Probability Methods in Engineering

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Lecture 14

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Probability Mass Function

- pmf of a discrete RV X is

$$p_X(x) = P[X = x] = P\left[\{\zeta : X(\zeta) = x\}\right]$$

- Properties

$$p_X(x) \geq 0$$

$$\sum_{x \in S_X} p_X(x) = 1$$

$$P[X \text{ in } B] = \sum_{x \in B} p_X(x) \text{ where } B \subset S_X$$

Examples

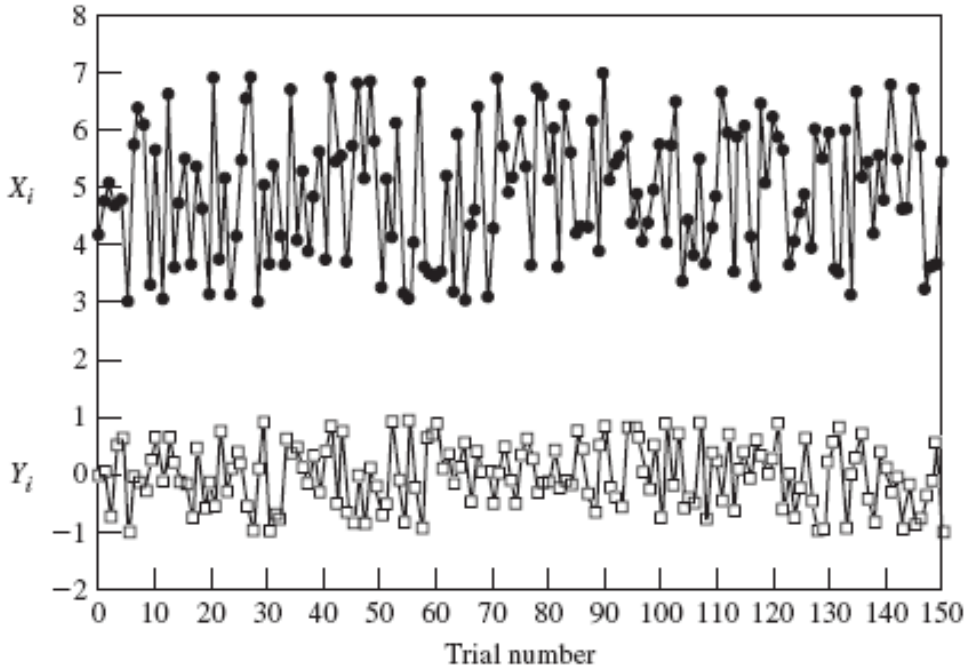
- A binary communications channel introduces a bit error in a transmission with probability 0.1. Let X be the number of errors in four independent transmissions. Find the pmf of X. Find the probability of one or fewer errors.

Examples (cont.)

- A fair coin is flipped 5 times and the number of heads X is noted. Find the pmf of X.

Expected Value of Discrete RV

- Entire pmf required for completely describing RV behavior
- In some cases, interest in parameters summarizing pmf



- Expected value or mean of discrete RV X defined by

$$m_X = E[X] = \sum_{x \in S_X} x p_X(x)$$

Examples (cont.)

- Find the expected value of the Bernoulli random variable X having success probability p. The value for success is 1 and failure is 0.

Examples (cont.)

- Let X be the number of heads in three tosses of a fair coin. Find $E[X]$.

Examples (cont.)

- A fair dice is rolled once. Let X be the outcome of the experiment. Find $E[X]$.

Expected Value of Discrete RV (cont.)

- The "expected value" does not mean expected outcome
- $E[X]$ not necessarily an outcome
  - E.g. the expected value of Bernoulli RV is p
  - But outcomes are always 0 or 1

- $E[X]$ corresponds to "average of X"
  - In large number of observations of X