Parato curve fitting by least squares principle exponential smoothing. 1.3 Choosing parameters for smoothing and forecasting. Forecasting based on exponential smoothing. 1.4 Measurement of seasonal variations: (i) Simple Average Method, (ii) Ratio to Moving Average Method, (iii) Ratio to Trend, where the linear trend is calculated by method of least squares.	07
Module -2:	**Demography** 2.1 Introduction and need of vital statistics 2.2 Mortality rates: Crude Death Rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR). 2.3 Fertility Rates: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR). 2.4 Reproduction Rate: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR). Interpretations of different rates, uses and applications. 2.5 Life Table – Concept and construction of Life Tables	07

Module -3:	**Reliability Theory** 3.1 Binary Systems: Block diagrams, the definition of binary coherent structure, and illustrations. Coherent systems of at most three components (a) Series, (b) Parallel, (c) 2 out of 3: Minimal cut, minimal path representation of system. 3.2 Reliability of binary System: reliability of above systems h(p), when components are independent and identically distributed with common probability p of operating. 3.3 Ageing Properties: Definitions: Hazard rate, hazard function, survival function, concept of distributions with Increasing and Decreasing Failure Rate (IFR, DFR)	08
Module -4:	**Decision Theory** 4.1 Introduction, steps in decision theory approach. 4.2 Type of decision-making environments. 4.3 Decision making under uncertainty: Criteria of optimism, criteria of pessimism, equally likely decision criterion, criterion of regret. 4.4 Decision making under risk: Expected Monetary Value (EMV), Expected Opportunity Loss (EOL), the Expected Value of Perfect Information (EVPI). 4.5 Examples and problems	08

Reference Books :-

1) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018
2) Rockwell, Peter J., and Richard A. Davis. Introduction to Time Series and Forecasting. Springer, 2016.
3) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing,2011.
4) Sharma, J. K. Operations Research: Theory and Applications. 4th ed., Macmillan Publishers India Ltd., New Delhi.2009.
5) Montgomery, Douglas C., et al. Introduction to Time Series Analysis and Forecasting. 2nd ed., Wiley, 2008.
6) Preston, Samuel H., et al. Demography: Measuring and Modeling Population Processes. Blackwell Publishing, 2001.
7) Stuart, Alan, and J. Keith Ord. Kendall's Advanced Theory of Statistics, Volume 1: Distribution Theory. 6th ed., Edward Arnold, 1994.
8) Sinha S.K., Reliability and Life Testing, Wiley Eastern Publishers, New Delhi, Second Edition,1987

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Major Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: STATISTICS MAJOR PRACTICAL – III (BSP 233)

Practical Batch: 16 Students / Batch

Course Objectives: Students should …

1) Understand the concepts, components, and forecasting techniques of time series analysis.
2) Compute and interpret demographic measures and construct life tables.
3) Analyze reliability of binary systems using coherent system models and reliability functions.
4) Apply statistical methods to solve practical problems in forecasting, demography, and reliability analysis.

Course Outcomes: Students will able to…

1) Analyze time series data using trend, smoothing, seasonal variation, and forecasting techniques.
2) Calculate and interpret demographic indicators, including mortality, fertility, reproduction rates, and life tables.
3) Evaluate the reliability of coherent binary systems and compute system reliability for different configurations.
4) Explain ageing properties and apply hazard, survival, IFR, and DFR concepts in reliability analysis.

List of Experiments	**Hrs.**
1) Fitting of Discrete Uniform and Binomial distribution. 2) Fitting of Poisson and Hypergeometric Distribution. 3) Fitting of Geometric and Negative Binomial distribution. 4) Model sampling from Discrete Uniform and Binomial distribution. 5) Model sampling from Hypergeometric and Poisson distribution. 6) Model sampling from Geometric and Negative Binomial distribution. 7) Sketching of Discrete Uniform, Binomial and Hypergeometric distribution. 8) Sketching of Poisson, Geometric and Negative Binomial distributions. 9) Computation of probabilities of Discrete distribution and application of Model Sampling Techniques using MS-Excel. 10) Estimation of Trend by Progressive averages and Moving Average Method. 11) Estimation of Trend by Least square estimation method and Measurement of Seasonal Variation in Time Series. 12) Forecasting using the Exponential Smoothing Method and fitting of Curves: Straight Line, Parabola and Exponential Curves. 13) Computation of Mortality Rates, Fertility Rates and Reproduction Rates in Demography. 14) Reliability Theory: Block Diagrams, Structure Functions, and System Reliability, Computation of Survival Function and Hazard Rate 15) Decision-Making Under Uncertainty: Best Investment Option Selection.	60

Reference Books :

1) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018

2) Rockwell, Peter J., and Richard A. Davis. Introduction to Time Series and Forecasting. Springer, 2016.

3) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing, 2011

4) Montgomery, Douglas C., et al. Introduction to Time Series Analysis and Forecasting. 2nd ed., Wiley, 2008.

5) Preston, Samuel H., et al. Demography: Measuring and Modeling Population Processes. Blackwell Publishing, 2001.

6) Stuart, Alan, and J. Keith Ord. Kendall's Advanced Theory of Statistics, Volume 1: Distribution Theory. 6th ed., Edward Arnold, 1994.

7) Sinha S.K., Reliability and Life Testing, Wiley Eastern Publishers, New Delhi, Second Edition,1987

8) Barlow R.E. and Proschan Frank, Statistical Theory of Reliability and Life Testing, Holt Rinebart and Winston Inc., New York, 1981.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• Journal: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: ANALYSIS OF CONTINUOUS DISTRIBUTIONS (BST 234)

Course Objectives: Students should …

1) Understand the fundamental concept of continuous distributions.
2) Analyze distribution symmetry, tail weight, and shape using cumulants, skewness, and kurtosis.
3) Learn the definitions, probability functions, and properties of Uniform and Exponential distributions.
4) Apply the key features of the Normal distribution and how to standardize continuous variables.

