Course Code				**23STMAP232**			
Title of the Course				**Continuous Probability Distributions Using R**			
Offered to: (Programme/s)				**B.Sc. Hons Statistics**			
L	**0**	**T**	**0**	**P**	**2**	**C**	**1**
Year of Introduction:	**2024-25**			**Semester:**			**3**
Course Category:	**Major**			**Course Relates to:**	Local, Regional, National, Global		
Year of Revision:	**NA**			**Percentage:**	**NA**		
Type of the Course:				Skill development			
Crosscutting Issues of the Course :				**NA**			
Pre-requisites, if any				**Probability and Basic R programming**			

Course Description:

The course "Continuous Probability Distributions" with practical and hands-on experience using R. This course covers key concepts such as rectangular, exponential, Laplace, beta, gamma, Cauchy, normal and log - normal distributions, alongside statistical analysis and data visualization. Gain proficiency in applying these distributions to real-world problems, from hypothesis testing to regression analysis, using R's powerful tools. Ideal for data scientists, analysts, and statisticians, the course emphasizes both theoretical understanding and practical skills. By the end, you'll be adept at performing calculations, simulations, and visualizations to tackle complex data challenges with confidence. Enhance your statistical toolkit and analytical capabilities in this comprehensive course.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Understand the fundamental concepts of continuous probability distributions.
2	Calculate and interpret key statistical measures for continuous probability distributions.
3	Apply continuous probability distributions to real-world problems.
4	Perform hypothesis testing using continuous probability distributions.
5	Compare and contrast different continuous probability distributions.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	apply R effectively to simulate, analyze, and visualize various continuous probability distributions	K3	PO1	PSO2
CO2	calculate and interpret key statistical measures such as mean, and Variance of these distributions.	K2	PO1	PSO2
CO3	apply appropriate distributions to solve problems and make informed decisions.	K2	PO1	PSO2
CO4	analyze and solve problems involving continuous probability distributions.	K4	PO1	PSO2
CO5	evaluate the appropriateness of different distributions for given scenarios.	K5	PO1	PSO2

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	**2**								**2**
CO2	**2**								**2**
CO3	**2**								**2**
CO4	**3**								**2**
CO5	**3**								**2**

Use the codes 3,2,1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Course Structure

This lab list covers the key areas of a Continuous Probability Distributions, providing hands-on practice with R - Programming

Unit 1: Continuous Uniform distribution (6Hrs)

Lab 1: Understanding and Generating Continuous Uniform Distributions in R

Title: Exploring the Continuous Uniform Distribution in R

Dataset: Simulated data generated using R's runif() function.

Experiment: Investigate the properties of the continuous uniform distribution and its applications in R.

Tasks:

1. **Generate uniform random numbers:** Create a vector of 1000 random numbers from a uniform distribution with specified minimum and maximum values.
2. **Visualize the distribution:** Plot a histogram and density plot of the generated random numbers to visualize the uniform distribution.
3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for a uniform distribution.
5. **Applications:** Explore real-world applications of the uniform distribution, such as random sampling, Monte Carlo simulations, or hypothesis testing.

Lab 2: Simulating and Analyzing Uniformly Distributed Data

Title: Simulating and Analyzing Uniformly Distributed Data in R

Dataset: Simulated data generated using R's runif() function.

Experiment: Simulate and analyze data from a continuous uniform distribution to understand its characteristics and applications.

Tasks:

1. **Generate random samples:** Create multiple samples of varying sizes from a uniform distribution with specified parameters.
2. **Calculate statistics:** Compute the mean, variance, and standard deviation for each sample.
3. **Visualize the distribution:** Plot histograms and density plots for each sample to observe the distribution's shape and variability.

Unit 2: Exponential Distribution **6Hrs**

Lab 1: Understanding and Generating Exponential Distributions in R

Title: Exploring the Exponential Distribution in R

Dataset: Simulated data generated using R's rexp() function.

Experiment: Investigate the properties of the exponential distribution and its applications in R.

Tasks:

1. **Generate exponential random numbers:** Create a vector of 1000 random numbers from an exponential distribution with a specified rate parameter (λ).

2. **Visualize the distribution:** Plot a histogram and density plot of the generated random numbers to visualize the exponential distribution.
3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for an exponential distribution.
5. **Applications:** Explore real-world applications of the exponential distribution, such as modeling waiting times, reliability analysis, or queuing systems.

Lab 2: Simulating and Analyzing Exponentially Distributed Data

Title: Simulating and Analyzing Exponentially Distributed Data in R

Dataset: Simulated data generated using R's rexp() function.

Experiment: Simulate and analyze data from an exponential distribution to understand its characteristics and applications.

Tasks:

1. **Generate random samples:** Create multiple samples of varying sizes from an exponential distribution with specified rate parameters.
2. **Calculate statistics:** Compute the mean, variance, and standard deviation for each sample.
3. **Visualize the distribution:** Plot histograms and density plots for each sample to observe the distribution's shape and variability.
4. **Hypothesis testing:** Conduct hypothesis tests to determine if a given sample comes from an exponential distribution.

Unit 3: Gamma and Beta Distributions **6Hrs**

Lab 1: Understanding and Generating Gamma Distributions in R

Title: Exploring Gamma Distributions in R

Dataset: Simulated data generated using R's rgamma() functions.

