

New York University Polytechnic School of Engineering

Finance and Risk Engineering

Course Outline FRE 6153: Foundations of Financial Technology and Services

Professor Roy S. Freedman

When: (Check Albert).

Where: Brooklyn TBA (Check Albert)

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Course Pre-requisites: Graduate status.

Course Description

Financial systems include trading systems, brokerage systems, exchange systems, regulatory systems, risk management systems, and clearing systems. Financial technology is the technology used in financial systems. This technology includes numerical methods, software engineering, telecommunication networks, fault tolerant design, database engineering, artificial intelligence, and auctions. This course introduces an evolutionary framework within which to understand the different aspects of financial technology. The course discusses historical systems, legacy systems, and proposed systems based on state-of-the-art technologies.

Course Objectives

1. Provide a survey of existing financial systems and their core technologies.
2. Discuss how the complex financial ecosystem (system of systems) works.
3. Help technologists learn about financial systems and help financial professionals learn about the financial technology that assists them in their work.
4. Facilitate communication among finance professionals and technology specialists.
5. Understand the trends of automating market participants such as traders, brokers, market makers, clearing members and analysts.

Course Structure

Classes consist of lectures, discussion of financial technology news, readings, team presentations, and case studies. Each student will be a member of a team. Individual and team assignments will be given. The final team project provides a way for students to present independent research (a review of a financial technology, system, or a case study). Teams will propose a topic, get feedback, and approval, and complete a professional report and formal presentation.

Readings

The required text for the course is: *Introduction to Financial Technology* by Roy S. Freedman, Academic Press, 2006, ISBN: 0123704782. Other material consisting of papers, case studies, and selected news articles are available at the course website:

<http://inductive.net/fe/6153/6153.htm> (password provided in class).

Course Requirements

Students must submit all of the following deliverables to be eligible for an A:

- 1) All Discussion Questions (DQs) in the Assigned Textbook Chapter (see below).
After we finish discussing the Chapter in class, DQs are due by the next class.
- 2) At least one* optional assignment *per week* (assigned during class).
This is due at the next class meeting.
- 3) Your participation in the team assignments (3 or 4).
- 4) Your *individual* performance on a surprise quiz.
- 5) Your team's project proposal – due at least 2 weeks before your presentation at the final meeting (the Class Seminar).
- 6) Your team's project Report – due at the Class Seminar.
- 7) Your team's project Presentation the Class Seminar
- 8) Your participation at the Class Seminar

Rules for submission

- Email all deliverables to roy.freedman@nyu.edu .
- Put the text "FRE 6153" in the Email subject line, Email text body, and all attachments so your email will be correctly indexed.
- Insert a <space> between FRE and the course number.
- Identify yourself by name and student number in the email subject line. The email text body, and all email attachments must include the names and student numbers of everyone (such as your team members) who helped you work on the assignment. Identify the assignment name as well.

If these rules are not followed there will be a delay in your grade.

Collaboration is encouraged and required. The class will be broken up into teams. Elect a Team Leader who will be responsible for submitting all team work. Identify the contributors and contributions and the name of the team in the email subject line. As long as all collaborators are listed, only one email need be submitted. Identify all collaborators by name and student number. If these rules are not followed there will be a delay in your grade.

Your expected course participation includes reading the assigned material from the textbook and course website before class. Class participation – questions, comments, observations, and feedback – is highly encouraged. Attendance will be taken.

First Team Assignment (Example)

Name of Assignment: The Financial Technology Companies bidding for the Consolidated Audit Trail (CAT).

Approximate Date: Meeting 4.

Description: The proposed CAT system will track securities orders across ****all markets**** and will have to include information for the entire life-cycle of a securities order, from order origination through routing, cancellation, modification, or execution. The SEC has approved the 10 financial technology companies as CAT bidders. Teams will be assigned to a financial technology company CAT bidder and will answer a set of questions relating to the company and its technology expertise. Teams will prepare a professional presentation with a single page for each answer and a single page for references.

Final Team Assignment

Name of Assignment: The Financial Technology of Yield Curves.

Approximate Date: Meeting 9.

Description: The US Treasury uses a cubic spline algorithm to compute interest rates and their resulting yield curves. Financial analysts use data from the zero-coupon bond yield curve to help them price and hedge everything, from options to swaps. Students will build zero-coupon bond yield curves in Excel and VBA using different spline technologies and algorithms.

