Vidya Prasarak Mandal's

B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Program Code: BUST

Programme: Bachelor of Science

Specific Programme: STATISTICS

[S. Y. B. Sc. Statistics]
Level 5.0
CHOICE BASED GRADING SYSTEM
Revised under NEP
From the Academic Year 2024-25

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Preamble

VPM's B.N. Bandodkar College (Autonomous), Department of Statistics is revamped the entire course of Bachelor of Science in Statistics according to the guidelines prescribed under the NEP-2020 and the process of restructuring the S.Y.B.Sc. syllabus for its implementation from academic year 2024-25.

The B.Sc. Statistics programme is aimed to develop the theoretical and analytical skills of the students so that they may be absorbed in the corporate world or able to pursue higher studies at the Master's level in Statistics. Statistical concepts and techniques will be taught to students so that they not only know how and when to use the statistical procedures but also to understand why these procedures should be used. Efforts will be taken to explain the ideas behind the statistical concepts and techniques.

The main objectives of the course are:
- To introduce statistical concepts that are relevant in the interpretation of measurements made on individuals and in the interpretation of statistical study materials.
- To get Knowledge and understanding of basic statistical methods such as sampling and collecting data, probability, distributions, and Regression Analysis.
- To be capable of managing Statistics projects with consideration of human, financial and environmental factors.
- To work effectively as a part of a team to achieve a common stated goal.
- To communicate effectively with a range of audiences both technical and non-technical.
- To develop an aptitude to engage in continuing professional development.

The syllabus is aimed to achieve these above objectives. The students will be ready for the jobs available in different fields like:
- Statistician
- Analyst
- Biostatistician
- Actuaries
- Banking sector
- Machine Learning and Artificial Intelligence
- Data Analytics
- Academics
- Government organizations like NSSO, NSO, ISS, SSC etc. And many others.

PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B.Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 - Disciplinary Knowledge

Lay a strong foundation of conceptual learning in science. Instill ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude

Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy

Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

PO4 - Sensitization towards Environment

Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Teamwork

Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness

Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build an attitude of unbiased, truthful actions and avoid unethical behavior in all aspects of life.

Eligibility: Passed F.Y.B.Sc. as Major or Minor Statistics Subject. (Level 4.5)

Duration: 1 year (Including Semester III & IV)

Total Credits for the Program: 44

Starting year of implementation: 2024-25

Mode of Conduct: Offline

Discipline/Subject: Statistics

Programme Specific Outcomes:

After successful completion of this course, every leaner will be able to:

1. Apply fundamental concepts of descriptive statistics, statistical methods, probability distributions, sampling theory, ANOVA, DOE, estimation theory, hypothesis testing, and reliability analysis to analyze, interpret, and solve real-world problems across diverse domains. L3
2. Demonstrate proficiency in using Excel, Tableau, Python, and SQL for data handling, cleaning, visualization, analysis, and reporting, enabling them to work effectively in data-driven environments. L2
3. Design and implement statistical models, including probability-based models, stochastic processes, regression techniques, and other inferential procedures to derive meaningful insights from data. L6
4. Apply Operations Research techniques, including linear programming, simplex method, inventory, transportation and assignment problems, and simulation models to optimize decision-making in business, industry, and management applications. L3
5. Build and evaluate basic machine learning models using Python, integrate statistical algorithms with computational approaches, and use programming skills to automate analysis and solve complex data problems. L6
6. Apply statistical techniques to vital statistics, demographic measures, public health data, life tables, and population studies, ensuring accurate interpretation and planning for social, health, and administrative applications. L3

Specific Programme:

S.Y.B.Sc. (Statistics) Major with Practicals Credits: 10

S.Y.B.Sc. (Statistics) Minor Credits: 02

S.Y.B.Sc.(Statistics) (Generic) Credits: 02

S.Y.B.Sc.(Statistics) (Vocational Skill Course) Credits: 02

S.Y.B.Sc.(Statistics) (Field Project) Credits: 02

Assessment:

Weightage for assessments (in percentage) For Major and Minor

Vertical	Type of Course	Formative Assessment / IA	Summative Assessment
Major	Theory	40%	60%
	Practical	-	100%
Minor	Theory	40%	60%
Generic	Theory	40%	60%
VSC	Theory	20%	30%
	Practical	-	50%

B. N. Bandodkar College of Science (Autonomous), Thane

S.Y.B.Sc. Statistics

Year	Sem.	Course code	Course Title	Theory/ Practical	No. of Lectures	Credits
Second Year	III	**Major**				
		24BUST3T01	Probability Distributions	Theory	30	02
		24BUST3T02	Theory of Sampling	Theory	30	02
		24BUST3T03	Operations Research I	Theory	30	02
		24BUST3P01	Practicals based on 24BUST3T01 and 24BUST3T03	Practical	60	02
		24BUST3P02	Practicals based on 24BUST3T02 and 24BUST3T03	Practical	60	02
		Total			**210**	**10**
		Minor				
		24BUST3T04	Statistical Inference - I	Theory	30	2
		Total			**30**	**2**
		Generic				
		24BUST3T05	Statistical Reasoning and Aptitude-I	Theory	30	2
		Total			**30**	**2**
		Vocational Skill Course (VSC)				
		24BU3VSC02	Statistical Programming with Python- I	Theory	15	1
			Statistical Programming with Python- I Practical	Practical	30	1
		Total			45	2
		Field Project				
		24BUST3P03	Field Project in Statistics I	Practical	60	2
		Total			**60**	**2**

