

Probability

Introduction

Probability is the branch of mathematics that measures the **chance of an event occurring**. It helps predict the likelihood of different outcomes and is widely used in statistics, science, economics, games, weather forecasting, medicine, and everyday decision-making.

Random Experiment

Meaning

A **Random Experiment** is an experiment whose exact outcome cannot be predicted in advance, although all possible outcomes are known.

Examples:

- Tossing a coin
 - Rolling a dice
 - Drawing a card from a deck
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Sample Space

Definition

The **Sample Space (S)** is the set of all possible outcomes of a random experiment.

Examples:

- Coin Toss: $S = \{H, T\}$
 - Rolling a Dice: $S = \{1, 2, 3, 4, 5, 6\}$
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Event

What is an Event?

An **Event** is a collection of one or more outcomes from the sample space.

Types of events include:

- Simple Event
 - Compound Event
 - Certain Event
 - Impossible Event
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Probability of an Event

Basic Formula

The probability of an event **E** is:

$$P(E) = \text{Number of favourable outcomes} / \text{Total number of possible outcomes}$$

The value of probability always lies between **0 and 1**.

- $P(E) = 0 \rightarrow$ Impossible event
 - $P(E) = 1 \rightarrow$ Certain event
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Properties of Probability

Important Properties

- $0 \leq P(E) \leq 1$
- $P(S) = 1$
- $P(\emptyset) = 0$
- $P(E') = 1 - P(E)$, where **E'** is the complement of **E**.

These properties are useful in solving probability problems.

Types of Events

Classification

Some important types of events are:

- Equally Likely Events
- Mutually Exclusive Events
- Independent Events
- Dependent Events
- Complementary Events

Understanding these events helps in calculating probabilities correctly.

Addition and Multiplication Rules

Probability Rules

For two events **A** and **B**:

- **Addition Rule:** Used to find the probability of either event occurring.
- **Multiplication Rule:** Used to find the probability of both events occurring together.

These rules are useful for solving complex probability questions.

Applications of Probability

Importance

Probability is used in:

- Statistics
 - Weather Forecasting
 - Insurance
 - Medical Research
 - Finance
 - Artificial Intelligence
 - Games and Sports
 - Risk Analysis
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Key Points

- Probability measures the chance of an event occurring.
 - A random experiment has uncertain outcomes.
 - Sample space contains all possible outcomes.
 - Probability ranges from **0 to 1**.
 - **$P(S) = 1$** and **$P(\emptyset) = 0$** .
 - Complement of an event is **$1 - P(E)$** .
 - Probability is widely used in science, business, and daily life.
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Chapter Summary

This chapter introduces the concept of probability and explains random experiments, sample space, events, and the probability of an event. It also covers the basic properties of probability, different types of events, and the addition and multiplication rules. Probability is an essential mathematical tool for analyzing uncertainty and making informed decisions in various fields such as science, finance, engineering, medicine, and statistics.