THE CUNY GRADUATE CENTER - PHYSICS PROGRAM
FINANCE FOR SCIENTISTS

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Syllabus

1. Financial markets and arbitrage

    (a) Stocks, bonds, options, and arbitrage

    (b) Option pricing on a tree

    (c) Derivation of the Black-Scholes formula

2. Stochastic differential equations

    (a) Review of probability theory

    (b) Brownian motion and stochastic differential equations (SDEs)

    (c) Ito's lemma, Girsanov theorem, and martingales

3. Mathematical Tools

    (a) Random number generators and Monte-Carlo simulations

    (b) Fourier transform and fast Fourier transform (FFT)

    (c) The Fokker-Planck equation and path integrals

4. Bigger Models

    (a) Quantos

    (b) Interest Rate models and the Heath-Jarrow-Morton framework

    (c) Multiple assets

5. Jumps (Lévy models)

   (a) Merton's jump model
   (b) Lévy distributions: properties and numerics
   (c) The CGMY model

6. Large deviation theory and applications

   (a) Large deviation theory
   (b) Variance reduction techniques and importance sampling
   (c) Minimum action methods

7. Further Topics

   (a) Random matrix theory and applications
   (b) Linear and logistic regression
   (c) Machine learning and recommender systems

References : Lecture notes will be available online! Further reading:

- Baxter/Rennie: *Financial Calculus: An Introduction to Derivative Pricing*

- Gardiner: *Stochastic Methods: A Handbook for the Natural and Social Sciences*

- Hull: *Options, Futures, and Other Derivatives*

- Tankov/Cont: *Financial Modelling with Jump Processes*