MASTER of SCIENCE PROGRAM
Mathematics in Finance

NEW YORK UNIVERSITY
Courant Institute of Mathematical Sciences

Class of 2018 Resume Book

Mathematics in Finance M.S. Program

Courant Institute of Mathematical Sciences
New York University

March 21, 2019

For the latest version, please go to
http://math.nyu.edu/financial_mathematics

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New York University
A private university in the public service

Courant Institute of Mathematical Sciences
Mathematics in Finance MS Program
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Dear Colleague,

We are pleased to provide you with the resumes of the recently graduated students in the Courant Institute's Mathematics in Finance Master's Program who just finished their degree at the end of December 2018. We hope you consider them for full-time positions at your firm.

We believe our students are the most elite, the most capable, and the best trained group of students of any program. This year, we admitted less than 8% of those who applied. The resumes you find here describe their distinguished backgrounds. For the past ten years we have a placement record close to 100% for both summer internships and full-time positions. Our students enter into front office roles such as trading or risk management, on the buy and the sell side. Their computing and hands-on practical experiences make them productive from day one.

Our curriculum is dynamic and challenging. For example, the first semester investments class does not end with CAPM and APT, but is a serious data driven class that, examines the statistical principles and practical pitfalls of covariance matrix estimation. During the second semester electives include a class on modern algorithmic trading strategies and portfolio management. Instructors are high-level industry professionals and faculty from the Courant Institute, the top ranked department worldwide in applied mathematics. You can find more information about the curriculum and faculty at the end of this document, or at http://math.nyu.edu/financial_mathematics/.

Sincerely yours,
Leif Andersen, Industry Adviser
Deane Yang, Chair
Petter Kolm, Director

MADHUR BHATTAD

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EDUCATION

NEW YORK UNIVERSITY, NY, NY January 2019
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance

- *Coursework*: Mean-variance optimization, factor models, regression and penalization, statistical learning, econometric methods, Black-Litterman, risk management, Black-Scholes, Greeks
- *Recitation leader:* Introduction to Mathematical Modeling (around 40 students)

INDIAN INSTITUTE OF TECHNOLOGY, GUWAHATI, INDIA May 2017
B.Tech in Mathematics and Computing

- *Coursework*: Calculus, probability, statistics, data structures and algorithms, scientific computing, time series econometric, Monte Carlo methods, macroeconomics, microeconomics

Certifications: CFA Level 2 candidate (CFA Institute)

Programming Languages: Python, Java, R, C/C++, Matlab, MySQL

EXPERIENCE

GUGGENHEIM PARTNERS INVESTMENT MANAGEMENT, NY, NY June 2018 – August 2018
Quant Risk Intern

- Reported different stress test and scenario analysis results to senior management
- Implemented a top down model valuation model and computed convenient risk measures
- Built a lean performance library in R and did reconciliation of performance and risk databases

RBT ALGO SYSTEMS, MUMBAI, INDIA June 2016-July 2016
Algorithmic Trading Intern

- Implemented and back-tested machine learning based positional trading strategy for index futures involving technical and fundamental indicators such as P/E ratio, moving averages and volumes
- Pitched the strategy to a group of 30 brokers explaining the benefits and the limitations

INDIAN INSTITUTE OF TECHNOLOGY, GUWAHATI, INDIA July 2016 – March 2017
Finance and Economics Club Mentor

- Initiated and led quantitative finance lecture series, workshops and mentoring programs
- Delivered lectures on topics including derivatives, equity valuation and accounting statements (cash flow statement, income statement and balance sheet) to around 100 campus students

PROJECTS

Betting against beta- Trading strategy implementation (Ongoing) (NYU Courant)

- Implemented a version of betting against beta strategy for US equities
- Built a portfolio optimizer, a transaction cost model, and a return attribution model for the strategy

Validity analysis of Phillips Curve (NYU Courant)

- Implemented a regression model on CPI to observe the validity of Phillips curve
- Observed seasonality effect of lagged CPI values and declining dependence on unemployment rate

Portfolio Optimization (NYU Courant)