			Major			
			Major			
		24BUST4T01	Probability and Sampling Distributions	Theory	30	02
		24BUST4T02	Analysis of Variance & Design of Experiments	Theory	30	02
		24BUST4T03	Operations Research II	Theory	30	02
		24BUST4P01	Practicals based on 24BUST4T01 and 24BUST4T03	Practical	60	02
		24BUST4P02	Practicals based on 24BUST4T02 and 24BUST4T03	Practical	60	02
			Total		**210**	**10**
			Minor			
		24BUST4T04	Statistical Inference - II	Theory	30	2
			Total		**30**	**2**
	IV		**Generic**			
		24BUST4T05	Statistical Reasoning and Aptitude -II	Theory	30	2
			Total		**30**	**2**
			Vocational Skill Course (VSC)			
		24BU4VSC01	Statistical Programming with Python- II	Theory	15	1
			Statistical Programming with Python- II Practical	Practical	30	1
			Total		**45**	**2**
			Field Project			
		24BUST4P03	Field Project in Statistics II	Practical	60	2
			Total		**60**	**2**

Semester I
(Statistics-Major)

Course Code: 24BUST3T01

CO1	Define moment-generating functions, cumulant-generating functions, and characteristic functions for various probability distributions (both discrete and continuous).	L1
CO2	Explain standard discrete probability distributions and their properties.	L2
CO3	Outline of Bivariate Probability Distributions (Both Discrete and Continuous)	L2
CO4	Solve the problem of transformation of random variables using Jacobian transformation	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	0	0
CO2	3	2	1	0	0	0
CO3	3	1	1	0	0	0
CO4	3	2	1	0	1	1

Course Code 24BUST3T01	Major 1 Course Title: Probability Distributions-1	Credits 2	No. of Lecture 30
Unit I :	**Univariate Random Variables (Discrete and Continuous):** • **Moment Generating Function(M.G.F.):**Definition, Properties. • **Cumulant Generating Function(C.G.F.):** Definition, Properties. Obtaining Cumulants using C.G.F. Relationship between moments and cumulants upto order four. • **Characteristic Function-** Definition and properties (without Proof) Examples of obtaining raw moments and central moments up to order four using M.G.F. and C.G.F. for continuous and **Standard Discrete Probability Distributions:** • **Discrete Uniform Distribution: -**Mean, Variance, coefficient of skewness using M.G.F. • **Bernoulli distribution: -**Mean, Variance, coefficient of skewness using M.G.F. • **Degenerate Distribution (One point distribution) P(X=c) =1**, Mean, Variance, Use of Degenerate distribution. • **Binomial Distribution:-**Mean, Variance, Measures of skewness and Kurtosis based on moments using M.G.F.and C.G.F. , Nature of probability curve, Mode, Additive property , If X follows Binomial, then to find distribution of n-X. • **Poisson Distribution:-** Mean, Variance, Measures of skewness		15

	and Kurtosis based on moments using M.G.F.and C.G.F., Additive property. If X and Y are two independent Poisson variables Conditional distribution of X given X+Y with proof • Poisson distribution as limiting distribution of Binomial (without proof)	
Unit II :	**Univariate Random Variables & Bivariate Probability Distributions:** **Standard Discrete Probability Distributions:** • **Geometric Distribution:-** Definition in terms of No. of failures and No. of trials. Mean, Variance, M.G.F., Mean and Variance using M.G.F., C.G.F., Mean and Variance,μ_3,μ_4 using C.G.F., Coefficients of skewness and Kurtosis. Lack of Memory property with proof. If X and Y are two i.i.d. Geometric variables; Conditional distribution of X given X+Y with proof. Distribution of k i.i.d. Geometric variables • **Negative Binomial Distribution Definition**: - Mean, Variance, M.G.F., Mean and Variance using M.G.F., C.G.F., Mean, Variance,μ_3,μ_4 using C.G.F., Coefficients of skewness and Kurtosis. Lack of Memory property with proof. • **Hyper Geometric Distribution**: -Definition Mean, Variance. • If X and Y are two independent Binomial variables Conditional distribution of X given X+Y **Two Dimensional Discrete Random Variables :-** • Joint Probability mass function and its properties, Distribution function and its properties, Definition of raw and central moments, covariance, correlation coefficient, Independence and correlation between two variables, Marginal and conditional probability distributions, Conditional expectation, conditional variance. • **Continuous bivariate random variables :-** Joint Probability density function and its properties, Distribution function and its properties, Definition of raw and central moments, covariance, correlation coefficient, Independence and correlation between two variables, Marginal and conditional probability distributions, Conditional expectation, conditional variance, Regression Function. • Transformation of Random Variables and Jacobian of transformation with illustrations.	**15**

Reference Books :

1. Introduction to the theory of statistics: A. M. Mood, F.A. Graybill, D. C. Boyes, Third Edition; McGraw-Hill Book Company.
2. Introduction to Mathematical Statistics: R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.
3. Probability and Statistical Inference: R.V.Hogg, E.A.Tannis, Third Edition; Collier McMillan Publishers.
4. John E. Freunds Mathematical Statistics: I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.
5. Introduction to Mathematical Statistics: P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.
6. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.
7. Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.
8. Statistical Methods: An Introductory Text: J. Medhi; Second edition; Wiley Eastern Ltd.
9. An Outline of Statistical Theory Vol. 1: A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.

Course Code: 24BUST3T02

CO1	Apply SRSWR and SRSWOR sampling techniques while conducting sample survey by discussing various principal concepts in sampling.	L3
CO2	Estimate estimators for population mean and population variance.	L5
CO3	Explain and compare various allocations using stratified random sampling.	L5
CO4	Utilize practical application of ratio and regression method of estimation.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	0	2	3
CO2	3	3	2	0	2	2
CO3	3	2	2	0	2	3
CO4	3	2	2	0	2	2

