Introduction to Probability

Objectives

1. Determine the probability of an event
2. Find the experimental probability of an event

Sample Space

Sample Space

The **sample space** is a listing of all possible outcomes.

Sample Space

Sample Space

The **sample space** is a listing of all possible outcomes.

Common sample spaces:

Sample Space

Sample Space

The **sample space** is a listing of all possible outcomes.

Common sample spaces:

- *Flipping a coin*: Heads, Tails

Sample Space

Sample Space

The **sample space** is a listing of all possible outcomes.

Common sample spaces:

- *Flipping a coin*: Heads, Tails
- *Rolling a single die*: 1, 2, 3, 4, 5, 6

Sample Space

Sample Space

The **sample space** is a listing of all possible outcomes.

Common sample spaces:

- *Flipping a coin*: Heads, Tails
- *Rolling a single die*: 1, 2, 3, 4, 5, 6
- *Drawing a card from a standard deck*: Ace of spades, ace of hearts, . . . , king of diamonds

Venn Diagrams

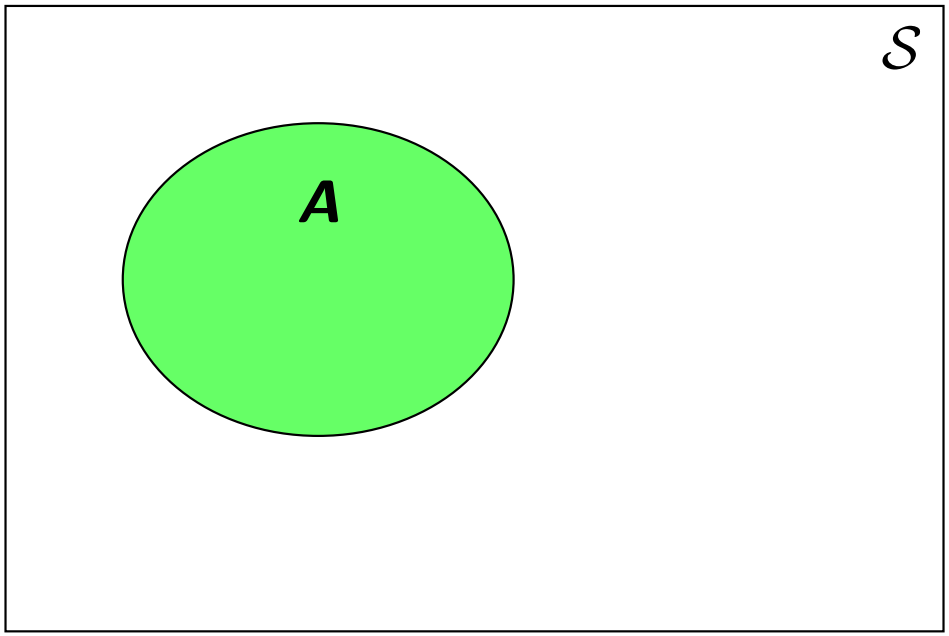
Venn Diagrams

A **Venn diagram** is a visualization of events and sample spaces.

