

# MIT IAP Presentation

## Preparing for a Career in Financial Engineering

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<http://web.mit.edu/career/www/graduate/fieldfinance.html>

# Samer Haj-Yehia, Short Vitae



## ■ Education

- MIT, PhD in Economics, 2004.
- Hebrew University, MBA in Finance, 1998
- Hebrew University, LLB (JD), Law, 1998
- Tel-Aviv University, Post-Graduate Studies in Auditing and Accounting, 1998
- Hebrew University, MA in Economics, 1994
- Hebrew University, BA in Accounting and Economics, 1991.

## ■ Professional Experience

- Fidelity Investments, Director, Financial Engineering, Boston, MA – 2006 to Present
- Analysis Group, Associate, Boston, MA – 2004 to 2006
- Deloitte Touche Consulting, Senior Manager, Tel-Aviv, Israel – 1999 to 2000
- Herzog, Fox & Neeman, Law Firm, Associate, Tel-Aviv, Israel – 1998 to 1999

## ■ Teaching Experience

- Harvard, MIT, Hebrew University, An-Najah University and others.

## ■ Research Area

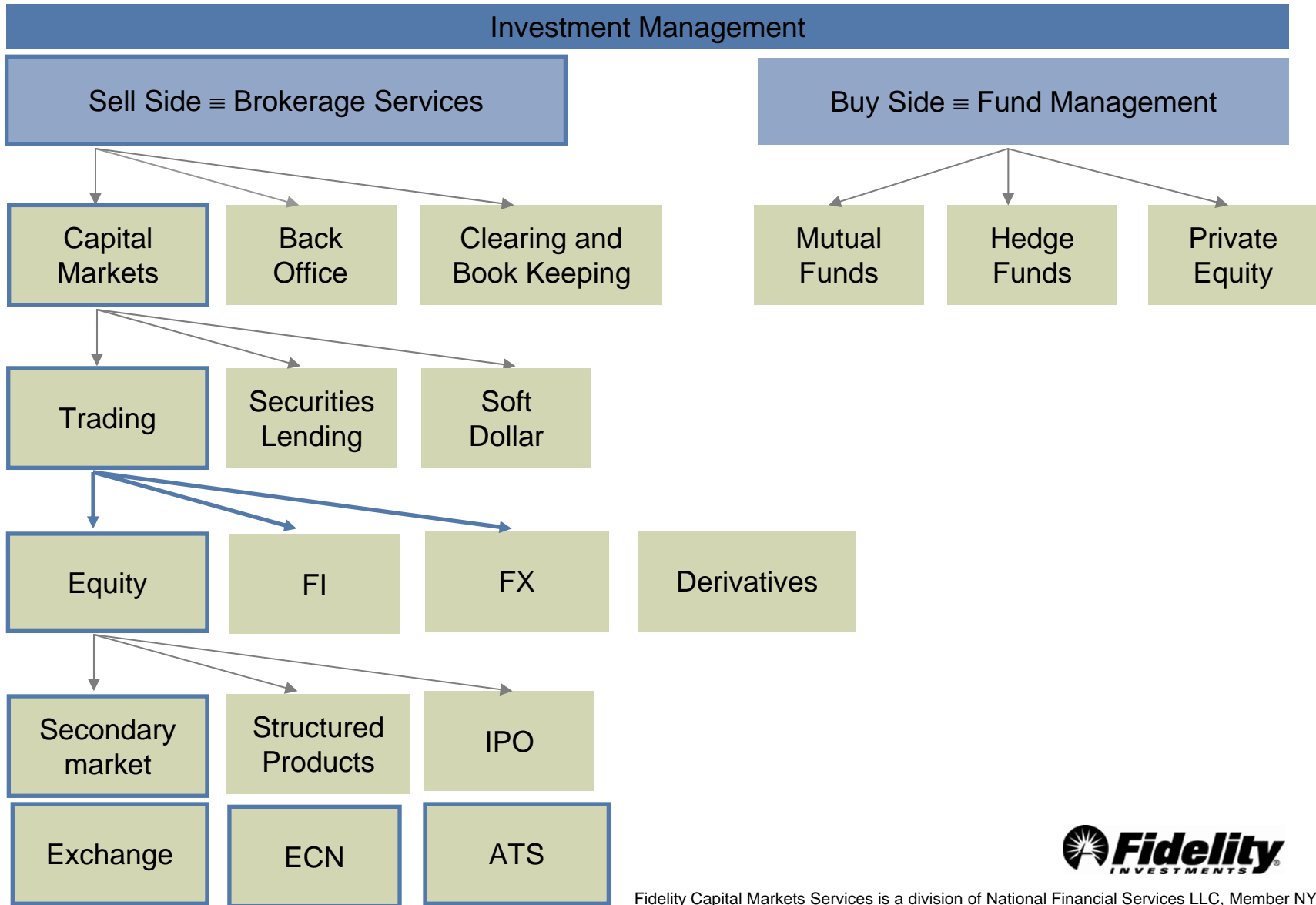
- Algorithmic trading, portfolio optimization, arbitrage, options, futures, equity, currency, exchange rates, macroeconomics, policy, and time series analysis.



