Programme Title	B. Tech / BE (BTCE, BECS,BEIS,BTIT,BTRE)	Semester	2
Course Title	STATISTICS AND PROBABILITY	Course Code	10ABTEC24211
Course Credits	3	Credit Hours	45

1. Course Description

- This course covers advanced statistical concepts and methodologies.
- It includes practical applications of statistical theories using software tools.
- The course is designed for students to develop a strong foundation in statistical inference and analysis.
- Emphasis is placed on both theoretical understanding and practical skills.

2. Goals

- Enhance students' understanding of advanced statistical techniques.
- To develop proficiency in using statistical software for data analysis.
- To faster critical thinking and problem-solving skills in statistical contexts.
- To prepare students for real-world applications of statistics in various field
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3. Objectives of Development

- To provide a comprehensive understanding of correlation and regression analysis.
- To familiarize students with random variables and probability distributions.
- To introduce students to stochastic processes and Markov chains.
- To equip students with skills in statistical inference and hypothesis testing.

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4. Course Outcome

COs	Course outcomes	RBT
CO1	**Analyze** relationships between variables using correlation and regression, and perform curve fitting to model data using linear and non-linear equations.	L3
CO2	**Understand** to model random phenomena using probability distributions.	L2
CO3	**Analyze** systems with probabilistic transitions using Markov Chains, compute and interpret higher-order transition probabilities.	L3
CO4	**Use** the statistical methods, including sampling distributions, standard error and testing hypothesis.	L3
CO5	**Apply** the basic concept of probability and statistics in MATLAB coding platform.	L3

5. Teaching Methods

- Lectures and interactive discussions to facilitate understanding of concepts.
- Hands-on exercises and workshops for practical application of theories.
- Group projects and case studies to encourage collaborative learning.

- Use of statistical software for demonstrations and tutorials.
- Activity based learning, Flip classroom, Projects, PPT

6. Teaching Plan

Week	Topic	Hours	Teaching Methods/ Multimedia
1-4	**MODULE-1:** **ADVANCED STATISTICS:** **Correlation:** Karl Pearson's coefficient of Correlation and Lines of regression, Spearman's Rank correlation. **Curve fitting:** Fitting of the curves Straight line, Second degree parabola and Power curve.	9 Hours 3 Hours/ Week	Lectures, group discussions, case studies, statistical software demonstrations PPT, Smart Board, , Video and Practical implementation
5-8	**Module-2:** **RANDOM VARIABLES AND DISTRIBUTIONS:** **ProbabilityDistributions:** Review of basic probability theory.Random variables (discrete and continuous), probability mass anddensity functions. Mathematical expectation, mean and variance. Binomial, Poisson and Exponential distributions, Normal distribution- problems.	9 Hours 3 Hours/ Week	Lectures, group discussions, case studies, statistical software demonstrations PPT, Smart Board, Case study, Video and Practical implementation
9-12	**Module-3:** **MARKOVCHAIN & STOCHASTIC PROCESS:** **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states.	9 Hours 3 Hours/ Week	Lectures, group discussions, case studies, statistical software Smart Board, Case study, Video and Practical implementation
12-16	**Module-4:** **STATISTICAL INFERENCE**: Sampling: Definitions, Types of sampling , Expected values of sample mean and variance, Standard error , Sampling distribution of means and	9 Hours 3 Hours/ Week	Lectures, group discussions, case studies, statistical software demonstrations PPT, Smart Board, Case study, Video and Practical implementation

	variance. Tests based on t, Chi-square, ANOVA and F distributions for mean, variance and proportion		
16-20	**Module-5: SOFTWAREBASED LEARNING** Baye's Analysis, Mean, Median, Mode, pdf, cdf, Standard deviation, Covariance, Correlation, Regression , Graphics and Data display , ANOVA , t-test implementation.	9 Hours 3 Hours/ Week	Lectures, group discussions, case studies, statistical software demonstrations PPT, Smart Board, Case study, Video and Practical implementation

7. Technology Tools

Statistical software such as R, Python, or SPSS will be used for data analysis and visualization. Online resources and e-learning platforms will supplement classroom instruction.

8. Skill Based training

Students will gain practical skills in data cleaning, preprocessing, analysis, and interpretation. Hands-on exercises and projects will reinforce these skills.

9. Areas of Employability

Graduates with a strong foundation in advanced statistics will be well-prepared for careers in data science, analytics, research, finance, and other fields that require data-driven decision-making.

10. Inter-department

The course may involve collaboration with other departments or disciplines to explore the applications of advanced statistics in various fields.

11. Skill Mentoring

Mentorship programs may be available to provide students with additional guidance and support in developing their statistical skills.

12. Quantitative Skill Assessment

Continuous Internal Assessment (CIA) will be done through IA quiz, Case Studies, Projects, Presentation and Examination.

13. Mentorship Model

Peer Mentoring (Mentor – Mentee)

14. Potential Employers

14.1 National Employers

TCS, HCL, BEL

14.2 International Employers

Intel, Robert Bosch, TCS, HCL

15 Evaluation Method

Formative and Summative Assessment methods

16 Teaching Materials and Methods

A combination of textbooks, articles, case studies, and online resources will be used as teaching materials. Lectures, discussions, group work, and hands-on exercises will be employed as teaching methods.