- Executed Markowitz mean variance and a gradient descent based constraint flexible optimizer
- Simulated the efficient frontier and calculated the maximum Sharpe ratio portfolio
- Performed the weight allocation using Black Litterman for a given set of subjective views

Derivative pricing (NYU Courant)

- Used Binomial model, Black Scholes model and Monte Carlo simulation for option pricing
- Simulated interest rate paths to get implied OAS for a pass-through of mortgages given PSA-curve and market price of the MBS

SIMEON BIKORIMANA
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected – January 2019)

- ***Current Coursework****:* Portfolio optimization, option pricing, risk management, asset pricing models, market impact model, market microstructure, numerical methods in python, OOP in Java

THE CITY COLLEGE OF THE CITY UNIVERSITY OF NEW YORK New York, NY
Ph.D. in Electrical Engineering (September 2012 – September 2017)
B.E. in Electrical Engineering (January 2009 – December 2011)

EXPERIENCE

EXILE CAPITAL MANAGEMENT, LP New York, NY
Quantitative Analyst-Intern(June – August 2018)

- Used web scraping in Python to crawl online archives of historical equity news headlines
- Built a model to predict daily stock movement direction using Natural Language Processing Toolkit and classification algorithms in Python

Equity Research Analyst(Consultant)(February – May 2018)

- Supported Telecom, Media, and Technology (TMT) research team to perform valuation analysis on companies and their securities across the telecom industry
- Analyzed industry and technology trends and wrote reviews on companies in the TMT sector to provide investment recommendations to customers of the firm and the trading desk

NORVATIS CAPITAL MANAGEMENT, LLC New York, NY
Analyst Intern(June – August 2016)

- Researched and analyzed data regarding investment opportunities in agribusiness in Rwanda

JOURNAL OF THE AMERICAN CHEMICAL SOCIETY Washington, DC
Reviewer(December 2016 – September 2017)

- Reviewed manuscripts submitted for publication in a peer-reviewed scientific journal of Langmuir
- Provided feedback and comments to authors to improve their manuscripts' quality

PROJECTS

NEW YORK UNIVERSITY New York, NY
Market Impact Model from Public Data in Python

- Prepared, cleaned and sampled the TAQ Data of NYSE (226 GB)
- Built an impact model following the Almgren et al.'s (2005) approach using the TAQ Data
- Performed cross-sectionally non-linear regression to estimate parameters in the market impact model, analyzed residuals and performed statistical tests

Cointegration Test

- Applied the Granger-Engle (1987) cointegration test on a matrix of stock returns, and performed efficient computation and updating for cointegrated pairs trading
- Implemented a dynamic approach of using data structures in Python and algorithms for tracking the condition of cointegration in real time

THE CITY COLLEGE OF THE CITY UNIVERSITY OF NEW YORK New York, NY
Dissertation

- Designed and investigated the performance of a novel fiber laser resonator

COMPUTER SKILLS/OTHER

Programming Languages: Java, Python, VBA, SQL
Other Software: Bloomberg Terminal, MATLAB, LabVIEW/Automation,
Award/Honors: CUNY-NASA SOLARPREP research scholarship, Tau Beta Pi, Eta Kappa Nu
Languages: Kinyarwanda (native), English (fluent), French (intermediate)

RUI (RAY) JIANG
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected – Dec. 2018)

- ***Current Coursework:*** algorithmic trading, hidden Markov models, mean-variance optimization, Black-Scholes formula, Ito's formula, Greeks, Monte Carlo method, CAPM, Black-Litterman model, scientific computing in Python, PCA, EM algorithm, market microstructure

ILLINOIS WESLEYAN UNIVERSITY Bloomington, IL
BA in Mathematics and History, *magna cum laude* (2013 – 2017)

- ***Coursework:*** wavelet analysis, B splines, numerical methods, combinatorics

EXPERIENCE

Capstone Investment Advisors, LLC New York, NY
Quantitative Strategist Intern (Jun. 2018 – Aug. 2018)

