AI TUTOR-ENABLED SELF-PACED PROFESSIONAL COURSE BOOK

# Probability Theory

Think clearly about uncertainty and solve probability problems step by step.

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**NoteStore Academy**

Level: Intermediate → Advanced | Estimated study time: 38 hours

# Probability Theory

AI Tutor-Enabled Self-Paced Professional Course Book

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# How to use this course book

Probability Theory is a self-paced course book covering counting, conditional probability, discrete and continuous random variables, joint distributions, expectation and the limit theorems. It is ideal preparation for statistics, actuarial science, data science and quantitative finance.

## A simple study routine

- Study one module at a time. Read the overview and objectives first.
- Work through each key concept, using the TEACH ME prompt whenever an idea is unclear.
- Attempt every practice problem yourself before asking for help.
- Use CHECK MY WORK to review your solutions and CHALLENGE ME to test yourself.
- Finish each module by writing a five-line summary in your own words.

## Suggested pace

Most learners complete this course in about 38 hours. Studying four to five hours a week, that is roughly 8 to 11 weeks. Go faster through topics you already know and slower where you need more practice.

# Your AI Tutor: five learning modes

This course book is designed to be used with an AI assistant such as ChatGPT, Microsoft Copilot or Gemini. The goal is not to get answers from AI, but to use it as a patient tutor that explains, guides, checks and challenges you. Copy a prompt, replace the text in brackets and keep the conversation going.

**TEACH ME**

Explain [topic from this module] to me step by step at a [beginner / intermediate / advanced] level. Use a simple example first, then a harder one. Stop and ask me a question to check I understood before moving on.

**GUIDE ME**

I am working on this problem: [paste problem]. Do not give me the answer. Give me one hint at a time and wait for my next step.

**CHECK MY WORK**

Here is my solution: [paste working]. Check each step, tell me exactly where any mistake is and why, but let me correct it myself.

**CHALLENGE ME**

Give me three exam-style questions on [topic from this module], getting harder each time. Wait for my answers, then mark them and explain what I missed.

**HELP ME APPLY IT**

Show me how [topic from this module] is used in a real situation such as work, research or everyday decisions, then give me a small task to try it myself.

## Verify before you trust

AI tools can make mistakes, especially with calculations. Use this five-step check every time:

- ASK: write a clear, specific prompt that includes your level and what you have tried.
- SOLVE: work the problem yourself first, even if you are unsure.
- TEST: substitute values, estimate or graph to see if the answer is reasonable.
- CHECK: compare with the worked examples in this book and your class notes.
- VALIDATE: if the AI and the book disagree, trust the book and your teacher, and ask the AI to explain the difference.

MODULE 1

# Counting and Combinatorics

Count outcomes without listing them.

## Learning objectives

- Explain permutations and combinations in your own words and recognise when it applies.
- Explain multiplication principle in your own words and recognise when it applies.
- Solve problems involving inclusion–exclusion accurately.

## Key concepts

### Permutations and combinations

Write a one-sentence definition in your own words, then work one example by hand. Use the prompt below if any step is unclear.

> TEACH ME: Explain permutations and combinations in Probability Theory step by step at my level. Start with a simple example, then a harder one, and ask me a question to check my understanding.

### Multiplication principle

Find where this appears in your class notes or textbook. Note the key formula or rule, one worked example and one mistake students often make.

> TEACH ME: Explain multiplication principle in Probability Theory step by step at my level. Start with a simple example, then a harder one, and ask me a question to check my understanding.

### Inclusion–exclusion

Explain this idea out loud as if teaching a friend. Where you hesitate, ask your AI Tutor for a simpler explanation and a second example.

> TEACH ME: Explain inclusion–exclusion in Probability Theory step by step at my level. Start with a simple example, then a harder one, and ask me a question to check my understanding.

## Practice problems

1. How many 5-card hands contain exactly two aces?
2. Arrange the letters of STATISTICS

After attempting each problem, paste your working into the CHECK MY WORK prompt. Then use CHALLENGE ME to get three more problems on the same topic.

**Before moving on:** write a five-line summary of this module in your own words, then ask your AI Tutor to point out anything you missed.

# Continue in the full course book

The full course book continues with:

- Module 2: Probability Axioms
- Module 3: Conditional Probability and Bayes
- Module 4: Discrete Random Variables
- Module 5: Continuous Random Variables
- Module 6: Functions of Random Variables
- Module 7: Joint Distributions
- Module 8: Expectation and Conditional Expectation
- Module 9: Limit Theorems
- Module 10: Introduction to Stochastic Processes
- Four practical projects and a capstone
- Portfolio guide, assessment rubric and completion checklist