FRE 9733: Special Topics
Introduction to Derivative Securities

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LecturePeriods	LaboratoryPeriods	RecitationPeriods	Credits
2 hrs	0 hrs	0 hrs	3

Course Description

This course is an introduction derivative securities. It introduces various derivatives and explains in detail the models and methods for pricing and hedging them. Some examples of the types of derivatives treated in the course include European, American and exotic options, swaps and convertible bonds. The course covers equity, interest rate and volatility derivative products. Modern probability and stochastic processes are the mathematical foundation, as well as some statistical methods for empirical studies. Computational methods are also introduced where necessary to price these derivatives.

Prerequisites

Students are expected to have knowledge in stochastic calculus, linear algebra, basic probability, statistics and programming. Those students who do not have this background should take the Probability and Statistics Refresher courses as well as Introduction to Numerical Methods.

Grading

Grades will be based on the following grading structure:

10% Participation during lectures
30% Homework (weekly assignments)
25% Midterm Exam
35% Final Examination

Week	Topics
1	Overview of Stochastic Calculus
2	Introduction to Derivatives: Fundamental Theorem of Asset Pricing, risk-neutral pricing, no-arbitrage assumption, complete markets
3	Feynman-Kac formula and PDEs for pricing. The Black Scholes model.
4	Binomial trees and extensions.
5	European and American options. Put-Call parity. Greeks, Delta hedging. Forward contracts.
6	Default modeling. Stopping times, hazard rates, and survival curves
7	Midterm Exam
8	Pricing American options. Asian options, convertible bonds.
9	Exotic options, Introduction to finite-difference method
10	Term-structure models. Introduction. One-factor term structure models. The affine one-factor models.
11	Variance swaps, log contract, static replication. Volatility swaps, options on variance swaps.
12	Modeling implied volatility. Local volatility model. Constraints on implied volatility surface.
13	From local volatility to stochastic volatility
14	Introduction to Monte-Carlo pricing methods
15	Final Exam

Textbooks and References

• J. Hull, Options, *Futures and other Derivatives*, University of Toronto, 9th edition, 2015.
• S.E. Shreve, *Stochastic Calculus for Finance II: Continuous-Time Models*, Springer 2004.
• S.N. Neftci, *An Introduction to the Mathematics of Financial Derivatives*, 2nd edition, Academic Press, 2000

Software

Students are expected to implement models in a language of their choice. This can be C++, Python, Matlab, R, or VBA.