

## Section 7.1 – Experiments, Sample Spaces, and Events

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:

$$E = \{2, 4, 6\} \quad F = \{1, 2, 3, 5\}$$

How many points are there in the sample space corresponding to the selection of events E or F?

$$n(E \cup F) = \{1, 2, 3, 4, 5, 6\} = 6$$

How many points are there in the sample space corresponding to the selection of events E and F?

$$n(E \cap F) = \{2\} = 1$$

**Example 2:** A sample of 3 apples taken from a fruit stand. They are 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 2 apples are good and let  $F$  be the event that exactly 2 are rotten. What are the selections that contain at least two good apples and exactly two rotten apples?

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

$$F = \{ (GRR), (RGR), (RRG) \}$$

$$E \cap F = \emptyset$$

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

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

$$S = \{ D, A, L, S \}$$

- b. Describe the event "the letter selected is a vowel."

$$V = \{ A \}$$

**Example 4:** The experiment is tossing two coins a dime and a nickel.

- a. What is the sample space for this experiment?

$$S = \{ (D,H), (D,T), (N,H), (N,T) \}$$

- b. Describe the event that the coin tossed is a dime.

$$D = \{ (D,H), (D,T) \}$$

- c. Describe the event that the coin tossed is a nickel and a tail.

$$N = \{ (N,T) \}$$

**Example 5:** At the library a patron is trying to pick 2 books out of 4 to check-out to take home to read.

- a. Describe the sample space of the outcomes (order does not matter). Use books numbered 1, 2, 3, 4

$$C(4,2) = 6$$

$$S = \{(1,2) (2,3) (3,4), (4,1) (1,3) (2,4)\}$$

- b. How many sample points have the selections have book 2?

$$E = \{(1,2) (2,3), (2,4)\}$$

- c. How many sample points have books 2 or 3?

$$F = \{(1,2) (2,3) (3,4) (1,3) (2,4)\}$$