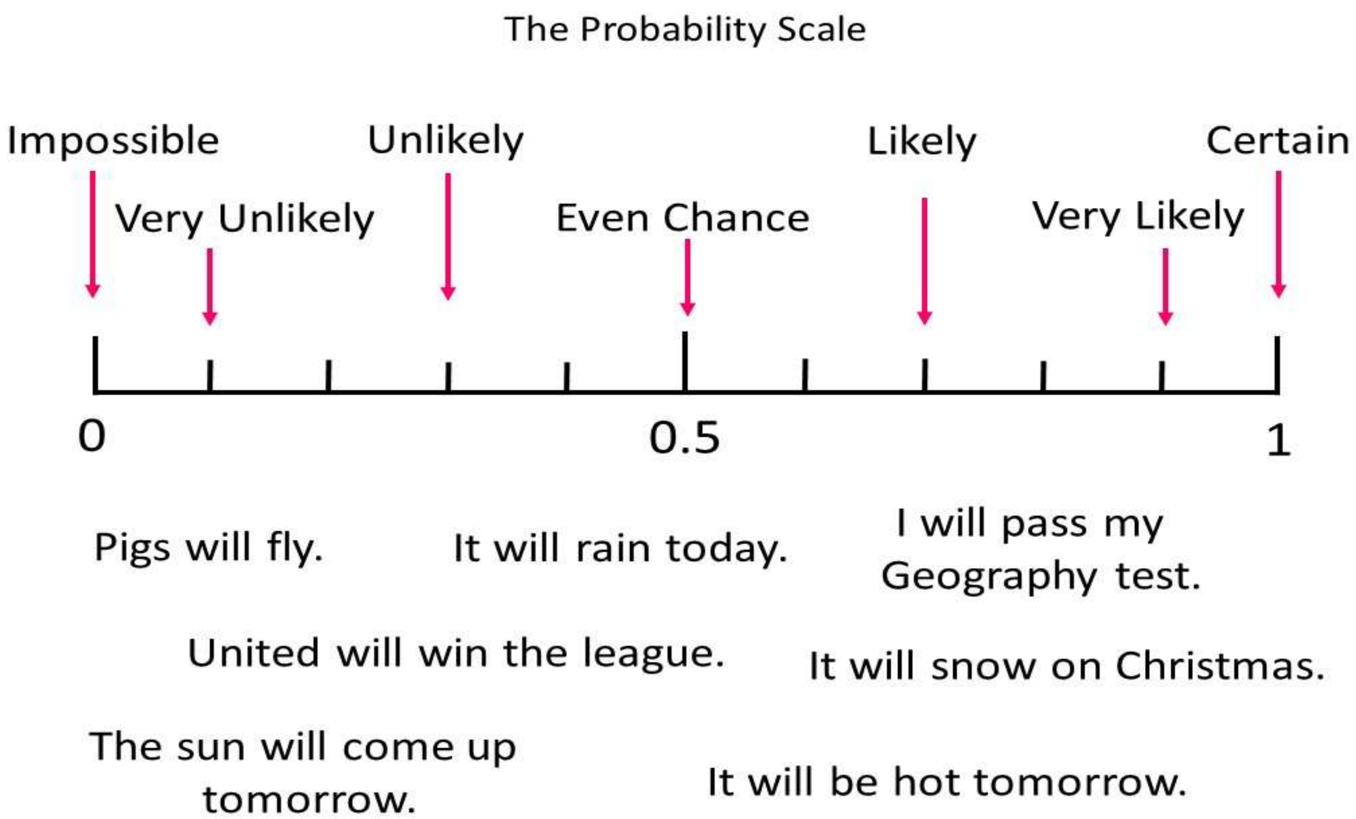
Probability basics

Probability scale



Basic Definitions

- **EXPERIMENT:** In the study of probability, any process of observation is referred to as experiment. The results of an observation are called the outcomes of an experiment.

- **RANDOM EXPERIMENT:** An experiment whose outcome is not known in certainty is known as random experiment.

  Example: Tossing a coin, throwing a die are random experiments.

- **TRIAL & EVENT:** An experiment which is repeated under essentially identical conditions to get some results, is known as a trial and the results are known as outcomes or events.

  Example: Tossing a coin is a trial and getting head or tail is an event.

Basic Definitions

- **EXHAUSTIVE EVENTS:** The total number of possible outcomes in any trial is known as exhaustive events.

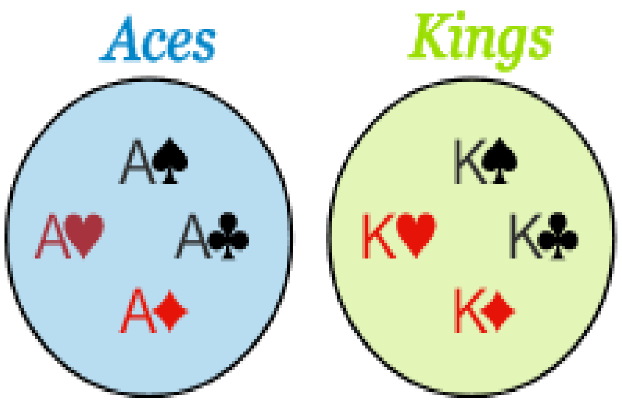
Example: In throwing a die, there are 6 exhaustive cases namely 1,2,3,4,5 and 6.

- **FAVOURABLE EVENTS:** The number of cases favourable for the occurrence of an event in a trial is known as favourable events.

Example: In a throw of a die, the number of cases favourable to get an even number is 3 as there are 3 even numbers namely 2,4 and 6 in a die.

