Instructor: José E. Figueroa-López

- Office: Math 542, Phone: (765) 494 6036.
- Office hours: TTh 2:00 - 2:50 p.m. or by appointment.
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Course description
This is the second course in a two-course sequence on mathematical finance. The course is divided into two main parts. The first part covers the valuation of interest-rate derivatives (bonds, swaps, caps, etc.) under three important paradigms: the short-rate-based modeling, the Heath-Jarrow-Morton framework, and the LIBOR market model. The second part introduces several numerical methods commonly used for option pricing, including finite-difference methods and variance reduction Monte-Carlo methods.

Main References
- Instructor’s class notes posted online in the course’s webpage

Other recommended reading

Prerequisites: MA 515/Stat 540, Mathematics of Finance. Experience with a high level programming language (Matlab, R, C/C++, etc.).


Tentative grading procedure (The following grading policy is tentative; any changes will be announced in advanced.)
- ATTENDANCE IS MANDATORY. Justified absence should be notified to the instructor with anticipation.
- One midterm exam (25 % total) will test your grasp of the material covered in class.
• **One in-class comprehensive final exam (30%)** will be administered towards the 12th week of classes.

• **Homework and projects (20%).**
  - The homework will include problems from the textbooks, computational implementation of some methods covered in class, and other assignments.
  - For problems involving computational implementation, you will be encouraged to write your code in Matlab, C++, or C.
  - While it is acceptable to briefly discuss individual assignments among students, the student’s work that is turn in for grading must reflect his/her understanding of the material (“almost” identical solutions will not be accepted and tolerated).

• **A final project (15%).**
  In a team setting, students will develop a topic of computational nature, taken from the literature in mathematical finance. The team will present the topic in class and a written team report will be required towards the end of the week of finals.

• **Oral examination (10%).**
  - You will have to take a mandatory oral examinations in front of one or more faculty members of the Computational Finance Program.
  - Most questions will test the student’s understanding of basic theoretical aspects of both MA 515/STAT 540 and MA 516/STAT 541.
  - **Note that in the Department of Statistics, receiving a passing grade on this oral exam is a requirement for graduation with a MS CF degree.**
  - Students seeking the CF specialization may be asked to retake the oral examination if their performance is unsatisfactory.

**Tentative course outline:**

• **Bonds, interest rate models, and interest rate derivatives (Björk Ch. 22-27).**
  - Bond markets and interest rates
  - Short rate models
  - Martingale models: examples and calibrations.
  - LIBOR market models

• **Numerical methods for option pricing:**
  - Finite-difference methods:
    1. European options (LL Ch 5)
    2. American options in continuous-time: free-boundary problems WHD Ch 7
  - Monte Carlo methods (CS Ch 4):
    1. Variance reduction methods: antithetic variables, control variates, etc.
    2. Valuation of American options
    3. Greeks valuation

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