Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

(Empowered Autonomous)

Skill Development Course
Syllabus
of
M.Sc. Part – II (Statistics)
Semester – III and IV
For Department of Statistics

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2024-2025

Course Structure for M.Sc. Part-II (Statistics)
(2023 Pattern)

Name of the Programme	: M.Sc. Statistics
Program Code	: PSST
Class	: M.Sc. Part – II
Semester	: III
Course Type	: Skill Development
Course Name	: Introduction to LaTeX
Course Code	: STA-631-SDC
No. of Credits	: 2 Credits
No. of Teaching Hours	: 30

Course Objectives:

1. To introduce the fundamentals of LaTeX
2. To teach document structuring and formatting
3. To develop skills in advanced content management
4. To enhance mathematical typesetting proficiency
5. To familiarize with document classes and packages
6. To enable customization of page layouts and margins
7. To improve skills in creating professional documents

Course Outcomes:

By the end of the course, students will be able to:

CO1. understand the basic concepts and applications of LaTeX.

CO2. learn about different document classes (e.g., article, report) and their uses.

CO3. apply various text formatting techniques, including bold, italics, and lists.

CO4. structure documents effectively using sections, subsections, and environments.

CO5. use packages (geometry, graphicx, amsmath) to enhance document functionality

CO6. construct and format tables using the tabular environment in LaTeX.

CO7. customize page layouts and margins with the geometry package.

CO8. develop skills in creating professional documents, including research papers and reports, using LaTeX.

Topics and Learning Points

Unit-1 **(15L)**

Introduction to LaTeX - What is LaTeX?, History and Importance , Basic Document Structure: `\documentclass`, `\begin{document}`, and `\end{document}` , Creating a Simple Document

Document Classes and Packages -Understanding Document Classes (`article`, `report`, `book`, `letter`), Using Packages (`geometry`, `graphicx`, `amsmath`, etc.), Managing Page Layout and Margins (`geometry` package)

Text Formatting- Basic Formatting: Bold, Italics, Underline, and Font Size, Creating Sections and Subsections, Lists: Itemized, Enumerated, and Descrip
tion Lists, Special Characters and Symbols

Unit-2 **(15L)**

Working with Tables and Images - Creating Simple Tables (`tabular` environment), Adjusting Table Alignment, Borders, and Spacing ,Including Images (`graphicx` package), Positioning and Resizing Images

Mathematical Typesetting-Basic Mathematical Expressions (`inline` and `display` math) Using the `amsmath` package, Fractions, Subscripts, Superscripts, Summations, and Integrals.

References:

1. Frank Mittelbach, Michel Goossens, Johannes Braams, David Carlisle, Chris Rowley (2004) The LaTeX Companion Addison-Wesley Professional
2. Leslie Lamport (1994) LaTeX: A Document Preparation System Addison-Wesley
3. Helmut Kopka, Patrick W. Daly (2003) Guide to LaTeX Addison-Wesle
4. Dilip Datta (2017) LaTeX in 24 Hours: A Practical Guide for Scientific Writing Springer
5. Stefan Kottwitz (2011) LaTeX Beginner's Guide Packet Publishing

COs POs Mapping

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	1	2	2	2	1	1	2
CO2	2	1	1	1	2	2	2	1	1	2
CO3	2	1	1	1	2	2	2	1	1	2
CO4	2	1	1	1	2	2	2	1	1	2
CO5	3	2	2	2	3	3	3	2	2	3
CO6	2	1	1	1	2	2	2	1	1	2
CO7	2	1	1	1	2	2	2	1	1	2
CO8	3	2	2	2	3	3	3	2	2	3

Justifications

PO1: Comprehensive Knowledge and Understanding

CO1 to CO4, CO6, CO7: Moderately related (2) as these outcomes require understanding the basic concepts, document structures, and formatting techniques in LaTeX, contributing to a comprehensive knowledge of document preparation.

CO5, CO8: Strongly related (3) because the use of LaTeX packages and the creation of professional documents like research papers enhance deep understanding and mastery of specialized document preparation.

PO2: Practical, Professional, and Procedural Knowledge

CO1 to CO4, CO6, CO7: Partially related (1) as these outcomes involve basic document preparation skills, which are foundational but not fully aligned with advanced professional and procedural knowledge.

