3.1 Terminology

Learning Objective:

In this section, you will:
• Understand the fundamentals of probability

Probability is a number between zero and one, inclusive, that gives the likelihood that a specific event will occur.
• The probability of any outcome is the long-term relative frequency of that outcome.
• P(A) = 0 means the event A can never happen.
• P(B) = 1 means the event B is certain to happen.
• P(C) = 0.5 means that event C is equally likely to happen or not happen.

An **experiment** is a planned activity carried out under controlled conditions.

An **outcome** is particular result of an experiment.

The **sample space** is the set of all possible outcomes of an experiment.

An **event** is a collection of results or outcomes of an experiment.

Equally likely means that each outcome of an experiment has the same probability.

To calculate the probability of an event A when all outcomes in the sample space are equally likely, count the number of outcomes for event A and divide by the total number of outcomes in the sample space.

Notation:
• P represents a probability
• A, B, and C represent specific events
• P(A) represents the probability of event A occurring
• P(A) = (number of outcomes for event A)/ (total number of outcomes in the sample space)

The **law of large numbers** states that as the number of repetitions of an experiment is increased, the relative frequency obtained in the experiment tends to become closer and closer to the theoretical probability.

Example 1

Roll a standard six-sided die once.

Sample space: S =

Identify each of the following events with a subset of S and compute its probability.

a. Event A = Roll an even number

b. Event B = Roll a number larger than 4

c. Event C = Roll a 2

d. Event D = Roll a 9

e. Event E = Roll number less than 10

The **complement** of event A consists of all outcomes that are **NOT** in A. Which is denoted as A′ (read "A prime") or $\bar{A}$.

P(A')= P(B')= P(C') =

Notice that P(A) + P(A′) = 1.

"OR" Event

An outcome is in the event **A OR B** if the outcome is in A or is in B or is in both A and B

Example 2: let A = {1, 2, 3, 4, 5} and B = {4, 5, 6, 7, 8}.

A OR B =

"AND" Event

An outcome is in the event **A AND B** if the outcome is in both A and B at the same time.

Example 3: let A and B be {1, 2, 3, 4, 5} and {4, 5, 6, 7, 8}.

A AND B =

“GIVEN” Event

The conditional probability of A given B is written P(A|B). P(A|B) is the probability that event A will occur given that the event B has already occurred. A conditional reduces the sample space. We calculate the probability of A from the reduced sample space B.

Example 4: Suppose we toss one fair, six-sided die. The sample space S = {1, 2, 3, 4, 5, 6}. Let A = face is 2 or 3 and B = face is even (2, 4, 6).

A GIVEN B =

Mutually Exclusive Events

A and B are mutually exclusive events if they cannot occur at the same time. This means that A and B do not share any outcomes.

Example 5: Suppose the sample space S = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. Let A = {1, 2, 3, 4, 5}, B = {4, 5, 6, 7, 8}, and C = {7, 9}.

A AND B =

A AND C =

For more information and examples see online textbook OpenStax Introductory Statistics pages 176- 180.

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