

MATH 607: Credit Risk Models

Fall 2018 Graduate Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: This course explores mathematical models and methods for credit risk measurement and rating. The nature of credit risk is reviewed through examination of credit instruments, including credit default swaps, collateralized debt obligations, and basket credit derivatives. These instruments, through which risk exposure opportunities and hedging possibilities are created and managed, are explored with respect to dynamics and valuation techniques, applying PDE methods and stochastic processes.

Number of Credits: 3

Prerequisites: MATH 604, MATH 605, MATH 606 or permission of the instructor.

Course-Section and Instructors

| Course-Section | Instructor |
|----------------|-------------------|
| Math 607-101 | Professor A. Pole |
| Math 607-851 | Professor A. Pole |

Office Hours for All Math Instructors: [Fall 2018 Office Hours and Emails](#)

Required Textbooks:

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| Title | <i>Credit Derivatives Pricing Models: Models, Pricing and Implementation</i> |
| Author | Schonbucher |
| Edition | 1st |
| Publisher | John Wiley & Sons, Inc. |
| ISBN # | 978-0470842911 |

University-wide Withdrawal Date: The last day to withdraw with a W is **Monday, November 12, 2018**. It will be strictly enforced.

COURSE GOALS

Course Objectives

This course explores mathematical models and methods for credit risk measurement and rating and pricing of credit risky securities. Topics include the nature of credit risk (examination of credit instruments, including credit default swaps, collateralized debt obligations, and basket credit derivatives), default probability models (structural, reduced form, credit rating), and approaches to portfolios (copulas).

Course Outcomes

After completing this course students will be able to:

- Describe the nature of credit risk and related risks (liquidity, market).
- Describe and analyze the most common credit risky financial instruments, including the main features, standard uses, and valuation procedures.
- Describe and implement the most common approaches to default probability modeling - structural, reduced form, ratings - including the analytical methods and estimation procedures used with each, for both single obligors and multiple obligors.

Course Assessment: Assessment of objectives is achieved through homework assignments, a project, and two examinations: a midterm exam and a comprehensive final exam.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the **Department of Mathematical Sciences Course Policies**, in addition to official **university-wide policies**. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

| | |
|----------------------|-----|
| Homework Assignments | 25% |
| Project | 15% |
| Midterm Exam | 30% |
| Final Exam | 30% |

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the **Math Department's Attendance Policy**. This policy will be strictly enforced.

Exams: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

| | |
|-------------------|------------------------|
| Midterm Exam | Week 8 |
| Final Exam Period | December 15 - 21, 2018 |

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the **Math Department's Examination Policy**. This policy will be strictly enforced.

Makeup Exam Policy: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

- http://math.njit.edu/students/policies_exam.php

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Accommodation of Disabilities: Disability Support Services (DSS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services at [973-596-5417](tel:973-596-5417) or via email at lyles@njit.edu. The office is located in Fenster Hall, Room 260. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Disability Support Services (DSS) website at:

- <http://www5.njit.edu/studentsuccess/disability-support-services/>

Important Dates (See: [Fall 2018 Academic Calendar](#), Registrar)

| Date | Day | Event |
|------------------------|--------|------------------------------|
| September 4, 2018 | T | First Day of Classes |
| September 10, 2018 | M | Last Day to Add/Drop Classes |
| November 12, 2018 | M | Last Day to Withdraw |
| November 20, 2018 | T | Thursday Classes Meet |
| November 21, 2018 | W | Friday Classes Meet |
| November 22 - 25, 2018 | R - Su | Thanksgiving Recess |
| December 12, 2018 | W | Last Day of Classes |
| December 13 & 14, 2018 | R & F | Reading Days |
| December 15 - 21, 2018 | Sa - F | Final Exam Period |

Course Outline

| Week | Topic |
|--------|--|
| 1 | Types of credit risk; Overview of credit instruments: asset swaps, total return swaps, credit default swaps; Credit spread products, credit linked notes |
| 2 | Hedge based pricing; Default correlation products and CDOs |
| 3 | Implied default probabilities; Recovery modeling; Pricing |
| 4 | Constructing and calibrating credit spread curves |
| 5 | Intensity models: Poisson processes & spreads; Inhomogeneous Poisson processes |
| 6 | Intensity models: Stochastic credit spreads; Cox processes, compound Poisson processes |
| 7 | Recovery models: Zero recovery, Recovery of treasury, Recovery of par, Multiple defaults, Recovery of market value, Stochastic recovery |
| 8 | MIDTERM EXAM |
| 9 & 10 | Credit rating models: Rating process and transition probabilities; Generator matrices; [Logistic regression;] Estimation, calibration |

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| | and pricing |
| 11 & 12 | Structural models: Merton's model; First Passage; KMV and CreditGrades models |
| 13 & 14 | Default Correlation: Factor models; Correlated intensity models; Copulas; Risk analysis; Pricing structured credit: CDOs and first-to-default |
| 15 | FINAL EXAM |

*Updated by Professor A. Pole - 8/30/2018
Department of Mathematical Sciences Course Syllabus, Fall 2018*