Course Code 24BUST3T02	Major 2 Course Title: THEORY OF SAMPLING	Credit 2	No. of Lectures in hours
Unit I :	**Concepts of Sampling and Simple Random Sampling Probability:** Population, Population unit, Sample, Sample unit, Parameter, Statistic, Estimator, Bias, Unbiasedness, Mean square error & Standard error. Census survey, Sample Survey. Steps in conducting a sample survey with examples on designing appropriate Questionnaire. Concepts of Sampling and Non- sampling errors. NSSO, CSO and their functions. Concepts and methods of Probability and Non-Probability Sampling. **Simple Random Sampling:** (SRS). Definition, Sampling with & without replacement (WR/WOR). Lottery method & use of Random numbers to select Simple random sample Estimation of population mean & total. Expectation & Variance of the estimators, unbiased estimator of variance of these estimators. (WR/WOR). Estimation of population proportion. Expectation & Variance of the estimators, unbiased estimator of variance of these estimators. (WR/WOR). Estimation of Sample size based on a desired accuracy in case of SRS for variables & attributes. (WR/WOR).	15	
Unit II :	**Stratified Sampling :** **Stratified Sampling:** Need for Stratification of population with suitable examples. Definition of Stratified Sample. Advantages of stratified Sampling. **Stratified Random Sampling:** Estimation of population mean & total in case of Stratified Random Sampling (WOR within each strata). Expectation & Variance of the unbiased estimators, unbiased estimators of variances of these estimators. Proportional allocation, Optimum allocation with and without varying costs. Comparison of Simple Random Sampling, Stratified Random Sampling using Proportional allocation & Neyman allocation. **Ratio and Regression Estimation:** **Ratio & Regression Estimation assuming SRSWOR:** Ratio Estimators for population Ratio, Mean & Total. Expectation & MSE of the Estimators. Estimators of MSE. Uses of Ratio Estimator. Regression Estimators for population Mean & Total. Expectation & Variance of the Estimators assuming known value of regression coefficient 'b'. Estimation of 'b'. Resulting variance of the estimators. Uses of regression Estimator. Comparison of Ratio, Regression & mean per Unit estimators.	15	

Reference Books:

1. Cochran. W.G. (1978): *Sampling Techniques*, Third Edition. Wiley Eastern Limited

2. Daroga Singh & F. S. Chaudhary. (1986): *Theory and Analysis of Sample Survey Design*. Wiley Eastern Ltd

3. Des Raj. (1968): *Sampling Theory*. McGraw Hill Series in Probability and Statistics.

4. Gupta S.C.& Kapoor V.K. (2007): *Fundamentals of Mathematical Statistics*. Sultan Chand & Sons

5. Mukhopadhyay P. (1998): *Theory and Methods of Survey Sampling.* Prentice Hall of India

6. Murthy M.N.(1967): *Sampling Theory and methods*. Statistical Publishing Society.

7. P.V. Sukhatme & B.V. Sukhatme. (1984): *Sampling Theory of Surveys with Applications*, Third Edition. Iowa State University Press. Pvt. Ltd.

8. Sampath S.(2005): *Sampling Theory and Methods*, Second Edition. Narosa Publishing House

Course Code: 24BUST3T03

CO1	Interpret and formulate real life problems as mathematical models	L2
CO2	Apply Operations research approach to solve industrial problems	L4
CO3	Make use of transportation techniques to find optimized solutions	L3
CO4	Solve assignment problems in various fields of applications	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	0	3	0
CO2	3	3	2	0	2	0
CO3	3	3	2	0	2	1
CO4	3	2	3	0	2	1

Course Code 24BUST3T03	Major – 3 Course Title: OPERATIONS RESEARCH I	Credit 2	No. of Lecture 30
Unit I :	**Linear Programming Problem (L.P.P.) :** Mathematical Formulation: Maximization & Minimization. Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution. Graphical Solution for problems with two variables. Simplex method of solving problems with two or more variables. Big M method. Concept of Duality. Its use in solving L.P.P. Relationship between optimum solutions to Primal and Dual. Economic interpretation of Dual.	15
Unit II :	**Transportation Problem:** Concept, Mathematical Formulation. Concepts of Solution, Feasible Solution. Initial Basic Feasible Solution by North-West Corner Rule, Matrix, Minima Method, Vogel's Approximation Method. Optimal Solution by MODI Method. Optimality test, Improvement procedure. Variants in Transportation Problem: Unbalanced, Maximization type. **Assignment Problem:** Concept. Mathematical Formulation Solution by: Complete Enumeration Method and Hungarian method. Variants in Assignment Problem: Unbalanced, Maximization type. Travelling Salesman Problem.	15

Reference Books:
1. Operations Research: Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons.
2. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.
3. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley &
4. Sons.
5. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
6. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall
7. of India Ltd.
8. Operations Research: S.D.Sharma.11th edition, Kedar Nath Ram Nath & Company.
9. Operations Research: H. A.Taha.6th edition, Prentice Hall of India.
10. Quantitative Techniques For Managerial Decisions: J.K.Sharma , (2001), MacMillan India Ltd.

Course Code: 24BUST3P01

CO1	Solve numerical problem based on univariate random variables and Standard Discrete Probability Distributions.	L3
CO2	Solve application based on different univariate discrete probability distribution and two dimensional discrete random variables	L3
CO3	Formulate and solve real life problems by applying Linear Programming methods	L3
CO4	Solve optimization problems in the various situations of decision making	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	0	1	1
CO2	3	2	3	0	1	1
CO3	3	2	3	0	2	1
CO4	3	2	3	0	1	1

Course Code 24BUST3P01	Course Title: Practicals based on 24BUST3T01 and 24BUST3T03	Credit 2	No. of Lecture 60
1	Moment Generating Function, Moments.		
2	Cumulant generating Function, Cumulants.		
3	Characteristic function.		
4	Standard Discrete Distributions.		
5	Fitting Standard Discrete Distributions – I		
6	Fitting Standard Discrete Distributions – II		
7	Bivariate Probability Distributions Discrete Random Variables		
8	Bivariate Probability Distributions Continuous Random Variables		
9	Transformation of discrete random variables		
10	Transformation of continuous random variables		
11	Formulation of L.P.P.		
12	Graphical Method of L.P.P.		
13	Simplex Method-I		
14	Simplex Method-II		
15	Duality		

