FIN-253A: Advanced Quantitative Analysis in Finance

Thursday, 6:30 - 9:20 pm, Lemberg Academic Center 180

Instructor:
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  Office Hours: Monday/Wednesday, 1:00 – 3:30 pm or by appointment.

OVERVIEW

This course is designed to be relevant to a finance student that desires to build a skillset that can harness the power of the quantitative analysis in making financial decisions. Computing power and the availability of a myriad of financial data has garnered the need for quantitative analysts to collect and analyze data and discern relevant insights. A set of financial topics that are relevant are time series analysis, technical analysis, security pricing, building a term structure of interest rates, algorithmic trading, and risk analysis.

This course introduces students to a broad range of topics related to using quantitative models and the latest financial technologies to understand the various techniques to model the time value of money via a term structure of interest rates, determining trading signals from an exchange limit order book, pricing securities which have no closed form solution, managing risks and asset allocation, and the creation of an algorithmic trading application.

This course is designed to be relevant to any finance student that wishes to build a skillset that can harness the power of the computer programming, algorithms, data analysis and applied mathematics.

LEARNING GOALS

Quantitative analysis can be mastered only through real-world examples of pricing, risk assessment, applications of algorithms and data analysis techniques. As a foundation, the student will harness previous skills in Python programming, statistical analysis and/or machine learning, and finance.

At the end of this course, the student should be able to:

- Build a term structure of interest rates to model the time value of money.
- Price securities that require a numerical solutions to price such as options, bonds, and credit default swaps.
- Explore and determine securities that can be used to hedge risk exposure.
- Build a back-testing engine that can be used to determine if a proposed strategy will be profitable.
- Build a real-time algorithmic trading application which will trade on real-world CME treasury data.
- Build a state-of-the-art pricing application for convertible bonds.
Success in this course is based on the expectation that students will spend a minimum of nine hours of study time per week in preparation for class.

COURSE REQUIREMENTS

Recommended Book(s):


Online Resource(s):

There are numerous online resources to learn and apply quantitative analysis to finance. Though no complete, these are a few that the instructor has found useful.

- https://wilmott.com/
- http://www.nuclearphynance.com/
- https://www.quantopian.com/
- https://www.quantstart.com/
- https://stackexchange.com/

Please note that there are numerous books and online resources to learn nearly everything about Python. However, please become familiar with the following sites:

- https://www.python.org/ Portal to everything Python from the keepers of the technology.

Prerequisite(s):

- **FIN 201A – Investments**: Covers topics related to financial economics, including investors’ attitudes toward risk, capital allocation, portfolio selection, and asset pricing models (Capital Asset Pricing Model and the Arbitrage Pricing Theory), the efficient market hypothesis, fixed income markets, equity valuation, and options and futures markets.
- **FIN 204A - Advanced Corporate Finance Theory and Practice**: Develops depth of financial skills and logical thought processes necessary to formulate and implement corporate finance decisions in a competitive environment.
- **FIN 215F – Python and Applications to Finance**: Designed for finance students to build a skill set that can harness the power of the computer, computer science, and data analysis to various applications in finance. A set of these applications in finance that are relevant is data analysis (statistics), data visualization (charting), algorithms (optimization, numerical methods, linear algebra), and forecasting (time series analytics, stochastic methods).
**Class Participation:** Class participation is expected of everyone, and class attendance is required.

**Assignments:** Assignments must be done in groups of no more than two students. Grades on each assignment are assigned to all members of the team (although the instructor reserves the right to alter individual grades in certain circumstances, e.g., when it is clear to me that an individual did not contribute to the assignment in a consistent and meaningful way). Students can choose their own partners and it is expected that all assignments are completed equally by both team members.

**Special Accommodation:** If you are a student with a documented disability on record at Brandeis and wish to have a reasonable accommodation made for you in this class, please see the instructor immediately. Please keep in mind that reasonable accommodations are not provided retroactively.

**Grading:** Assignments = 60% and Final Examination = 40%

**Class Format.** In general, the instructor will lecture for most of the class time using lecture notes that are available to all students via Latte. In addition, the instructor will display Python code on various quantitative models used by the industry. In addition, one speaker will be invited to the class from the industry to discuss his/her background and duties in the quantitative finance field.

**Academic Honesty.** Students are expected to be honest in all of your academic work. Please consult Brandeis University Rights and Responsibilities for all policies and procedures related to academic integrity. Students may be required to submit work to TurnItIn.com software to verify originality. Allegations of alleged academic dishonesty will be forwarded to the Director of Academic Integrity. Sanctions for academic dishonesty can include failing grades and/or suspension from the university. Citation and research assistance can be found at LTS - Library guides.

**COURSE OUTLINE**

- Trading in the Financial Markets
- Python Programming
- Probability and Statistics
- Technical Analysis
- Interest Rate Securities (Bonds, Futures, and Swaps)
- Building of a Term Structure of Interest Rates
- Pricing Options Numerically with Variance Reduction Techniques
- Pricing Credit Default Swaps
- Building a Backtest Framework
- Market Microstructure and Limit Order Books
- Building an Algorithmic Trading Application
- Pricing Distressed Convertible Bonds
- Machine Learning Applied to Finance