Homeworks and team assignments count for 60% of the grade. The Team Project, consisting of a proposal, report, and presentation, counts for 40% of the grade.

Proposal for Team Project

Name of Project Proposal: Chosen by Team.

Approximate Date: Meeting 11.

Percentage of final grade: 10%

Description: The goal of the proposal is to prove that your team can do independent research, and present your results in a professional context. You are free to study any topic of interest to you that is related to the class topics. You can do a book report, an article review, a case study, a detailed description of a financial organization, system, or technology, method, or product. There are many papers you can review that are cited in class ("news") or cited by the text or that are posted on the course web site. Your work can be a review or a case study of someone else's work – as long as this is unambiguously identified in your title and your references. For example, "A Review of Authored by ..."

I will give you feedback on your proposal and help refine the scope of your study. Your proposal must be approved at least two weeks before presentation. Your proposal must include a set of references you will study.

Presentation and Report for Course Seminar

Name of Project: Chosen by Team – same as Team Proposal (see above).

Date: Last Class Meeting.

Percentage of final grade: 30%

Description: The report should be something you can be proud to cite on your resume and bring to interviews. The report should be at least 6 pages, written

professionally, delivered in Word or PDF. It should be a professional review of your study. Make sure that you know the meaning of every word and define every acronym or abbreviation before use. Include page numbers. Formally identify the source of all diagrams, pictures, and quotes. Include a list of references. Include page numbers. Most (at least $\frac{3}{4}$) of your references should be primary sources – not encyclopedias like Wikipedia (note this). When researching material on the web, use <https://scholar.google.com/> for academic papers and legal cases.

The presentation should be something you can be proud to bring to interviews. You should be able to talk about your work for 10-12 minutes. A shorter presentation that covers the major points is better than a longer presentation. *Do not read your report* during the presentation. Most professionals use PowerPoint (a good guideline is 1 minute per PowerPoint slide), but be careful! Read Edward Tufte's caveats on using PowerPoint.

For more information:

Consult points 6-10 on <http://inductive.net/fe/news/FAQ.htm>.

Discussion Questions

Approximate Date: Week after finishing the Chapter in class

Percentage of final grade: 20%

Schedule and List of Chapters Assigned from the Textbook

Week	Topics and Homework (Discussion Questions are at end of each chapter)
1	What is Financial Technology - Chapter 1. Financial vs. Commercial Systems; Financial vs. Gambling Systems; Financial vs. Military Systems
2	Physical vs. Virtual Delivery The First Wireless Network – Chapter 1
3	Form Teams. Team Assignment #1.
4	Prices, Interest, Time – Chapter 2 Financial Terms; Numbers and Prices Time is Money: Loans and Interest; Days, Months, and Years.
5	Algorithms and Financial Technology – Chapter 3 Financial Algorithms; Spreadsheets; Interpreters and Compilers for Procedural Languages. Fincad.
6	Algorithms and Financial Technology – Chapter 3 Spreadsheet Algorithms for Interpolating Prices and Rates
7	Financial Products – Chapter 4 Cash flows, yields, financial prices, and databases
8	Identifying Financial Objects – Chapter 5

	Symbology and Ticker Symbols
9	Team Assignment #2.
10	Financial Networks – Chapter 6 Critical infrastructures and market data technologies
11	Orders and Messages – Chapter 7 Anatomy of orders; FINRA Order Audit Trail System (OATS); TCP/IP and sockets FIX messages, XML standards; rule-based (algorithmic) trading
12	Systems of Financial Systems – Chapter 8 Representing systems; system analogies
13	Financial Risk– Chapter 9 Types of risk; Markov models for credit risk; optimization; bootstrap statistics
14	Final Seminar: Presentations and Reports

Standards and Plagiarism

You are not allowed to present other people's work as your own. Summarize in your own words ("paraphrase"), quote, cite, and provide a professionally formatted reference.

Copying violates professional standards. Review the NYU Code of Conduct at

- <https://engineering.nyu.edu/sites/default/files/2018-06/code-conduct2-2-16.pdf>
- <http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/educational-and-research-uses-of-copyrighted-materials-policy-st.html>

For more information:

Consult point 5 on <http://inductive.net/fe/news/FAQ.htm> .

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.