Course Code: 24BUST3P02

CO1	Apply sampling techniques to real-life datasets.	L3
CO2	Compare and contrast different sampling methods.	L2
CO3	Analyze industrial data using Operations research techniques.	L4
CO4	Develop problem-solving skills through real-world case studies.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	0	3	3
CO2	3	3	2	0	1	1
CO3	2	2	2	0	3	3
CO4	2	2	2	0	3	3

Course Code 24BUST3P02	Course Title: Practical based on 24BUST3T02 and 24BUST3T03	Credit 2	No. of Lecture 60
1	Framing of Questionnaire		
2	Simple Random Sampling for Variables – I		
3	Simple Random Sampling for Variables - II		
4	Simple Random Sampling for Attributes		
5	Estimation of Sample Size in Simple Random Sampling.		
6	Stratified Random Sampling – I		
7	Stratified Random Sampling - II		
8	Ratio Estimation - I		
9	Ratio Estimation - II		
10	Regression Estimation		
11	Transportation Problems – I		
12	Transportation Problems – II		
13	Assignment Problems – I		
14	Assignment Problems – II		
15	Travelling Salesman Problem.		

Semester III
(Statistics-Minor)

Course Code: 24BUST3T04

CO1	Explain the assumptions, test statistic, applications, advantages and disadvantages of parametric tests.	L2
CO2	Solve various problems using parametric tests.	L3
CO3	Construct non-parametric tests where assumptions of parametric tests get violated.	L3
CO4	Distinguish between parametric and non-parametric tests.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	0	0	1	0
CO2	3	2	0	0	2	2
CO3	3	2	0	0	2	1
CO4	3	2	0	0	0	0

Course Code 24BUST3T04	Minor Course Title: Statistical Inference- I	Credits 2	No. of lectures

Unit I:	**Parametric Tests:**
	Introduction, objective, assumption, advantages and disadvantages of parametric test.
	Statistical tests:
	  I. Z test
	  II. t test (one sample, two sample and independent sample tests)
	 III. Chi Square test
	 IV. F test
	  V. ANOVA
	Introduction, assumptions, test statistic, applications, advantages and disadvantages.
		15	

Unit II :	**Non - Parametric Test:**
	Introduction, objective, assumption, advantages and disadvantages of non - parametric test.
	Statistical tests:
	  I. Sign test (one sample and two sample)
	  II. Wilcoxon sign rank test (one sample and two sample)
	 III. Run test (one sample and two sample)
	 IV. Mann Whitney test
	  V. Spearman Rank correlation coefficient test
	Introduction, assumptions, test statistic, applications, advantages and disadvantages.
		15	

Reference Books:

1. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics.
2. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics.
3. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods- An Introductory Text

Semester III
(Statistics-Generic)

Course Code: 24BUST3T05

CO1	Illustrate problems based on analytical aptitude.	L2
CO2	Solve problems related to spatial aptitude.	L3
CO3	Solve problems based on aptitude in competitive exams.	L3
CO4	Simplify aptitude-based problems quickly.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	0	0	2	0
CO2	2	2	2	0	3	0
CO3	1	2	1	0	2	0
CO4	1	2	1	0	1	2

Course Code 24BUST3T05	Course Title Statistical Reasoning and Aptitude-I	Credits 2	No. of hours
Unit I :	**Analytical Aptitude:** • Direction • Conditions • Grouping • Blood relations questions • Simple and coded inequalities • Ranking and time sequence • Jumbled relation • Seating arrangement questions • Complex arrangement • Problems on ages		15
Unit II :	**General Aptitude-II** • Rotation • translation • mirroring • scaling • grounding paper folding • assembling • cutting • patterns in 2 and 3 dimensions		15

Reference Books:

1. <u>Shortcuts in Quantitative Aptitude for Competitive Exams</u>
2. <u>Kiran Quanta Quantitative Aptitude</u>
3. <u>Best 4000 Questions for Banking - Quantitative Aptitude</u>
4. <u>Quantitative Aptitude and Reasoning</u>
5. <u>Quantitative Aptitude Book for Competitive Exams</u>
6. <u>Quantitative Aptitude for Competitive Examinations</u>

Semester III
Vocational Skill Course (VSC)

Course Code: 24BU3VSC02

CO1	Demonstrate the ability to write, debug, and execute basic Python programs using core programming concepts such as variables, expressions, functions, control statements, and compound data types including strings, tuples, and lists.	L2
CO2	Apply Python programming constructs such as functions, control statements, loops, dictionaries, list comprehensions, and object-oriented concepts to write efficient and structured code.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	**3**	**0**	**2**	**2**
CO2	**3**	**3**	**3**	**0**	**2**	**2**

Course Code 24BU3VSC02	Course Title STATISTICAL PROGRAMMING WITH PYTHON- I	Credits 1	No. of lectures 15
Unit I :	**Introduction to Python Programming :** • Programming Languages, its features, Introduction to IDLE Interpreter, its basic syntax, built-in Number types, Expression, Operators, Built-in function Type, Operator Precedence. • Detail of Statements: Expression, Assert, Assignment, Augmented, del, Import. • Python Input/Output with print() and input() function, Function, Defining and Calling function, Function Call. • Compound Data Type: Strings, Updating Strings, Tuples, Accessing Values in Tuples, Updating Tuples, Delete Tuple elements, Lists, Accessing Values in Lists, Updating Lists, Delete List elements. • Built-in function: Min, Max, and Sum. **Functions & Control Statements:** • Function: Advantage, Types, Return Statement, Range function. • Conditional Statement: If, If-else, if-then-else, Nested If. • Looping: For loop, For loop with else, While loop, Nested loop. • Control Statement: Break, Continue, Pass Statement. Dictionary: Dictionaries, Accessing values in Dictionary, Updating Dictionary, Delete elements from Dictionary. **List Comprehensions & OOP in Python:** • Anonymous Function, List Comprehensions, Directory Methods	15

| | | in Python. | |
| | | • Introduction to object oriented Programming. Methods: Methods of Strings, Methods of Tuples, Methods of Lists, Methods of Dictionaries. | |

