Probability
Sections 12.1, 12.2, 12.3
Lecture 21

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Fri, Feb 19, 2016

Outline

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Probability

- The “probability” that a fair coin lands head is $\frac{1}{2}$.
- What exactly does that mean?

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- What exactly does that mean?
- If I toss the coin 10 times, I will get 5 heads?
  - That is simply not true.
- If I toss the coin many times, I will get heads "about" half the time?
  - Then shouldn't we say that the probability is "about" $\frac{1}{2}$, not "exactly" $\frac{1}{2}$?

Probability

Definition (Probability)

The probability of a particular outcome of procedure is the proportion of the times that that outcome occurs out an enormous number (actually infinite number) of repetitions of the procedure.

- More technically, it is the “limit” of the proportion of the time that the outcome occurs.
- That means that the proportion of times that the particular outcome actually occurs will get closer and closer to the exact value as the number of repetitions increases.

Outline

The Probability Model

- The basis of a probability model is a procedure.
- The procedure involves at least one step that is left to chance.
- When we perform the procedure, we observe a specific outcome.

Example

Example (Probability Model)

- In the coin-tossing example,
  - The procedure is to toss the coin.
  - The outcome that we observe is which side landed up.

The Probability Model

Definition (Sample Space)

The sample space of a procedure is the set of all possible outcomes.

Definition (Event)

An event is a set of outcomes. That is, it is a subset of the sample space.

Example

Example (Tossing a Coin)

- Let the procedure be to toss a coin.
- The observation is, which side landed up.
- The possible outcomes are heads (H) and tails (T).

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- The observation is, which side landed up.
- The possible outcomes are heads (H) and tails (T).
- What is the sample space?
- List a couple of events.

Example

Example (Rolling a Die)

- Let the procedure be to roll a die.
- The observation is, which number landed up.

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Example (Rolling a Die)

- Let the procedure be to roll a die.
- The observation is, which number landed up.
- What is the sample space?
- List a couple of events.
- Describe the event “the number is odd.”

Example

Example (Rolling a Pair of Dice)

- Let the procedure be to roll a pair of dice.
- The observation is, which number landed up on each die.

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Example (Rolling a Pair of Dice)

- Let the procedure be to roll a pair of dice.
- The observation is, which number landed up on each die.
- What is the sample space?
- List a couple of events.
- Describe the event “the sum of the two numbers is 7.”

Example

Example (Rolling a Pair of Dice)

- Let the procedure be to roll a pair of dice.
- The observation is the sum of the two numbers.

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Assignment

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- Read Sections 12.1, 12.2, 12.3.
- Apply Your Knowledge: 5, 6, 7.
- Check Your Skills: 22, 23, 25, 26, 27.
- Exercises 32, 33, 35, 36, 38.