Course Outcomes: Students will be able to:

1) Use the concept of continuous distributions with real-life situations.
2) Determine distribution shape and asymmetry using cumulants, skewness, and kurtosis.
3) Solve real-world probability problems of Uniform and Exponential distributions.
4) Apply Normal distribution formulas to find probabilities and Z-scores for real data.

Module	Title and Contents	Hrs.
Module -1:	**Introduction to Continuous Random Variables** 1.1 Definition of Continuous Sample Space with Illustrations 1.2 Continuous Random Variable (r.v.) and Probability Density Function (p.d.f.) 1.3 Concept of Expectation for Continuous Random Variable 1.4 Raw Moments and Central Moments 1.5 Related Examples and Applications	07
Module -2:	**Measures of Shape for Continuous Distributions** 2.1 Introduction to Cumulates, Properties and Applications 2.2 Introduction to Skewness, Properties and Applications 2.3 Introduction to Kurtosis, Properties and Applications 2.4 Related Examples	08
Module -3:	**Uniform and Exponential Distribution** 3.1 Uniform Distribution: Definition, p.d.f., Mean and Variance, Basic Properties (Without Proof) 3.2 Exponential Distribution: Definition, p.d.f., Mean and Variance, Basic Properties (Without Proof) 3.3 Related Examples	06
Module -4:	**Normal Distribution** 4.1 Normal Distribution: Definition, p.d.f., Mean and Variance 4.2 Properties of Normal Distribution (Without Proof) 4.3 Importance and Applications of Normal Distribution 4.4 Related Examples	09

Reference Books :-

1) Agarwal B. L, Statistics, New Age International P Ltd. Delhi, 2015.
2) Goon A. M, Gupta M. K. and Dasgupta B, Fundamentals of Statistics Vol. I and II, Calcutta World Press, 2016.
3) Gupta S. P, Statistical Methods, Sultan Chand and Sons, Delhi, 2002.
4) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018.
5) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, Seventh Edition, 2013.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: STATISTICAL TECHNIQUES (BST 235)

Course Objectives: Students should …

1) Understand the concepts and techniques of time series analysis for trend and seasonal variation.
2) Apply statistical quality control methods to monitor and improve process quality.
3) Compute and interpret demographic measures related to mortality, fertility, and reproduction.
4) Apply decision theory to analyze and solve problems under uncertainty and risk.

Course Outcomes: Students will be able to:

1) Analyze time series data using trend estimation and seasonal index measurement techniques.
2) Construct and interpret control charts for variables and attributes to assess process quality.
3) Calculate and interpret demographic indicators, including mortality, fertility, and reproduction rates.
4) Apply decision-making techniques under uncertainty and risk to solve practical business and industrial problems.

Module	Title and Contents	Hrs.
Module -1:	**Time Series** 1.1 Introduction to Time Series Analysis 1.2 Components: Trend, Seasonal, Cyclical, and Irregular Variations 1.3 Additive vs. Multiplicative Models 1.4 Measurement of Trend: Moving Averages, Progressive Average, Least Square Method 1.5 Measurement of Seasonal Indices: Simple Average Method	07
Module -2:	**Statistical Quality Control** 2.1 Overview of SQC: Process and Product Control 2.2 Shewhart's Control Chart: Construction and Working 2.3 Control Charts for Variables: Mean & Range Charts 2.4 Control Charts for Attributes: np- chart, p-chart and C-chart	08
Module -3:	**Demography** 3.1 Introduction and need of vital statistics 3.2 Mortality rates: Crude death rate (CDR), Specific Death Rate (SDR), Standardized Death Rate (STDR). 3.3 Fertility Rates: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR), Total Fertility Rate (TFR). 3.4 Reproduction Rate: Gross Reproduction rate (GRR), Net Reproduction Rate (NRR). Interpretations of different rates, uses and applications.	07

Module -4:	**Decision Theory** 4.1 Introduction to Decision Theory 4.2 Types of Decision-Making Environments 4.3 Decision Making Under Uncertainty 4.4 Decision Making Under Risk Examples and Problems	08

Reference Books:

1) Agarwal B. L, Statistics, New Age International P Ltd. Delhi, 2015.
2) Goon A. M, Gupta M. K. and Dasgupta B, Fundamentals of Statistics Vol. I and II, Calcutta World Press, 2016.
3) Gupta S. P, Statistical Methods, Sultan Chand and Sons, Delhi, 2002.
4) Barlow R.E. and Proschan Frank, Statistical Theory of Reliability and Life Testing, Holt Rinebart and Winston Inc., New Yark, 1981.
5) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018.
6) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, Seventh Edition,2013.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: Minor Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: STATISTICS MINOR PRACTICAL – III (BSP 236)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should be:

1) Understand the basic concepts of probability distributions, time series, quality control, and demography.
2) Perform statistical calculations and practical's using manual methods and MS-Excel.
3) Analyse data and interpret the results using different statistical techniques.
4) Apply statistical methods to solve simple real-life problems.

Course Outcomes: Students will be able to:

1) Fit discrete probability distributions, generate random samples, and calculate probabilities using statistical methods and MS-Excel.
2) Analyse time series data by estimating trend and seasonal variation using appropriate methods.
3) Construct and interpret statistical quality control charts for monitoring process performance.
4) Compute demographic measures such as mortality, fertility, and reproduction rates and apply them to real-life data analysis.

