

STAT 2593

Lecture 005 - Sample Spaces and Events

Dylan Spicker

Sample Spaces and Events

Learning Objectives

1. Define probabilities in terms of sample spaces and events.
2. Understand the basic properties and operations on events.



What is Probability?

Probability refers to the study of *randomness* and *uncertainty*.

Uncertainty is central to the study of statistics.

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather
- ▶ The **sample space** is the collection of *all possible outcomes* for an experiment.

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather
- ▶ The **sample space** is the collection of *all possible outcomes* for an experiment.
 - ▶ Denoted as \mathcal{S}

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather
- ▶ The **sample space** is the collection of *all possible outcomes* for an experiment.
 - ▶ Denoted as \mathcal{S}
- ▶ An **event** is a specified collection of outcomes from an experiment.

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather
- ▶ The **sample space** is the collection of *all possible outcomes* for an experiment.
 - ▶ Denoted as \mathcal{S}
- ▶ An **event** is a specified collection of outcomes from an experiment.
 - ▶ Can be viewed as a subset of the sample space.

Statistical Experiments and Outcomes

- ▶ In statistics, we refer to an **experiment** as any action with an uncertain outcome.
 - ▶ Examples: tossing a coin, rolling a die, weighing material produced, giving a medical treatment, observing the weather
- ▶ The **sample space** is the collection of *all possible outcomes* for an experiment.
 - ▶ Denoted as \mathcal{S}
- ▶ An **event** is a specified collection of outcomes from an experiment.
 - ▶ Can be viewed as a subset of the sample space.
 - ▶ Whenever the outcome of an experiment is contained in the event, we say that the event occurred.

Properties and Operations on Events

- ▶ Take $A, B \in \mathcal{S}$ to be events of interest.

Properties and Operations on Events

- ▶ Take $A, B \in \mathcal{S}$ to be events of interest.
- ▶ The **complement** of A , denoted as A^C , is the event that A does not occur (i.e., everything in \mathcal{S} not in A).

Properties and Operations on Events

- ▶ Take $A, B \in \mathcal{S}$ to be events of interest.
- ▶ The **complement** of A , denoted as A^C , is the event that A does not occur (i.e., everything in \mathcal{S} not in A).
- ▶ The **union** of A and B , denoted $A \cup B$, is the set of all outcomes in A , B , or both.

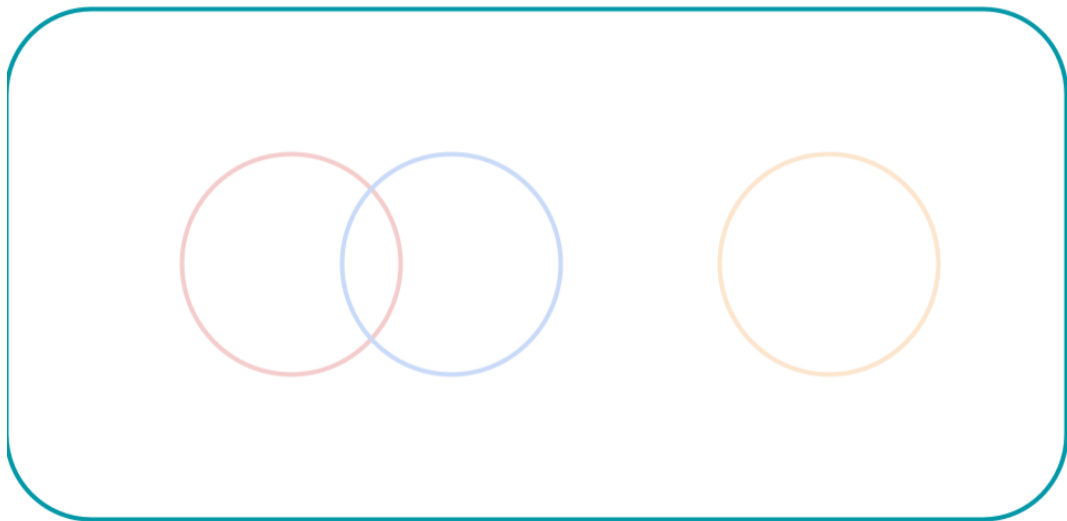
Properties and Operations on Events

- ▶ Take $A, B \in \mathcal{S}$ to be events of interest.
- ▶ The **complement** of A , denoted as A^C , is the event that A does not occur (i.e., everything in \mathcal{S} not in A).
- ▶ The **union** of A and B , denoted $A \cup B$, is the set of all outcomes in A , B , or both.
- ▶ The **intersection** of A and B , denoted $A \cap B$, is the set of all outcomes in **both** A and B .

Properties and Operations on Events

- ▶ Take $A, B \in \mathcal{S}$ to be events of interest.
- ▶ The **complement** of A , denoted as A^C , is the event that A does not occur (i.e., everything in \mathcal{S} not in A).
- ▶ The **union** of A and B , denoted $A \cup B$, is the set of all outcomes in A , B , or both.
- ▶ The **intersection** of A and B , denoted $A \cap B$, is the set of all outcomes in **both** A and B .
 - ▶ If $A \cap B = \emptyset$ (the **empty set**), we say that they are **mutually exclusive** or **disjoint**.

Venn Diagrams



Summary

- ▶ Probability is the study of randomness and uncertainty.
- ▶ A statistical experiment is any action with an uncertain outcome.
- ▶ The sample space contains all possible outcomes, and events are subsets of the sample space.
- ▶ The basic operations on events include taking complements, unions, and intersections.