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Chapter 3

Discrete Random Variables

- 3.1 Random Variables
- 3.2 Probability Distributions**
- 3.3 Expected Values
- 3.4 The Binomial Probability Distribution
- 3.5 Hypergeometric and Negative Binomial Distributions
- 3.6 The Poisson Probability Distribution

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pmf

The probability distribution or probability mass function (pmf) of a discrete rv X is defined for every number x by

$$p(x) = P(X=x)$$

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Example

Roll two dice and let X be the sum of the two numbers.

Find the pmf of X and draw a line graph for the pmf and a probability histogram.

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Example

It is known that two out of five certain machines are not functioning properly. The machines are put in random order and tested successively until a broken machine is identified. Let the random variable X denote the number of tests necessary to identify a broken machine.

Find the pmf of X and draw a line graph for the pmf and a probability histogram.

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Parameters of a pmf

Suppose the pmf depends on a quantity that can be assigned any one of a number of possible values, with each different value determining a different pmf. Such a quantity is called a parameter of the pmf. The collection of all pmfs for different values of the parameter is called a family of pmfs.

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Example

Assume that the probability that a bulb manufactured by a certain company is broken is equal to p . We pick bulbs (randomly and independently) and test them until a broken bulb is identified. We denote the number of necessary tests by X .

Find the pmf of X .

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cdf

The **cumulative distribution function (cdf)** of a discrete rv X is defined for every number x by

$$F(x) = P(X \leq x)$$

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Example

Roll a die and let X be the number thrown.

- Find the **cdf** of X and draw a **graph of the cdf**.
- Find the probability that X is bigger than 4.
- Find the probability that X is 3, 4 or 5.

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Example

Roll two dice and let X be the sum of the two numbers.

- Find the **cdf** of X and draw a **graph of the cdf**.
- Find the probability that X is bigger than 6.
- Find the probability that X is 9, 10 or 11.
- Find the probability that X is between 3 and 9 (incl.)

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Example

It is known that two out of five certain machines are not functioning properly. The machines are put in random order and tested successively until a broken machine is identified. Let the random variable X denote the number of tests necessary to identify a broken machine.

Find the **cdf** of X and draw a **graph of the cdf**.

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Example

Assume that the probability that a bulb manufactured by a certain company is broken is equal to p . We pick bulbs (randomly and independently) and test them until a broken bulb is identified. We denote the number of necessary tests by X .

Find the **cdf** of X .

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