# Investment Management Overview

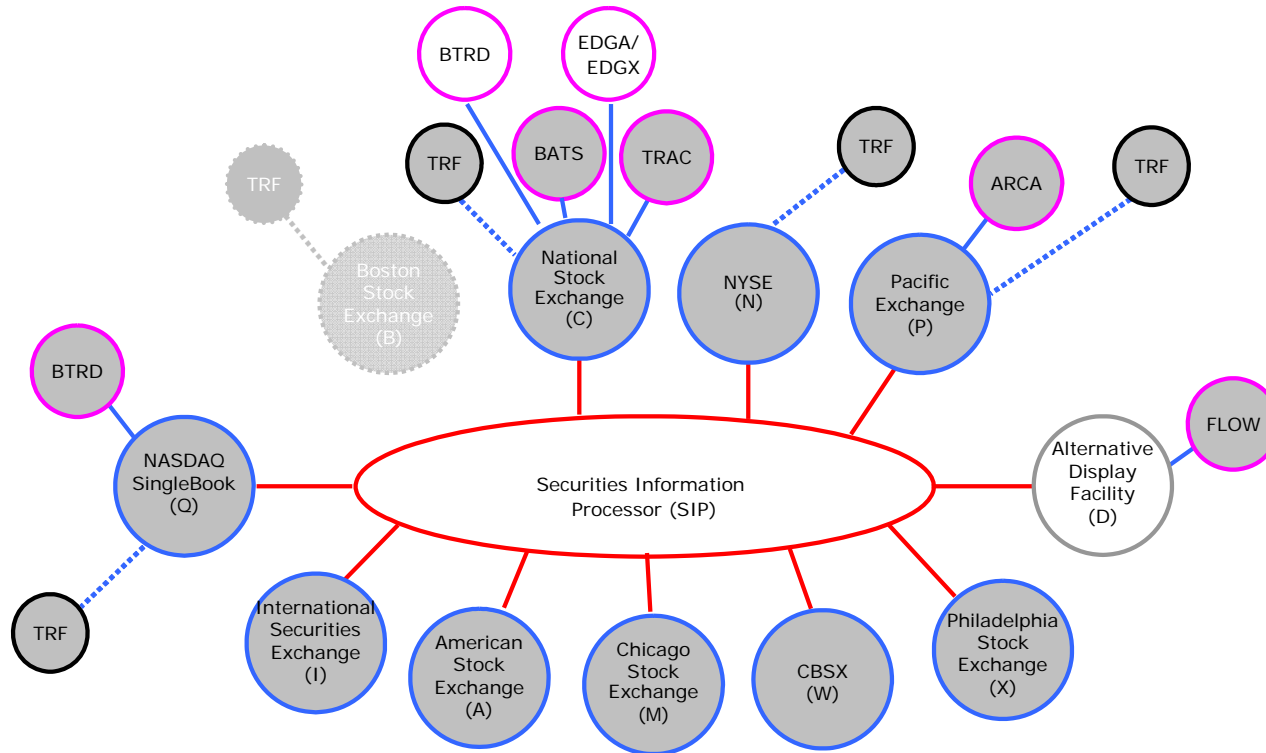


The investment management industry is broken down into different fields



# Exchange Landscape

The exchange landscape is becoming complicated, fragmented, and connected.



Source: FCMS, January 7, 2008.

# Fidelity Capital Markets Services (FCMS)



Fidelity Capital Markets Services is the last touch-point of any order to the markets within Fidelity.



NASDAQ, NYSE



# FCMS Products and Services



Fidelity Capital Markets Services offers personal service and consultation, as well as an array of unique trading solutions combined with a dedication to execution excellence.

