FE610 Probability and Stochastic Calculus - Syllabus

Textbooks

1. "Introduction to the Mathemtics of Financial Derivatives" by Salih N Neftci, 2nd ed, AP ISBN 0125153929
2. “Financial Calculus” by Martin Baxter and Andrew Rennie, Cambridge University Press, 1999. ISBN 0 521 55289 3.

References

1. F. Solomon, Probability and Stochastic Processes, Prentice-Hall 1987.
2. E. P.C. Kao, An introduction to Stochastic Processes, Duxbury Press 1997.
3. John L. Teall, Financial Market Analytics, Quorum Books, 1999.

Overview

This course provides the mathematical foundation for understanding modern financial theory. It includes topics such as basic probability, random variables, discrete and continuous distributions, random processes, Brownian motion, and an introduction to Itô calculus. Applications to financial instruments are discussed throughout the course.

Course Topics

Probability and Stochastic Calculus for Financial Engineering

1. Financial Markets and Probability
a. Introduction to financial markets and instruments
b. Modeling: deterministic vs. probabilistic
2. Elementary probability principles
a. Discrete random variables
b. Continuous random variables
c. The Poisson process
d. Joint probability distributions
e. joint distributions of discrete random variables
f. joint distributions of continuous random variables
g. independence
h. examples and applications to financial cases
3. Variance, covariance, correlation coefficient
4. The central limit theorem
a. properties of normally distributed random variables
b. the central limit theorem and the law of large numbers
5. Discrete-time Markov chains
a. the transition matrix
b. the steady-state probability vector
c. random walks and asset pricing
6. Continuous-time Markov chains

a. introduction
b. the Kolmogorov differential equation
c. parabolic partial differential equations
d. numerical techniques and applications
7. Brownian motion and diffusion processes
a. diffusion processes
b. Ito’s calculus and stochastic differential equations (qualitative introduction)