- Created a regime-classifying model (trending and mean-reverting regimes) by calculating half-life from OU process, and backtested it with equity and future contract indices
- Researched over 20 technical indicators to construct strategies for straddles, and built a daily-updated backtest live monitor to present PNLs and other necessary statistical results with all technical strategies across indices
- Generated trading signals with technical indicator scores, backtesting results and statistics with machine learning models (Lasso, Random Forest, and etc.) for straddles
- Built CNN and RNN with technical indicator scores into the regime-classifying model to identify regimes, and constructed a trading strategy with Hidden Markov Model
- Assisted in building local database by systematically pulling a large amount of Bloomberg data fast with Bloomberg Desktop API instead of Bloomberg Server API

Capstone Investment Advisors, LLC New York, NY
Part-Time Intern (Feb. 2018 – Apr. 2018)

- Analyzed statistics based on historical and implied volatilities to generate trading signals for straddles with technical indicators and their combos, and applied machine learning techniques (OLS, ridge regression, SVR, random forest and gradient boost) for volatility prediction

CreditEase Wealth Management Beijing, China
VC/PE Summer Analyst (Jul. 2017 – Aug. 2017)

- Oversaw management of offshore FoFs, including 8 global private equity funds, through due diligence, reference check and on-going monitoring on 8 global funds for venture capitals
- Contributed to quarterly and semi-annual reports about invested GPs and startups

PROJECTS

NEW YORK UNIVERSITY New York, NY
Algorithmic Trading and Quantitative Strategies with Impact Model (Python) (Spring 2017)

- Calculated and analyzed return-based statistics of high-frequency TAQ data for S&P 500 constituents
- Implemented Almgren-Chriss impact model, and used non-linear regression to determine parameters and market impact within 10-day trailing window
- Built a kernel-based market impact model and calibrated model parameters to some stock prices

ILLINOIS WESLEYAN UNIVERSITY Bloomington, IL
Irregular Triangulation of Spline Functions and Wavelet Functions *(1st Author)* (2015 – 2017)

- Built algorithms to construct spline functions and wavelet functions over irregular triangulations in Barycentric coordinates in one and higher dimensions with respect to Berstein-Bezier polynomials with Matlab
- Presented the results at *The 3rd International Symposium on Riordan Arrays and Related Topics*

COMPUTER SKILLS/OTHER

Programming and Software: Python, Java, MATLAB, Mathematica, R, Tableau
Skills: Mandarin (native), English (fluent)

SULIN (SHIRLEY) LIU
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences 8.2017 - 12.2018
M.S. in Mathematics in Finance

- ***Coursework:*** stochastic calculus, machine learning, time-series analysis, interest rate models, securitized product, market microstructures, Monte Carlo simulations, option pricing and hedging, portfolio optimization, VaR-based risk management

WUHAN UNIVERSITY Wuhan, China
B.S. in Mathematics and Economics 9.2013 - 6.2017

EXPERIENCE

J.P. MORGAN CHASE & CO. New York, NY
Quantitative Research Summer Associate 6.2018 - 8.2018

- **Financial Modeling:** Improved lending value models on fixed income products including structured notes, unrated bonds and convertible bonds;
- **Model Evaluation:** Backtested model performance under different assumptions and visualized results; evaluated sensitivity analysis with respect to model inputs;
- **Platform Development:** Controlled aggregated model risk by building interconnected platforms with auto-updating tools for data governance. (SQL, Python, VBA)

CHANGJIANG SECURITIES Wuhan, China
Quantitative Research Intern 7.2015 - 8.2015

- **Statistical Modeling:** Predicted Bitcoin price variation by applying Bayesian regression to Latent Source model, a time-series classification method; (R)
- **Strategy Testing:** Integrated forecast model into strategy and achieved 15% annualized return in backtesting.

PROJECTS

NEW YORK UNIVERSITY New York, NY
Factor-Based Systematic Trading on Equities (OOP in Python) 9.2018 - 12.2018

- **Software Engineering:** Designed and built backtesting engines for portfolio management of alpha models;
- **Factor Selection:** Tested alpha models based on factor selection techniques in machine learning.

SVD Algorithm Implementation and Application (Python) 10.2018 - 11.2018

- **Sparse-SVD:** Improved recommender by predicting missing data of an 8.4M sparse matrix; Sped up the latent factor model by gradient descent SVD and compared it with the random projection method in cosine distance;
- **Natural Language Processing:** Improved financial news recommender by applying Latent Semantic Analysis to TF-IDF vectorizer.