Experiment: Investigate the properties of the gamma distributions and their applications in R.

Tasks:

1. **Generate gamma random numbers:** Create vectors of 1000 random numbers from gamma and beta distributions with specified parameters (shape and rate for gamma).
2. **Visualize the distributions:** Plot histograms and density plots of the generated random numbers to visualize the gamma distributions.

3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for gamma and beta distributions.
5. **Applications:** Explore real-world applications of the gamma distributions, such as modeling waiting times, survival analysis.

Lab 2: Understanding and Generating Beta Distributions in R

Title: Exploring Beta Distributions in R

Dataset: Simulated data generated using R's rbeta() functions.

Experiment: Investigate the properties of the gamma and beta distributions and their applications in R.

Tasks:

1. **Generate gamma and beta random numbers:** Create vectors of 1000 random numbers from gamma and beta distributions with specified parameters (shape1 and shape2 for beta).
2. **Visualize the distributions:** Plot histograms and density plots of the generated random numbers to visualize the beta distributions.
3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for gamma and beta distributions.
5. **Applications:** Explore real-world applications of the beta distributions, such as modeling beta distributions in Bayesian statistics.

Unit 4: Normal Distribution **6Hrs**

Lab 1: Understanding and Generating Normal Distributions in R

Title: Exploring the Normal Distribution in R

Dataset: Simulated data generated using R's rnorm() function.

Experiment: Investigate the properties of the normal distribution and its applications in R.

Tasks:

1. **Generate normal random numbers:** Create a vector of 1000 random numbers from a normal distribution with specified mean and standard deviation.
2. **Visualize the distribution:** Plot a histogram and density plot of the generated random numbers to visualize the normal distribution.

3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for a normal distribution.
5. **Applications:** Explore real-world applications of the normal distribution, such as modeling measurement errors, financial returns, or population characteristics.

Lab 2: Simulating and Analyzing Normally Distributed Data

Title: Simulating and Analyzing Normally Distributed Data in R

Dataset: Simulated data generated using R's rnorm() function.

Experiment: Simulate and analyze data from a normal distribution to understand its characteristics and applications.

Tasks:

1. **Generate random samples:** Create multiple samples of varying sizes from a normal distribution with specified mean and standard deviation.
2. **Calculate statistics:** Compute the mean, variance, and standard deviation for each sample.
3. **Visualize the distribution:** Plot histograms and density plots for each sample to observe the distribution's shape and variability.
4. **Hypothesis testing:** Conduct hypothesis tests to determine if a given sample comes from a normal distribution (e.g., Shapiro-Wilk test).

Unit 5: Exact Sampling Distributions

Lab 1: Understanding and Generating Chi-Squared Distributions in R

Title: Exploring the Chi-Squared Distribution in R

Dataset: Simulated data generated using R's rchisq() function.

Experiment: Investigate the properties of the chi-squared distribution and its applications in R.

Tasks:

1. **Generate chi-squared random numbers:** Create a vector of 1000 random numbers from a chi-squared distribution with a specified degrees of freedom (df).
2. **Visualize the distribution:** Plot a histogram and density plot of the generated random numbers to visualize the chi-squared distribution.
3. **Calculate statistical properties:** Compute the mean, variance, and standard deviation of the generated random numbers.
4. **Compare with theoretical values:** Verify that the calculated statistical properties match the theoretical values for a chi-squared distribution.

5. **Applications:** Explore real-world applications of the chi-squared distribution, such as goodness-of-fit tests, tests of independence).

Lab 2: Simulating and Analyzing t-Distributed Data

Title: Simulating and Analyzing t-Distributed Data in R

Dataset: Simulated data generated using R's rt() function.

Experiment: Simulate and analyze data from a t-distribution to understand its characteristics and applications.

Tasks:

1. **Generate random samples:** Create multiple samples of varying sizes from a t-distribution with specified degrees of freedom.
2. **Calculate statistics:** Compute the mean, variance, and standard deviation for each sample.
3. **Visualize the distribution:** Plot histograms and density plots for each sample to observe the distribution's shape and variability.

Lab Manual:

1. Continuous Probability distributions using R programming –Sri K. Siva Naga Raju, 2024 First Edition, Department of Statistics, PBSCAS

References:

1. Zaven A. Karian, Edward J. Dudewicz, 2010, **Handbook of Fitting Statistical Distributions with R, 1st edition, Chapman and Hall/CRC.**
2. Vito Ricci, 2005, FITTING DISTRIBUTIONS WITH R, R-Cran Projects. https://cran.r-project.org/doc/contrib/Ricci-distributions-en.pdf

SEE (LAB) Model Question Paper

23STMAP232: Continuous Probability Distributions Using R

Offered to B.Sc. Hons STATISTICS

Max. Marks: 50 **Max. Time: 3Hrs**

Pass. Min: 20

(A)	**Evaluation Procedure**	**35 Marks**
I	Experiments (Exam & Execution)	**30 Marks**
II	Viva	**3 Marks**
III	Record	**2 Marks**
(B)	**CONTINUOUS ASSESMENT(Internal)**	**15 MARKS**

15 marks for the continuous assessment (Day to day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the regularity/ record/viva). Laboratory teachers are mandated to ensure that every student completes 80%-90% of the lab assessments.

TOTAL: (A)+(B) = **50 MARKS**