Course Objective
This course focuses on studying and implementing quantitative trading strategies. Some quantitative models will be presented. The practical aspects of the implementation of these strategies will be discussed, such as the statistical estimation of the parameters in the models and the assessment of the strategies’ performance. Some examples with real data will be presented.

The coursework will require students to read extensively, work out examples and also implement algorithms using statistical software (R is recommended). Students are also encouraged to meet with the instructor for assistance with any of the topics or to pursue in-depth research on related topics of specific interest.

Please note that slides, relevant course readings and solutions to past assignments will be posted on NYU Classes before each class. Students will be expected to read materials ahead of course meetings to participate actively in class and also be prepared to discuss assignments in class. Readings in addition to the ones outlined in the syllabus may be posted on NYU Classes for better understanding of topics.

March 2017 Bloomberg article: Quants Are Eating Away at Wall Street’s Edge (included in class one reading)

Research/Career Focus
Quantitative trading has been around for about seventy years but is more important than ever in the current market environment. Becoming a quant requires understanding and skills in a variety of different fields that include business, finance, statistics, mathematics, computer science and economics. The lectures will equip and prepare the students to actively pursue advanced research or seek careers in the area.

Prerequisites
Strong interest in working with mathematical finance and its business applications is required. Basic understanding of financial markets and related concepts is recommended. Some knowledge of stochastic processes, times series models and econometric analysis is recommended. Working skills with Matlab/Excel VBA/R (http://www.r-project.org) or another statistical analysis software is recommended. The instructor will use R and R Studio for demonstrations of examples.

For project implementation download data from Reuters/Bloomberg/relevant data-source using API functions (BDH, BDP are examples). Import them into R. For any model implementation two models are expected – data segment using API functions or VBA and the analytical model in R/Matlab/VBA.
Schedule and Grading
Classes will be held every Monday.
Assignments and mid-term will count towards 40% of the student’s final grade.
Class participation and attendance will be 10% of the final grade.
Final project (proposal submission, teamwork, presentation in class and report) will be 50% of the final grade.
Students are encouraged to form groups of three and choose from a selected pool of project topics presented to them in the first class. The groups are expected to submit a report and make a presentation of their project on the last class. Students are also encouraged to contact the instructor for any assistance with their final project.

Course Outline

Class One – 11 September 2017
Objective of Class One is to introduce the concept of “quantitative trading systems”, its components (mainly alpha generating strategy) and the areas of focus for the rest of the semester. Final projects, types of assignments and grading systems will be discussed. The following topics will be covered:
- Introduction – History of the industry and Definitions in quantitative trading, a simple overview of the existing models and the challenges.
- Performance evaluation of portfolios and walk-through worked out examples.
In this class the following topics will be discussed along with working examples: Calculating returns for a portfolio, measuring a portfolio’s performance using performance ratios (Sharpe ratio, Treynor ratio, Jenson’s alpha), risk metrics for large portfolios, using an index to track performance and also performance attribution analysis. Examples will be worked out in class to equip the students for the assignment which will cover all discussed topics.
Familiarization with firms that actively participate in systematic trading.

References:
1. Readings posted under Class One Resources NYU Classes.
2. PowerPoint slides
3. Seeking Alpha: risk-reward profiles of strategies

Class Two – 18 September 2017
Objective of Class Two is to review or to familiarize the students with the necessary statistical and analytical methods for researching and start working on their final projects. With that end in focus regression analyses and time series models are discussed and implemented. Please have R Studio installed in your computers/laptops to follow along with implementation steps in the class. The following topics will be covered:
- Working model of performance attribution for large portfolios, setup of relevant benchmark, rebalancing, drawdown, value at risk,
- Example setup of a simple strategy – prototype in Excel and working model implementation in R (moving average strategy),
- Familiarization with regression analyses and interpretation of statistical measures,
- Time series analyses and forecasting in automated trading.
References:
1. Chatterjee Hadi (2006), Regression Analysis by Example. Chapters One through Nine are helpful for a quick recap of regression analyses and various related measures.
3. Students are encouraged to make use of online resources (videos, research websites) for learning more about R (free software with extensive online documentation).
4. Tsay, R.S. Analysis of Financial Time Series. Chapter Two

Class Three – 25 September 2017 (Midterm + Topic discussion)
- Second half of class is midterm (covers topics from classes one and two)
- Final project proposal due (deliverable)

Objective of Class Three is to study the implementation of trend following strategies – momentum and contrarian. The class will cover phases involved in devising a successful strategy – setup of trading signals, stop loss triggers, monitoring of portfolio risk. In addition to covering the trend following strategies, we will also discuss Trading and Exchanges by Larry Harris. The following topics will be covered:
- Introduction to Alpha-seeking strategies,
- Momentum strategies and contrarian strategies,

In this class we also study the basic characteristics of prices. Explore the mean reversion and random walk processes and their connection with price movements/returns. Discuss ways in which assumptions affect trading strategies. In this context we will discuss some important properties displayed by sets of price data – co-integration, correlation and their differences.

Discuss the terminologies involved in trading.

References:

Optional Reading:
7. Shen, Szakmary, and Sharma (2007): An Examination of Momentum Strategies in Commodity Futures Markets
Class Four – 2 October 2017

Objective of Class Four is to study the statistical arbitrage techniques, particularly pairs trading. This class will review the time series analysis from Class Two. It will also cover Capital Asset Pricing Model and its implications in quantitative trading. The following topics will be covered:

- Mean reversion vs random walk,
- Momentum and contrarian strategies,
- Implementation of momentum strategy prototype and worked out R implementation.

Class Five – 9 October 2017

Objective of Class Five is to study statistical arbitrage strategies and their implementation. Introduction to pairs strategy and identification of potential pairs are covered in this class. Familiarization with Engle and Granger approach and Johansen’s methodology. The following topics will be covered:

- Cointegration,
- Testing for cointegration in two time series,
- Different ways for implementing pairs trading strategies.

References:


Class Six – 16 October 2017

Objective of Class Six is to review pairs trading strategies and their implementation in R using VECM (including prototype setup in Excel). Recap of all strategies and implementation techniques covered in the course. Review and workshop session for final presentations. Topics covered will include:

- Implementation of pairs trading strategies in R,
- Chriss-Almgren Framework for Execution.

References:


Class Seven – 23 October 2017

Project Presentation: Each group will submit their final report and present their assigned project. All groups are encouraged to read all topics and be prepared to ask questions and learn from presentations of your peers.