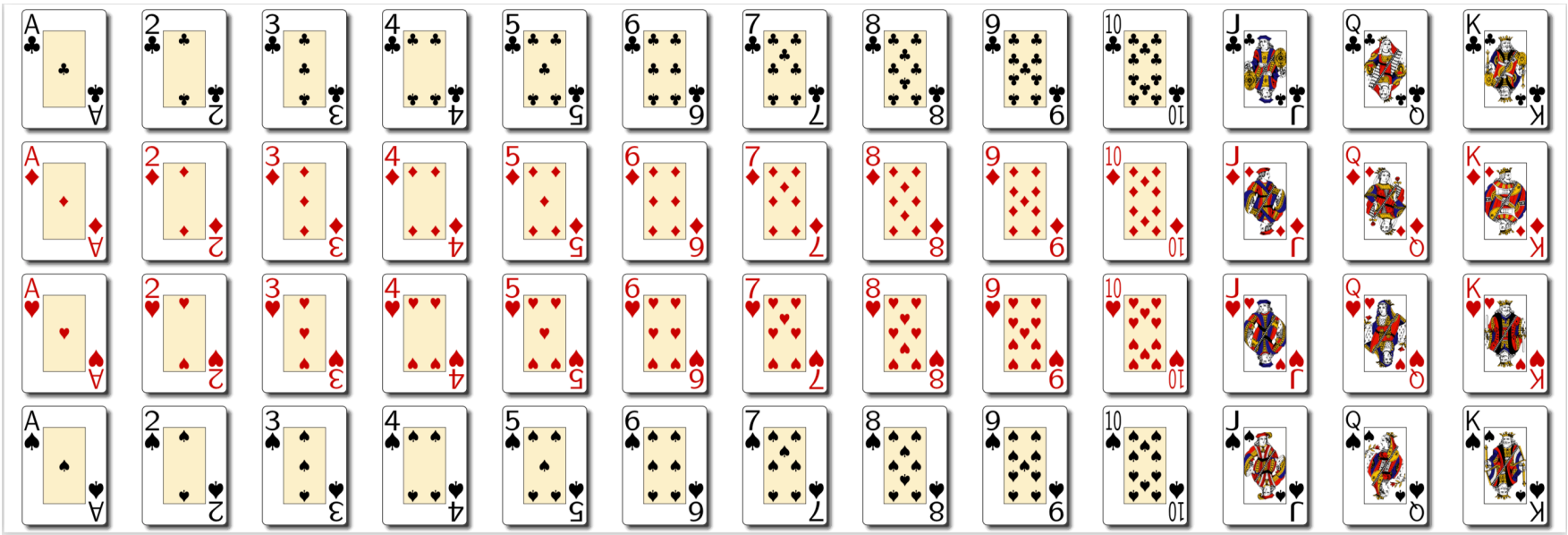
Venn Diagrams

Venn Diagrams

A **Venn diagram** is a visualization of events and sample spaces.



Playing Cards



Probability

Probability

Probability is a measure of the likelihood of an event occurring.

Probability

Probability

Probability is a measure of the likelihood of an event occurring.

$$\text{Probability} = \frac{\text{number of ways the event can occur}}{\text{total number of outcomes in sample space}}$$

Example 1

Determine the probability of each event.

(a) Flipping a coin and landing on heads

Example 1

Determine the probability of each event.

(a) Flipping a coin and landing on heads

1 outcome: Heads

Example 1

Determine the probability of each event.

(a) Flipping a coin and landing on heads

1 outcome: Heads 2 outcomes in sample space

Example 1

Determine the probability of each event.

(a) Flipping a coin and landing on heads

1 outcome: Heads 2 outcomes in sample space

$$P(\text{heads}) = \frac{1}{2}$$

Example 1

(b) Rolling a number less than 3 on a single die.

Example 1

(b) Rolling a number less than 3 on a single die.

2 outcomes: 1, 2

Example 1

(b) Rolling a number less than 3 on a single die.

2 outcomes: 1, 2 6 outcomes in sample space

Example 1

(b) Rolling a number less than 3 on a single die.

2 outcomes: 1, 2 6 outcomes in sample space

$$P(\text{rolling less than 3 on a single die}) = \frac{2}{6} = \frac{1}{3}$$

Example 1

(c) Drawing a face card from a standard deck.

Example 1

(c) Drawing a face card from a standard deck.

Face cards include jacks, queens, and kings.

Example 1

(c) Drawing a face card from a standard deck.

Face cards include jacks, queens, and kings.

There are four suits for each card: clubs, diamonds, hearts, and spades.

Example 1

(c) Drawing a face card from a standard deck.

Face cards include jacks, queens, and kings.

There are four suits for each card: clubs, diamonds, hearts, and spades.