Mutually Exclusive Events/ Disjoint Events:

- Two events are said to be mutually exclusive or incompatible, if the happening of one event prevents the happening of the other event.
- **Example:** In a tossing of a coin, the events head and tail are mutually exclusive events.



INDEPENDENT EVENTS

- Two events are said to be independent, if the happening of one event does not affect the happening of the other event.
- **Example:** In tossing 2 coins, getting head in first coin is independent of getting tail in the second coin.

Mutually Exclusive & Independent Events

$$P(A \text{ and } B) = P(A) \times P(B)$$

Independent

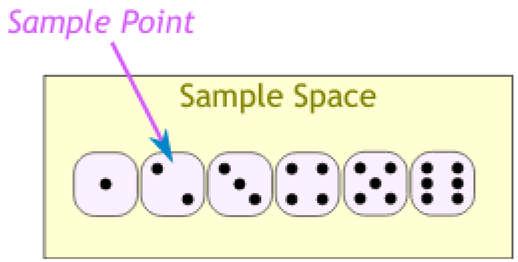
$$P(A \text{ or } B) = P(A) + P(B)$$

Mutually Exclusive

Probability

- **SAMPLE SPACE (S):** The set of all possible outcomes of a random experiment is called sample space.

  Example: The sample space in a toss of a coin is $S = \{H.T\}$.



- **PROBABILITY:** The chance of occurrence of an event in a random experiment is said to be probability.

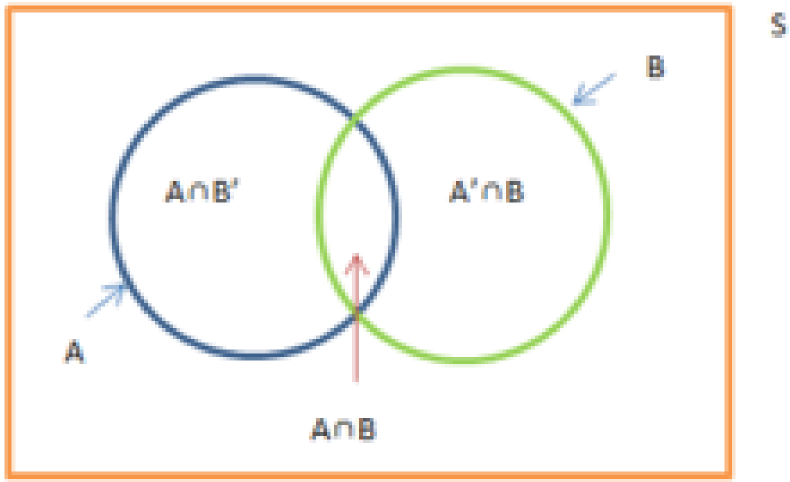
- **Definition:** Let *S* be the sample space and *A* be an event with a random experiment. Let $n(S)$ and $n(A)$ be the number of elements of *S* and *A*. Then the probability of event *A* occurring is defined by $P(A) = \frac{n(A)}{n(S)} = \frac{\text{number of cases favourable to } A}{\text{exhaustive number of cases in } S}$

Axioms Of Probability:

- Let S be the sample space and A be an event with a random experiment. Then the probability of event A , denoted by $p(A)$ is defined as a real number satisfying the following axioms.
  - $0 \leq P(A) \leq 1$
  - $P(S) = 1$
  - If $A_1, A_2, \cdots, A_n$ are mutually exclusive and exhaustive events then $P(A_1 \cup A_2 \cup \cdots \cup A_n) = P(A_1) + P(A_2) + \cdots + P(A_n)$

Addition Theorem

If A and B are any two events in a sample space S, then $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

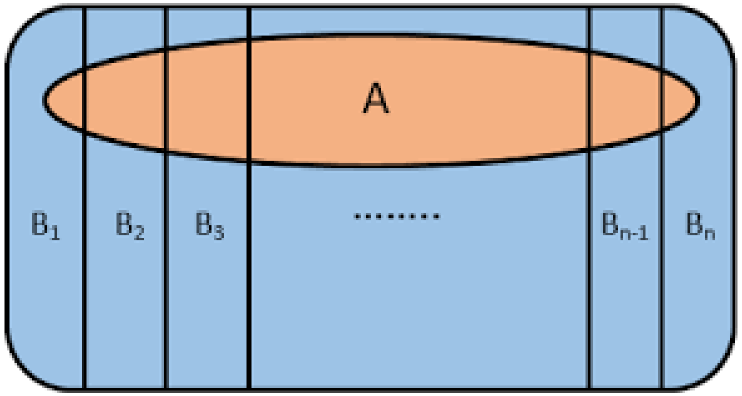


Multiplication Theorem / Conditional Probability

- The probability of an event B after the occurrence of an event A, is said to be conditional probability of B over A and is given by
- $P(B/A) = \frac{P(A \cap B)}{P(A)}$, provided $P(A) \neq 0$
- => $P(A \cap B) = P(B/A).P(A)$

TOTAL PROBABILTY OF AN EVENT

- If $B_1, B_2, \cdots, B_n$ are mutually exclusive and exhaustive events of a sample space S and A is any event in S, then
- $P(A) = P(A/B_1).P(B_1) + P(A/B_2).P(B_2) + \cdots + P(A/B_n).P(B_n).$
- The probability of event A, that is $P(A)$ is called the total probability of event A.



BAYE'S THEOREM

- If $A_1, A_2, \cdots, A_n$ are mutually exclusive and exhaustive events of a sample space S such that $P(A_i) > 0$ for $i = 1,2, \ldots, n$ and B is any event in S, such that $P(B) > 0$ then
- $P(A_i/B) = \frac{P(A_i).P(B/A_i)}{P(B)}$

Thank you