List of Experiments	**Hrs.**
1) Fitting of Discrete Uniform and Binomial Distribution. 2) Fitting of Poisson Distribution. 3) Fitting of Geometric and Negative Binomial Distribution. 4) Model sampling from Discrete Uniform and Binomial Distribution. 5) Model sampling from Poisson Distribution. 6) Model sampling from Geometric Distribution. 7) Sketching of Discrete Uniform, Binomial and Hypergeometric Distributions. 8) Sketching of Poisson, Geometric and Negative Binomial Distributions. 9) Computation of probabilities of discrete distributions using MS-Excel. 10) Estimation of Trend by Progressive averages and Moving Average Method. 11) Estimation of Trend by Least Squares estimation method. 12) Measurement of Seasonal Variation in Time Series. 13) Construction of Variable Charts: R-chart and Mean Chart. 14) Construction of Attribute Chart : np-and p-chart, c-chart. 15) Demography : Computation of Mortality Rates and Fertility Rates.	60

Reference Books:

1) Gupta, S. P. Statistical Methods. New Delhi: Sultan Chand & Sons, 2019.
2) Gupta, S. C., and Kapoor, V. K. Fundamentals of Applied Statistics. New Delhi: Sultan Chand & Sons, 2018.
3) Gupta, S. C., and Kapoor, V. K. Fundamentals of Mathematical Statistics. New Delhi: Sultan Chand & Sons, 2011.
4) Hogg, R. V., and Craig, A. T. Introduction to Mathematical Statistics. 7th Edition. New York: Macmillan Publishing Company, 2013.
5) Mukhopadhyay, P. An Introduction to the Theory of Probability. Singapore: World Scientific Publishing, 2011.
6) Mood, A. M., Boes, D. C., and Graybill, F. A. Introduction to the Theory of Statistics. 3rd Edition. New Delhi: Tata McGraw-Hill, 1974.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• Journal : 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 arks each) • Section II: Attempt any TWO questions (05 marks each)

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: VSC Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: R Software-I (BSPVSC-I)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should …

1) Develop proficiency in R Software for statistical computing and data analysis.
2) Apply R programming concepts for data handling, manipulation and matrix operations.
3) Create graphical representations of data using appropriate statistical charts and plots.
4) Implement simulation techniques to solve statistical problems.

Course Outcomes: Students will be able to:

1) Import, organize and manipulate data using R programming.
2) Perform data analysis using vectors, matrices, lists, factors and data frames.
3) Generate and interpret statistical graphs and data visualizations in R.
4) Apply control structures and simulation techniques to solve statistical problems using R.

List of Experiments	**Hrs.**
1) Introduction to R: Installing R and R-Studio. 2) Importing Data from CSV Files. 3) Creating and Handling Vectors. 4) Handling Missing Data (NA), Data Sorting and Ordering. 5) Basic Operations on Vectors. 6) Creating, Indexing Matrices and perform Matrix Operations (Addition, Multiplication, Transpose) 7) Working with Factors, Creating and Accessing Lists. 8) Creating and Modifying Data Frames. 9) Drawing Simple Bar, Multiple Bar, Subdivided Bar Charts and Pie Charts. 10) Drawing Histograms, Frequency Polygon and Frequency Curve. 11) Drawing Ogive Curves and Creating Boxplots. 12) Drawing Scatter Plots. 13) Use if-else and for loops. 14) Use While loop and Repeat loop. 15) Simulation of random experiments.	60

Reference Books:

1) G. J. S. S. Raju, R Programming: A Practical Approach, BS Publications, 2016.
2) K. V. S. Sarma, Statistics Made Simple: Do It Yourself on PC Using R, PHI Learning Pvt. Ltd., 2010.
3) A. K. Sharma, Statistical Computing Using R, Discovery Publishing House, 2019.
4) B. K. Tyagi, R Programming for Statistical Computing, Wiley India, 2021.
5) V. K. Jain, R Programming and Data Analysis, Khanna Book Publishing, 2022.
6) S. K. Shukla, Statistical Computing with R, Himalaya Publishing House, 2020.

7) P. G. Dixit, R Programming for Data Analysis and Statistics, Notion Press, 2021.
8) Crawley, M. J., The R Book, Wiley, 2013.
9) Dalgaard, P., Introductory Statistics with R, Springer, 2008.
10) Kabacoff, R. I., R in Action, Manning Publications, 2015.
11) Wickham, H., R for Data Science, O'Reilly Media, 2016.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• Journal : 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: SEC Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: Introduction to Power BI (BSPSEC-I)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should…

1) Introduce the concept of business intelligence and data analysis.
2) Describe the Power BI interface and basic functionalities.
3) Perform data visualization using Power BI.
4) Construct a dashboard to solve real-life data.

Course Outcomes: Students will be able to:

1) Import, transform, and manage data from multiple sources in Power BI.
2) Navigate the Power BI interface and perform basic tasks.
3) Gain proficiency in creating simple visualizations and reports using Power BI.
4) Develop an appreciation for the role of data visualization in conveying insights effectively.

List of Experiments	**Hrs.**
1) Installation and Configuration of Power BI Desktop, exploring the Power BI Interface (Report, Data, and Model Views). 2) Importing Data from Excel, CSV, Text Files, and connecting to different data sources. 3) Understanding data types and data loading. 4) Creating and managing data relationships. 5) Creating and formatting Bar Charts (Clustered, Stacked, and 100% Stacked). 6) Creating and formatting Column Charts (Clustered, Stacked, and 100% Stacked). 7) Creating and formatting Line Charts. 8) Creating and formatting Area Charts and Stacked Area Charts. 9) Creating and formatting Line and Clustered Column Charts,Line and Stacked Column Charts. 10) Creating and formatting Pie Charts, Donut Charts, and Treemap Charts. 11) Creating and formatting Scatter Charts. 12) Creating and formatting Ribbon Charts, Waterfall Charts, and Funnel Charts. 13) Creating Map and ArcGIS Map Visualizations. 14) Creating and formatting Table visualizations, Matrix visualizations. 15) Applying Filters, Slicers, Cross-filtering, and Drill-through Features.	60

Reference Books :

1) Errin O'Connor and Patrick LeBlanc, Power BI Step by Step, 2022
2) Dan Clark, Beginning Power BI: A Practical Guide to Self-Service Data Analytics with Excel 2016 and Power BI Desktop, 2019
3) Ken Puls and Miguel Escobar, M is for (Data) Monkey: A Guide to the M Language in Excel Power Query, 2019
4) Brett Powell, "Mastering Power BI: Power BI's Advanced Features and Techniques for Experienced Power Users", 2018
5) Marco Russo, Alberto Ferrari, and Daniele Perilli, "The Definitive Guide to DAX: Business intelligence with Microsoft Excel, SQL Server Analysis Services, and Power BI", 2014
6) Martijn Evers and Hendrik den Ouden, "Dashboarding and Reporting with Power BI Desktop and Excel: How to Design and Create a Financial Dashboard with PowerPivot – End to End", 2012.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• Journal : 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – III
Type: IKS	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: INDIAN STATISTICAL KNOWLEDGE SYSTEM (BSTIKS-I)

Course Objectives: Students should…

1) Understand the historical evolution of statistics in India from the British period to modern times.
2) Explain the structure and functions of India's official statistical system and organizations.
3) Study the contributions of P. C. Mahalanobis and other eminent Indian statisticians.
4) Identify the applications of statistics in agriculture, higher education, and national development.

