

# Probability Rules

## Section 12.4

### Lecture 23

Robb T. Koether

Hampden-Sydney College

Wed, Feb 24, 2016

# Outline

1 Probability Rules

2 Assignment

# Outline

1 Probability Rules

2 Assignment

# Probability Rules

- The probability of an event is the fraction of the time that that event occurs.
- Therefore, the probability must be between 0 and 1.
  - 0 = 0% of the time = never.
  - 1 = 100% of the time = always.

# Disjoint Events

## Definition (Disjoint Events)

Events  $A$  and  $B$  are **disjoint** if they have no outcomes in common.

- Disjoint events cannot both occur in a single performance of the procedure.

# Example

## Example (Disjoint Events)

In the die-rolling procedure, which pairs of the following events are disjoint?

- $A$ : The number is even.
- $B$ : The number is at least 4.
- $C$ : The number is 1 or 3.
- $D$ : The number is 5 or 6.

# Addition Rule

## Addition Rule

If events  $A$  and  $B$  are disjoint, then

$$P(A \text{ or } B) = P(A) + P(B).$$

- That is, to find the probability that either  $A$  or  $B$  occurs, we add their individual probabilities, *provided  $A$  and  $B$  are disjoint*.

# Example

## Example (Disjoint Events)

- Draw one card from a well shuffled deck of 52 cards and note the value and the suit of the card.
- Let  $A$  be the event that the card is clubs.
- Let  $B$  be the event that the card is a red face card.
- Let  $C$  be the event that the card is one of 2 through 6 of spades.



# Example

## Example (Disjoint Events)

- Draw one card from a well shuffled deck of 52 cards and note the value and the suit of the card.
- Let  $A$  be the event that the card is clubs.
- Let  $B$  be the event that the card is a red face card.
- Let  $C$  be the event that the card is one of 2 through 6 of spades.
- Find  $P(A \text{ or } B \text{ or } C)$ .

# Example

## Example (Nondisjoint Events)

- The weatherman says that

$$P(\text{rain today}) = 30\%,$$

$$P(\text{rain tomorrow}) = 40\%,$$

$$P(\text{rain the day after tomorrow}) = 50\%.$$

# Example

## Example (Nondisjoint Events)

- The weatherman says that

$$P(\text{rain today}) = 30\%,$$

$$P(\text{rain tomorrow}) = 40\%,$$

$$P(\text{rain the day after tomorrow}) = 50\%.$$

- Let  $A$  be the event that it rains today.
- Let  $B$  be the event that it rains tomorrow.
- Let  $C$  be the event that it rains the day after tomorrow.

# Example

## Example (Nondisjoint Events)

- The weatherman says that

$$P(\text{rain today}) = 30\%,$$

$$P(\text{rain tomorrow}) = 40\%,$$

$$P(\text{rain the day after tomorrow}) = 50\%.$$

- Let  $A$  be the event that it rains today.
- Let  $B$  be the event that it rains tomorrow.
- Let  $C$  be the event that it rains the day after tomorrow.
- Can we find  $P(A \text{ or } B \text{ or } C)$ ?

# Complement Rule

## Complement Rule

If  $A$  is any event, then

$$P(A \text{ does not occur}) = 1 - P(A).$$

- That is, to find the probability that  $A$  does not occur, subtract from 1 (or 100%) the probability that it does occur.
- This rule follows directly from the Addition Rule.

# Example

## Example (Disjoint Events)

- Draw one card from a well shuffled deck of 52 cards and note the value and the suit of the card.
- Let  $A$  be the event that the card is clubs.
- Let  $B$  be the event that the card is a red face card.
- Let  $C$  be the event that the card is one of 2 through 6 of spades.

# Example

## Example (Disjoint Events)

- Draw one card from a well shuffled deck of 52 cards and note the value and the suit of the card.
- Let  $A$  be the event that the card is clubs.
- Let  $B$  be the event that the card is a red face card.
- Let  $C$  be the event that the card is one of 2 through 6 of spades.
- Find the probabilities that
  - $A$  does not occur (not clubs).
  - $B$  does not occur (not a red face card).
  - $C$  does not occur (not 2 - 6 of spades).

# Outline

1 Probability Rules

2 Assignment



# Assignment

## Assignment

- Read Section 12.4.
- Apply Your Knowledge: 8, 9, 10, 11.
- Check Your Skills: 22, 23.
- Exercises 39, 40, 47, 48ab, 50.