25

PROBABILITY

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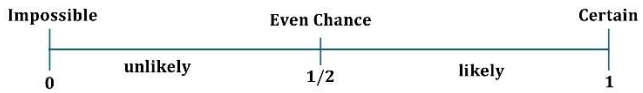
Probability is a measure of the likelihood that an event will occur, represented on a scale from 0 to 1. A probability close to 0 suggests unlikelihood, while a probability close to 1 suggests near certainty (Figure 25.1). Probability is a mathematical tool used to study and predict outcomes, such as the chance of rain, winning a bet, exam success, or financial gains like increased share prices or return on investment (ROI).

Figure 25.1 Probability Scale



NOTE:

- An experiment is a process or procedure that generates outcomes (e.g., flipping a coin, rolling dice, conducting surveys, or running scientific trials).
- Events are specific outcomes from a probability experiment, usually denoted by capital letters (e.g., A). Examples of events include rolling a six on a die, drawing a red card from a deck of cards, or getting heads when flipping a coin.
- The probability of an event (A) is represented as $P(A)$.
- The probability of an event not occurring (A^C) is found by subtracting the probability of A from 1: $1-P(A)$.

PROBABILITIES

There are three approaches of assigning probabilities: classical, relative frequency, and subjective methods.

Method	*Explanation*
Classical method	The classical method is appropriate when all the outcomes are equally likely to occur. If N outcomes are possible, a probability of **1/N** is assigned to each outcome.

	An example of the classical method is rolling a die because it is equally likely that you will land on any of the 6 numbers on the die: 1, 2, 3, 4, 5, or 6. Another example is a coin toss because it is equally likely that your toss will yield a heads or tails.
Relative frequency	The relative frequency method is appropriate when an experiment is repeated a large number of times and a particular outcome occurs a percentage of the time. Then that particular percentage is the probability of that outcome. For example, if a company produces 100,000 phones in a year, and 1,000 of those phones are defective, the probability of that company producing a defective phone is approximately 1,000 out of 100,000, or 0.01. The probability of an event occurring is therefore given by: $$\boldsymbol{P(\text{event}) = \frac{\text{Number of successful outcomes}}{\text{Total number of possible outcomes}}}$$
Subjective method	The subjective method is based on opinion, previous experience or intuition. After considering all available information, a probability value that shows your degree of belief (on a scale from 0 to 1) that the outcome will occur is specified.

Irrespective of the method used, there are two basic requirements for assigning probabilities:

a) The probability assigned to each outcome must be between 0 and 1.
b) The sum of the probabilities for all the outcomes must equal 1.

☑ EXAMPLE 25.1

Consider the toss of a coin; the two outcomes are head and tail. What is the probability for each outcome?

SOLUTION**tips**

The two outcomes are equally likely: classical probability.
Thus, the probability of observing a head is ½ (or 0.50).
Similarly, the probability of observing a tail is also ½ (or 0.50).

☑ EXAMPLE 25.2

A student records the number of his designer accessories and obtains the following results.

Designer Label	Gucci	Prada	Chanel	Burbery	Rolex	Coach
Accessories	2	10	7	8	2	1

Suppose the student wants to randomly choose one of these accessories to wear. What is the probability that the accessory chosen will be (a) Prada (b) Rolex

SOLUTION**tips**

a) By the relative frequency method, the probability of choosing Prada is

$$P(\text{Prada}) = \frac{\text{Number of Prada accessories}}{\text{Total number of accessories}} = \frac{10}{30} = \frac{1}{3} = 0.33$$

b) The probability of choosing Rolex is

$$P(\text{Rolex}) = \frac{\text{Number of Rolex accessories}}{\text{Total number of accessories}} = \frac{2}{30} = \frac{1}{15} = 0.07$$

☑ EXAMPLE 25.3

What is the probability of rolling a sum of 10 with two dice?