Course Code				**23STMAP231**			
Title of the Course				**Discrete 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 "Discrete Probability Distributions Using R" offers a comprehensive introduction to the theory and application of discrete probability distributions, with a focus on practical implementation using R. Students will explore key distributions such as Bernoulli, Binomial, Poisson, Geometric, and Hypergeometric, gaining a solid understanding of their properties, applications, and interrelationships. Through hands-on exercises in R, learners will simulate distributions, compute probabilities, and analyze real-world data, equipping them with the tools to apply statistical concepts in various fields. The course emphasizes both theoretical foundations and practical skills, making it ideal for students aiming to deepen their statistical knowledge and computational proficiency.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Understand the fundamental concepts of discrete probability distributions.
2	Calculate and interpret key statistical measures for discrete probability distributions.
3	Apply discrete probability distributions to real-world problems.
4	Perform hypothesis testing using discrete probability distributions.
5	Compare and contrast different discrete 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 discrete probability distributions (e.g., binomial, Poisson, geometric).	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 discrete 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	**3**								**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 ….(title of the course) course, providing hands-on practice with ….(technology/software)

Unit 1: Binomial Distribution (6Hrs)

Lab 1: Modelling Coin Tosses with a Binomial Distribution

Dataset: Simulated or real-world data on coin tosses.

Experiment:

1. Simulate a series of coin tosses using a random number generator.
2. Count the number of heads and tails.

3. Calculate the probability of success (e.g., heads) based on the simulation results.

Tasks:

1. Calculate the mean and variance of the binomial distribution.
2. Compare the simulated results with the theoretical values for a binomial distribution.
3. Explore the effect of changing the number of trials and the probability of success on the distribution.

Lab 2: Fitting of Binomial distribution

Dataset: Real world data set

Tasks:

1. Calculate the mean and variance of the binomial distribution and also calculate Probability of success.
2. Compare the expected results using recurrence relation for probabilities with the theoretical values for a binomial distribution.

Unit 2: Poisson Distribution 6Hrs

Lab 1: Simulating and analysing a Poisson Distribution

Dataset: Simulated data generated in R.

Experiment:

1. Generate a random sample from a Poisson distribution using the **rpois** function in R.
2. Calculate the mean, variance, and standard deviation of the sample.

Tasks:

1. Compare the calculated statistics with the theoretical values for a Poisson distribution.
2. Create a histogram to visualize the distribution of the simulated data.
3. Explore the effect of changing the rate parameter (lambda) on the distribution.

Lab 2: Fitting of Poisson distribution

Dataset: Real world data set

Tasks:

1. Calculate the mean and variance of the Poisson distribution and also calculate lambda value.
2. Compare the expected results using recurrence relation for probabilities with the theoretical values for a Poisson distribution.

Unit 3: Geometric Distribution 6Hrs

Lab 1: Simulating and Analysing a Geometric Distribution

Dataset: Simulated data generated in R.

Experiment:

1. Generate a random sample from a geometric distribution using the **rgeom** function in R.
2. Calculate the mean, variance, and standard deviation of the sample.

Tasks:

1. Compare the calculated statistics with the theoretical values for a geometric distribution.
2. Create a histogram to visualize the distribution of the simulated data.
3. Explore the effect of changing the probability of success (p) on the distribution.

Lab 2: Fitting of Geometric distribution

Dataset: Real world data set

Tasks:

1. Calculate the mean and variance of the geometric distribution and also calculate Probability of success.
2. Compare the expected results using recurrence relation for probabilities with the theoretical values for a geometric distribution.

Unit 4: Negative Binomial Distribution **6Hrs**

Lab 1: Simulating and Analysing a Negative Binomial Distribution

Dataset: Simulated data generated in R.

Experiment:

1. Generate a random sample from a negative binomial distribution using the rnbinom function in R.
2. Calculate the mean, variance, and standard deviation of the sample.

Tasks:

1. Compare the calculated statistics with the theoretical values for a negative binomial distribution.
2. Create a histogram to visualize the distribution of the simulated data.
3. Explore the effect of changing the size parameter (r) and the probability of success (p) on the distribution.

Lab 2: Fitting of Negative Binomial Distribution

Dataset: Real world data set

Tasks:

1. Calculate the mean and variance of the negative binomial distribution and also calculate r and p.
2. Compare the expected results using recurrence relation for probabilities with the theoretical values for a negative binomial distribution.

Unit 5: Hypergeometric Distribution

Lab 1: Simulating and Analysing a Hypergeometric Distribution

Dataset: Simulated data generated in R.

Experiment:

1. Generate a random sample from a hypergeometric distribution using the rhyper function in R.
2. Calculate the mean, variance, and standard deviation of the sample.

Tasks:

1. Compare the calculated statistics with the theoretical values for a hypergeometric distribution.
2. Create a histogram to visualize the distribution of the simulated data.
3. Explore the effect of changing the population size (N), the number of successes in the population (K), and the sample size (n) on the distribution.

Lab 2: Modelling Real-World Data with a Hypergeometric Distribution

Dataset: Real-world data on the number of successes in a sample drawn without replacement from a finite population.

Experiment:

1. Import the dataset into R.
2. Fit a hypergeometric distribution to the data using the dhyper function to calculate probabilities.

Tasks:

1. Calculate the estimated population size (N) and the number of successes in the population (K) based on the sample data.
2. Conduct a goodness-of-fit test (e.g., chi-square test) to assess how well the hypergeometric distribution fits the data.
3. Use the fitted hypergeometric model to make predictions or inferences about the population parameters.

Lab Manual:

1. Discrete 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

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Lab Model Question Paper Pattern

23STMAP231: Discrete 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