Practicals

CO1	Design and implement Python programs using fundamental syntax, control structures, functions, and compound data types to solve real-world problems through hands-on coding and practical exercises.	L6
CO2	Develop the ability to write efficient Python programs using functions, control statements, loops, and dictionaries for dynamic data handling and logical flow control.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	0	2	2
CO2	3	3	3	0	2	2

Course Code 24BU3VSC02	Course Title: STATISTICAL PROGRAMMING WITH PYTHON- I Practicals	Credit 1	No. of Lecture 30
1	Introduction to Python Programming – Data Types and Expressions		
2	Python Statements, Input/Output, and Operator Precedence		
3	Defining and Using Functions in Python		
4	Manipulating Strings, Tuples, and Lists in Python		
5	Conditional and Looping Constructs in Python		
6	Using Control Statements: Break, Continue, and Pass		
7	List Comprehensions and Anonymous Functions in Python		
8	Getting Started with Object-Oriented Programming in Python		

Reference Books :
1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes.
2. Automate the Boring Stuff with Python: Practical Programming for Total Beginners by Al Sweigart.
3. Fluent Python: Clear, Concise, and Effective Programming by Luciano Ramalho.

Semester III

(Field Project)
Course Name: Field Project in Statistics I
Course Code: 24BUST3P03

CO1	Explain the fundamental steps of a statistical investigation, including data collection, classification, and summarization.	L2
CO2	Apply basic descriptive statistics (mean, median, mode, variance, charts, and tables) to analyze real-world field data.	L3
CO3	Develop skills to design simple questionnaires, conduct surveys, and record data systematically.	L6
CO4	Interpret results using basic statistical tools and present findings through structured reports and presentations.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	0	2	2
CO2	3	3	3	0	2	2
CO3	3	3	3	0	2	2
CO4	3	3	3	0	2	2

Semester IV
(Statistics)

Semester IV
(Statistics Major)

Course Code: 24BUST4T01

CO1	Explain standard continuous probability distributions and their properties	L2
CO2	Solve statistical problems on standard continuous probability distributions.	L6
CO3	Outline of the Normal distribution, their properties, and applications.	L2
CO4	Outline of the exact sampling distributions, their properties, and applications.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	0	0	1
CO2	3	3	2	0	0	1
CO3	3	3	2	0	0	1
CO4	3	3	2	0	0	1

Course Code 24BUST4T01	Major – 1 Course Title: PROBABILITY AND SAMPLING DISTRIBUTIONS	Credit 2	No. of Lectures
Unit I :	**Standard Continuous Probability Distributions:** **Rectangular or Continuous Uniform** over (a, b) Mean, Median Standard deviation, C.D.F., M.G.F., Mean, variance,μ_3 using M.G.F., skewness of distribution. For X following U (0,1), distribution of i)$\frac{1}{1+x}$ ii) $\frac{1}{1-x}$ **Triangular distribution over (a, b) with peak at c:-** M.G.F. **Exponential Distribution:-**Definition, M.G.F., C.G.F. Raw moments and central moments upto order four using M.G.F. and C.G.F. Measures of Skewness and Kurtosis, Nature of Probability curve, Median and Quartiles, Forgetfulness Property with proof and examples based on it. Distribution of i) ratio of two i.i.d. Exponential variables, ii)$\frac{1}{\lambda}$ ln(1-X) if X follows Exponential with parameter λ. iii) X+Y and, $\frac{x}{x+y}$for two independent Exponential variables X and Y with mean 1. (All without proof.) **Cauchy (with Single & Double parameter):-**Properties without proof **Gamma (with Single & Double parameter):-**Expression for rth raw moment, Mean, Mode & Standard deviation. M.G.F., Additive property, C.G.F. Raw moments and central moments up to order four using M.G.F. and C.G.F. Distribution of sum of independent Exponential variables. **Beta Distribution: Type I & Type II: -** Expression for rth raw moment, Mean, Standard deviation. If a R.V. X follows Beta of type 1, distribution of 1- X. If a r.v. X follows Beta of type 2, distribution of i) $\frac{1}{1+x}$		15

	, ii) $\frac{x}{1+x}$ without proof. For two independent Gamma variables X and Y with parameters m and n respectively, distribution of U = $\frac{x}{y}$ and V=$\frac{x}{x+y}$ without proof.	
Unit II :	**Normal Distribution :** Definition, Derivation of Mean, Median, Mode, Standard deviation, M.G.F., C,G,F., Moments & Cumulants (up to fourth order). skewness & kurtosis, Nature of Normal curve, Properties of Normal Distribution. Expression for even order central moments and to show that odd order central moments zero. Distribution of Standard normal variable Distribution of linear function of independent Normal variables aX, (ii) X+b, (iii) aX+bY in particular X+Y and X-Y, (iv) aX+bY+c. (all with proof.) Central Limit theorem for i.i.d. random variables.(only statement) Log Normal Distribution: Derivation of mean & variance. **Exact Sampling Distributions :** **Chi-Square Distribution: Derivation of p.d.f.,** Concept of degrees of freedom. Mean, Mode & Standard deviation. M.G.F.,C.G.F., Measures of skewness and Kurtosis, Additive property, Distribution of ratio two independent Chi-square variables, Distribution of $\frac{x}{x+y}$ if X and Y two independent Chi-square variables all with proof, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution (without proof). **Applications of Chi-Square:** Development of decision criterion with test procedures of (i)Test of significance for specified value of variance of a normal population (ii)Test for goodness of fit, **Student t-distribution:** Derivation of p.d.f.**,** Mean, Median, Mode, Mean Deviation & Standard deviation. M.G.F., C.G.F., Measures of skewness and Kurtosis and Additive property, Limiting distribution of t distribution with proof. **Applications of t:** Development of decision criterion with test procedure of Test of significance for specified value of mean of Normal population. Test procedure of test of significance for difference between means of (i) Two independent Normal populations with equal variances (ii) Dependent samples (Paired t test) Derivation of Confidence intervals for Mean of Normal population,	**15**

	difference between means of two independent Normal populations having the same variance. **Snedecor's F-distribution:** Derivation of p.d.f.**,** Mean, Mode &Standard deviation Distribution of Reciprocal of F variable with proof. Applications of F: Test procedure for testing equality of variances of two independent Normal populations (i) Mean is known (ii) Mean is unknown Derivation of confidence interval for ratio of variances of two independent Normal populations.	