CO5, CO8: Moderately related (2) since these involve more advanced skills, like using specific LaTeX packages and creating professional-grade documents.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding

CO1 to CO4, CO6, CO7: Partially related (1) as these outcomes foster basic technical skills that could be foundational for innovative document creation.

CO5, CO8: Moderately related (2) because mastering LaTeX for advanced document creation can support innovative practices in professional settings.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving

CO1 to CO4, CO6, CO7: Partially related (1) as they contribute to developing basic technical skills necessary for problem-solving in document creation.

CO5, CO8: Moderately related (2) since advanced LaTeX usage requires critical thinking and specialized skills, particularly in creating complex documents.

PO5: Research, Analytical Reasoning, and Ethical Conduct

CO1 to CO4, CO6, CO7: Moderately related (2) since understanding and applying LaTeX contributes to the ability to produce well-structured research documents.

CO5, CO8: Strongly related (3) as these skills are critical for producing professional, research-focused documents that adhere to academic and ethical standards.

PO6: Communication, Collaboration, and Leadership

CO1 to CO4, CO6, CO7: Moderately related (2) as effective document preparation in LaTeX enhances communication through clear and structured documentation.

CO5, CO8: Strongly related (3) since creating professional documents is key to clear and effective communication in collaborative and leadership roles.

PO7: Digital Proficiency and Technological Skills

CO1 to CO4, CO6, CO7: Moderately related (2) as these outcomes involve using LaTeX, a digital tool, to create documents, enhancing students' technological proficiency.

CO5, CO8: Strongly related (3) because advanced LaTeX usage is a significant aspect of digital proficiency and professional document creation.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 to CO4, CO6, CO7: Partially related (1) as the skills learned can be applied in diverse settings, though they do not directly address multicultural competence.

CO5, CO8: Moderately related (2) since the ability to create professional documents can support inclusive communication in multicultural environments.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices

CO1 to CO4, CO6, CO7: Partially related (1) as these outcomes contribute to ethical document preparation practices, though they do not directly address environmental awareness or values.

CO5, CO8: Moderately related (2) because creating well-structured, ethical documents in professional settings can reflect values and ethical practices.

PO10: Autonomy, Responsibility, and Accountability

CO1 to CO4, CO6, CO7: Moderately related (2) as these outcomes encourage independent learning and responsible document creation in LaTeX.

CO5, CO8: Strongly related (3) because mastering LaTeX for professional documents demands a high level of autonomy and accountability in producing quality work.

Course Structure for M.Sc. Part-II (Statistics) (2023 Pattern)

Name of the Programme	: M.Sc. Statistics
Program Code	: PSST
Class	: M.Sc. Part – II
Semester	: IV
Course Type	: Skill Development
Course Name	: Introduction to Mathematica
Course Code	: STA-691-SDC
No. of Credits	: 2 Credits
No. of Teaching Hours	: 30

Course Objectives:

1. To introduce the foundational concepts of matrix algebra and its application to solve mathematical problems using Mathematica.
2. To equip students with the ability to calculate eigenvalues, eigenvectors, and perform spectral decomposition for matrix analysis.
3. To enable students to apply matrix operations for solving systems of linear equations and perform quadratic form analysis.
4. To familiarize students with advanced optimization techniques, including solving constrained and global optimization problems using Mathematica.
5. To introduce numerical methods such as root-finding, differentiation, and integration techniques, emphasizing their practical applications.
6. To train students in solving complex nonlinear equations and differential equations numerically using Mathematica.
7. To enhance students' ability to apply integration techniques to handle improper, multidimensional integrals, and their applications in real-world problems.

Course Outcomes:

By the end of the course, students will be able to:

CO1. perform matrix operations such as calculating determinants, finding inverses, and conducting matrix exponentials using Mathematica.

CO2. solve systems of linear equations and understand quadratic forms in matrix algebra.

CO3. gain proficiency in applying eigenvalues, eigenvectors, and spectral decomposition to solve real-world matrix algebra problems.

CO4. apply optimization techniques to solve constrained and unconstrained optimization problems in various fields.

CO5. implement numerical methods for solving root-finding problems, performing numerical differentiation, and integrating complex functions.

CO6. apply Monte Carlo methods, numerical solutions to differential equations, and perform error analysis in numerical methods.

