

Lecture 10: Bernoulli and Geometric Random Variables

Chapter 3.3-3.5

Goals for Today

Define

- ▶ Bernoulli random variables
- ▶ Geometric random variables

Mathematical Definition of a Bernoulli Random Variable

A **random variable X** is a random process or variable with a numerical outcome. The behavior of random variables is described in terms of their **distribution**.

Bernoulli Distribution

Say we have an experiment where each **trial** (or instance) has two possible outcomes:

Bernoulli Distribution

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- ▶ Coin flips: heads vs tails
- ▶ Medical test (for a disease): positive vs negative
- ▶ Rolling a die and getting a 6 vs not getting a 6

Bernoulli Distribution

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- ▶ Coin flips: heads vs tails
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- ▶ Rolling a die and getting a 6 vs not getting a 6

In each case we can **define** the outcomes to be a **success** or a **failure**. No moral judgement; just labels.

Bernoulli Distribution

Definition of a Bernoulli Random Variable

Example of Bernoulli Distribution

- ▶ A success as rolling a 6.
So $P(X = 1) = P(\text{success}) = p = \frac{1}{6}$.
- ▶ A failure as rolling anything else
So $P(X = 0) = P(\text{failure}) = 1 - p = \frac{5}{6}$.

Intuition Behind σ

Sample Proportion

Back to Lecture 3.1: Population vs Sample Values

	True Population Value	Sample Value
Mean	μ	\bar{x}
Variance	σ^2	s^2
Standard Deviation	σ	s
Proportion	p	\hat{p}

Back to Lecture 3.1: Population vs Sample Values

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Proportion	p	\hat{p}

The **sample proportion** \hat{p} is a specific kind of **sample mean** for Bernoulli random variables, which **estimates** p , a specific kind of population mean.

Scenario

Geometric Random Variables

Intuition Behind μ