Section 6.1: Experiments, Events, and Sample Spaces

An **experiment** is an activity with observable results (outcomes).

A **sample point** is an outcome of an experiment.

A **sample space** is a set consisting of all possible sample points of an experiment.

A **Finite Sample Space** is a sample space with finitely many outcomes.

An **event** is a subset of a sample space of an experiment.

Given two events, E and F:

The **union** of E and F is denoted by $E \cup F$.

The **intersection** of E and F is denoted by $E \cap F$.

If $E \cap F = \emptyset$ then E and F are called **mutually exclusive**. (An event is mutually exclusive also means that two events that cannot happen at the same time, such as getting a head and a tail on the same toss of a coin).

The **complement** of an event is $E^c$ and is the set of all outcomes in a sample space that is not in E.

**Example 1:** Consider the experiment of tossing a die.

a. Describe the sample space, S, of this experiment.

$$S = \{1, 2, 3, 4, 5, 6\}$$

b. Let E be the event that an even number is tossed and F be the event that a prime number is tossed. Describe E and F in set notation then find the following:

$E = \{2, 4, 6\}$

$F = \{2, 3, 5\}$

$E \cup F = \{2, 3, 4, 5, 6\}$

$E \cap F = \{2\}$

$E^c = \emptyset$

$\overline{(E \cup F)^c} = \{1, 3, 5\}$

Apply De Morgan’s Law:

$E^c \cap F = \{1, 3, 5\}$

$\{1, 3, 5\} \cap \{2, 3, 5\} = \{3, 5\}$
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Example 2: A sample of 3 apples taken from a fruit stand is examined to determine whether they are good or rotten. The sample space $S = \{GGG, GGR, GRG, GRR, RGG, RGR, RRG, RRR\}$. Let $E$ be the event that at least 1 apple is good and let $F$ be the event that exactly 2 apples are rotten. Find the events.

$E = \{GGG, GGR, GRG, GRR, RGG, RGR, RRG\}$

$F = \{GRG, RGG, RGR, RRG\}$

Example 3: An experiment consists of selecting a letter at random from the letters in the word COMMUNICATION and observing the outcomes.

a. What is an appropriate sample space for this experiment?

$S = \{C, O, M, U, N, t, A, T\}$

b. Describe the event “the letter selected is a vowel.”

$E = \{O, U, I, A\}$

Example 4: Describe a sample space associated with the experiment of tossing 2 fair coins.

$S = \{H, H, H, T, T, H, T, T\}$

Describe the event of having the same outcome on each coin.

$E = \{H, H, T, T\}$