CO7. apply integration techniques, including handling improper and multidimensional integrals, to solve real-life problems in engineering and economics using Mathematica.

Topics and Learning Points

Unit 1: Matrix Algebra and Optimization Using Mathematica (15L)

Introduction to Matrix Operations, Determinants, Inverses, Eigenvalues, and Eigenvectors, Spectral Decomposition and Quadratic Forms, Positive Definite Matrices and Canonical Forms, Solving Systems of Linear Equations, Matrix Functions, Exponentials, and Applications in Optimization, Finding Maxima and Minima of Functions, Solving Constrained and Global Optimization Problems, Case Studies in Matrix Algebra and Optimization

Unit 2: Numerical and Integration Methods Using Mathematica (15L)

Introduction to Numerical Methods and Root-Finding Algorithms, Numerical Integration and Differentiation Techniques, Solving Nonlinear Equations, Interpolation, and Approximation, Numerical Solutions to Differential Equations and Monte Carlo Methods, Error Analysis in Numerical Methods, Riemann and Riemann-Stieltjes Integration, Handling Improper and Multidimensional Integrals, Applications in Numerical Methods and Integration, Case Studies in Numerical Methods and Integration

References:

1. Sal Mangano (2010) Mathematica Cookbook O'Reilly Media.
2. Steven C. Chapra, Raymond P. Canale (2015) Numerical Methods for Engineers (7th Edition) McGraw-Hill Education.
3. Gene H. Golub, Charles F. Van Loan (2013) Matrix Computations (4th Edition)
4. David G. Luenberger (1997) Optimization by Vector Space Methods Wiley-Interscience.

5. Steven C. Chapra (2017) Applied Numerical Methods with MATLAB for Engineers and Scientists" (4th Edition) McGraw-Hill Education

COs POs Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	1	1	1	3	1	1	2
CO2	3	3	1	2	1	1	2	1	1	2
CO3	3	3	2	3	2	1	2	1	1	2
CO4	3	2	3	3	2	2	2	1	1	3
CO5	3	2	3	2	3	2	3	1	2	2
CO6	3	2	3	2	3	2	3	2	2	3
CO7	3	2	2	2	3	2	3	2	2	2

Justification for CO-PO Mapping:

PO1: Comprehensive Knowledge and Understanding

CO1 (2): Matrix operations are foundational concepts in linear algebra, contributing moderately to a deep understanding of the field.

CO2 (3): Solving systems of linear equations and quadratic forms is crucial in matrix algebra, making it strongly related to the comprehensive understanding of the subject.

CO3 (3): Applying eigenvalues, eigenvectors, and spectral decomposition to real-world problems reflects advanced understanding.

CO4 (3): Optimization techniques are essential in various fields, reflecting a comprehensive grasp of multidisciplinary applications.

CO5 (3): Numerical methods are core techniques in applied mathematics, reflecting deep knowledge.

CO6 (3): Monte Carlo methods and numerical solutions show a high level of understanding in computational approaches.

CO7 (3): Advanced integration techniques are a strong component of foundational knowledge in applied mathematics.

PO2: Practical, Professional, and Procedural Knowledge

CO1 (3): Performing matrix operations in Mathematica directly ties into practical, real-world applications of algebra.

CO2 (3): Proficiency in solving linear systems is key in numerous professional and procedural contexts.

CO3 (3): Eigenvalue applications are frequently employed in professional fields, making it highly relevant.

CO4 (2): Optimization skills are necessary in professional environments, but not as frequent as other skills.

CO5 (2): Numerical methods are practically applied across various disciplines.

CO6 (2): Monte Carlo and numerical methods have practical relevance, though not as frequent as core matrix operations.

CO7 (2): Integration techniques have practical applications but are used more in specialized fields.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding

CO1 (1): Matrix operations have indirect relevance to entrepreneurship and business understanding.

CO2 (1): Linear systems are moderately related to innovation and solving practical business problems.

CO3 (2): Eigenvalue problems can be applied to model and analyze business and market dynamics.

CO4 (3): Optimization is crucial in decision-making and risk management, directly supporting entrepreneurial efforts.

CO5 (3): Numerical methods can help foster innovation by providing technical solutions to complex business problems.

CO6 (3): Monte Carlo methods are often used in risk management and financial modeling, supporting an entrepreneurial mindset.