- **Equities Trading**
  - Electronic Trading
    - Algorithmic Trading Strategies
    - Program Trading
    - Direct Market Access
    - CrossStream® (FCMS; Internal Proprietary Crossing Network)
  - Block Trading
  - Institutional Execution Quality (IEQ®)
  - International Trading
  - Options Trading
- **Securities Finance**
- **Institutional Custody Reporting**
- **Syndicate Products**
- **Structured Products**
- **Foreign Exchange (Fidelity FOREX, Inc.)**
- **Fixed Income Trading**
  - Auction Rate Preferreds
  - Certificates of Deposit
  - Commercial Paper
  - Corporate Bonds
  - Fixed Rate Capital Securities
  - Government Sponsored Enterprises
  - Investment Grade and High Yield Corporate Bonds
  - Mortgage-Backed Securities
  - Municipal Bonds and Resets
  - Structured Investments
  - Unit Investment Trusts
  - U.S. Treasuries
  - U.S. Treasury Auction
- **Fidelity Prime Services®**
  - Execution
  - Securities Lending
  - Clearing/Custody
  - Financing
  - Reporting
- **Additional Services/Support**
  - Transition Management Services
  - Fixed Income Outsourcing
  - Managed Account Services
  - NYSE Floor Brokerage
  - Broker/Dealer Compliance Consulting
  - Trading Technology Vendor Management
  - Execution Quality Reporting
  - Rule 28(e) Client Commission Programs
  - Commission Recapture/Expense Reimbursement Arrangement



# Electronic Trading Products and Services



Product or Service	FCMS Product
<ul style="list-style-type: none"> <li>Alternative Trading System (ATS). Dark Pools and dark pools aggregators: Venue outside of exchanges for bringing buyers and sellers together</li> </ul>	CrossStream <sup>®</sup> and DarkSweep <sup>SM</sup> Fidelity's internal ATS
<ul style="list-style-type: none"> <li>Algorithmic trading strategies</li> <li>Quantitative trading strategies</li> <li>Pre-trade analytics</li> </ul>	Model Trade Execution (MTRX) <sup>®</sup>
<ul style="list-style-type: none"> <li>Manual access to the marketplace</li> </ul>	Direct Market Access Platforms and Connectivity
<ul style="list-style-type: none"> <li>Client-focused insight into the electronic marketplace</li> <li>Pre-trade and post-trade analytics and reports</li> </ul>	Electronic Brokerage Services Desk
<ul style="list-style-type: none"> <li>Post-trade analytical tools for measuring the quality of equity trade executions</li> </ul>	Institutional Execution Quality (IEQ) <sup>®</sup>



# Electronic Trading Product Lifecycle



Financial Engineering



Product Development



Operations and support



Sales



# Financial Engineering Roles and Responsibilities



- Research, design, back-test, deploy, evaluate, interpret, monitor and tune high-frequency equity trading systems including:
  - Algorithmic trading strategies
  - Automated dealing strategies
  - Program trading
  - Institutional order size automated market making
- Build models for intraday stock price, volume and volatility
- Derive optimal program trading strategies (e.g., smart routing strategies)
- Analyze impact of trading activities on portfolios and portfolio transitions and perform slippage and performance attribution analyses.
- Concisely and credibly communicate results to portfolio managers and traders
- Create and support analytical systems used for comprehensive performance measurement and attribution
- Conduct research and analysis on market structure changes and competitors
- Identify trends and implications of regulatory and market changes on FCMS equity business model



# Financial Engineering Qualifications



- Solid skills in the following fields:
  - Applied financial econometrics and time series analysis
  - Optimization and simulation models
  - Financial modeling and mathematical finance
  - Statistical pattern recognition techniques
  - Game theory and PDE
  - Building platforms for back-testing of models and algorithms, extraction of vast amounts of data from relational databases
  - Financial real-time and historical databases as such Bloomberg, CompuStat, CRSP and Factset and managing and modeling tic-by-tic data
- Computer skills (Matlab, Java, C++, C#, SAS, EViews, CPLEX, SQL, Unix)
- Proven, effective verbal and written communication skills appropriate to all levels of internal and customer audiences
- Strong leadership abilities including the ability to project credibility and authority with cross-functional teams and strategic partners.
- Ability to think creatively and make logical conclusions and critical decisions without direction



# Example of Problems that Build on Engineering



- What is expected intraday price and volume?
- Do some stocks behave like one another?
- How should I schedule my trade over time?
- What is the optimal way to route through the different ECNs, ATs and exchanges?
- How to design algorithms able to crunch hundreds of thousands of messages per second?
- How to distill simple, condensed information from huge financial databases?



