PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

Course Code			23STMDL202				
Title of the Course			**Probability and Random Variables for Computer Applications**				
Offered to: (Programme/s)			**Bachelor of Computer Applications (BCA) Hons**				
L	**2**	**T**	**0**	**P**	**0**	**C**	**2**
Year of Introduction:		**2024-25**	**Semester:**				**3**
Course Category:		MDC	**Course Relates to:**		**Local, Regional, National, Global**		
Year of Revision		NA	**Percentage:**		NA		
Type of the Course:			**Multi-Disciplinary Course**				
Crosscutting Issues of the Course			NA				
Pre-requisites, if any			Basic Mathematics				

Course Description:
This course introduces fundamental concepts of probability and random variables, emphasizing their applications in computing. Students will explore classical, statistical, and axiomatic definitions of probability and learn key theorems such as Bayes' theorem and the addition and multiplication rules. The course will also cover discrete and continuous random variables, probability mass and density functions, mathematical expectations, and generating functions. The knowledge gained will be essential for understanding data analysis, algorithm design, and stochastic processes in computer science.

Course Objectives:

S. No	COURSE OBJECTIVES
1	Understand and differentiate various probability definitions.
2	Apply Bayes' theorem to real-world problems in computing.
3	Apply random variables in computational models and simulations.
4	Understand the use of covariance in evaluating the relationship between random variables.
5	Calculate the expected value and moments of random variables.

Course Outcomes

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

NO	COURSE OUTCOME	BTL	PO	PSO
CO1	define key probability concepts and apply them to computing problems.	K1	1	1
CO2	understand and work with random variables and their probability distributions.	K2	1	1
CO3	calculate expectations, moments, and covariance, and apply these to real-world data.	K3	1	1
CO4	use generating functions to simplify and solve complex problems in probability.	K3	1	1
CO5	analyze probability distributions using pmf, pdf, and cdf.	K4	1	1

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

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

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

I. **Course Structure:**

Unit – I Probability: Definitions of various terms, classical, statistical and axiomatic probability definitions, addition theorem of probability. Conditional probability-definition, multiplication theorem of probability and Bayes' theorem – applications.

Applications

Probability, the mathematical study of chance and uncertainty, finds applications in a vast array of fields. Here are some key areas
Business and Economics, Social Sciences, Medicine, Insurance and Investment

Activities:
i. Coin Flipping and Dice Rolling Experiments
ii. Students can analyze lottery systems to understand probability and expected value.
iii. Students can collect real-world data (e.g., sports statistics, weather data) and analyze it
iv. Provide real-world scenarios (e.g., insurance, finance, medicine) and ask students to apply probability concepts to solve problems
v. Utilize online resources for interactive probability games and simulations

Unit – II Random Variables (Univariate)

Definition, Discrete and Continuous random variables -Probability mass function and Probability density function with simple illustrations. Distribution function and its properties. Definitions –Discrete, Continuous random variables.

Applications

1. **Demographics:** Age, income, education level, and gender distribution within a population.
2. **Finance:** Stock prices, interest rates, and return on investments

3. **Quality Control:** Product dimensions, weight, or defect rates.

4. **Engineering:** Reliability analysis.

5. Telecommunications: Signal processing, error correction

<u>**Activities:**</u>

i. Students can flip a coin multiple times and record the number of heads. They can

ii. then calculate the probability of getting different numbers of heads and compare it to the theoretical binomial distribution.

iii. Students can roll a die multiple times and record the outcomes. They can then

iv. calculate the probability of different outcomes and compare it to the theoretical uniform distribution

Unit – III

Mathematical Expectations & Generating Functions

Definition, Mathematical expectation of a random variable, Properties of expectations. Moments and covariance using mathematical expectation and their properties. Addition and Multiplication theorems on expectation of two and n variables (Statements only). Cauchy - Schwartz inequality (Statements only) and Chebychev's inequality(Statements only) - applications. Definitions of Moment Generating Function (m.g.f.), Cumulant Generating Function (c.g.f.), Probability Generating Function (p.g.f.), Characteristic Function (c.f.)- properties and applications.

Applications

1. **Finance:** Calculating expected returns on investments.

2. **Insurance:** Determining insurance premiums based on expected claims

3. **Physics:** Statistical mechanics and thermodynamics.

Activities:

i. **Coin Tossing:** Experiment with tossing a coin multiple times and calculate the expected number of heads.

ii. Stock market analysis

iii. Quality control in manufacturing

Textbook:

S. C. Gupta, Fundamentals of Statistics, 8th Edition, 2023, Himalaya Publishing House Pvt. Ltd 'Ramdoot', Dr. Bhalerao Marg, Girgaon, Mumbai – 400 004, Maharashtra, India

References Books:

1. **Business Statistics A First Course, 8e Paperback – 30 October 2022, David.** Levine (Author)

2. Business Statistics: Problems & Solutions by J.K. Sharma (Author), Vikas Publishing House Pvt Ltd. Noida, UP, India

23STMDL202: Probability and Random Variables for Computer Applications

Offered to : Bachelor of Computer Applications (BCA) Hons

Max. Marks: 35   **Semester III**   **Max. Time: 2Hrs**

Section - A

Answer any THREE from the following   **3 X 5M =15M**

1. Explain the terms exhaustive, mutually exclusive and equally likely events (CO1-, K-2)
2. Define Axiomatic definitions of probability. (CO-1, K-1)
3. Define a random variable and explain its types. (CO-2, K-1)
4. Define mathematical expectation and write its properties. (CO-3, K-1)
5. What do you mean by co-variance and write its properties (CO-3, K-1)

Section - B

Answer any TWO from the following   **2 X 10M = 20M**

6. A tyre manufacturing company kept a record of the distance covered before a tyre needed tobe replaced. The table shows the results of 1000 cases.

Distance(in km)	Less than 4000	4000 - 9000	9001 - 14000	More than 14000
Frequency	20	210	325	445

If a tyre is bought from this company, what is the probability that :

(i) it has to be substituted before 4000 km is covered?

(ii) it will last more than 9000 km?

(iii) it has to be replaced after 4000 km and 14000 km is covered by it?   (CO-1, K-3)

7. A random variable has the following probability distribution

x	0	1	2	3	4	5	6	7	8
P(X= x)	a	3a	5a	7a	9a	11a	13a	15a	17a

(i) Determine 'a' (ii) Find $P(X<3)$, $P(X \geq 3)$ and $P(0<X<5)$

(iii) Find the distribution function of X.   (CO-2, K-3)

8. Given the following table:

X = x	-3	-2	-1	0	1	2	3
P(X = x)	0.05	0.1	0.3	0	0.3	0.15	0.1

Compute (i) E(X), (ii) E(2X+3), (iii) V(X) and (iv) V(2X+3)   (CO-3, K-3)

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