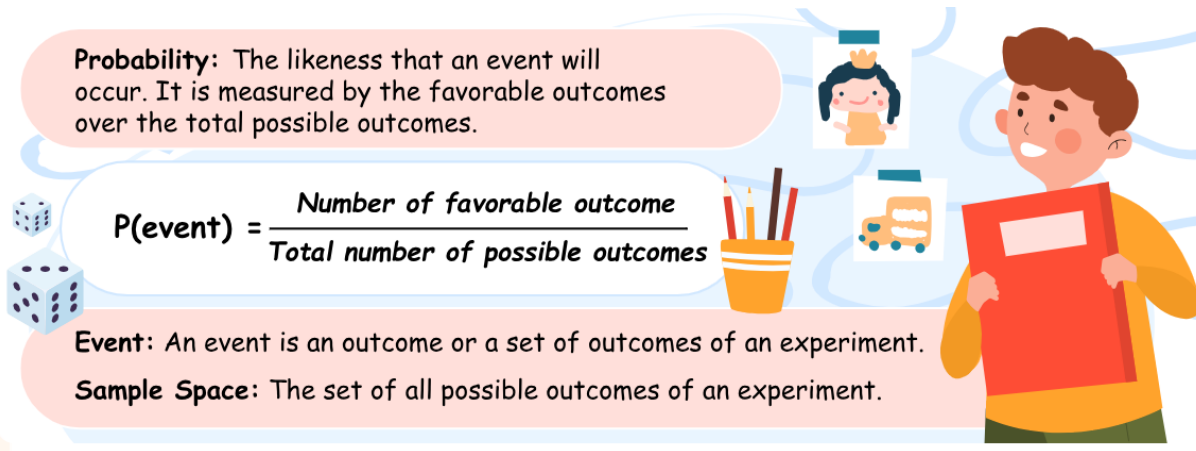


Chapter 3: Probability Topics

3.1: Terminology

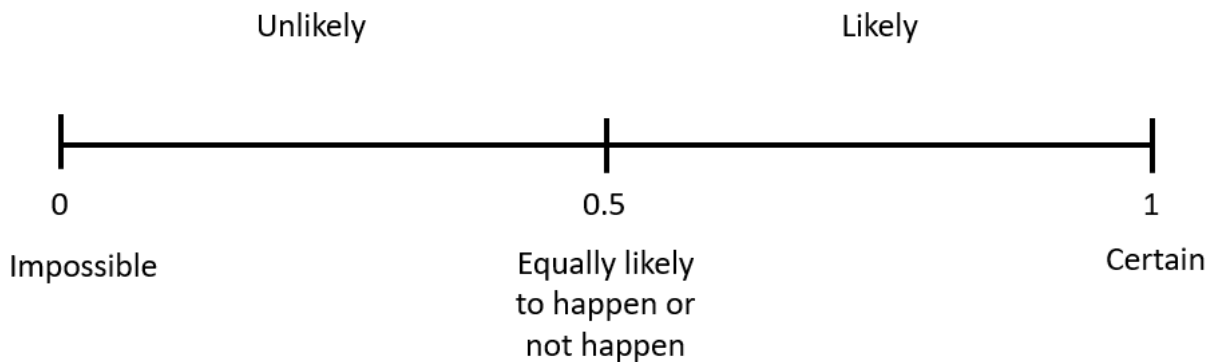


Probability: The likeness that an event will occur. It is measured by the favorable outcomes over the total possible outcomes.

$$P(\text{event}) = \frac{\text{Number of favorable outcome}}{\text{Total number of possible outcomes}}$$

Event: An event is an outcome or a set of outcomes of an experiment.
Sample Space: The set of all possible outcomes of an experiment.

- **Outcome** - the result of an experiment
- **Event** - any combination of outcomes
- **Sample Space** - the set of all possible outcomes of an experiment
- **Probability** - a long-term relative frequency of an outcome whose value is between zero and one, inclusive $0 \leq P(\text{event}) \leq 1$
 - A probability of zero means that the event is **impossible** (0% chance of happening)
 - A probability of one means that the event is **certain to occur** (100% chance)



- **Equally Likely** - when each outcome of an experiment occurs with equal probability.
 - In a fair, six-sided die, it is equally likely to roll any of the numbers one through six.

$$P(1) = P(2) = P(3) = P(4) = P(5) = P(6) = \frac{1}{6} \quad P(\text{event}) = \frac{\text{number of correct choices}}{\text{total number of choices}}$$
 - In a fair coin, it is equally likely to get heads and tails.

$$P(\text{heads}) = P(\text{tails}) = \frac{1}{2}$$
- The **complement** of event, A , denoted A' , is the set of outcomes **not** in A .

$$P(A) + P(A') = 1 \quad \text{or} \quad P(A') = 1 - P(A)$$
- The **conditional probability** of A given B , denoted $P(A|B)$, is the probability that event A will occur given that event B has already occurred.

3.2: Independent and Mutually Exclusive Events

- Two events are **independent** if the knowledge that one occurred does not affect the chance the other occurs. Mathematically, this means that $P(A|B) = P(A)$.
- Sampling **with replacement** means that members of the population are replaced after being selected and that each member can be chosen more than once. (known as **independent** sampling because the result of the second pick **is not** affected by the first pick).
- Sampling **without replacement** means that members of the population are not replaced after being selected and that each member cannot be chosen more than once. (known as **dependent** sampling because the result of the second pick **is** affected by the first pick).
- **Mutually exclusive** events cannot occur at the same time, meaning that they share no common outcomes and $P(A \text{ and } B) = 0$.

Example 1. Events A , B , and C are all equally likely and mutually exclusive.

(a) Find $P(A)$.

(b) Find $P(A')$.

(c) Find $P(A \text{ and } B)$.

3.3: Two Basic Rules of Probability

- The **multiplication rule** - the probability of two events both happening, $P(A \text{ and } B)$, is equal to $P(A)P(B|A)$.

The Multiplication Rule for Independent Events:
If events A and B are independent, then $P(A \text{ and } B) = P(A) * P(B)$.

- The **addition rule** - the probability of either one of two events happening, $P(A \text{ or } B)$, is equal to $P(A) + P(B) - P(A \text{ and } B)$.

The Addition Rule for Mutually Exclusive Events:
If events A and B are mutually exclusive, then $P(A \text{ or } B) = P(A) + P(B)$.

Example 2. A spinner has 4 equal sectors colored yellow, blue, green, and red.



- (a) What is the probability the spinner lands on yellow?
- (b) What is the probability the spinner lands on red or blue?
- (c) What is the probability the spinner does NOT land on green?