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| Related image | **KONERU LAKSHMAIAH EDUCATION FOUNDATION**  (Deemed to be University estd, u/s, 3 of the UGC Act, 1956) (NAAC Accredited “A++” Grade University)  Green Fields, Guntur District, A.P., India – 522502  **Department of Computer Science and Engineering**  (DST - FIST Sponsored Department) |  |

**B.Tech. II CSE(H) PROGRAM**

**A.Y. 2023-24 ODD, Semester-II**

**Course Code: 22MT2005**

**PROBABILIRT, STATISTICS AND QUEUING THEORY**

**Course Outcome-1**

**Session 5:** **Random Variables and Probability Functions**

**Course Description (Description about the subject)**

1. **Aim**

To explain the rules of different probability distribution functions

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**2. Instructional** **Objectives (Course Objectives)**

Demonstrate the concept of Random variables and its types, List out the rules of discrete probability and continuous probability functions and the Cumulative distribution function

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**3.Learning** **Outcomes (Course Outcome)**

**CO1**: Students will be able to Identify the different types of random variables, Write the rules of Probability functions and their properties, and Differentiate the Cumulative distribution function from other functions.

**Module** **Description** **(CO-1 Description)**

Module on Random Variables and Probability Functions! In this extensive learning experience, we will delve into the fundamental ideas of random variables and probability functions, creating a solid framework for comprehending and analysing uncertainty in numerous domains.

**Session** **Introduction**

In this session, we'll bring these concepts to life with examples, games, and practical applications. So, get ready to tackle uncertainty like a pro and make informed decisions with the power of random variables and probability functions.

1. **Session description**

**In this lesson**, we'll have exciting games, examples, and practical applications to bring these concepts to life. By the end, you'll feel confident in tackling uncertainty, making informed decisions, and having fun with random variables and probability functions

**Random Variables**

**Random:** In an experiment of chance, outcomes occur randomly. We often summarize the outcome from a random experiment by a simple number.

**Variable:**  is a symbol such as X or Y that assumes values for different elements. If the variable can assume only one value, it is called a constant.

**Random variable:** A function that assigns a real number to each outcome in the sample space of a random experiment.

• Denote by an uppercase letter: X, Y, Z etc.,

**Example:** A balanced coin is tossed two times. List the elements of the sample space, the corresponding probabilities, and the corresponding values X, where X is the number of getting heads.

Let X be a random variable that the number of getting heads

X: HH HT TH TT

X=x: 2 1 1 0

P(X=x) 1/4 1/4 1/4 ¼

**Types of Random Variables**

**Discrete Random Variables:** A random variable is discrete if its set of possible values consist of discrete points on the number line.

(Or )

It is a numerical value associated with the desired outcomes and has either a finite number of values

**Example**

Number of defective parts among 1000 tested, number of transmitted bits received error

number of scratches on a surface

**Continuous Random Variables:** A random variable is continuous if its set of possible values consist of an entire interval on the number line.

(Or)

It has infinite numerical values associated with any interval on the number line system without any gaps or breaks.

**Example:**

Time, Temperature, Height, Weight, Length, Electrical current

**Discrete Probability distributions**

If X is a discrete random variable , the function given by

f(x)=P(X=*x*)=P*=*P X(*x*)=P(*x*)

for each *x* within the range of X is called the probability distribution of X.

Properties

1. Probability of each value of the discrete random variable is between 0 and 1, inclusive.

0P(X=x)

2. Total probability is equal to 1.

=1

**Example:**

Check whether the given function can serve as the probability distribution random variable

*f* (*x*) =for *x*=1,2,3,4,5

**Solution:**

25 25 25 25 25

= 3/25+ 4/25+ 5/25+ 6/25+ 7/25

= 25/25

= 1

1. P(x)
2. Total probability is 1.

Hence, the given function is a probability distribution of a discrete random variable.

CONTINUOUS PROBABILITY DISTRIBUTIONS

**Definition**: In dealing with continuous variables, f(x) is usually called the probability density function or simply the density function of X. The function f(x) is a probability density function for the continuous random variable X, defined over the set of real numbers R, if

1. f(x)
2. , Total area under the curve is 1

3. 

