The Quant Roadmap

The eight maths topics behind every option price, in the order you should learn them. For each one: what to master, what to read for free, and where it is taught in full.

1 Probability and expectation
2 **Random walks and Brownian motion**
3 **Martingales**
4 **Itô's lemma**
5 **SDEs and geometric Brownian motion**
6 **Change of measure (Girsanov)**
7 **Risk-neutral pricing**
8 Monte Carlo and numerics

Teal topics, 2 to 7, are the Stochastic Calculus for Finance module: full derivations, runnable Python and a validation suite for each.

See the module →

2 Random walks and Brownian motion

$$W(t) \sim \mathcal{N}(0,\ t)$$

Independent Gaussian increments, scaling with √t, paths that are continuous but nowhere differentiable, and a quadratic variation that grows exactly like t.

READ FREE

→ What is quadratic variation?

→ Brownian bridge for barrier options

TAUGHT IN FULL

Stochastic Calculus for Finance

3 Martingales

$$\mathbb{E}[\,M_t \mid \mathcal{F}_s\,] = M_s$$

Filtrations, conditional expectation as a projection, and why discounted prices must be martingales for there to be no arbitrage.

READ FREE

→ What is a martingale? (for quant interviews)

TAUGHT IN FULL

Stochastic Calculus for Finance

4 Itô's lemma

$$df = \partial_W f\, dW + \tfrac{1}{2}\,\partial_{WW} f\, dt$$

The chain rule with a second-order term. It is where the σ²/2 in every formula comes from, and how a PDE turns into an expectation.

READ FREE

→ What is Itô's lemma?

→ Feynman-Kac: formula and Python example

TAUGHT IN FULL

Stochastic Calculus for Finance

5 SDEs and geometric Brownian motion

$$dS_t = \mu S_t\,dt + \sigma S_t\,dW_t$$

Solving GBM exactly, the gap between its mean and its median, and discretising SDEs that have no closed form.

READ FREE

→ GBM in Python: simulate and test paths
→ Euler vs Milstein: when the extra term matters

TAUGHT IN FULL

Stochastic Calculus for Finance

6 Change of measure (Girsanov)

$$dW_t^{\mathbb{Q}} = dW_t^{\mathbb{P}} + \theta\,dt$$

Radon-Nikodym derivatives, Girsanov's theorem and numéraires: how the drift changes while volatility stays the same.

READ FREE

→ Girsanov's theorem explained
→ P vs Q without the measure theory
→ What is a numéraire?

TAUGHT IN FULL

Stochastic Calculus for Finance

7 Risk-neutral pricing

$$C = e^{-rT}\,\mathbb{E}^{\mathbb{Q}}\left[(S_T - K)^+\right]$$

Price as a discounted expected payoff under Q, Black-Scholes as one closed form of it, and the parity checks every pricer must pass.

READ FREE

→ What is a risk-neutral measure?
→ Black-Scholes from scratch
→ Put-call parity: the free-lunch check

TAUGHT IN FULL

Stochastic Calculus for Finance + Risk-Neutral Valuation

8 Monte Carlo and numerics

$$\hat{C}_n \pm \frac{1.96\,s}{\sqrt{n}}$$

Simulating paths, confidence intervals, variance reduction and quasi-random numbers. Four times the paths only buys twice the accuracy.

READ FREE

→ Monte Carlo option pricing in Python
→ Why doesn't my Monte Carlo match Black-Scholes?
→ Variance reduction: which technique when?

TAUGHT IN FULL

Free on the blog: the posts above

How to use this

Go in order.
Each topic leans on the one before. Skipping 3 makes 6 feel like magic.

Code every formula.
If you cannot simulate it and check it against the closed form, you do not know it yet.

Test, do not trust.
Put-call parity, martingale checks, convergence. A reviewer will run them; run them first.

Keep the formulas in one place

Get the free 4-page Quant Reference Card →

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