16.1 Text and Main Document

- Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye "Probability & Statistics for Engineers & Scientists", Pearson Education, 9 th edition, 2017.
- Peter Bruce, Andrew Bruce & Peter Gedeck "Practical Statistics for Data Scientists" O'Reilly Media, Inc.,2nd edition 2020.
- Introduction to Probability Models" by Sheldon M. Ross
- Statistics" by Robert S. Witte and John S. Witte

16.2 Documents for further study

- Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9 th Edition, 2006.
- B. S. Grewal "Higher Engineering Mathematics", Khanna publishers, 44 th Ed., 2021.
- G Haribaskaran "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
- Irwin Miller & Marylees Miller, John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8 th edition, 2014.
- S C Gupta and V K Kapoor, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition. 6. Robert V. Hogg, Joseph W. McKean & Allen T. Craig. "Introduction to Mathematical Statistics", Pearson Education 7 th edition, 2013.

17. E- Learning https://onlinecourses.nptel.ac.in/noc21_ma74/#https://www.probabilitycourse.com/

https://onlinecourses.nptel.ac.in/noc21_ma74/#

18. Online and Print Magazines

- **St**atistical Modeling and Prediction

- Journal of the American Statistical Association
- Biometrika

18.1 Online and Print Journals

Journal of the American Statistical Association (JASA)
Journal of Statistical Planning and Inference

18.2 Videos

https://archive.nptel.ac.in/courses/111/105/111105090/
https://onlinecourses.nptel.ac.in/noc21_ma74/#

19 What are the likely improvements suggested for the course over the next 12 months?

Based on the syllabus provided, here are some likely improvements suggested for the course Probability and Statistical Inference

Content Updates:

- **Real-world Case Studies:** Incorporate more real-world case studies to demonstrate the practical
- applications of statistical concepts.
- **Industry Collaborations:** Collaborate with industry professionals to provide guest lectures and project opportunities.
- **Data Science Competitions:** Encourage students to participate in data science competitions to apply their skills in a competitive setting.

Delivery Methods:

- **Online Courses:** Offer online courses with video lectures, quizzes, and assignments.
- **Blended Learning:** Combine traditional classroom instruction with online components, such as asynchronous materials or virtual labs.
- **Webinars:** Conduct webinars or live online sessions to supplement classroom instruction or reach students who cannot attend in person..

- **Continuous assessment:** Implement quizzes, assignments, or short coding challenges to assess student understanding regularly.

Additional Resources:

- **Coursera:** Offers a variety of advanced statistics courses from top universities, including "Statistical Inference" from Harvard University and "Advanced Statistics" from Duke University.
- **edX:** Provides courses on advanced statistical topics, such as "Statistical Inference" from Harvard University and "Data Analysis and Statistics" from MIT.
- **DataCamp:** Offers interactive tutorials and courses on advanced statistics using R and Python..

Overall Course Structure:

- **Interdisciplinary connections:** Explore connections between discrete mathematics and other fields, such as computer science, engineering, and economics.
- **Online resources:** Utilize online resources, such as textbooks, videos, and practice problems, to supplement classroom instruction.
- **Assessment:** Employ a variety of assessment methods, including homework assignments, quizzes, exams, and projects, to evaluate student understanding.

Statistics and Probability CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3									2
CO2	2	2	3									3
CO3	1	3	2									2
CO4	1	2	3									
CO5		2	3		2						2	3

>70-100	> 40 & < 70	< 40
3	2	1

CO1	**Analyze** relationships between variables using correlation and regression, and perform curve fitting to model data using linear and non-linear equations
CO2	**Understand** to model random phenomena using probability distributions.
CO3	**Analyze** systems with probabilistic transitions using Markov Chains, compute and interpret higher-order transition probabilities.
CO4	**Use** the statistical methods, including sampling distributions, standard error and testing hypothesis.
CO5	Apply the basic concept of probability and statistics in MATLAB coding platform.

CO-PO Justification Matrix

Course Outcome (CO)	Relevant POs	Justification
CO1: Analyze relationships between variables using correlation and regression, and perform curve fitting to model data using linear and non-linear equations	PO1, PO2, PO3, PO12	Builds analytical skills essential for engineering knowledge and problem-solving, using regression and curve fitting techniques
CO2: Understand to model random phenomena using probability distributions	PO1, PO2, PO3, PO12	Reinforces knowledge of probability for analyzing random phenomena and improves analytical skills in uncertainty
CO3: Analyze systems with probabilistic transitions using Markov Chains, compute and interpret higher-order transition probabilities	PO1, PO2, PO3, PO12	Develops competencies in analyzing probabilistic systems and enhances understanding of Markov Chains in system modeling
CO4: Use statistical methods, including sampling distributions, standard error, and hypothesis testing	PO1, PO2, PO3, PO12	Enhances statistical methods critical for engineering analysis, testing hypotheses, and developing valid solutions.
CO5 :Apply the basic concept of probability and statistics in MATLAB coding platform	PO2, PO3, PO5, PO11, PO12	Integrates MATLAB tool usage with probability and statistics for engineering solutions, supporting lifelong learning.