

Unit 3 Outline

Unit 3: Random Variables and Distributions

In the last unit, you learned how to calculate probabilities in the framework of sample spaces, outcomes, and events. In this unit, you will build on those ideas and learn about random variables. A random variable describes the outcomes of a statistical experiment. A statistical distribution describes the numbers of times each possible outcome occurs in a sample. The values of a random variable can vary with each repetition of an experiment. Intuitively, a random variable is an observable that takes on values with certain probabilities.

A random variable can be classified as being either discrete or continuous, depending on the values it assumes. Suppose you count the number of people who go to a coffee shop between 4:00 pm and 5:00 pm and the amount of money that they spend in that hour. In this case, the number of people is an example of a discrete random variable and the amount of money they spend is an example of a continuous random variable.

In this unit, you will study probability problems involving random distributions. You will also learn about both discrete and continuous random variables and their applications. Finally, you will study an important example of a continuous distribution, the normal distribution, which is a bell-shaped distribution used widely across many disciplines.

A note from the textbook: “The values of discrete and continuous random variables can be ambiguous. For example, if X is equal to the number of miles (to the nearest mile) you drive to work, then X is a discrete random variable. You count the miles. If X is the distance you drive to work, then you measure values of X , and X is a continuous random variable. How the random variable is defined is very important.”^[1]

[1] Illowsky, Barbara and Susan Dean. *Collaborative Statistics*. Connexions. Accessed March 22, 2010, <http://cnx.org/content/col10522/1.38/>.

Sections:

3.1 Discrete Random Variable and Discrete Probability Distributions

3.2 Continuous Random Variables

3.3 Normal Distribution

3.1 Discrete Random Variables and Discrete Probability Distributions

3.1.1 Probability Distribution Functions

- Reading: Barbara Illowsky and Susan Dean’s *Collaborative Statistics*: Chapter 4: Discrete Random Variables: “Section 1: Discrete Random Variables” and “Section 2: Probability Distribution Function (PDF) for a Discrete Random Variable”
- Lecture: Khan Academy’s *Statistics*: “Introduction to Random Variables” and “Probability Density Functions”

3.1.2 Expected Value and Standard Deviation

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 4: Discrete Random Variables: "Section 3: Mean or Expected Value and Standard Deviation"
- Lecture: Khan Academy's Statistics: "Expected Value: $E(X)$ "

3.1.3 Common Discrete Probability Distributions

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 4: Discrete Random Variables: "Section 4: Common Discrete Probability Distribution Functions," "Section 5: Binomial," "Section 6: Geometric (optional)," "Section 7: Hypergeometric (optional)," and "Section 8: Poisson"
- Lecture: Barbara Illowsky and Susan Dean's Collaborative Statistics: "Video Lecture 4: Discrete Distributions"
- Assessment: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 4: Discrete Random Variables: "Practice 1: Discrete Distribution," "Practice 2: Binomial Distribution," "Practice 3: Poisson Distribution," "Practice 4: Geometric Distribution," and "Practice 5: Hypergeometric Distribution"
- Lecture: Khan Academy's Statistics: "Binomial Distribution 1," "Binomial Distribution 2," "Binomial Distribution 3," and "Binomial Distribution 4"
- Lecture: Khan Academy's Statistics: "Expected Value of Binomial Distribution"
- Lecture: Lecture: Khan Academy's Statistics: "Poisson Process 1" and "Poisson Process 2"

3.2 Continuous Random Variables

3.2.1 Continuous Probability Functions

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 5: Continuous Random Variables: "Section 1: Continuous Random Variables" and "Section 2: Continuous Probability Functions"

3.2.2 Uniform Distribution

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 5: Continuous Random Variables: "Section 3: The Uniform Distribution"

3.2.3 Exponential Distribution

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 5: Continuous Random Variables: "Section 4: The Exponential Distribution"
- Lecture: Barbara Illowsky and Susan Dean's Collaborative Statistics: "Video Lecture 5: Continuous Random Variables"
- Assessment: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 5: Continuous Random Variables: "Practice 1: Uniform Distribution" and "Practice 2: Exponential Distribution"

3.3 Normal Distribution

3.3.1 The Standard Normal Distribution

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 6: The Normal Distribution: "Section 1: The Normal Distribution" and "Section 2: The Standard Normal Distribution"

- Lecture: Khan Academy's Statistics: "Law of Large Numbers"
- Lecture: Khan Academy's Statistics: "Normal Distribution Excel Exercise," "Introduction to Normal Distribution," and "Normal Distribution Problems: Qualitative Sense of Normal Distributions"

3.3.2 Z-scores

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 6: The Normal Distribution: "Section 3: Z-scores"
- Lecture: Khan Academy's Statistics: "Normal Distribution Problems: Z-score," "Normal Distribution Problems: Empirical Rule," and "Standard Normal Distribution and the Empirical Rule"

3.3.3 Areas to the Left and Right of X

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 6: The Normal Distribution: "Section 4: Areas to the Left and Right of x"

3.3.4 Calculations of Probabilities

- Reading: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 6: The Normal Distribution: "Section 5: Calculations of Probabilities"
- Lecture: Barbara Illowsky and Susan Dean's Collaborative Statistics: "Video Lecture 6: The Normal Distribution"
- Assessment: Barbara Illowsky and Susan Dean's Collaborative Statistics: Chapter 6: The Normal Distribution: "Practice: The Normal Distribution"