

Probability Basics for AI

Today's Agenda

- What is Probability? Why it matters in AI
- Types of Probability: Theoretical, Experimental, Conditional
- Basic Rules: Addition & Multiplication
- Independent vs Dependent Events
- Real AI Applications of Probability
- Hands-On Practice
- Kahoot(Quiz)



What is Probability & Why It Matters in AI

Definition:

Probability is a measure of the **likelihood** that an event will occur.

It ranges from **0 (impossible)** to **1 (certain)**.

Why is it important in AI?

- Models like **Naive Bayes**, **Hidden Markov Models**, and **Bayesian Networks** are built on it.
- Used for handling **uncertainty**, predictions, and class distributions.

 Example: What is the probability an email is spam?

AI models use training data to **learn these probabilities**.

Types of Probability

1. Theoretical Probability

Calculated mathematically.

Example: $P(\text{head})$ in a fair coin = $1/2$

2. Experimental (Empirical) Probability


Based on real data or experiments.

Example: 3 out of 10 students liked a video $\rightarrow P(\text{like}) = 0.3$

3. Conditional Probability

Probability of event **A**, given that **B** has occurred:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

 Example: $P(\text{"buying umbrella"} \mid \text{"raining"})$ is higher.

Basic Probability Rules

Rule 1: Addition Rule (OR)

If A and B are mutually exclusive:

$$P(A \cup B) = P(A) + P(B)$$

Rule 2: Multiplication Rule (AND)


If A and B are independent:

$$P(A \cap B) = P(A) \times P(B)$$

Tip:

If not independent, use **conditional probability**:

$$P(A \cap B) = P(A|B) \times P(B)$$

 Used in AI to combine probabilities from multiple features.

Short break

Independent vs Dependent Events

Concept	Example	Impact on AI
Independent	Tossing 2 different coins	Naive Bayes assumption
Dependent	Rain and carrying an umbrella	Bayesian Networks, NLP models

✓ Knowing event dependency helps design **better models** (e.g., don't assume word independence in complex NLP tasks).

Real Applications of Probability in AI

Area	Use of Probability
Email Classification	Spam probability based on words (Naive Bayes)
Recommender Systems	Probability user likes item = personalized
NLP (ChatGPT!)	Next word prediction uses word probabilities
Medical Diagnosis	$P(\text{disease})$

🔍 AI doesn't just guess — it **calculates probabilities** from data to make smart predictions.

Main Break