

Permutation and Combination

Introduction

Permutation and Combination is an important branch of mathematics that deals with **counting, arranging, and selecting objects**. It helps solve problems involving the number of possible arrangements or selections and has applications in probability, statistics, computer science, and everyday life.

Fundamental Principle of Counting

Basic Counting Rule

The **Fundamental Principle of Counting** states that if one event can occur in **m** ways and another independent event can occur in **n** ways, then both events together can occur in:

m × n ways.

This principle forms the basis of permutations and combinations.

Factorial Notation

Factorial of a Number

The **factorial** of a positive integer **n** is denoted by **n!**.

It is defined as:

$$n! = n \times (n - 1) \times (n - 2) \times \dots \times 2 \times 1$$

Important facts:

- **0! = 1**
- **1! = 1**

Factorials are widely used in counting formulas.

Permutation

Arrangement of Objects

A **Permutation** is an arrangement of objects in a **specific order**.

Here, **order is important**.

The number of permutations of **r** objects selected from **n** distinct objects is:

$${}^n P_r = n! / (n - r)!$$

When all **n** objects are arranged:

$$n!$$

Types of Permutations

Common Types

Some important types are:

- **Permutation of Distinct Objects**
- **Permutation with Repetition**
- **Circular Permutation**

In a **circular permutation**, the number of arrangements of **n** distinct objects is:

$$(n - 1)!$$

Combination

Selection of Objects

A **Combination** is the selection of objects where **order does not matter**.

The number of combinations of **r** objects selected from **n** distinct objects is:

$${}^n C_r = n! / [r!(n - r)!]$$

Difference Between Permutation and Combination

Comparison

- **Permutation:** Arrangement of objects where **order matters**.
- **Combination:** Selection of objects where **order does not matter**.

Example:

Choosing a **captain and vice-captain** is a permutation because positions matter.

Choosing **two team members** is a combination because order does not matter.

Relationship Between Permutation and Combination

Formula

Permutation and Combination are related by:

$${}^n P_r = {}^n C_r \times r!$$

This formula is useful for converting between the two.

Applications of Permutation and Combination

Importance

Permutation and Combination are used in:

- Probability
 - Statistics
 - Computer Science
 - Cryptography
 - Scheduling
 - Selection and arrangement problems
 - Daily life decision-making
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Key Points

- Counting begins with the Fundamental Principle of Counting.
 - **Factorial (n!)** is used in all counting formulas.
 - In **Permutation**, order is important.
 - In **Combination**, order is not important.
 - Circular permutations use **(n – 1)!**.
 - ${}^n P_r = {}^n C_r \times r!$
 - These concepts are essential for probability and higher mathematics.
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Chapter Summary

This chapter introduces the Fundamental Principle of Counting, factorial notation, permutations, and combinations. A permutation refers to the arrangement of objects where order is important, while a combination refers to the selection of objects where order does not matter. The chapter also explains the relationship between permutations and combinations and their applications in mathematics, statistics, computer science, and real-life problem-solving.