

IEOR E4731: Credit Risk Modeling and Credit Derivatives
Fall 2017

Department of Industrial Engineering and Operations Research, Columbia University,
Where: TO BE DETERMINED

Instructor: Dr. Agostino Capponi
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Office Hours: Monday 5:00-6:00pm, in Mudd 535G

Teaching Assistant: TO BE DETERMINED, Email: TO BE DETERMINED, Office Hours: TO BE DETERMINED

Meeting days: Monday and Wednesday (6:10 - 8:40PM)

Class schedule: The class will meet on the following days: May 23, May 25, June 1, June 6, June 8, June 10, June 13, June 15, June 29, July 8, July 10, July 13, July 15, July 20.

Email Communication with Instructor and Teaching Assistants: When emailing the instructor or TAs, please make the subject of the email the following – “IEOR E4731, *YOUR LAST NAME, ISSUE*”. This will be beneficial for tracking email communications. Please include the issue in the subject (e.g., Homework Problem Question). Additionally, your email should follow good business letter writing principles. You can find more about business letter writing from the Columbia Writing Center at <http://www.college.columbia.edu/core/uwp/writing-center>. The email should have a salutation, appropriate grammar, correct spelling and capitalization, a clear description of the question or issue, and your full name.

Prerequisite: The prerequisite for this class is a master level knowledge of probability theory and stochastic processes. (filtration, conditional expectation, Brownian motion, Poisson processes, stochastic integral, Ito formula). Students are expected to be familiar with the material covered in IEOR E4701: Stochastic Models for Financial Engineering (or an equivalent course on stochastic processes), and IEOR E4707: Continuous-time Asset Pricing. Some elementary exposure to partial and stochastic differential equations can be helpful, but not mandatory. Knowledge of basic financial engineering is highly desirable. Knowledge of some programming language, such as Mathematica, Matlab or R can be useful.

Teaching facilities: The course will be administered on Coursework. I will use Microsoft Surface to explain to the class.

Textbook: There is no required textbook for the class. My lecture notes will be based on material extracted from excellent textbooks such as

- *Credit Risk: Pricing, Measurement and Management*, by D. Duffie and K. Singleton.
- *Credit Risk Modeling: Theory and Applications*, by D. Lando.
- *Credit Risk: Modeling, Valuation, and Hedging* by T. Bielecki and M. Rutkowski.

Course Objectives: Credit risk is a topic of fundamental importance in modern banking systems. Quantitative credit risk methodologies play a fundamental role in the risk-management units of major investment banks. The recent crisis has led to numerous regulatory reforms requiring banks to comply with capital requirements. This can only be achieved via the implementation of a sophisticated and mathematically sound credit risk framework. This course deals with quantitative modeling and measuring of credit risk. You will learn how to price financial instruments, whose payoff is contingent to the realization of a credit event. You will also learn how to measure credit losses, manage portfolios of credit sensitive securities, and calibrate financial models to using market data. Topics of high recent interest, such as counterparty risk, systemic risk, and credit valuation adjustments will be discussed.

Homework Assignments: There will be five homework problems that will test you on class material. Homework will be posted on Coursework. Students are encouraged to collaborate with each other, but each student must complete and submit his/her homework individually. Copying homework solutions from other students will not be tolerated and considered as cheating. Make sure all pages of the assignments are stapled together.

Late Homework Policy: Late homework will not be accepted. Any homework which is not turned in class on the due date will be worth zero.

Exams: There will be one midterm exam on June 15, 2016, and one final exam on July 20 2016. Both exams will be closed book although a formula sheet will be provided. The final exam will be comprehensive and include all material covered in the class.

Weights

Homework: 25%
Midterm: 35%
Final Exam: 40%

Attendance Policy: Attendance of each lecture is mandatory. My class notes will be posted on Coursework.

Grading: The final grade will be based on the total number of points earned during the semester. If you earn 85% of the available (weighted points) you are guaranteed at least an A-, 75% guarantees at least a B-, 60% guarantees at least a C, etc... However, the final scores might be adjusted at the discretion of the course instructor.

Course Topics: We will cover the below mentioned course topics:

- Structural Models of Credit Risk:
 - Merton Model, Black Cox Model, Leland model.
- Intensity Based Models of Credit Risk:
 - Doubly stochastic and Cox Processes
- Modeling Dependent Defaults and Contagion:
 - Markov modulated intensities, contagion through intensities, copula approach
- Rating Based Term Structure Models:
 - Class Dependent Recovery, Fractional Recovery of Market Value, Calibration.
- Credit Derivatives
 - Credit Default Swaps, Collateralized Debt Obligations, Bootstrapping.
- Counterparty Risk:
 - Exposure, Credit Valuation Adjustment (time allowing).

- Systemic risk:
 - Network Risk, Financial Networks, Common Holding Networks, Dealer Networks.