Course Outcomes: Students will be able to…

1) Describe the evolution of statistics in India and its role in national development.
2) Explain the functions of major statistical organizations such as MOSPI, NSO, CSO, and NSSO.
3) Discuss the contributions of P. C. Mahalanobis and other Indian statisticians.
4) Illustrate the applications of statistics in Indian agriculture, universities, and public policy.

Module	Title and Contents	Hrs.
Module -1:	**Evolution of Statistics** 1.1 Statistics During the British Raj: 1858–1947 1.2 India's Statistical Revolution: 1947–1972	07
Module -2:	**Statistical system after Independence** 2.1 Historical perspective of official statistics in India. 2.2 CSO, NSO, MOSPI, and NSSO 2.3 Statistical division and activities in government. 2.4 Significant contributions of Some Indian Statisticians.	08
Module -3:	**PC Mahalanobis and Indian Statistical Institute** 3.1 The early period (1915-1931) 3.2 The second period (1931-1950) 3.3 Fifties and sixties	08
Module -4:	**Statistics in India** 4.1 Statistics in Indian Agriculture 4.2 Statistics in Indian Universities	07

Reference Books :

1) Ghosh, J. K., Maiti, P., Rao, T. J., & Sinha, B. K., Evolution of Statistics in India, International Statistical Review, Vol. 67, 1999.
2) Ghosh, J. K., Mitra, S. K., & Parthasarathy, K. R., Glimpses of India's Statistical Heritage, Wiley Eastern, New Delhi, 1992.
3) Chaudhuri, S. B., History of the Gazetteers of India, Publications Division, New Delhi, 1964.
4) Adhikari, B. P., Social Construction of the Statistical Estimation of the Crop Yield, XII World Congress of Sociology, Madrid, 1990.
5) Buchanan, F., Survey of Eastern India, Court of Directors, London, 1807.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

Bachelor of Science (B. Sc.) Part II,
Semester-IV Statistics

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Major	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: PROBABILITY DISTRIBUTIONS (BST 241)

Course Objectives: Students should …

1) Understand the concepts, properties, and applications of Gamma and Beta distributions.
2) Explain the theoretical foundations of multinomial and bivariate normal distributions.
3) Differentiate between univariate and bivariate probability distributions and their statistical characteristics.
4) Develop an understanding of moment inequalities and their significance in probability theory.

Course Outcomes: Students will be able to :

1) Analyze Gamma and Beta distributions by evaluating their probability density functions and distributional characteristics.
2) Construct and interpret the joint, marginal, and conditional distributions of the bivariate normal distribution.
3) Apply multinomial and bivariate normal distributions to model and solve statistical problems.
4) Evaluate probability bounds using Markov's and Chebyshev's inequalities in statistical applications.

Module	Title and Contents	Hrs.
Module -1:	**Gamma Distribution** 1.1 Gamma distribution with scale parameter θ and shape parameter n, Nature of probability curve, special case θ = 1, n =1, Moment generating function (m.g.f.), cumulant generating function (c.g.f.), mean, mode, variance, moments, cumulants, β_1,β_2, $\gamma 1$, and γ_2 coefficients. 1.2 Additive property: distribution of a sum of i.i.d. exponential variates. 1.3 Relation between distribution function of Poisson and Gamma variates. Properties of gamma	07
Module -2:	**Beta Distribution** 2.1 Beta distribution of the first kind: Beta distribution of the first kind with parameters m & n. mean, mode, variance, symmetric when m = n, Uniform distribution as a particular case when m = n = 1, distribution of (1-X). 2.2 Beta distribution of the second kind: Beta distribution of the second kind with parameters m & n. mean, mode, variance, relation between the beta distribution of first kind and second kind, 2.3 Distribution of X+Y, X/Y, and X/(X+Y) where X and Y are independent gamma variate.	08
Module -3:	**Bivariate Normal Distribution & Multinomial Distribution** 3.1 P.d.f. of bivariate Normal Distribution, BN($\mu 1$, $\mu 2$, σ^2, σ^2,ρ), marginal and	08

	conditional distributions, identifications of parameters, conditional expectation, and conditional variance. 3.2 Distribution of aX+bY+c, where a, b, and c are real numbers. And Examples. 3.3 Multinomial Distribution: Probability mass function (p.m.f.), Joint MGF of (X1,X2, :.Xk), use of MGF to obtain means, variances, covariances, total correlation coefficients, variance-covariance matrix, rank of variance-covariance matrix and its interpretation. 3.4 Additive property of multinomial distribution, univariate marginal distribution, distribution of Xi + Xj, the conditional distribution of Xi even Xj =r, the conditional distribution of Xi given Xi + Xj = r, real-life situations, and applications.	
Module -4:	**Order Statistics and Moment Inequalities** 4.1 Order statistics for a random sample of size n from a continuous distribution, definition, derivation of the distribution function and density function of the i-th order statistic, particular cases for i=1 and i=n. 4.2 Derivation of joint p. d. f. of i -th and j- th order statistics, statement of distribution of the sample range. Distribution of the sample median when n is odd. 4.3 Chebyshev's inequality for discrete and continuous distributions, Markov Inequality, Chuchy-Schwarz Inequality, Jensen's Inequality, and Lyapunov's Inequality without proof and applications.	07

Reference Books :-

1) Goon, A.M., Gupta M.K. and Dasgupta B, Fundamentals of Statistics Vol. I and Vol. II, World Press, Calcutta, 2016
2) Gupta S. C. & Kapoor V. K., Applied Statistics, Sultan Chand & Sons, New Delhi,2018
3) Gupta S. C. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2014
4) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, Seventh Edition, 2013
5) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing, 2011

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Major	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: SAMPLING DISTRIBUTIONS AND STATISTICAL TESTS (BST 242)

Course Objectives: Students should …

1) Understand the properties and applications of sampling distributions used in statistical inference.
2) Apply the principles of hypothesis testing for large and small sample problems.
3) Perform statistical tests using Chi-square, Student's *t*, and Snedecor's *F* distributions.
4) Interpret the results of hypothesis tests to support statistical decision-making in practical situations.

