NYU TANDON SCHOOL OF ENGINEERING

Finance & Risk Engineering

FRE-GY 6083 I2,
Quantitative Methods In Finance

Fall 2021

Daniel Totouom-Tangho

Thursday 7:00pm-9:30pm

To contact professor: dtt226@nyu.edu

Course Prerequisites

- Students are expected to have knowledge in calculus, linear algebra, basic probability and statistics.

Course Description

- This course focuses on the art and science of building models of processes that occur in business, economics, and finance. These may include models of interest rates, derivative securities, or behavior of asset prices. These models can be solved by using techniques of modern probability and stochastic processes, which constitute the mathematical foundation.
- We do not attempt to cover the spectrum of model types and modeling methodologies; rather, the focus is on models that can be expressed in equation form, relating variables quantitatively.

Course Objectives

- The main goal of this course is to provide students with a rigorous introduction to quantitative models in Finance. First of all, the students will be taught the basic concepts of stochastic processes that constitute a prerequisite to quantitative modeling and Econometrics.
- Secondly, they will become familiar with a number of specific models and their underlying assumptions.
- The techniques learned are applied to model, assess and simulate (using Python/ R/ C++ or Java) essential derivative and related problems of practical importance in finance.
- Finally, this course also serves as an introductory course to the area of Computational Finance and prepares the students to pursue coursework in Computational Finance and Algorithmic trading.

Course Structure

- This course will be delivered through a series of lectures, followed by a question and answer session and a discussion. Some weeks, problem solving sessions will be incorporated.

Course Requirements

Students will be expected to attend classes, to read materials ahead of course meetings and also be prepared to discuss assignments in class. There will be weekly homework assignments and a final project with presentation.

Grading of Assignments

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

Assignments/Activities	% of Final Grade
Class participation	10%
Homework	30%
Final Project	60%

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

Indicative program:

- Introduction to statistics & Probability

    - Convergence concepts for random variables, law of large numbers, and central limit theorem.
    - Markov sequences, martingale property for sequences of random variables.
- Stochastic Process
    - Brownian motion
    - Geometric Brownian motion
- Martingale
- Multivariate stochastic processes
- Overview of numerical methods in Stochastic finance
- Focus on Finite Difference Methods 1D
- Focus on Finite Difference Methods 2D
- Monte Carlo
- Introduction to Option pricing & Hedging
- Selective topics
    - Volatility as an asset class and the smile
    - Statistical Arbitrage in the Stock Market
    - Interest Rate Modeling
    - Convertible bonds / Callable Bonds pricing
    - Credit Market & CDS Pricing
    - Copulas & applications
    - Value at Risk & Optimization technics
    - Applications to credit & Interest rate pricing

Course Materials

Readings

- Reading materials ahead of course meetings helps students participate actively in class. Additional readings may be posted in NYU Classes for better understanding of topics.

Recommended Textbooks & Materials

- A set of notes will be distributed through NYU classes before the Semester starts.
- In addition, the textbooks below are optional for this course:
    - Paul Wilmott on Quantitative Finance 3 Volume Set, Publisher: Wiley; 2 edition (March 13, 2006), ISBN-10: 0470018704 or ISBN-13: 978-0470018705
    - Steven E. Shreve, Stochastic Calculus for Finance , I, Steven E. Shreve, 2004, Springer.

Resources

- **Access your course materials**: NYU Classes (nyu.edu/its/classes)

- **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.