Short-term Course Projects (Python) New York, NY

- **Monte Carlo Simulation:** Employed one-factor Gaussian Copula model to price synthetic CDO, and reduced variance by antithetic variate and importance sampling;
- **Volatility Calibration:** Calibrated SABR model by minimizing MSE based on market convention.

UNIVERSITY OF CALIFORNIA, BERKELEY Berkeley, CA
Projection of Performance for Private Companies using Alternative Data (Python) 7.2016 – 8.2016

- **Data Collection:** Web scrapped website rank data and built a predictive model for companies' performance;
- **Regression Analysis & Neural Network:** Designed regression tests for correlations among website rank, industry sector and financial performance; cross-validated results using fully-connected Neural Network model.

COMPUTER SKILLS / OTHER

Programming/Software: Java, Python, SQL, VBA, SAS, Stata, Matlab
Certification: CFA Level I

ANDREW (YUSONG) PAN

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EDUCATION

New York University, the Courant Institute of Mathematical Sciences New York, NY
MS in Mathematics in Finance (expected – January 2019)

- ***Math & Stats***: Stochastic calculus, multivariate regression, time series
- ***Finance***: Derivatives pricing, portfolio optimization, risk management, volatility forecasting
- ***Computer Science***: Big data, machine learning, statistical inference, monte carlo methods

University of Michigan Ann Arbor, MI
BS in Mathematics and Statistics (Sept.2015 – May.2017)

- ***Math & Stats***: Numerical method, ODE, econometrics, regression

Syracuse University
Mathematics and Statistics (Sept.2013 – May.2015) Syracuse, NY

EXPERIENCE

GTechFin Inc New York, NY
Quantitative Analyst Intern (Python, SQL) Jun.2018 – Aug.2018

- Predicted S&P 500 movement and achieved 72% accuracy based on historical data back-testing by incorporating Hidden Markov, XGBoost and Decision Trees
- Enhanced predicting accuracy by utilizing PLS to synthesize financial and quantity factors
- Maintained the research database, renew and improve it by SQL server in UNIX platform

GuoYuan Securities Co., Ltd Hefei, China
Quantitative Analyst Intern (Python) Jun.2017 – Aug.2017

- Analyzed portfolio excess returns by utilizing Mean Variance Analysis and risk adjusted indices
- Simulated bilateral exposure of credit risk using stochastic intensity under ISDA framework
- Monitored risk exposure for all trading activities using ES, CVA, stress testing and scenario analysis

RESEARCH and PROJECTS

Option Pricing (Java) New York, NY

- Priced vanilla European and Asian Option by Monte Carlo Simulation using Anti-Thetic decorator
- Applied ActiveMQ system and GPU programming to achieve faster convergence
- Priced American options by trinomial tree and evaluated theoretical boundary of early exercising
- Calibrated implied volatility and modeled the parameterization of the IV smile by SVI model

Interest Rate (Python) New York, NY

- Bootstrapped the IR curve with tension spline by interpolating various interest rate instruments
- Derived the IR curve from Eurodollar futures and interest swap rates

Forecasting Factors with Economic Indicators (Python) New York, NY

- Tested economic indictors' effectiveness and performed sparse PCA to analyze the information quantity
- Utilized various machine learning techniques to analyze features' ability to forecast factor performance
- Backtested factor performance using forecasting models; implemented walk forward cross validation
- Constructed portfolio to compute risk premia with respect to market benchmark

COMPUTER SKILLS/OTHER

Programming Languages: Python (2 years), Java (1 year), R (2 years), SQL (1 year), MATLAB (1 year)
Other Software: Microsoft Office Suite, Bloomberg

SHUHAN (JENNY) TIAN
(814) 777-8161 ■ st3367@nyu.edu

EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected – January 2019)

- ***Coursework:*** stochastic calculus, quantitative portfolio theory (mean-variance optimization), OOP, derivative securities pricing (Black-Scholes model, Greeks), risk management (VAR, back testing, stress testing), time series analysis, big data application (machine learning), continuous time finance