# How to Get Prepared



- Summer internships
- IAP externships
- Keep in contact with professionals and class of seniors
- Use MIT resources (Career office and online library, writing center, ICAN)
- Take CFA exams
- Try project-based classes at Sloan
- Take advanced classes in mathematical and statistical tools
- Learn how to do high-quality analysis in very short time-frames
- Practice and enhance communication skills
- Attend company presentation
- Prepare for interviews
- Improve project management skills<sup>1</sup>



# MIT Courses to Consider



- 14.416J Introduction to Financial Economics
- 14.440J Advanced Financial Economics I
- 14.441J Advanced Financial Economics II
- 14.442J Advanced Financial Economics III
- 14.126 Game Theory
- 14.128 Dynamic Optimization and Economic Applications
- 14.147 Topics in Game Theory
- 14.30 Introduction to Statistical Method in Economics
- 14.32 Econometrics
- 14.36 Advanced Econometrics
- 14.381 Statistical Method in Economics
- 14.382 Econometrics
- 14.384 Time Series Analysis
- 14.385 Nonlinear Econometric Analysis
- 14.386 New Econometric Methods
- 14.387 Topics in Applied Econometrics
- 15.081J (6.251J) Introduction to Mathematical Programming
- 15.084J (6.252J) Nonlinear Programming
- 15.093J (6.255J) Optimization Methods
- 15.034 Applied Econometrics and Forecasting for Management
- 15.070 Advanced Stochastic Processes
- 15.075 Statistical Thinking and Data Analysis
- 15.077J Statistical Learning and Data Mining
- 1.155 Engineering Risk-Benefit Analysis
- 1.151 Probability and Statistics in Engineering
- 6.041 Probabilistic Systems Analysis
- 6.231 Dynamic Programming and Stochastic Control
- 6.245 Multivariable Control Systems
- 6.262 Discrete Stochastic Processes
- 6.253 Convex Analysis and Optimization
- 8.044 Statistical Physics I
- 8.08 Statistical Physics II
- 16.322 Stochastic Estimation and Control
- 16.323 Principles of Optimal Control
- 17.872 Quantitative Research Methods I: Introduction
- 17.874 Quantitative Research Methods II: Multivariate
- 18.05 Introduction to Probability and Statistics
- 18.175 Theory of Probability
- 18.177 Stochastic Processes
- 18.440 Probability and Random Variables
- 18.443 Statistics for Applications
- 18.445 Introduction to Stochastic Processes
- 18.447 Probabilistic Methods in Combinatorics and Algorithms
- 18.465 Topics in Statistics
- 22.38 Probability and Its Applications To Reliability, Quality Control, and Risk Assessment
- MAS.622J Pattern Recognition and Analysis



# Readings



- Books:
  - Green (2007) , "Econometric Analysis"
  - Hamilton (1994), "Time Series Analysis"
  - Webb (1999), "Statistical Pattern Recognition"
  - Vapnik (1999), "The Nature of Statistical Learning Theory"
  - Hull (2002), "Options, Futures, and Other Derivatives"
  - Wilmott (2006), "Paul Wilmott on Quantitative Finance "
- Journals
  - The Wall Street Journal
  - The Financial Times
  - Traders Magazine
  - The Trade
  - Trader
  - Wall Street and Technology
  - The Journal of Trading
  - Advanced Trading
  - Institutional Investors Journals



# Interview Tips



- Demonstrate honesty, clarity, concision and full disclosure
- Demonstrate long-term and immediate interest
- Demonstrate a tools-box applicable to financial engineering
- Demonstrate reasonable knowledge of market microstructure and current news and developments
- Demonstrate knowledge of who's who in the industry and academia



# Work Life



- Constant effort to educate and better yourself and stay abreast
- Evolving business environment relative to geo-political, economic and academia
- Need always to balance multiple high-priority projects
- Structured work life as compared to your academic schedule
- Nights and weekends are (usually!) to yourself and personal pursuits
- Limited travel
- High degree of independence and great reliability on self motivation
- Fast-paced, competitive environment
- Interesting multi-disciplinary tasks

# Financial Engineering Offering at FCMS



- Managed opportunities to interact with clients
- Intimate details of trading microstructure
- State of the art forecasting models
- Highly calibrated algorithmic trading strategies
- Close contact with traders and sales team
- Managed opportunities to interact with clients
- Mentorship
- Available summer internships and IAP externships



## Contact Information:

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