

Statistics for Data Science -1

Lecture 8.3: Discrete and Continuous Random Variable

Usha Mohan

Indian Institute of Technology Madras

Learning objectives

Learning objectives

1. Define what is a random variable.

Learning objectives

1. Define what is a random variable.
2. Types of random variables: discrete and continuous.

Learning objectives

1. Define what is a random variable.
2. Types of random variables: discrete and continuous.
3. Probability mass function, graph, and examples.

Learning objectives

1. Define what is a random variable.
2. Types of random variables: discrete and continuous.
3. Probability mass function, graph, and examples.
4. Cumulative distribution function, graphs, and examples.

Learning objectives

1. Define what is a random variable.
2. Types of random variables: discrete and continuous.
3. Probability mass function, graph, and examples.
4. Cumulative distribution function, graphs, and examples.
5. Expectation and variance of a random variable.

Discrete and Continuous random variables

Definition

*A random variable that can take on at most a countable number of possible values is said to be a **discrete random variable**.*

- ▶ Thus, any random variable that can take on only a finite number or countably infinite number of different values is discrete.
- ▶ There also exist random variables whose set of possible values is uncountable.

Definition

*When outcomes for random event are numerical, but cannot be counted and are infinitely divisible, we have **continuous random variables**.*

Discrete and continuous random variable

Discrete and continuous random variable

- ▶ A **discrete random variable** is one that has possible values that are discrete points along the real number line.

Discrete and continuous random variable

- ▶ A **discrete random variable** is one that has possible values that are discrete points along the real number line.
 - ▶ Discrete random variables typically involve counting.

Discrete and continuous random variable

- ▶ A **discrete random variable** is one that has possible values that are discrete points along the real number line.
 - ▶ Discrete random variables typically involve counting.
- ▶ A **continuous random variable** is one that has possible values that form an interval along the real number line.

Discrete and continuous random variable

- ▶ A **discrete random variable** is one that has possible values that are discrete points along the real number line.
 - ▶ Discrete random variables typically involve counting.
- ▶ A **continuous random variable** is one that has possible values that form an interval along the real number line.
 - ▶ Continuous random variables typically involve measuring.

Example: Apartment complex

Example: Apartment complex

Apartment complex data:

- ▶ There are four floors in the apartment complex.
- ▶ Each floor has three apartments: a one bedroom, a two bedroom and a three bedroom apartment.
- ▶ The data on the apartments is summarized in the table

Apartment complex data

Apartment complex data

Apartment number	Floor number	No. of bedrooms	Size of apartment (sq.ft)	Distance of apartment from lift (meters)
1	1	1	900.23	503.5
2	1	2	1175.34	325.6
3	1	3	1785.85	450.8
4	2	1	900.48	500.1
5	2	2	1175.23	324.5
6	2	3	1785.35	456.7
7	3	1	900.53	502.5
8	3	2	1176.34	325.6
9	3	3	1787.85	450.8
10	4	1	900.78	500.1
11	4	2	1176.03	325.4
12	4	3	1784.85	455.7

Apartment complex

Apartment complex

- ▶ Random experiment: Randomly selecting an apartment in an apartment complex of 12 apartments.

Apartment complex

- ▶ Random experiment: Randomly selecting an apartment in an apartment complex of 12 apartments.
- ▶ $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

Questions

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Answer: 1, 2,3,4

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Answer: 1, 2,3,4

3. Let the random variable be size of the apartment. What are the possible values that might be observed?

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Answer: 1, 2,3,4

3. Let the random variable be size of the apartment. What are the possible values that might be observed?

Answer: [900,1800] sq. ft

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Answer: 1, 2,3,4

3. Let the random variable be size of the apartment. What are the possible values that might be observed?

Answer: [900,1800] sq. ft

4. Let the random variable be distance of the apartment from the lift. What are the possible values that might be observed?

Questions

1. Let the random variable be number of bedrooms, what are the possible values that might be observed?

Answer: 1,2,3

2. Let the random variable be floor number of the apartment. What are the possible values that might be observed?

Answer: 1, 2,3,4

3. Let the random variable be size of the apartment. What are the possible values that might be observed?

Answer: [900,1800] sq. ft

4. Let the random variable be distance of the apartment from the lift. What are the possible values that might be observed?

Answer: [324,505] meters

Discrete versus continuous

Discrete versus continuous

- ▶ Which variables are discrete random variables?

Discrete versus continuous

- ▶ Which variables are discrete random variables?
 - ▶ Number of bedrooms, floor number.

Discrete versus continuous

- ▶ Which variables are discrete random variables?
 - ▶ Number of bedrooms, floor number.
- ▶ Which variables are continuous random variables?

Discrete versus continuous

- ▶ Which variables are discrete random variables?
 - ▶ Number of bedrooms, floor number.
- ▶ Which variables are continuous random variables?
 - ▶ Size, distance to the lift.

Discrete and continuous- more examples

Discrete and continuous- more examples

► Discrete:

Discrete and continuous- more examples

- ▶ Discrete:
 - ▶ Number of people in a household
 - ▶ Number of languages a person can speak
 - ▶ Number of times a person takes a particular test before qualifying.
 - ▶ Number of accidents in an intersection.
 - ▶ Number of spelling mistakes in a report.

Discrete and continuous- more examples

- ▶ Discrete:
 - ▶ Number of people in a household
 - ▶ Number of languages a person can speak
 - ▶ Number of times a person takes a particular test before qualifying.
 - ▶ Number of accidents in an intersection.
 - ▶ Number of spelling mistakes in a report.
- ▶ Continuous:

Discrete and continuous- more examples

- ▶ Discrete:
 - ▶ Number of people in a household
 - ▶ Number of languages a person can speak
 - ▶ Number of times a person takes a particular test before qualifying.
 - ▶ Number of accidents in an intersection.
 - ▶ Number of spelling mistakes in a report.
- ▶ Continuous:
 - ▶ Temperature of a person.
 - ▶ Height of a person.
 - ▶ Speed of a vehicle.
 - ▶ Time taken by a person to write an exam.

Section summary

- ▶ Definitions of Discrete random variable versus continuous random variable
- ▶ Identify discrete and continuous random variables.