

Probability: Sample Spaces and Events

MATH 3342
Section 2.1

Probability

- The study of randomness and *uncertainty*.
- Important for inferential statistics because random sampling results in *uncertainty*.
- Two random samples from the same population may likely have two different sample means!
 - Probability helps us understand how to work with this.

Experiments

- Also called random processes.
- Exhibit **chance behavior**:
 - Individual outcomes are uncertain, but there is a regular distribution in a large number of repetitions.
 - **Unpredictable in the short-run**, but produce a predictable pattern in the long-run.

Outcomes

- The most basic possible results from random processes.
- Examples:
 - Rolling a 1 on a die.
 - Flipping a head on a coin.
 - Drawing the 2 of diamonds from a deck of cards.

Events

- Outcomes or a collection of outcomes that share some property of interest.
 - **Simple events:** consist of one outcome
 - **Compound events:** consists of more than one outcome
- Examples:
 - Rolling an odd number.
 - Flipping exactly two heads on four coin tosses.
 - Drawing a heart from a deck of cards.

The Sample Space S

- The set of *all* possible outcomes of a random process.
- Events are *subsets* of the sample space S .

Example

- Describe the sample space S :
- A new business is started. After two years, it is either still in business or it has closed.

Example

- Describe the sample space S :
- A rust prevention treatment is applied to a new car. The response variable is the length of time before rust begins to develop on the vehicle.

Example

- Describe the sample space S :
- A quality inspector examines four mp3 players and rates each as either **acceptable** or **unacceptable**.
You record the sequence of ratings.

Example

- Describe the sample space S :
- A quality inspector examines four mp3 players and rates each as either **acceptable** or **unacceptable**.
You record the number of units rated **acceptable**.

Important Relationships from Set Theory

- Complements
- Unions
- Intersections

Complements

- The **complement** of event A is the set of all outcomes in S that are not contained in A .
- The event that A does *not* occur
- Denoted by A' .

Unions

- The **union** of A and B is the event consisting of the outcomes that are *either in A or B or in both*.
- Denoted by $A \cup B$
- Read as “ A or B ”

Intersections

- The **intersection** of events A and B is the event consisting of all outcomes that are in *both A and B* .
- Denoted by $A \cap B$
- Read as “ A and B ”

The Null Set

- The event consisting of no outcomes.
- Also called the null event.
- Denoted by \emptyset
- If $A \cap B = \emptyset$, the events are said to be **disjoint** or **mutually exclusive**.