Example: Let X be a continuous random variable with the following

A math equations on a white background

Description automatically generated

1. Verify whether this distribution is a probability density function
2. Find P(0) 3.Find P(0.5)

Solution: The distribution is probability density function if it fulfill the following requirements

1. f(x)

In this problem,

**(1)First requirement**

1. f(0)=3/4≥0,
2. f(1)=3/2≥0,
3. f(x)=0, otherwise

ll f(x)≥0

**Must write the conclusion**

**so that we know the first**

**requirement is fulfill**

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**Since all requirements are fulfill, the distribution is probability density function.**

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**CUMULATIVE DISTRIBUTION FUNCTION**

* **The cumulative distribution function of a discrete random variable *X* , denoted as *F(x),* is**



* **For a discrete random variable *X, F(x)* satisfies the following**

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**Example 1: The time to recharge the flash is tested in three cell phone cameras. The probability a camera passes the test is 0.8 and the camera perform independently. List the elements of the sample space, the corresponding probabilities and the corresponding values *X*, where *X* denotes the number of camera passes the test.**

**Solution: *X* : the number of cameras that pass the test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Camera 1** | **Camera 2** | **Camera 3** | **Probability** | ***X*** |
| **Pass(0.8)** | **Pass(0.8)** | **Pass(0.8)** | **0.512** | **3** |
| **Pass(0.8)** | **Pass(0.8)** | **Fail(0.2)** | **0.128** | **2** |
| **Pass(0.8)** | **Fail(0.2)** | **Pass(0.8)** | **0.128** | **2** |
| **Pass(0.8)** | **Fail(0.2)** | **Fail(0.2)** | **0.032** | **1** |
| **Fail(0.2)** | **Pass(0.8)** | **Pass(0.8)** | **0.128** | **2** |
| **Fail(0.2)** | **Pass(0.8)** | **Fail(0.2)** | **0.032** | **1** |
| **Fail(0.2)** | **Fail(0.2)** | **Pass(0.8)** | **0.032** | **1** |
| **Fail(0.2)** | **Fail(0.2)** | **Fail(0.2)** | **0.008** | **0** |

1. **Activities/ Case studies/related to the session.**

An important factor in solid missile fuel is the particle size distribution. Significant problems occur if the particle sizes are too large. From the production data in the part, it has been determined that the particle size (in micrometers) distribution is characterized by

f(x)=3x-4, x>1

= 0 elsewhere

a) Verify that this is a valid density function

b) Evaluate the Cumulative distribution function F(x)

c) What is the probability that a random particle from the manufactured fuel exceeds 4 micrometers?

d) What is the probability that a random particles’ size is between 2 and 4 micrometers?

a) f(x) is a valid density function if x≤X

Therefore, f(x) is a valid density function.

b) Cumulative distribution function F(x) is given by

f(x)=P(X=

c) Probability that a random particle’s size exceeds 4 micrometers

=P(X>4)=1-F(4)=1-(1-(1/43))=0.0156.

d) Probability that a random particle’s size is between 2 and 4 micrometers

=P(2≤X≤4)=F(4)-F(2)=(1-1/43)-(1-1/23)=1/8-1/64 =0.109.

1. **Examples & contemporary extracts of articles/ practices to convey the idea of the Session**
2. **SAQ's-Self Assessment Questions**

1.The milk produce by a cow is

2. The probability of all possible outcomes of a random experiment is always equal to:

1. **Summary**

n this session, identify the different types of random variables, probability functions and their properties have discussed.

1. Difference between discrete and continuous random variables

2. Probability Mass and Probability density function and their properties

3. Cumulative distribution function and its properties.

1. **Terminal Questions**

1.A shipment of 8 similar microcomputers to a retail outlet contains 3 defectives. If a school makes a random purchase of 2 of these computers, find the probability distribution for the number of defectives.

2. Given that f(x)=k/2x is a probability distribution for a random variable that can take on the values x=0, 1, 2, 3 and 4. Find K.

a) Find K b) Find the Cumulative probability distribution F(x)

3.Given that



1. Evaluate k.
2. Evaluate P(0.3<X<0.6) using the density function

4. For the density function



1. To evaluate P(0<X1)
2. Find Cumulative distribution function
3. **Case Studies (CO Wise)**

**NA**

1. **Answer Key**

**NA**

1. **Glossary**

**NA**

1. **References of books, sites, links Textbooks:**

**Textbooks:**

1. Probability and Statistics Rukmangad Achari E. and E. Keshava Reddy
2. Probability and Statistics for Engineers and Scientists” Ronald E. Walpole, Sharon L. Myers and Keying Ye 8th Edition Pearson pub
3. Probability & Statistics for Engineers Dr. J. Ravichandran first Edition Wiley-India

**Reference books:**

Chapter 1 of TP1: William Feller, An Introduction to Probability Theory and Its Applications: Volume 1, Third Edition, 1968 by John Wiley & Sons,Inc.

2. Richard A Johnson, Miller& Freund’s Probability and statistics for Engineers, PHI, New Delhi, 11th Edition (2011).

**Web Resources**

1. <https://www.probabilitycourse.com/chapter3/3_2_1_cdf.php>
2. <https://en.wikipedia.org/wiki/Cumulative_distribution_function>
3. **Keywords**

Discrete random variable, continuous random variable