CO7 (2): Integration methods are sometimes relevant for complex economic modeling but are more specialized.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving

CO1 (1): Basic matrix operations contribute indirectly to critical thinking.

CO2 (2): Solving systems and quadratic forms supports problem-solving but in more specific cases.

CO3 (3): Eigenvalue problems often require critical thinking and specialized problem-solving skills.

CO4 (3): Optimization is directly linked to problem-solving and critical thinking in real-world applications.

CO5 (2): Numerical methods develop problem-solving skills in specialized technical contexts.

CO6 (2): Monte Carlo methods support critical thinking, especially in probabilistic problems.

CO7 (2): Advanced integration supports problem-solving but is less frequently applied than other skills.

PO5: Research, Analytical Reasoning, and Ethical Conduct

CO1 (1): Matrix operations have limited direct relevance to research methodologies.

CO2 (1): Solving linear equations is foundational but not central to research activities.

CO3 (2): Eigenvalue and spectral decomposition are more relevant to advanced research.

CO4 (2): Optimization techniques are frequently employed in research settings to solve complex problems.

CO5 (3): Numerical methods are highly relevant in research involving mathematical modeling.

CO6 (3): Monte Carlo and numerical solutions are commonly used in research requiring statistical modeling.

CO7 (3): Integration techniques are essential in research, particularly in fields like engineering and economics.

PO6: Communication, Collaboration, and Leadership

CO1 (1): While Mathematica skills support communication, they are not central to collaboration.

CO2 (1): Linear systems solve individual problems but do not directly foster collaboration.

CO3 (1): Eigenvalue problems indirectly contribute to teamwork and communication when applied to group projects.

CO4 (2): Optimization can support leadership when used in collaborative decision-making contexts.

CO5 (2): Numerical methods are more collaborative when applied in team-based research.

CO6 (2): Monte Carlo methods can promote collaboration in multidisciplinary research.

CO7 (2): Integration techniques are often used in team-based engineering problems, fostering collaboration.

PO7: Digital Proficiency and Technological Skills

CO1 (3): Mathematica is a digital tool, making this outcome strongly related to technological proficiency.

CO2 (2): Linear algebra problems require technological tools for complex calculations.

CO3 (2): Eigenvalue problems are often solved using computational tools.

CO4 (2): Optimization often requires software tools for implementation, enhancing digital proficiency.

CO5 (3): Numerical methods demand high proficiency in digital tools, including software for computation.

CO6 (3): Monte Carlo simulations and differential equations often rely on technology.

CO7 (3): Complex integration is often performed using computational tools, requiring high digital proficiency.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 (1): Limited relevance to multicultural settings.

CO2 (1): Little direct impact on empathy or multiculturalism.

CO3 (1): Eigenvalue problems are less relevant to multicultural competence.

CO4 (1): Optimization could be applied to diverse team scenarios, though indirectly.

CO5 (1): Numerical methods offer limited direct contributions to multicultural understanding.

CO6 (2): Monte Carlo methods are sometimes used in diverse fields that foster collaboration.

CO7 (2): Integration techniques can be applied in interdisciplinary fields, promoting diverse perspectives.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices

CO1 (1): Matrix operations do not directly foster ethical or environmental practices.

CO2 (1): Linear equations contribute minimally to ethics or environmental awareness.

CO3 (1): Limited direct relevance to ethical considerations.

CO4 (1): Optimization can promote ethical decision-making but is not a central concern.

CO5 (2): Numerical methods can support environmental modeling, promoting sustainability.

CO6 (2): Monte Carlo methods are often used in fields like environmental science, promoting awareness.

CO7 (2): Complex integrals are applied to real-life environmental problems, supporting ethical practices.

PO10: Autonomy, Responsibility, and Accountability

CO1 (2): Mathematica allows for independent problem-solving.

CO2 (2): Linear systems promote independent learning and responsibility.

CO3 (2): Eigenvalue problems require autonomy and accountability in solving complex issues.

CO4 (3): Optimization often involves autonomous decision-making, fostering responsibility.

CO5 (2): Numerical methods support independent problem-solving, particularly in research.

CO6 (3): Monte Carlo methods and error analysis require high levels of responsibility.

CO7 (2): Integration techniques often demand independent and accountable work, especially in engineering contexts.