Reference Books :

1. A M Mood, F.A. Graybill, D C Boyes; Third Edition; McGraw-Hill Book Company.: Introduction to the theory of statistics

2. R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.: Introduction to Mathematical Statistics

3. R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.: Probability and Statistical Inference

4. I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.: John E. Freund"s Mathematical Statistics

5. P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.: Introduction to Mathematical Statistics

6. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics

7. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics

8. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods- An Introductory Text

9. A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.: An Outline of Statistical Theory Vol. 1

Course Code: 24BUST4T02

CO1	Construct one-way and two-way ANOVA and estimate the parameters.	L3
CO2	Evaluate various sums of squares, the expectation of various sums of squares & variance of the estimators.	L5
CO3	Explain the different designs, various terms and principles of randomization, replication, and local control in design of experiments.	L5
CO4	Design CRD, RBD and LSD using ANOVA.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	0	2	2
CO2	3	3	2	0	2	2
CO3	3	3	0	0	0	2
CO4	3	3	2	0	3	3

Course Code 24BUST4T02	Major – 2 Course Title: ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS	Credit 2	No. of Lecture 30
Unit I :	**Analysis of Variance:** Introduction, Uses, Cochran's Theorem (Statement only). **One way classification with equal & unequal observations per class, Two way classification with one observation per cell.** Mathematical Model, Assumptions, Expectation of various sums of squares F- test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard Error and Confidence limits for elementary treatment contrasts.		15
Unit II :	**Design Of Experiments:** Concepts of Experiments, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. Principles of Design of Experiments: Replication, Randomization & Local Control. Efficiency of design D1 with respect to design D2.Choice of size, shape of plots & blocks in agricultural &nonagricultural experiments. **Completely Randomized Design (CRD) & Randomized Block Design (RBD):** Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of RBD relative to a CRD. **Latin Square Design:** **Latin Square Design (LSD):** Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. Least square estimators of the parameters, Variance		15

| | | of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of the design relative to RBD, CRD. Missing plot technique for one missing observation in case of CRD, RBD & LSD. | |

Reference Books:

1. Cochran W.G.& Cox G.M. (1992): *Experimental Designs*, Second Edition. John Wiley and Sons.
2. Chakrabarti, M. C. (1962): *Mathematics of Design and Analysis of Experiments*. Asia Publishing house.
3. Das, M. N. and Giri, N. C. (2002): *Design and Analysis of Experiments*. New Age International. 2nd Edition.
4. Montgomery, D. C. (2017): *Design and Analysis of Experiments*. John Wiley. 9th Edition.
5. Gupta S.C.& Kapoor V. K. (2001): *Fundamentals of Applied Statistics*, Third Edition. Sultan Chand and Sons.
6. Kempthorne O.(1994): *The Design and Analysis of Experiments*. John Wiley and Sons.
7. Winer B.J. (1962): *Statistical Principles in Experimental Design*. McGraw Hill Book Co.

Course Code: 24BUST4T03

CO1	Make use of network analysis techniques to understand and present project scheduling problems	L3
CO2	Apply Operations research methods to identify optimum solutions in network analysis	L3
CO3	Explain the concepts of Quality, control charts, 3 sigma limits	L5
CO4	Apply lot sampling methods to find optimum solutions	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	0	2	1
CO2	3	2	2	0	2	1
CO3	3	2	2	0	2	1
CO4	4	3	2	0	2	0

Course Code 24BUST4T03	Major – 3 Course Title: OPERATIONS RESEARCH II	Credit 2	No. of Lecture 30
Unit I :	**CPM and PERT :** Objective and Outline of the techniques. Diagrammatic representation of activities in a project: Gantt Chart and Network Diagram. Slack time and Float times. Determination of Critical path. Probability consideration in project scheduling. Project cost analysis.		15
Unit II :	**Statistical Quality Control:** Introduction, Assignable causes, Chance causes, Process control, Product control, Shewhart's control charts, 3σ limits. $\bar{X}$ and R, p, c, np charts, their uses, p-chart with variable sample size. Problems involving setting up standards for future use. Process ca Expected probability. **Acceptance Sampling:** Introduction to Lot Acceptance Sampling Plans by Attributes, Consumers Risk, Producers Risk, Single and Double Sampling Plans : OC function and OC curves, AQL, LTPD, ASN, ATI, AOQ, Concept of 6σ limits.		15

Reference Books:
1. Duncan D.B. , 3rd edition, Taraporwala sons & co.: Quality Control and Industrial Statistics 2nd edition, McGraw-Hill Publishers: Statistical Quality Control
2. Sirnath, 2nd edition, East West Press Pvt Ltd..: PERT and CPM Principles and Applications
3. Kantiswaroop, P.K. Gupta and Manmohan, 4th edition, Sultan Chand & Sons. ; 1986: Operations Research
4. S.D.Sharma, 11th edition, Kedaarnath, Ramnath and Co.: Operations Research
5. H.A.Taha 6th edition, Prentice Hall of India : Operations Research
6. V.K.Kapoor, 7th edition, Sultan Chand & Sons. : Operations Research

Course Code: 24BUST4P01

CO1	Utilize standard continuous probability distributions such as Uniform, Normal, Triangular, Exponential, Cauchy, Gamma, and Beta to model real-life phenomena and derive transformations and properties relevant to applied probability and statistics	L3
CO2	Solve statistical problems involving standard continuous distributions such as Uniform, Normal, Triangular, Exponential, Gamma, Beta, and Cauchy, including computation of probabilities, moments, transformations, and applications in real-world contexts.	L3
CO3	Apply exact sampling distributions such as Chi-Square, t, and F to test statistical hypotheses and construct confidence intervals in the context of normal populations.	L3
CO4	Analyze project networks using CPM and PERT techniques to find optimum time and cost for real life projects.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	0	2	2
CO2	3	3	3	0	2	2
CO3	3	3	3	0	1	1
CO4	3	3	3	0	1	1

