Pre-Read: Analyzing Sachin Tendulkar’s ODI Career

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1. Probability Theory Basics

Probability theory deals with uncertainty and measures the likelihood of events happening.

- Experiment: A process with uncertain outcomes (e.g., tossing a coin).
- Sample Space (S): The set of all possible outcomes.
- Event: A subset of the sample space (e.g., getting heads).
- Probability: A number between 0 and 1 representing the likelihood of an event.

Why important?

- Provides a mathematical foundation for decision-making under uncertainty.
- Used in risk analysis, quality control, AI, finance, and everyday reasoning.

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2. Visualizing Events with Set Operations

Events can be represented as sets within the sample space.

- Union (A ∪ B): Event that A or B (or both) occurs.
- Intersection (A ∩ B): Event that both A and B occur.
- Complement (A'): Event that A does not occur.

- Mutually Exclusive: Events that cannot occur together.

Visualization: Venn diagrams are widely used to represent these relationships.

Why important?

- Helps in understanding combined probabilities and overlapping events.
- Essential for solving multi-event probability problems (e.g., probability a student passed math or science).

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3. Conditional Probability

Conditional probability measures the chance of event A occurring given that event B has already occurred.

- Formula:
 P(A∣B)=P(A∩B)P(B), P(B)≠0P(A|B) = \frac{P(A ∩ B)}{P(B)}, \; P(B) \neq 0P(A∣B)=P(B)P(A∩B),P(B)=0
- Example: Probability of a person being diabetic given that they are above 40 years of age.

Why important?

- Core to decision-making under partial knowledge.
- Basis for Bayes' theorem, which powers spam filters, medical diagnosis, fraud detection, and machine learning models.

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4. Probability Rules

Several fundamental rules govern how probabilities work:

- Addition Rule:
  $P(A \cup B) = P(A) + P(B) - P(A \cap B) P(A \cup B) = P(A) + P(B) - P(A \cap B) P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- Multiplication Rule:
  $P(A \cap B) = P(A) \times P(B \mid A)]$
- Complement Rule:
  $P(A') = 1 - P(A)$
- Independence: Events A and B are independent if $P(A \cap B) = P(A)P(B)$Why important?
- Rules simplify complex probability problems.

- Provide building blocks for advanced topics like random variables, distributions, and statistical inference.