Course Outcomes: Students will be able to:

1) Explain the properties and applications of Chi-square, Student's *t*, and Snedecor's *F* distributions.
2) Formulate hypotheses and perform large sample tests for means, proportions, and correlation coefficients.
3) Conduct *t*-tests, *F*-tests, and Chi-square tests to analyze statistical data.
4) Interpret hypothesis testing results and draw appropriate conclusions for real-world statistical problems.

Module	Title and Contents	Hrs.
Module -1:	**Sampling Distributions** 1.1 Chi-Square distribution: Definition of chi-square variate, derivation of probability density function (p.d.f.) of the chi-square distribution with n degrees of freedom. 1.2 Properties of Chi-Square distribution: m.g.f., c.g.f., mean, variance, moments, cumulants, mode, skewness, kurtosis and additive property. 1.3 Student's t-distribution: Definition of Student's t-variate; derivation of p.d.f., mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients. Snedecor's F-distribution: Definition of F-variates; derivation of p.d.f., mean, variance and mode; distribution of 1/F; interrelation between t, F and χ^2 distributions (without proof).	07
Module -2:	**Basics of Testing of Hypothesis** 2.1 Notion of population, sample, parameter, statistic, sampling distribution of statistic, hypothesis, simple and composite hypotheses; null and alternative hypotheses; Type I and Type II errors, critical region, level of significance and p-value; one- and two-tailed tests; power of the test. 2.2 Large Sample Tests: General procedure of testing of hypotheses. a) Tests for means: i) Testing of population mean (H_0: $\mu = \mu_0$) ii) Testing equality of population means (H_0: $\mu_1 = \mu_2$) b) Tests for Proportion: i) Testing of population proportion (H_0: $P = P_0$) ii) Testing equality of population proportion (H_0:$P_1 = P_2$) c) Test for Population Correlation: i) Testing a population correlation	08

	coefficient (H_0: $\rho = \rho_0$) ii)Testing equality of population correlation coefficients (H_0: $\rho_1 = \rho_2$) using Fisher's Z-transformation	
Module -3:	**Tests based on t and F distribution** 3.1 Test for Means: i) Single population mean (H_0: $\mu = \mu_0$) ii) Equality of two population means (H_0: $\mu_1 = \mu_2$, assuming $\sigma_1 = \sigma_2$) iii) Paired t-test 3.2 Test for Equality of Variance (F-Test): Testing H_0: $\sigma_1^2 = \sigma_2^2$ against one-sided and two-sided alternatives when: i) Population means are known ii)Population means are unknown	08
Module -4:	**Tests based on Chi-square distribution** 4.1 Test for population variance (H_0: $\sigma^2 = \sigma_0^2$) 4.2 Test for goodness of fit 4.3 Test for independence of attributes: i) m x n contingency table ii) 2 x 2 contingency table, Yate's correction for continuity	07

Reference Books :

1) E. L. Lehmann, Joseph P. Romano, Testing Statistical Hypotheses, Springer New York, 3rd Edition, 2005.
2) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing, 2011.
3) Gibbons, Jean Dickinson, and Subhabrata Chakraborti. Nonparametric Statistical Inference. 5th ed. Chapman and Hall/CRC, 2011.
4) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, 7th Edition, 2013.
5) Gupta S.C. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2014.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Major Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: MAJOR STATISTICS PRACTICAL – IV (BSP 243)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should be,

1) Understand and be able to articulate the practical applications of probability distributions in real-world scenarios.
2) Apply statistical techniques to estimate parameters of probability distributions and assess the goodness of fit.
3) Assess the fit of continuous distribution on given data.
4) Visualize probability distributions through sketches and understand their key characteristics.

Course Outcomes: Students will be able to,

1) Learn the applications of Continuous Uniform distribution, Exponential distribution, Normal distribution, and Bivariate Normal distribution.
2) Assess the fit of continuous distribution.
3) Simulate data from various continuous distributions.
4) Demonstrate proficiency in generating random numbers following various probability distributions using different methods.

List of Experiments	**Hrs.**
1) Fitting of Continuous Uniform, Exponential and Normal distribution. 2) Model sampling from Continuous Uniform, Exponential and Normal Distribution. (using Normal Table and Box-Muller Transformation) 3) Application of Exponential and Normal distribution. 4) Application of Bivariate Normal and Multinomial distribution. 5) Sketching of Continuous Uniform, Exponential, Normal, Gamma and Beta Distributions using MS-Excel. 6) Application of Order Statistics. 7) Application of Moment Inequalities. 8) Computations of probabilities of Chi-square, t, and F- Distributions using MS-Excel. 9) Large sample tests for means. 10) Large sample tests for proportions. 11) Tests for population correlation coefficients. (Using Fisher's Z transformation.) 12) Tests based on Chi square distribution (Test for population variance, Goodness of fit and tests for independence) 13) Tests Based on t-Distribution I: Single Mean, Equality of Two Means 14) Tests Based on t-Distribution II: Paired t-Test	**60**

15) Tests Based on F-Distribution: Equality of two variances.

