Even understanding finance doesn’t prepare you for the realities of how markets and their underlying infrastructure work today. Technology is a key driver of advances in the global markets. Virtually all US trading is done on electronic markets with exchange floors a relic of the past. Trading is done using algorithms, high frequency quant models and automated market makers. We have 11 competing stock exchanges and over 40 Alternative Trading Systems (ATSs) providing the mysterious dark liquidity which executes more than a third of our stock trades. We hear the markets rigged? We examine the issues of market structure and technology interaction that underlie these claims and make our own objective assessment. We study evolving payment systems, such as online transaction security using encryption, hashing, digital signatures, EMV, mobile payment products and Bitcoin. In examining post trade clearing and settlement we consider how the blockchain may significantly improve these processes.

The financial services industry is being transformed by globalization, regulation, competition, consolidation and technology. These forces will be explored, focusing on how technology is both a driver of change as well as the vehicle for its implementation. Industry consolidation and convergence will be viewed in light of current events. The course objective is to bring both the business practitioner and technologist closer together. Topics will be covered through a combination of lectures, readings, news and case studies.

**COURSE DESCRIPTION**

The course is made of modules, describing industry practice and the underlying technology:

- **Topic 1** Introduction to the Financial Services Industry
  - Money
  - Banks, Securities Firms, Insurance
  - The IPO Process
Topic 2  Payment Systems, retail and institutional, use of cryptography
  o Check, ATMs, Credit and Debit Cards
  o Automated Clearing House (ACH)
  o Intro to Cryptography, SSL, Public key infrastructure
  o New Models, PayPal, NFC, EMV, Apple Pay, Bitcoin
  o Institutional Money Transfer, Fedwire, CHIPS, SWIFT
  o Blockchain and its applications

Topic 3  Introduction to Markets and Trading
  o Market Data and the SIP
  o Market Indices
  o Order and Execution Management Systems (OMS/EMS)

Topic 4  US Equity Markets
  o NYSE history and new DMM structure
  o NASDAQ history and becoming an Exchange
  o Electronic ECN Markets
  o Maker Taker Market models
  o Bulletin Board and Pinksheets

Topic 5  Institutional Trading
  o Liquidity and Transaction Cost Accounting (TCA)
  o Institutional Algorithmic Trading
  o Alternative Trading Systems (ATSs)
  o Dark Liquidity and Dark Pools and Smart Order Routing

Topic 6  Low latency Trading and the Flash Crash
  o Automated Market Making
  o The May 2010 Flash Crash
  o Quant Trading (Stat Arb, Pairs, etc.) Trading Strategies

Topic 7  HFT and Are US Equity Markets Rigged?
  o Payment for Order Flow
  o Wholesalers (Internalizers)
  o HFT, Colocation, Latency Arbitrage, Front Running
  o Market Structure, Fragmentation, Spreads, Volatility
  o International Views on HFT
Topic 8  After the Trade, Clearance and Settlement
   o CUSIPS, LEI
   o Central Counterparties, Depositories
   o Prime Brokers

Topic 9  Introduction to Foreign Exchange Spot and Forwards

Topic 10  Introduction to Futures Contracts

Topic 11  Introduction to Options Contracts

PREREQUISITES

You should have had at least one course in investments, equities, fixed income, etc. or equivalent experience. If you have any questions, please contact me.

TEACHING MATERIALS

  o NYU Classes website for this course will contain lecture materials and late breaking news
  o Readings will be posted on NYU Classes at least a week early and should be read prior to class each class. THERE IS NO TEXT BOOK for this course.
  o Students are encouraged to find current materials in the news or on the Internet for class discussion.
  o Industry speakers will be invited periodically. Their materials will also be posted on NYU Classes.

GRADING

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>First Quiz – Intro and Payment Systems</td>
<td>30%</td>
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<tr>
<td>Second Quiz – Financial Markets</td>
<td>35%</td>
</tr>
<tr>
<td>Third Quiz – FX, Futures and Options</td>
<td>25%</td>
</tr>
<tr>
<td>Class participation</td>
<td>10%</td>
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</tbody>
</table>

CLASSROOM BEHAVIOUR

Default Policies for Stern Courses are incorporated by reference:
http://www.stern.nyu.edu/portal-partners/academic-affairs-advising/policies-procedures/default-policies-stern-courses

http://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/academic-integrity-for-students-at-nyu.html

Stern rules state that you may not use cell phones, laptops or other ELECTRONIC DEVICES OF ANY KIND during class meetings. You must silence cell phones BEFORE class. If you are on-call for work or family, place your device on vibrate and leave the room before taking the call. If your phone rings, you will be asked to leave. Further I reserve the right to reduce your final grade by reducing points normally awarded for class participation.
Arriving late interferes with other students' learning and is not acceptable. Subway delays and other problems are unavoidable on occasion, but it is each student's responsibility to plan carefully to arrive on time and well prepared. Repeated latecomers will be penalized. Classes are recorded and will be available the next day for students unable to attend a session. Repeated absences will affect class participation grades.

You may eat in class as long as it is not odiferous or noisy. There will be a break at about 7:30 when you can get “dinner”. Please clean up and throw away all trash.