Course Code 24BUST4P01	Course Title: Practicals based on 24BUST4T01 and 24BUST4T03	Credits 2	No. of Lectures 60
1	Rectangular or Continuous Uniform		
2	Triangular distribution		
3	Exponential Distribution		
4	Gamma Distribution		
5	Beta Distribution: Type I & Type II		
6	Normal Distribution and its application		
7	Fitting of Normal distribution		
8	Chi-Square Distribution and its application		
9	Student t-distribution and its application		
10	F-distribution and its application		
11	CPM- I		
12	CPM- II		

13	PERT-I
14	PERT-II
15	Project Cost Analysis

Course Code: 24BUST4P02

CO1	Develop practical problem-solving skills through real-world problems.	L6
CO2	Design experiments to address specific research questions.	L6
CO3	Estimate a missing observation and accordingly perform ANOVA test.	L5
CO4	Apply lot sampling techniques to find optimum sampling plans	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	0	3	3
CO2	3	2	3	0	3	3
CO3	3	2	2	0	1	1
CO4	3	2	2	0	1	1

Course Code 24BUST4P02	Course Title: Practicals based on 24BUST4T02 and 24BUST4T03	Credits 2	No. of Lectures 60
1	Analysis of Variance- One Way		
2	Analysis of Variance- Two Way		
3	Completely Randomized Design		
4	Randomized Block Design		
5	Latin Square Design		
6	Missing Observations in RBD		
7	Missing Observations in LSD		
8	Practical using MS-Excel (ANOVA One Way and Two Way)		
9	Practical using MS-Excel (RBD, CRD and LSD)		
10	Practical using R Software (ANOVA)		
11	P & D Chart		
12	C & U Chart		
13	$\overline{X}$ and S Chart		
14	$\overline{\overline{X}}$ and R Chart		
15	Acceptance Sampling Plans.		

Semester IV
(Statistics-Minor)

Course Code: 24BUST4T04

CO1	Explain the basic concepts of statistical inference.	L2
CO2	Solve various problems by the different methods of point estimation.	L3
CO3	Explain the concept of hypothesis and various terms used in testing of hypothesis.	L5
CO4	Construct various tests for testing various specified values.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	0	0	0
CO2	3	2	2	0	2	2
CO3	3	3	3	0	0	2
CO4	2	2	2	0	2	2

Course Code 24BUST4T04	Minor Course Title Statistical Inference - II	Credits 2	No. of lectures
Unit I :	**Elementary topics on Estimation and Testing of hypothesis:** Estimation: Concept of Parameter, Statistic, Estimator, Estimate, Estimation and Bias. Standard error of an estimator. Central Limit theorem (statement only). Sampling distribution: Sampling distribution of an estimator, Sampling distribution of sample mean and sample proportion for large samples. Standard errors of sample mean and sample proportion. Point and Interval estimation of single mean, single proportion from sample of large size.		15
Unit II :	**Statistical Tests:** Concept of Hypothesis, Null and alternate Hypothesis, Types of errors, Critical region, Level of significance and P-value. Large sample tests (using central limit theorem, if necessary) • For testing specified value of Population mean • For testing specified value in difference of two Population Means • For testing specified value of Population Proportion. For testing specified value of difference of Population Proportions.		15

Reference Books:

1. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics.
2. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics.
3. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods- An Introductory Text
4. Gupta S.C.& Kapoor V. K. (2001): Fundamentals of Applied Statistics, Third Edition. Sultan Chand and Sons.

Semester IV
(Statistics-Generic)

Course Code: 24BUST4T05

CO1	Apply Statistical knowledge to solve problems asked in competitive exams.	L3
CO2	Build their intellectual level.	L3
CO3	Solve various aptitude-based problems quickly in any competitive exam.	L3
CO4	Improve their professional potential.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	0	2	0
CO2	3	2	0	0	2	0
CO3	3	2	2	0	2	0
CO4	2	2	2	0	2	3

Course Code 24BUST4T05	Generic Course Title: Statistical Reasoning and Aptitude-II	Credit 2	No. of Lecture 30
Unit I :	**Statistical Aptitude:** • Data Interpretation: Tabulation, bar graph, pie chart, line graph. • Permutation and Combination and Counting Rule • Probability • Measure of central tendency • Measure of dispersion • Measure of skewness and kurtosis.		15
Unit II :	**Quantitative Aptitude** • Percentage • Partnership Business • Time and distance • Time & Work • Fractions • Profit and Loss • Discount • Relationships between numbers • Ratio and Proportion • Square roots		15

Reference Books and links :

1. Shortcuts in Quantitative Aptitude for Competitive Exams
2. Kiran Quanta Quantitative Aptitude
3. Best 4000 Questions for Banking - Quantitative Aptitude
4. Quantitative Aptitude and Reasoning
5. Quantitative Aptitude Book for Competitive Exams
6. Quantitative Aptitude for Competitive Examinations

Semester IV
Vocational Skill Course (VSC)

Course Code: 24BU4VSC01

CO1	Explain the fundamentals of Numpy arrays, Pandas dataframes, and data exploration techniques, including array Operations, data manipulation, and text data Operations.	L2
CO2	Demonstrate understanding of statistical methods using Python, including descriptive statistics, probability distributions, hypothesis testing (t-test, ANOVA), and linear regression.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	0	1	0
CO2	3	2	2	0	1	0