Thus, there are 12 total face cards: jack of clubs, jack of diamonds, . . . , king of spades

Example 1

(c) Drawing a face card from a standard deck.

Face cards include jacks, queens, and kings.

There are four suits for each card: clubs, diamonds, hearts, and spades.

Thus, there are 12 total face cards: jack of clubs, jack of diamonds, . . . , king of spades There are 52 total cards

Example 1

(c) Drawing a face card from a standard deck.

Face cards include jacks, queens, and kings.

There are four suits for each card: clubs, diamonds, hearts, and spades.

Thus, there are 12 total face cards: jack of clubs, jack of diamonds, ..., king of spades There are 52 total cards

$$P(\text{drawing a face card}) = \frac{12}{52}$$

$$P(\text{drawing a face card}) = \frac{3}{13}$$

Example 1

(d) The number of students in each class at a college is shown in the table below.

Freshmen	Sophomore	Junior	Senior
1670	2017	2975	3026

Find the probability that a randomly selected student is a sophomore.

Example 1

(d) The number of students in each class at a college is shown in the table below.

Freshmen	Sophomore	Junior	Senior
1670	2017	2975	3026

Find the probability that a randomly selected student is a sophomore.

Out of the 9,688 students attending the college, 2,017 of them are sophomores.

Example 1

(d) The number of students in each class at a college is shown in the table below.

Freshmen	Sophomore	Junior	Senior
1670	2017	2975	3026

Find the probability that a randomly selected student is a sophomore.

Out of the 9,688 students attending the college, 2,017 of them are sophomores.

$$P(\text{sophomore}) = \frac{2017}{9688}$$

Example 1

(e) The 36 possible sums from rolling 2 dice are shown below.

	1	**2**	**3**	**4**	**5**	**6**
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

What is the probability of rolling a sum of 7?

Example 1

(e) The 36 possible sums from rolling 2 dice are shown below.

	1	**2**	**3**	**4**	**5**	**6**
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

What is the probability of rolling a sum of 7?

$$P(\text{sum of } 7) = \frac{6}{36}$$

Example 1

(e) The 36 possible sums from rolling 2 dice are shown below.

	1	**2**	**3**	**4**	**5**	**6**
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

What is the probability of rolling a sum of 7?

$$P(\text{sum of } 7) = \frac{6}{36}$$

$$= \frac{1}{6}$$

Objectives

1. Determine the probability of an event

2. Find the experimental probability of an event

Types of Probability

In the previous examples, each outcome had an equal chance of being selected. This is referred to as **classical probability**.

Types of Probability

In the previous examples, each outcome had an equal chance of being selected. This is referred to as **classical probability**.

There are two other types of probability: experimental and subjective.

Experimental and Subjective Probabilities

Experimental Probability

Experimental probability is probability based on events that have actually occurred.

Experimental and Subjective Probabilities

Experimental Probability

Experimental probability is probability based on events that have actually occurred.

Subjective Probability

Subjective probability is probability based on opinion.

Example 2

Flip a coin 10 times and state the experimental probability of landing on tails.

Law of Large Numbers

As the number of events increases, the experimental probability of an event will approach the classical (a.k.a. *theoretical*) probability.

Rules of Probability

Rules of Probability Club:

Rules of Probability

Rules of Probability Club:

- Each probability must be a value between 0 and 1, inclusive.

Rules of Probability

Rules of Probability Club:

- Each probability must be a value between 0 and 1, inclusive.
  - A probability of 0 is an *impossible event*.

Rules of Probability

Rules of Probability Club:

- Each probability must be a value between 0 and 1, inclusive.
  - A probability of 0 is an *impossible event*.
  - A probability of 1 is a *certain event*.

Rules of Probability

Rules of Probability Club:

- Each probability must be a value between 0 and 1, inclusive.
  - A probability of 0 is an *impossible event*.
  - A probability of 1 is a *certain event*.
- The sum of all possible probabilities of a sample space must equal 1.