MATH 515 / STAT 540
Mathematics of Finance
TTh 3:00 - 4:15, Univ 119
Purdue University, Spring 2009

Instructor: *José E. Figueroa-López*

- Office: Math 542, Phone: (765) 494 6036
- Office hours: TTh 1:40 - 2:55 or by appointment.
- e-mail: ***figueroa@stat.purdue.edu*** (best way to contact me).

Course description

This course will introduce the mathematical concepts and tools for the arbitrage-free pricing of derivatives such as options or more general contingent claims. We will cover in detail the discrete-time Binomial model and its continuous-time version, the Black-Scholes model. The fundamental concepts of hedging strategies, arbitrage, and market completeness will be given a rigorous mathematical formulation. The main mathematical tool is stochastic calculus and its connection to partial differential equations. The goal will be to built a toolbox of formulas that will enable us to derive the main formulas for the pricing and hedging of derivatives, and their implementation in practice.

Textbook:

- **[Björk]** *Arbitrage theory in continuous time* by Björk. Oxford U.P. 2004. Second edition.

Other recommended reading: Some topics of the course will be complemented with some excerpts from the instructor's notes and from the following books.

- **[S]** *Stochastic Calculus for Finance Vol. I and II* by S. Shreve, 1st Edition.
- **[LL]** *Introduction to stochastic calculus applied to finance* by Lamberton and Lapeyre. Chapman and Hall 1996/CRC 2000.
- **[W]** *Paul Wilmott on Quantitative Finance* by P. Wilmott. Wiley. Second edition.
- **[H]** *Options, Futures, and other derivatives*, by J.C. Hull. Prentice Hall. Sixth edition.

Course website: *http://www.stat.purdue.edu/∼figueroa/Stat540.html*.

Prerequisites and suggested preparation:

- A graduate introduction to probability theory (no measure theory needed) at the level of MA/Stat 519. At least concurrent enrollment is required.
- Multivariate calculus at the level of MA 261 required.
- Elementary real analysis at the level of MA 440 required. MA 504 desirable, or concurrent enrollment desirable.
- Differential equations at the level of MA 360 is required.
- Programming experience in a high-level language such as Matlab, C, C++, etc.

Grading and attendance policy:

- ATTENDANCE IS MANDATORY. Justified absence should be notified to the instructor with anticipation.
- *Two in-class exams (15 % each)* will test your grasp of the material covered in class.
- *An in-class comprehensive final exam (30 %).*
- *Homework (20 %).*
  Note: While it is acceptable to work in groups, each student must turn in a separate assignments, which must reflect YOUR understanding of the material ("almost" identical solutions will not be accepted and tolerated). NO LATE homework will be accepted without a valid justification.
- *A final group project (20 %).*
  You will be required to turn in one class project/paper and give an in-class presentation based on it. Project topics will be taken from advanced chapters of the textbook or suggested reading, and/or student's personal reading (with instructor's accord).

Tentative subjects to be presented:

- The binomial model and other discrete-time models. [Björk] Chap. 2 & 3. [LL] Chap. 1. [S] Vol. I. Ch. 1 and Ch. 4.
- Stochastic calculus. [Björk] Chap. 4 & 5. [S] Vol. II. Ch. 4 and Ch. 6.
- Portfolio dynamics and arbitrage theory. The Black-Scholes model. [Björk] Chap. 6 & 7.
- Completeness and Hedging. [Björk] Chap. 8 & 10.
- Multidimensional models and incompleteness. [Björk] Chap. 13-15.
- Portfolio optimizations. [Björk] Chap. 19.

I hope you will enjoy this course. Have a nice semester.