Course Code 24BU4VSC01	Course Title STATISTICAL PROGRAMMING WITH PYTHON- II	Credits 1	No. of lectures 15
Unit I :	**Numpy, Pandas and Data Exploration:** • Numpy arrays: Creating arrays crating n-dimensional arrays using np.array and array Operations (indexing and slicing, transpose, mathematical Operations). • Pandasdataframes: Creating series and dataframes and Operations on series and dataframes. • Reading and writing data: From and to Excel and CSV files. • Text data Operations: len, upper, lower, slice, replace, contains. **Descriptive Statistics and Statistical Methods:** • Plotting: using "matplotlib" (Histograms, Box plots, Scatter plot, Bar plot, Line plot) • Descriptive Statistics: mean, median, mode, min, max, quantile, std, var, skew, kurt, correlation. • Probability Distributions: (using scipy.stats) • Computations of probabilities, Cumulative probabilities, quantiles and drawing random sample using functions for following distributions: Binomial, Poisson, Hypergeometric, normal, exponential, gamma, Cauchy, Lognormal, uniform, Graphs of pmf/pdf by varying parameters for above distributions. **Inferential Statistics:** • Hypothesis testing and t test: (using scipy.stats, math) ttest_1samp, ttest_ind(2 sample test), ttest_rel(paired), Type I and Type II error		15

	ANOVA: (using scipy.stats) f_oneway, Linear regression: from sklearn import linear model and use linearmodel.linearregression function.	

Practicals

CO1	Apply Numpy and Pandas for data analysis and manipulation, including array creation, data Operations, and handling text and file Operations in real-world datasets.	L3
CO2	Utilize Python to analyze data through plotting, calculating descriptive statistics, solving probability distribution problems, and conducting hypothesis testing and linear regression.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**2**	**0**	**1**	**0**
CO2	**3**	**2**	**2**	**0**	**1**	**0**

Course Code 24BU4VSC01	Course Title: STATISTICAL PROGRAMMING WITH PYTHON - II Practicals	Credit 1	No. of Lectures 30
1	Hands-on with NumPy: Array Creation, Indexing, and Operations		
2	Data Manipulation Using Pandas: Series, Data Frames, and Operations		
3	Visualization Techniques: Creating Graphs and Diagrams using Matplotlib & Seaborn		
4	Descriptive Statistics Using Python: Central Tendency and Dispersion Measures		
5	Probability and Probability Distribution		
6	Correlation and Regression Analysis using Python		
7	Curve Fitting and Model Estimation		
8	Hypothesis Testing: Performing t-test and ANOVA using Python		

Reference Books :
1. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes.
2. Automate the Boring Stuff With Python: Practical Programming for Total Beginners by Al Sweigart.
3. Fluent Python: Clear, Concise, and Effective Programming by Luciano Ramalho.

Useful Weblinks

- https://www.guvi.in/courses/programming/python/?utm_source=Placement-Preparation-Blog&utm_medium=cross_promotion&utm_campaign=best_websites_to_learn_python &utm_content=visit_now
- https://www.w3schools.com/python/
- https://www.freecodecamp.org/news/python-programming-course/

Semester III

(Field Project)
Course Name: Field Project in Statistics II
Course Code: 24BUST4P03

CO1	Apply inferential statistical techniques such as estimation, confidence intervals, and hypothesis testing to field data.	L3
CO2	Utilize advanced tools such as Excel, Python, or statistical software for data cleaning, visualization, and analysis.	L3
CO3	Apply sampling techniques, correlation, regression, or ANOVA to derive meaningful insights from the project data.	L3
CO4	Develop the ability to critically evaluate results, provide evidence-based conclusions, and communicate outcomes effectively with proper statistical justification.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	0	2	2
CO2	3	3	3	0	2	2
CO3	3	3	3	0	2	2
CO4	3	3	3	0	2	2

VPM's B.N. Bandodkar College of Science (Autonomous), Thane
Curriculum Structure for the Undergraduate Degree Programme S.Y.B.Sc Statistics

Course Code	SEMESTER – III	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Major Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
24BUST3T01	Probability Distributions	--	--	√	--	--	--	--
24BUST3T02	Theory of Sampling	--	--	√	√	--	--	--
24BUST3T03	Operations Research 1	√	--	√	--	--	--	--
24BUST3P01	Practical based on 24BUST3T01 and 24BUST3T03	√	--	√	--	--	--	--
24BUST3P02	Practical based on 24BUST3T02 and 24BUST3T03	√	--	√	--	--	--	--
24BUST3P03	Field Project in Statistics I	√	√	√	√	√	√	√
	Minor Course Title							
24BUST3T04	Statistical Inference - I	--	--	√	--	--	--	--
	Generic - Course Title							
24BUST3T05	Statistical Reasoning and Aptitude-I	√	--	√	--	--	--	--
	Vocational Skill Course (VSC)							
24BU3VSC02	Statistical Programming with Python- I	√	√	√	--	--	--	--
09	***Total***	**06**	**02**	**09**	**02**	**01**	**01**	**01**

Course Code	SEMESTER – IV	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
	Major Course Title	EM	EN	SD	PE	GE	HV	ES
24BUST4T01	Probability and Sampling Distributions	--	--	√	--	--	--	--
24BUST4T02	Analysis of Variance & Design of Experiments	√	--	√	--	--	--	--
24BUST4T03	Operations Research 2	--	--	√	--	--	--	--
24BUST4P01	Practical based on 24BUST4T01 and 24BUST4T03	√	--	√	--	--	--	--
24BUST4P02	Practical based on 24BUST4T02 and 24BUST4T03	√	--	√	--	--	--	--
24BUST4P03	Field Project in Statistics II	√	√	√	√	√	√	√
	Minor Course Title							
24BUST4T04	Statistical Inference - I	--	--	√	--	--	--	--

	Generic - Course Title							
24BUST4T05	Statistical Reasoning and Aptitude-II	√	--	√	--	--	--	--
	Vocational Skill Course (VSC)							
24BU4VSC01	Statistical Programming with Python- II	√	√	√	--	--	--	--
09	*Total*	**06**	**02**	**09**	**01**	**01**	**01**	**01**