Reference Books :-

1) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing, 2011
2) Hogg R.V. and Criag A.T, Introduction to Mathematical Statistics, Macmillan Publishing, New York, SeventhEdidtion,2013
3) Gupta S.C.& Kapoor V.K., Fundamentals of Mathematical Statistics Sultan Chand& sons, New Delhi, 2014
4) Gupta S. C. &Kapoor V.K.: Applied Statistics, Sultan Chand &Sons, New Delhi, 2018
5) Boes D.C and Mood A. M., Introduction to the Theory of Statistics, Tata, McGraw-Hill, New Delhi. Third Edition,1973.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journal: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

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Faculty of Science and Technology

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Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: APPLICATIONS OF PROBABILITY DISTRIBUTIONS (BST 244)

Course Objectives: Students should …

1) Understand the properties and applications of the Gamma distribution.
2) Learn characteristics and applications of Beta distributions.
3) Apply concepts of the Bivariate Normal distribution.
4) Derive MGF of Multinomial distribution.

Course Outcomes: Students will be able to…

1) Apply the Gamma distribution to compute probabilities and statistical measures.
2) Analyze Beta distributions and solve related statistical problems.
3) Compute joint, marginal, and conditional distributions from Bivariate normal distributions.
4) Use the Multinomial distribution to model and analyze data.

Module	Title and Contents	Hrs.
Module -1:	**Gamma Distribution** 1.1 Gamma distribution with scale parameter θ and shape parameter n, Nature of probability curve, special case θ = 1, n =1, Moment generating function (m.g.f.), cumulant generating function (c.g.f.), mean, mode, variance, moments, cumulants, β1, β2, γ1, and γ2 coefficients. 1.2 Additive property: distribution of a sum of i.i.d. exponential variates. 1.3 Relation between distribution function of Poisson and Gamma variates. Properties of gamma	07
Module -2:	**Beta Distribution** 2.1 Beta distribution of the first kind: Beta distribution of the first kind with parameters m & n. mean, mode, variance, symmetric when m = n, Uniform distribution as a particular case when m = n = 1, distribution of (1-X). 2.2 Beta distribution of the second kind: Beta distribution of the second kind with parameters m & n. mean, mode, variance, relation between the beta distribution of first kind and second kind, 2.3 Distribution of X+Y, X/Y, and X/(X+Y) where X and Y are independent gamma variate.	08

Module -3:	**Bivariate Normal Distribution** 3.1 Probability density function (p.d.f.) of Bivariate Normal Distribution 3.2 BN(μ_1, μ_2, σ_1^2, σ_2^2, ρ): Definition and properties, Marginal distributions and conditional distributions, Identification of parameters. 3.3 Conditional expectation and conditional variance. 3.4 Linear combinations: Distribution of aX + bY + c, where a, b, and c are real numbers (with solved examples).	06
Module -4:	**Multinomial Distribution** 4.1 Multinomial Distribution: Probability mass function (p.m.f.), Joint Moment Generating Function (MGF) of (X_1, X_2, ..., X_k). 4.2 Using MGF to derive: Means, variances, covariances, Total correlation coefficients. 4.3 Variance-covariance matrix: Calculation, rank and interpretation. 4.4 Properties and Applications:	09

Reference Books :-

1) Agarwal B. L, Statistics, New Age International P Ltd. Delhi, 2015.
2) Goon A. M, Gupta M. K. and Dasgupta B, Fundamentals of Statistics Vol. I and II, Calcutta World Press, 2016.
3) Gupta S. P, Statistical Methods, Sultan Chand and Sons, Delhi, 2002.
4) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018.
5) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, Seventh Edition,2013.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test • (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

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Faculty of Science and Technology

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Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: APPLIED STATISTICAL METHODS (BST 245)

Course Objectives: Students should …

1) Understand the fundamental concepts of population, sample, parameter, statistic, and sampling distribution.
2) Learn hypothesis testing techniques, including Type I and Type II errors, critical regions, and p-value calculations.
3) Examine and apply the properties of Chi-Square, t, and F distributions to solve real-world statistical problems.
4) Interpret the results of hypothesis tests and distribution-based tests to make informed decisions in research and industry applications.

Course Outcomes: Students will be able to…

1) Define key terms related to hypothesis testing, including null and alternative hypotheses, and perform hypothesis testing for different distributions.
2) Apply the chi-square, t-distribution, and F-distribution in real-world statistical problems.
3) Calculate and interpret p-values and critical regions for one-tailed and two-tailed tests, understanding the significance of Type I and Type II errors.
4) Solve practical problems using sampling distributions to make informed statistical decisions and interpret results effectively.

Module	Title and Contents	Hrs.
Module -1:	**Introduction to Hypothesis Testing** 1.1 Population, Sample, Parameter, Statistic 1.2 Sampling Distribution of Statistic 1.3 Null and Alternative Hypothesis, Simple vs. Composite Hypothesis 1.4 Type I and Type II Errors, Critical Region, Level of Significance, p-value One-tailed and Two-tailed Tests 1.5 Power of the Test 1.6 Illustrations and Applications	07
Module -2:	**Sampling Distributions: Chi-Square Distribution** 2.1 Definition of Chi-Square Distribution 2.2 Derivation of p.d.f. of Chi-Square Distribution (with n degrees of freedom) 2.3 Mean, Variance, Moments, and Cumulants of Chi-Square Distribution 2.4 Mode, Skewness, Kurtosis of Chi-Square Distribution 2.5 Additive Property of Chi-Square Distribution	08
Module -3:	**Student's t-Distribution** 3.1 Definition of Student's t-Variate 3.2 Derivation of p.d.f., Mean, Mode, Variance, Moments 3.3 Coefficients: β_1, β_2, γ_1, and γ_2	07

Module -4:	**Snedecor's F-Distribution** 4.1 Definition of F-Variate 4.2 Derivation of p.d.f., Mean, Variance, and Mode 4.3 Distribution of 1/F 4.4 Interrelation Between t, F, and χ^2 Distributions (Without Proof)	08