PENNSYLVANIA STATE UNIVERSITY State College, PA
BS in Mathematics and BS in Economics (Schreyer Honors College), Highest Distinction (2013-2017)

EXPERIENCE

CONNING Hartford, CT
Quantitative Finance Intern in Risk Solutions Department (June 2018 – Aug 2018)

- Worked with real financial market and simulation data (pulled from ADVISE-risk modeler) to generate interactive reports by implementing Dash (web-based interfaces) in Python
- Programmed an automated dashboard of various statistics and graphical representations of economic variables including Treasuries, Spreads, Swap, Foreign Exchange, etc.
- The Dashboard served as the validation report for Conning's proprietary Economic Scenario Generator

BANK OF CHINA INSURANCE COMPANY Beijing, China
Actuarial Intern in Actuarial Department (Jul 2016 - Dec 2016)

- Updated the auto policy dataset by classifying and merging relevant data in SAS
- Participated in building Generalized Linear model (implementing Poisson regression and Gamma regression to estimate frequency and severity of claims) to price auto insurance by using SAS
- Refined Generalized Linear model by adjusting existing parameters, such as price of car, age of car, age of policyholder and adding new parameters, such as no claims discount factor, type of car in SAS

PROJECTS

NEW YORK UNIVERSITY New York, NY

Computing in Finance (Java, Python)

- Implemented K-Means algorithm to get clusters and enhanced algorithm by fixing clustering size
- Valued options by using Monte Carlo simulation and applied different techniques such as antithetic variate, importance sampling to reduce variance and accelerate convergence

Risk and Portfolio Management (Excel, Python)

- Applied Brownian Bridge, regression-based EM, bootstrapping techniques for missing data
- Estimated VAR by using Variance/Covariance, Historical simulation, and Monte Carlo simulation techniques; Analyzed market portfolios by implementing stress testing and back testing methods
- Constructed mean-variance model by using seven Vanguard funds to get minimum variance portfolio and maximum Sharpe ratio portfolio with returns derived by Black-Litterman model

Interest rate and FX models (Python)

- Calibrated SABR model with market quotes of ATM, RR, and BF of FX options to construct implied volatility smile curve
- Bootstrapped IR curve by interpolating the cumulative yield using tension spline techniques with LIBOR swaps as the benchmark instruments

Forecasting Factors with Economic Indicators (Python)

- Collected 170+ economic indicators data from Datastream (Thomson Reuters) database and automated the process of cleaning (including stationarity check), merging these indicators data into one csv file
- Replicated Fama-French factor returns; Performed PCA to test effectiveness of economic indicators
- Utilized various machine learning techniques (Lasso, Ridge, Elastic Net, etc.) to analyze economic indicators' ability of forecasting factor performance

COMPUTER SKILLS/OTHER

Programming Languages & Other: Java, Python, SAS, STATA, R, MATLAB, Power BI, HTML, CSS
Certificates: CFA Level I, FRM Level I, Society of Actuaries exams P, FM, Bloomberg Market Concepts

YICHEN WANG
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected – December 2018)

- ***Coursework*:** Black-Scholes & Greeks, Monte Carlo simulation, OOP and data structure in Java, Machine Learning, CAPM and multifactor models, linear regression, FX options & Interest Rates, Volatility modeling, statistical arbitrage, numerical methods
- ***Future Coursework*:** Continuous time finance, time series modeling, big data application

BRYN MAWR COLLEGE Bryn Mawr, PA
BA (Honor) in Mathematics, Minors in Economics and Statistics (2013 – 2017) GPA: 3.8/4.0

EXPERIENCE

FIDESSA
Quantitative Analyst Intern (June 2018 – August 2018) Jersey City, NJ

- Built a stochastic model for a limit order book; the book was updated with Deltix L2 tick data in milliseconds (Java virtual machine)
- Calibrated the model with ESZ 16' based on a penalty function, and obtained optimal parameters for initial insertion and cancellation rates of limit orders, and market orders
- Performed preliminary tests for mid-price and sizes of orders at each limit order book level; analyzed stationary and difference-stationary properties
- Fitted an ARCH model for high frequency log returns of index futures ESZ 16' (R studio)
- Used SVMs to model the real high-frequency limit order book dynamics and to predict mid-price movement; performed cross validation and grid search for feature selection; SVM performances were evaluated with accuracy (0.6563) and F-1 score (0.722) (Java, Python, Excel)

WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA Philadelphia, PA
Statistics Research Assistant (February 2016 – August 2016)

- Implemented a Bayesian changepoint model to solve the Parasite Clearance Estimation problem
- Optimized estimates of the treatment effects via utilizing individual-level data in R; reduced mean square error of estimators by 75% compared to those of the classical method

PROJECTS

NEW YORK UNIVERSITY New York, NY

Implied Volatility Smile for FX

- Calibrated SABR model for the implied volatility for FX options with ATM, 25d RR, 25d BF quotes; constructed the implied volatility smile in Python

Portfolio risk management with VaR

- Filled in missing data with Bootstrap, Brownian Bridge and Regression-based techniques in Excel
- Estimated VaR with variance/covariance, historical simulation and Monte Carlo simulation
- Backtested portfolios for 95% and 99% VaR and evaluated desk-level limits set on VaR

Option Pricing with Monte Carlo Simulation

- Built an extendable Java-based Monte Carlo option pricing framework in Java
- Reduced errors of simulation results and achieved faster convergence rate with three techniques, antithetic variate, importance sampling and stratified sampling
- Implemented parallel computing via middleware using Java Message Service (ActiveMQ)
- Performed the GUI computing (openCL) to improve the process

K-Means Clustering in Java

- Implemented and improved the Lloyd's algorithm to perform generic multi-dimensional point clustering and fixed-size clustering; measured the efficiency with within-cluster distance variance

COMPUTER SKILLS/OTHER

***Programming Languages* & Other Software:** Java, R, Python, Mathematica, SPSS, STATA, LaTeX
Certificates: Passed Actuarial Exam P and Exam FM

YAO XIAO
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected – Dec. 2018)

- ***Coursework:*** Linear regression, portfolio optimization, derivative securities, Black-Scholes Model, stochastic calculus and Brownian motion, factor models, Monte Carlo, OOP in Java
- ***Future Coursework:*** Big data applications, advanced econometrics, continuous time finance

UNIVERSITY OF MICHIGAN Ann Arbor, MI
BS in Mathematics and Economics (Sep. 2013 - May 2016)

- ***Coursework:*** Numerical methods, linear algebra, probability theory, regression analysis
- ***Honors:*** James B. Angell Scholar (2015 & 2016), University Honors for 6 semesters (2013-2016)

EXPERIENCE

BANK OF AMERICA Charlotte, NC
Intern, Quantitative Management Associate Program Summer (Jun 2018 – Aug 2018)
Enterprise Consumer & Small Business Credit Risk

- Back tested effectiveness of 'Market Health Designation' rules for consumer portfolios using least square regressions, decision trees and Principal Component Analysis
- Accommodated adjustments to existing designation rules based on back-testing results
- Analyzed market-level delinquency drivers and their correlations to macro-economic variables

TRUVALUE ASSET MANAGEMENT Shenzhen, China
Intern, Quant Strategy (Oct. 2016 - May 2017)

- Implemented and back-tested trading strategies based on Tom DeMark's trading framework in MATLAB, using diversified performance metrics like Sharp ratio and maximum withdraw
- Created an asset allocation adjustment strategy by building an auto regression model based on price-earnings ratio, yield to maturity and net income growth
- Managed the launch of a fixed income fund by performing market research, drafting contracts and assisting regulatory approval

AVIC SECURITIES CO.LTD Nanchang, China
Intern, Channel Manager (June 2014 - July 2014)

- Compiled product development plan by performing benchmark analysis and feasibility analysis
- Prepared and presented trend reports of Channel sales information for senior management

PROJECTS

NEW YORK UNIVERSITY New York, NY
Monte Carlo Option Pricing (Java) (Oct. 2017)

- Priced vanilla option using Monte Carlo simulation; designed a flexible Monte Carlo framework extendable to Asian and other exotic options
- Raised simulation speed by 50% using antithetic variants method to reduce variance

K-Means Clustering (Java) (Sep. 2017)