As a mark of respect, I ask all men to remove their caps or hats while in class, unless worn for a religious reason.

This course has a “zero tolerance” policy on cheating and plagiarism. Any student who breaks academic rules in this course has violated the mutual trust on which teaching and learning are based and will not only receive a zero for that assignment, but will be excluded from taking any further quizzes or exams in this course, which is likely to result in a failing grade for the course. For serious infractions I will ask the University’s Disciplinary Panel to suspend the violator from all future courses. Remember that giving improper help is as clearly a violation as taking it. Please see the NYU Stern Code of Conduct.

If you have a qualified disability and will require academic accommodation during this course, please contact the Moses Center for Students with Disabilities (CSD, 998-4980) and provide me with a letter from them verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the CSD, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation.

**Your e-mail address**

Be sure your email address in NYU Classes is correct. I will use it to communicate timely information about the course.

**Preliminary Class Schedule**

All topics, dates and guest speakers are subject to change. Changes will be posted on NYU Classes

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Questions</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Course Logistics</td>
<td>What’s this course about?</td>
</tr>
<tr>
<td></td>
<td>Introduction to the Financial Services Industry</td>
<td>How are the teaching materials organized? What is the grading policy? How should we communicate?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How is the financial services industry organized</td>
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<tr>
<td></td>
<td></td>
<td>What are the functions of banking, securities, insurance, markets</td>
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<td>Differences between retail and institutional, buy side and sell side</td>
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<td></td>
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<td>How firms raise capital, The IPO process and Google’s Dutch auction</td>
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<td>How to research a firm and Homework Assignment</td>
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</tbody>
</table>
| Week 2 | Payment Systems I | What is the history and economics of various payment methods? Cash, debit cards, credit cards  
How are payments processed in the US? ACH  
What has the experience been with emerging payment systems, Paypal, EMV, Square, EZpass, Metrocard |
| --- | --- | --- |
| Week 3 | Payment Systems II | How do secure payment systems work? SSL Encryption  
Institutional high value payments via Fedwire, CHIPS and SWIFT.  
Blockchain and Bitcoin |
| Week 4 | US Equity Markets | **Quiz Weeks 1-3**  
What was the history of the NYSE  
How is the floor organized in posts and booths  
What is a seat  
Who are the people on the floor, brokers, (house and $2) and the specialists - What do they do  
What is the trading process  
How did abuses and regulation drive it  
Reg 390, Reg ATS and decimalization  
What happened in 2005 – the new NYSE Group  
Merger with Arca Exchange  
Implications of Reg NMS  
DMMs, SLPs – the new trading process  
International mergers  
Future of the NYSE |
| Week 5 | US Equity Markets II | Return and Review Quiz  
What is the history of NASDAQ  
How does its multi-dealer model work; What is its trading process and rules  
How does an order book work  
What was the impact of ECNs  
Maker taker model  
Acquisitions of INET and BRUT by NASDAQ  
What happened when NASDAQ became an “exchange” the Trade Reporting Facility (TRF)  
What are NASDAQ’s future plans  
Bulletin Board and Pinksheets |
| Week 6 | Guest Speaker | TBA  
The institutional search for liquidity  
Transaction Cost Accounting (TCA)  
Benchmarks, VWAP, implementation shortfall etc. and post trade analytics  
Dark liquidity, dark pools  
Alternative Trading Systems e.g., Liquidnet, BIDS, LEVEL, etc.  
Market Structure 11Exchanges and 50+Dark Pools and internalization  
Algorithmic trading by institutions |
| Week 7 | Low latency Trading and the Flash Crash | Automated Market Making  
The May 2010 Flash Crash  
Quant Trading (Stat Arb, Pairs, etc.) Trading Strategies |
<table>
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<tr>
<th>Week 8</th>
<th>HFT and Are US Equity Markets Rigged?</th>
<th>Payment for Order Flow Wholesalers (Internalizers) HFT, Colocation, Latency Arbitrage, Front Running Market Structure, Fragmentation, Spreads, Volatility International Views on HFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 9</td>
<td>Quiz 2 Weeks 3-8</td>
<td>Guest Speaker TBA After the Trade What is clearance and settlement What are CUSIPs, LEI What are T+1 and T+3 processes What are the functions of a prime broker and custodian</td>
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<tr>
<td></td>
<td>No Class</td>
<td>Thanksgiving</td>
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<tr>
<td>Week 10</td>
<td>Forex, Futures</td>
<td>How is foreign exchange traded? How to read FX rates What are FX forwards How are forward rates calculated How are FX rates related – purchasing power parity How are cross rates calculated What are futures How are they traded and settled What is in the futures contract How are they valued What are the margin requirements What is the difference between forwards and futures? New electronic markets</td>
</tr>
<tr>
<td>Week 11</td>
<td>Options</td>
<td>What are options How are they traded and settled How are they valued – Black Scholes model What are the Greeks How do futures and options differ Review for final</td>
</tr>
<tr>
<td></td>
<td>Review for final</td>
<td></td>
</tr>
<tr>
<td>Week 12</td>
<td>3rd Quiz</td>
<td>Wrap-up and 3rd Quiz Weeks 9-11</td>
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