Introduction to Probability

Adejumo Ridwan Suleiman

Why Probability?

Why Probability

- Make inference from data.
- Check for the significance of our statistic.

Why Probability

- Imagine a pharmaceutical company that developed a new vaccine to prevent a viral infection.
- Before release, it is important to if it is safe and effective.
- Probability makes it easy to quantify the uncertainty of the data.
- Probability let’s us know factors that might influence a patients resistance.
- The more factors controlled in the trial, the more accurate the probability estimate is.

Defining Probability

What is Probability?

- This is a measure of the likelihood or uncertainty of an event.
- Probability ranges from **0** to **1**.

Ways of Defining Probability.

- Classical Probability
- Empirical Definition
- Subjective Definition

Classifcal Probability

- This is probability gotten from prior information, where all outcomes are equally likely to occur.
- Examples:
  - Rolling a fair die ().
  - Flipping a fair coin ().

$$\frac{1}{2}$$

Empirical Probability

- This is based on actual observations or experiments.
- Measures the likelihood of an event through trials.
- Examples:
  - Weather Forecasting.
  - Sports Peformance
  - Traffic Accidents

Subjective Probability

- This is probability based on personal judgement.
- Examples:
  - Medical Diagnosis
  - Business Decisions

Terms and Definintions

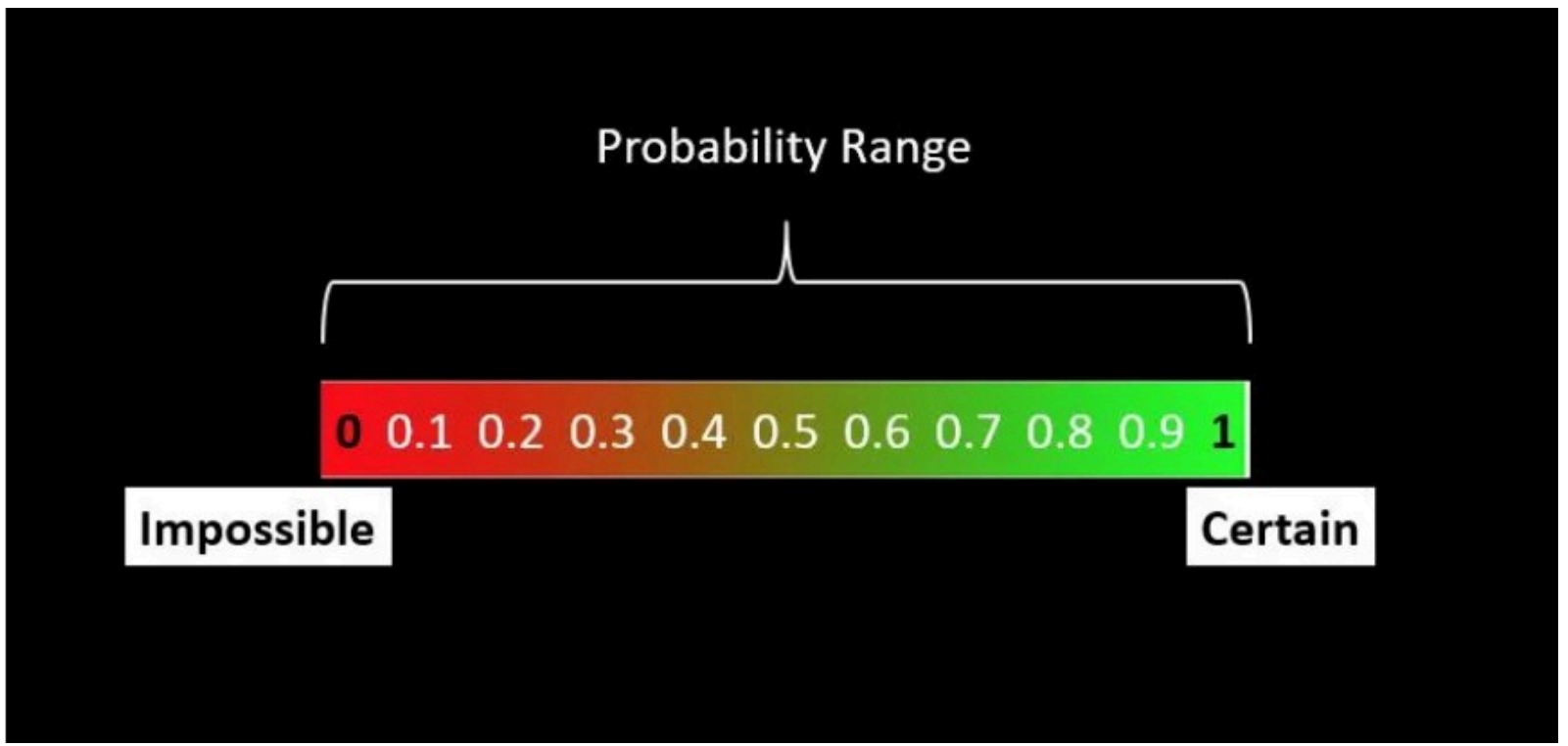
Terms and Definitions

- **Experiment** - Any process which when repeated generates a set of observed results.
- **Trial** - Act of conducting an experiment.
- **Outcome** - The result of a trial.
- **Sample Space** - Totality of all possible outcomes of an experiment.
- **Equally Likely** - All outcomes of an experiment having the same chance of occurence.

Events

Probability Values

- **0** - means an event did not take place.
- **1** - means the event is sure to take place



Source: Medium

Complement of an event

- This is an event that occurs when the other event fails.
- If the probability of surviving an epidemic is **0.65**, then the probability of dying from the epidemic is

$$1 - 0.65 = 0.35$$

Notations

- Intersection (**and**) - $A \bigcap B$
- Union (**or**) - $A \bigcup B$

Types of Probability

Types of Probability

- Joint Probability of an event is $P(A \bigcap B)$.
  - If $P(A \bigcap B) = 0$, A and B are mutually exclusive.
- Conditional probability of an event A is given as.

$$P(A/B) = \frac{P(A \bigcap B)}{P(B)}$$

  - If $P(A \bigcap B) = 0$, the two events are mutually exclusive.
  - If $P(A/B) = P(A)$, if the events are independent.
  - $P(A)$ and $P(B)$ are known as the marginal probabilities of an event A and event B.

Additions and Multiplication Rule of Probability

Additions rule for multually exclusive events

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

- When the events are mutually exclusive,

$$P(A \bigcup B) = P(A) + P(B) - P(A \bigcap B)$$

$$P(A \text{ and } B) = 0$$

Multiplication rule for independent events

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

$$P(A \bigcap B) = P(A) \cdot P(B)$$