📘 Class 12 Mathematics – Chapter: Probability

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1. Introduction

- Probability is the branch of mathematics that deals with the likelihood of the occurrence of events.
- Extends basic concepts to **conditional probability**, **independent events**, **Bayes' Theorem**, and **random variables**.

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2. Important Terms

- **Experiment**: An operation that gives some outcome.
- **Sample Space (S)**: Set of all possible outcomes.
- **Event**: A subset of the sample space.
- **Equally Likely Events**: Events with the same probability of occurring.
- **Mutually Exclusive Events**: Events that cannot happen at the same time.
- **Exhaustive Events**: Events that cover the entire sample space.

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3. Conditional Probability

- **Definition**:
  $P(A|B) = \frac{P(A \cap B)}{P(B)}$, provided $P(B) > 0$

- Describes the probability of event A **given** that event B has occurred.

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4. Independent and Dependent Events

- **Independent Events**: $P(A \cap B) = P(A) \cdot P(B)$

- If A and B are independent, then the occurrence of one **does not** affect the other.

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5. Multiplication Theorem

- For any two events A and B:
  $P(A \cap B) = P(A) \cdot P(B|A) = P(B) \cdot P(A|B)$

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6. Total Probability Theorem

- If $B_1, B_2, \dots, B_n$ are mutually exclusive and exhaustive:
  $P(A) = \sum_{i=1}^{n} P(B_i) \cdot P(A|B_i)$

7. Bayes' Theorem

Used to find the probability of an underlying cause given an outcome:

$$P(B_i|A) = \frac{P(B_i) \cdot P(A|B_i)}{\sum P(B_j) \cdot P(A|B_j)}$$

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8. Random Variables

- A **random variable** assigns numerical values to outcomes of a random experiment.
- **Probability distribution** lists values of the variable and their probabilities.

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9. Expected Value (Mean)

- $E(X) = \sum x \cdot P(x)$, where X is a random variable.
- Represents the **average** outcome.

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10. Bernoulli Trials and Binomial Distribution

- **Bernoulli Trial**: An experiment with exactly two outcomes (Success/Failure).

- **Binomial Distribution Formula**:
  $P(X = k) = {n \choose k} p^k (1 - p)^{n-k}$

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11. Tips for Exams

- Know all formulas and when to use them.
- Draw probability trees and Venn diagrams for visual understanding.
- Practice plenty of conditional and Bayes’ Theorem problems.

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12. Real-Life Applications

- Genetics, weather prediction, quality control, insurance, and risk assessment.