



Probability Methods in Engineering

CSE-209

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Lecture 14



Probability Mass Function

- pmf of a discrete RV X is

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

- 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.



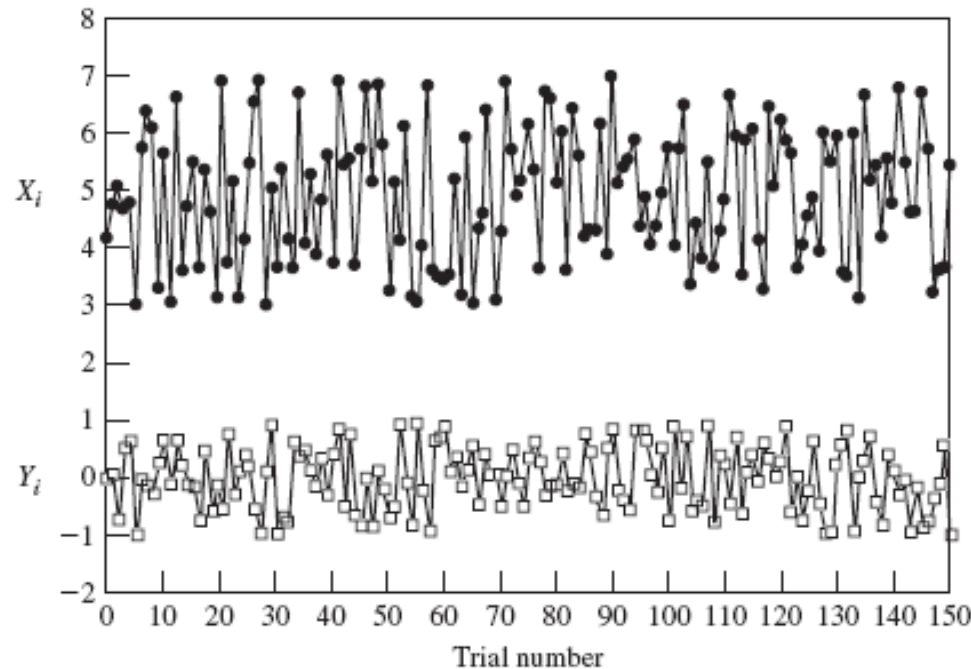
Examples (cont.)

- 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