Outline

Twelve lectures on a select set of topics in financial engineering, in particular, derivative pricing and risk hedging. The focus is on stochastic modeling, analysis, and numerical solution techniques.

Prerequisite:
Basic probability models and elementary stochastic processes (at the level of IEOR4606).

Texts:
Supplemented by lecture notes.

References:

Homework:
11 sets, each with about 10 problems, assigned at every class, and due in two weeks, unless otherwise specified; full credit if returned on time.

Midterm Exam:
October 24 (class hours); a closed book exam, but an “aid sheet” is allowed.

Final Exam:
Tentative: December 19 (class hours); same format as the midterm.
Grading:
20% homework, 40% midterm, 40% final.

Contact:
Office Hours: Monday, 1:30-2:30p; Tuesday, 3-4p; or by appointment.
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Topics and Schedule (subject to changes):

- normal and lognormal distributions, stock price models, Brownian motion and geometric BM, relations to random walk; (lecture 1)

- Itô’s calculus; option pricing, risk-neutral valuation, put-call parity; Black-Scholes partial differential equations and solutions, sensitivity: the Greek letters; (lectures 2,3)

- variations of the Black-Scholes model: index options, currency options, futures options; American options, inequalities (lecture 4);

- binomial trees; dividend models; finite difference methods; delta hedging; VaR; (lectures 5,6)

- risk hedging, self-financing; multi-dimensional Itô’s calculus, the product rule; (lecture 7)

- conditional expectation w.r.t. sigma algebra, filtration, martingales, stochastic integral; change of measures, Girsanov theory; (lecture 8)

- equivalent martingale measures, market price of risk; martingale representation theorem; existence and uniqueness of the risk-neutral measure; (lectures 9,10)

- numeraire, Siegel’s paradox, applications of change of measures, interest-rate derivatives. (lectures 11,12)