Bernoulli and Geometric Random Variables

Probability Theory: Foundation for Data Science

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Random Variables

At the end of this module, students should be able to

- Define a discrete random variable and give examples of a probability mass function and a cumulative distribution function.
- Calculate probabilities of Bernoulli, Binomial, Geometric, and Negative Binomial random variables.
- Calculate the expectation and variance.

Discrete random variables can be categorized into different types or classes. Each type/class models many different real-world situations.

Bernoulli rv

Bernoulli rv, sometimes called a binary rv, is any random variable with only two possible outcomes: 0 or 1.

The probability mass function (pmf) is given by:

Notation: We write _____ to indicate that X is a Bernoulli rv with success probability p.

Geometric rv

Motivating Example A patient needs a kidney transplant and is waiting for a matching donor. The probability that a randomly selected donor is a suitable match is p.

What is the sample space? What is an appropriate rv? What is the pmf?

Geometric rv - continued

A **geometric rv** consists of independent Bernoulli trials, each with the same probability of success p, repeated until the first success is obtained.

- Each trial is identical, and can result in a success or failure.
- The probability of success, p, is constant from one trial to the next.
- The trials are independent, so the outcome on any particular trial does not influence the outcome of any other trial.
- Trials are repeated until the first success.

Geometric rv - continued

Summary

- Sample space for a geometric rv:
- Probability mass function for a geometric rv with probability of success p
- Notation: We write _____ to indicate that X is a geometric rv with success probability p.