Reference Books :-

1) Agarwal B. L, Statistics, New Age International P Ltd. Delhi, 2015.
2) Goon A. M, Gupta M. K. and Dasgupta B, Fundamentals of Statistics Vol. I and II, Calcutta World Press, 2016.
3) Gupta S. P, Statistical Methods, Sultan Chand and Sons, Delhi, 2002.
4) Barlow R.E. and Proschan Frank, Statistical Theory of Reliability and Life Testing, Holt Rinebart and Winston Inc., New Yark, 1981.
5) Gupta S. C. & Kapoor V.K. Applied Statistics, Sultan Chand & Sons, New Delhi. 2018.
6) Hogg R.V. and Criag A.T., Introduction to Mathematical Statistics, Macmillan Publishing, New York, Seventh Edition,2013.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: Minor Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: MINOR STATISTICS PRACTICAL – IV (BSP 246)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should…

1) Understand the theoretical properties and applications of continuous and discrete probability distributions.
2) Identify the relationships between different statistical distributions like Gamma, Beta, Normal, t, F, and Chi-square.
3) Develop skills for computing and interpreting moments, cumulants, skewness, kurtosis, and related measures.
4) Apply knowledge of sampling distributions in hypothesis testing and inferential statistics.

Course Outcomes: Students will be able to:

1) Derive the properties of Gamma, Beta, and Normal distributions.
2) Apply statistical distributions in real-world scenarios, including modeling and simulation.
3) Compute and interpret statistical parameters like mean, variance, skewness, and kurtosis of continuous distributions.
4) Perform hypothesis testing and interpret p-values and error types.

List of Experiments	**Hrs.**
1) Fitting of Continuous Uniform distribution. 2) Fitting of Continuous Exponential distribution. 3) Fitting of Normal distribution. 4) Model sampling from Continuous Uniform distribution. 5) Model sampling from Exponential distribution. 6) Model sampling from Normal Distribution. (using Normal Table and Box-Muller Transformation) 7) Application of Exponential distribution. 8) Application of Normal distribution. 9) Application of Bivariate Normal distribution. 10) Application of Multinomial distribution. 11) Sketching of Continuous Uniform, Exponential, and Normal Distributions using MS-Excel. 12) Sketching of Gamma and Beta Distributions using MS-Excel. 13) Computations of probabilities of Chi-square Distribution using MS-Excel. 14) Computations of probabilities of t- Distribution using MS-Excel. 15) Computations of probabilities of F- Distributions using MS-Excel.	60

Reference Books :

1) Gupta S.P, Statistical Methods, Sultan Chand and Sons, New Delhi, 2019
2) Gupta S. C. &Kapoor V.K.: Applied Statistics, Sultan Chand &Sons, New Delhi, 2018
3) Gupta S.C.& Kapoor V.K., Fundamentals of Mathematical Statistics Sultan Chand& sons, New Delhi, 2011
4) Hogg R.V. and Criag A.T, Introduction to Mathematical Statistics, Macmillan Publishing, New York, SeventhEdidtion,2013
5) Parimal Mukhopadhyaya, An Introduction to the Theory of Probability, World Scientific Publishing, 2011
6) Boes D.C and Mood A. M., Introduction to the Theory of Statistics, Tata, McGraw-Hill, New Delhi. Third Edition,1973.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journal: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: VSC Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: R Software-II (BSPVSC-II)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should …

1) Develop proficiency in performing statistical computations and data analysis using R.
2) Apply descriptive statistics, probability distributions and regression techniques using R software.
3) Create effective statistical visualizations for data interpretation and presentation.
4) Perform hypothesis testing and interpret statistical results using appropriate inferential methods.

Course Outcomes: Students will be able to…

1) Compute descriptive statistical measures and analyze data using R.
2) Apply probability distributions, random number generation and regression analysis using R.
3) Generate and interpret statistical graphs and visualizations using R packages.
4) Perform and interpret hypothesis tests, including large-sample tests, t-tests, Chi-square tests and F-tests using R.

List of Experiments	**Hrs.**
1) Computations based on Measures of Central Tendency (For ungrouped data) using R 2) Computations based on Measures of Central Tendency (For grouped data) using R 3) Computations based on Measures of Dispersion (For ungrouped data) using R 4) Computations based on Measures of Dispersion (For grouped data) using R 5) Computations of Moments, Skewness and Kurtosis using R 6) Computation of Correlation Coefficient and Fitting a Simple Linear Regression Model 7) Creating Heat maps in R and Data Visualization Using ggplot2 8) Generating Random Numbers from discrete distributions 9) Sketching probabilities of discrete distributions 10) Generating Random Numbers from Continuous distributions 11) Sketching probabilities of Continuous distributions 12) Computation of Probabilities for t, F and Chi-square Distributions using R Software 13) Performing large sample test for means and proportions 14) Performing t-test (One-Sample and Two-Sample) 15) Performing Chi-Square Test for Independence and F-test for Equality of Two Variances	60

Reference Books:

1) K. V. S. Sarma, Statistics Made Simple: Do It Yourself on PC Using R, PHI Learning Pvt. Ltd., 2010.
2) U. Dinesh Kumar, Business Analytics: The Science of Data-Driven Decision Making, Wiley India, 2017.
3) James, G., Witten, D., Hastie, T., & Tibshirani, R., An Introduction to Statistical Learning with Applications in R (2nd ed.), Springer, 2021.
4) A. K. Sharma, Statistical Computing Using R, Discovery Publishing House, 2019.

5) Kabacoff, R. I., R in Action: Data Analysis and Graphics with R (2nd ed.), Manning Publications, 2015.
6) Dalgaard, P., Introductory Statistics with R (2nd ed.), Springer, 2008.
7) Crawley, M. J., The R Book (2nd ed.), Wiley, 2013.
8) Wickham, H., R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2016.
9) Wickham, H., ggplot2: Elegant Graphics for Data Analysis (2nd ed.), Springer, 2016.
10) Chang, W., R Graphics Cookbook (2nd ed.), O'Reilly Media, 2018.
11) Verzani, J., Using R for Introductory Statistics (2nd ed.), Chapman & Hall/CRC, 2014.
12) Braun, W. J., & Murdoch, D. J., A First Course in Statistical Programming with R (2nd ed.), Cambridge University Press, 2016.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• Journal: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: SEC Practical	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: ADVANCED POWER BI (BSPSEC-II)

Practical Batch: 16 Students/ Batch

Course Objectives: Students should…

1) Understand data integration techniques in Power BI.
2) Learn data transformation options using Power Query.
3) Apply data flows for data preparation.
4) Draw insights from data by visualization.