- Implemented Lloyd's algorithm to cluster multidimensional objects based on re-definable factors; enhanced algorithm to fix-size clustering

UNIVERSITY OF MICHIGAN Ann Arbor, MI
Natural Language Processing (Dec. 2014)

- Analyzed text data collected from 10K+ posts on a student forum: identified the most frequently occurring words and phrases using the TF-IDF algorithm, and visualized the result as a word cloud

COMPUTER SKILLS/OTHER

Programming Languages: Python, Java, MATLAB, C/C++, STATA
***Credentials*:** CFA level 1
Languages: Mandarin (native), English (fluent)

WANYING XU
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (2017 - 2018)

- *Computing*: OOP in Java, scientific computing in Python, data analysis in R;
- *Mathematics & Finance:* Risk management (VaR, factor models, market risk), machine learning, Black-Scholes model, Black–Litterman model, interest rate derivatives pricing, Greeks and hedging, Brownian motion, numeriare, SDE, Monte Carlo, statistical arbitrage, model validation

BRYN MAWR COLLEGE Bryn Mawr, PA
A.B. in Mathematics and Economics (2013 - 2016)

- ***Coursework:*** Multiple linear regression, time series, Bayesian inference, linear ODEs, Granger causality

EXPERIENCE

RBC Capital Markets New York, NY

Summer Market Risk Analyst (Summer 2018)

- Developed Python scripts to process the risk data and integrated with the original VBA code; improved stability and efficiency of daily Repo risk reporting and day-over-day risk metric decomposition by 80%
- Reconciled the historical data and automated the risk exposure graph generation for the annual limit review
- Analyzed the hedging efficiency of CDS for the Muni bonds and investigated alternative hedging instruments

JUMORE E-COMMERCE CO. Beijing, China

Intern, ***Strategic Development*** (Summer 2016)

- Analyzed the corporate risk using the adjusted VaR model by including the current market volatility
- Automated data of the online commodity trading platform using VBA. Improved process efficiency by 50%

PROJECTS

Data-Driven Analysis in Python

- Performed and interpreted the PCA analysis on historical and simulated constant maturity treasury data
- Bootstrapped the IR curve with tension spline and devised the hedging portfolio that minimizes the risk
- Implemented Euler discretization and the Milstein scheme in the Monte Carlo simulation of the CIR process

Portfolio Risk Management

- Exploratory Data Analysis, missing data, hypothesis testing, portfolio optimization, Gaussian corpula
- VaR methodologies: Variance/Covariance, Historical Simulation, Monte Carlo Simulation
- Stress testing, CCAR, regulatory capital calculations, Hull-White Model Validation

Cash Flow Analysis of Securitized Products

- Simulated the cash flow and derived the OAS of various ABS structures (sequential, PAC)
- Analyzed the investment risk by evaluating PV01s of shocked forward rates and the effect on prepayment

Causality Analysis of China's Economic Growth

- Investigated factors of economic growth on GDP, capital accumulation, productivity growth, and trade
- Conducted Granger Causality Test in Stata to select factors that have causal relationships with China's growth
- Applied two criterions (FPE and BEC) to determine the proper lag length for the causality tests

COMPUTER SKILLS/OTHER

Programming Languages: Java, Python, R, Matlab, VBA
Other Skills: Stata, Processing, Bloomberg Terminal, SQL
Languages: English, Mandarin, Japanese
Professional Certifications: CFA Level I (passed), Bloomberg Certificate, IAQF member

TIANCI ZHU
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (September 2017 – December 2018)

- ***Coursework:*** Black-Scholes formula and Greeks, Monte Carlo, Black-Litterman, VaR, stresstest, ARMA, logistic regression, NLP, ridge regression, lasso regression, PCA
- ***Awards:*** Ranked top 4 for 2018 Morgan Stanley Prize for Excellence

ILLINOIS INSTITUTE OF TECHNOLOGY Chicago, IL
BS in Applied Mathematics (August 2013 – May 2017) **GPA: 3.97/4**

- ***Coursework:*** Differential Equations, Hypothesis Tests, Time Series Econometrics, OOP
- ***Awards:*** 'Meritorious Winner' in Mathematical Contest in Modeling, Menger best undergrad award

