NYU TANDON SCHOOL OF ENGINEERING

Finance & Risk Engineering

FRE 7801,
PDE for Finance

Instructor Information

- Dr. Roza Galeeva, Adjunct Professor.

- Office hours: by appointment
  rg63@nyu.edu

Course Information

- FRE 7801
  PDE for Finance
- The goal of this course is to introduce the main technique of solving parabolic PDE such as separation of variables, integral transform , Green function, perturbation methods, eigenfunction expansions with a specific goal of financial applications. The methods will be illustrated on particular derivatives pricing problems in fixed income, credit and commodities.
- The minimum course pre-requisites is FRE 6083. Knowledge of a programming language is required for numerical applications.
- Thursdays 2-4.41 pm
- Rogers Hall, rm 339

Course Overview and Goals

This course is intended for students of the Master Program in Science in Financial Engineering, who wants to deepen their knowledge in the PDE technique and their applications for derivatives pricing. It will prepare the students to apply for quantitative positions, as well as a Ph.D. program in Financial Engineering or Mathematical Finance. The accent of the course is on using theoretical methods for solving important practical problems in major financial asset classes.

Upon completion of this course, students will be able to:

- Learn main techniques for solving SDE and the connection to PDE
- Learn the main techniques for solving linear parabolic PDE and apply it to price financial derivatives
- Enrich the inventory of tools for pricing derivatives

Course Requirements

Class Participation

Students are supposed to actively participate in classes, work on home assignments and final project

Assignments

There will be four assignments due April 7, 14, 21 ,28 and one final project. The assignments and the project can be done in small teams.

Tests & Quizzes

No tests, no quizzes

Assigned Readings

Each team will get suggested readings to study for their final project

Grading of Assignments

The grade for this course will be determined according to the following formula:

Assignments/Activities	% of Final Grade
4 assignments	50%
Final Project	50%

Letter Grades

Letter grades for the entire course will be assigned as follows:

Letter Grade	Points	Percent
A	4.00	Example: 92.5% and higher
A-	3.67	Example: 90.0 – 92.49%
B+	3.33	Example: 87.5% - 89.99%
B	3.00	Example: 82.5% - 87.49%
B-	2.67	Example: 80% - 82.49%
C+	2.33	Example: 77.5% - 79.99%
C	2.00	Example: 70.0% - 77.49%
F	.00	Example: 69.99% and lower

Course Schedule

Topics and Assignments

Week/Date	Topic	Reading	Assignment Due

Week1	Recall on ODE, SDE and stochastic calculus	Chapters 3 and 4 in the textbook	April 7
Week 2	Feynman-Kac theorem, SDE and PDE connection	Chapter 6 in the textbook	April 14
Week 3	Boundary value problems, fundamental solution, Green function. BS by heat equation	Lecture slides	April 21
Week 4	Pricing single and double barrier options	Lecture slides	April 28
Week 5	Interest rate models	Chapter 6 textbook	May 5
Week 6	PDE for credit derivatives: stochastic intensity models. CIR and Vasicek models.	Chapter 10 textbook	
Week 7	Final Project		

Course Materials

Required Textbook

- Steve Shreve, *Stochastic Calculus for Finance II*, Springer 2004

Additional Readings

- Stanley Farlow, *Partial Differential Equations for Scientists and Engineers* , Dover Publications, 1982.
- Alan Lewis, *Option Valuation under Stochastic Volatility*, Finance Press, 2000.
- Peter Carr, *On the valuation of arithmetic–average Asian options: the Geman–Yor Laplace transform revisited*, 2001.
- Peter Carr, Dilip Madan, *Option valuation using the fast Fourier transform*, 1999.
- Peter Carr, Andrey Itkin, *Semi-closed form solutions for barrier and American options written on a time-dependent Ornstein Uhlenbeck process*, 2020.

Resources

- **Access your course materials**: NYU Brightspace, https://brightspace.nyu.edu/
- **Databases, journal articles, and more**: Bern Dibner Library (library.nyu.edu)
  NYU Virtual Business Library (guides.nyu.edu/vbl)
- **Obtain 24/7 technology assistance:** Tandon IT Help Desk (soehelpdesk@nyu.edu, 646.997.3123)
  NYU IT Service Desk (AskIT@nyu.edu, 212-998-3333)

Policies

Academic Misconduct

A. Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:
    1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.
    2. Fabrication: including but not limited to, falsifying experimental data and/or citations.
    3. Plagiarism: Intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.
    4. Unauthorized collaboration: working together on work that was meant to be done individually.
    5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission have been received from the course instructor(s) or research adviser involved.
    6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.

Disability Disclosure Statement

Academic accommodations are available for students with disabilities. Please contact the **Moses Center for Students with Disabilities** (212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.

Inclusion Statement

The NYU Tandon School values an inclusive and equitable environment for all our students. I hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect. It is my intent that all students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. If this standard is not being upheld, please feel free to speak with me.