Course Outcomes: Students will be able to…

1) Perform various data integration techniques and their applications.
2) Performing data transformation tasks using power query.
3) Create and manage data flows for data preparation and reuse.
4) Implement best practices for ensuring data governance and compliance within Power BI projects.

List of Experiments	**Hrs.**
1) Introduction to Power Query Editor. 2) Data Type Detection and Data Type Conversion. 3) Data Cleaning using Power Query. 4) Replacing Values, Handling Null Values, and Removing Errors. 5) Removing Columns, Duplicate Records, and Unwanted Data. 6) Splitting Columns using Delimiters and Positions. 7) Merging Columns and Appending Queries. 8) Extracting Text, Date and Number Values. 9) Pivoting, Unpivoting and Group by Operations. 10) Creating Conditional Columns and Data Profiling. 11) Introduction to Power Query M Language. 12) Creating Calculated Columns, Measures using DAX, and Aggregate Functions (SUM, AVERAGE, COUNT, DISTINCTCOUNT, MIN, MAX). 13) Creating Time Intelligence Measures (YTD, MTD, QTD, Previous Year). 14) Creating and formatting KPI Cards, Multi-row Cards, and Gauge Visuals. 15) Creating an Interactive Power BI dashboard	60

Reference Books :

1) Brett Powell, "Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards", 2018.
2) Gordon S. Linoff and Daniel T. Vodoo,"Data Analysis Using SQL and Excel", 2016
3) Alberto Ferrari and Marco Russo, "Analyzing Data with Power BI and Power Pivot for Excel", 2017.
4) Chris Webb, "Power Query for Power BI and Excel",2014.
5) Leila Etaati and Matt Allington, "Advanced Analytics with Power BI and R", 2017.
6) Phil Seamark, "Power BI Desktop Advanced", 2019.
7) Grant Paisley, "Mastering Power BI: Unlock deeper insights with the buildout of BI reporting and dashboards from distributed data sources", 2023.
8) Teo Lachev, "Applied Power BI: Bring Your Data to Life!", 2018.

Evaluation Pattern:	
Total Marks: 50	
Continuous Comprehensive Evaluation (20 Marks): • Journal: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**End Semester Examination (30 Marks):** • Section I: Attempt any TWO questions (10 marks each) • Section II: Attempt any TWO questions (05 marks each)

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Statistics

Programme: B.Sc.	**Semester** – IV
Type: VEC	**Marks:** 50
Credits: 2	**From:** A. Y. 2025-26

Name of the Course: ENVIRONMENTAL AWARENESS WITH STATISTICS (BSTVEC-II)

Course Objectives: Students should…

1) Understand major environmental issues, their causes, impacts, and the role of statistics in environmental studies.
2) Explain environmental laws, ethics, and the responsibilities of citizens toward environmental protection.
3) Understand the Sustainable Development Goals (SDGs), their indicators, and their implementation at global and national levels.
4) Apply statistical concepts and official statistics to monitor, analyze, and support the achievement of Sustainable Development Goals.

Course Outcomes: Students will be able to…

1) Explain major environmental issues, their causes, impacts, and the contribution of statistics in environmental analysis.
2) Describe environmental laws, ethical practices, and the role of citizens in promoting environmental sustainability.
3) Interpret the Sustainable Development Goals (SDGs), Global Indicator Framework, and National Indicator Framework.
4) Analyze and interpret statistical data and official statistics for monitoring and evaluating Sustainable Development Goals (SDGs).

Module	Title and Contents	Hrs.
Module -1:	**Environmental Issue** 1.1 Pollution (Air, Water and Land), Fresh-water overuse, Natural disasters, Fuel and Energy shortage due to overuse, Increase in wasteland 1.2 Biodiversity loss, Global warming and climate change (Causes and intensity of the problem) 1.3 Role of Statistics in creation of environmental issues.	08
Module -2:	**Environmental laws and Ethics** 2.1 Environmental Protection Act, Wildlife Protection Act, Forest Conservation Act 2.2 Prevention and Control of Pollution Act (Air, Water and Land) from unsustainable t o sustainable development. 2.3 Responsibilities of an Environmentally aware citizen.	07
Module -3:	**Sustainable Development Goals** 3.1 Overview of the Sustainable Development Goals, Sustainable Development Goals in India 3.2 Global Indicator Framework, National Indicator Framework Policy and Guidelines	07

Module -4:	**Role of Statistics in meeting the sustainable development goals (SDGs)** 4.1 Role of data and Statistics in sustainable development goal implementation, 4.2 Official Statistics for SDGs.	08

Reference Books :

1) V Barnett, Environmental Statistics - Methods and Applications, Wiley Series in Probability and Statistics, 2003
2) Environment, Shankar IAS Academy 9th Edition, 2023
3) Sharma, S., and Sharma, K., Environment and society: Climate change and sustainable development. Routledge India, 2023
4) Verma, S. K, and Kumar M. Environmental Ethics and Law, VL Media, 2020
5) Environment and Sustainable Development Goals, Ministry of Statistics & Programme Implementation. http://moef.gov.in/wp-content/themes/moef-green/ebook/ncmefcc/ncmefcc.html
6) Wilson M., Environmental and Ecological Statistics, Murphy & Moore Publishing, 2022.

Evaluation Pattern:

Total Marks: 50

Continuous Comprehensive Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Activity • CCE - II: 10 Marks: Activity • CCE - III: 10 Marks: MCQ Test (Best of 2 from CCE I, II & III Selected for final Score)	• Question -1: Solve the following questions (five questions of 2 Marks) • Question -2: Attempt any two questions. (Three questions of 10 marks) • Question -3: Attempt any four questions. (Six questions of 5 marks) (50 Marks converted to 30 marks)