EXPERIENCE

NANHUA-USA Chicago, IL
Summer Analyst (May 2018 – August 2018)

- Forecasted crude oil futures prices, demand and supply using vector autoregressive model in Python
- Applied OLS to study the relationship between crude oil futures prices and spot prices in Python
- Calculated Monte Carlo VaR with different portfolio positions and backtested it in Python

CHINA CONSTRUCTION BANK Dalian, China
International Business and Investment Banking Division Intern (June 2017 – July 2017)

- Checked files attached to Documentary Collection and Documentary Credit to avoid risk of default
- Communicated with clients on their needs and advised them on appropriate products

ILLINOIS INSTITUTE OF TECHNOLOGY Chicago, IL
Research Assistant (May 2016 – July 2016)

- Implemented Heston Stochastic Volatility model using Quadratic Exponential and Broadie-Kaya Scheme in the Guaranteed Automatic Integration Library (GAIL)
- Modified the algorithm to extend the applicable range to the case when volatility of asset prices' volatility is approaching zero by change of variables

Student Assistant (May 2016 – May 2017)

- Assisted with office work and holding math conference, such as creating schedules and name tag

PROJECTS

Factor Forecasting with Economic Indicators (Python)

- Replicated Fama-French size and value factor returns successfully using monthly asset return data
- Forecasted replicated factors using PCA, OLS, ridge regression and random forests technique
- Cleaned raw economic indicators collected from Datastream and CEIC to generate stationary dataset and forward filled in missing values to avoid look-ahead bias

Latent Semantic Analysis (Python)

- Recommended most related articles to an input string from 10k article corpus using SVD

Computing in Finance (Python & Java)

- Priced American options and constructed its early exercise boundary by least squares
- Priced European and Asian options using Monte Carlo simulation and antithetic method

Risk and Portfolio Management

- Developed industry momentum change strategy on constituent data of S&P 1500
- Optimized portfolio on seven Vanguard Funds using mean-variance and Black-Litterman model
- Filled in missing data using regression-based EM, bootstrapping and Brownian bridge method

Prediction of Sales of Large Shopping Malls (R)

- Collected and constructed features including ratings, population and income from public website
- Applied OLS, ridge regression and ARMA model to predict sales of large shopping malls in US and selected proper models by MSE and explained variation

COMPUTER SKILLS/OTHER

Programming Languages: Python, MATLAB, Java, R, GitHub, Bloomberg Terminal, Datastream, LaTeX
Languages: Mandarin (native), English (fluent)

The Mathematics in Finance Masters Program
Courant Institute, New York University
Academic Year 2018-2019

The curriculum has four main components:

1. **Financial Theory and Econometrics**. These courses form the theoretical core of the program, covering topics ranging from equilibrium theory to Black-Scholes to Heath-Jarrow-Morton.

2. **Practical Financial Applications**. These classes are taught by industry specialists from prominent New York financial firms. They emphasize the practical aspects of financial mathematics, drawing on the instructor's experience and expertise.

3. **Mathematical Tools**. This component provides appropriate mathematical background in areas like stochastic calculus and partial differential equations.

4. **Computational Skills**. These classes provide students with a broad range of software skills, and facility with computational methods such as optimization, Monte Carlo simulation, and the numerical solution of partial differential equations.

		First Semester	Second Semester	Third Semester
Practical Financial Applications			Advanced Risk Management ___ Interest Rate and FX Models ___ Securitized Products & Structured Finance (1/2 Credit) ___ Energy Market & Derivatives (1/2 Credit) ___ Advanced Topics in Equity Derivatives (1/2 Credit) ___ Market Microstructure (1/2 Credit)	Fin. Eng. Models for Corp. Finance ___ Credit Analytics: Bonds, Loans & Derivatives (1/2 Credit) ___ Counter Party Credit: Valuation Adjustments, Capital, and Funding ___ Fixed Income Derivatives: Models & Strategies in Practice (1/2 Credit)

Financial Theory and Econometrics		Derivative Securities ___ Risk & Portfolio Mgmt. with Econometrics	Active Portfolio Management ___ Algorithmic Trading & Quant. Strategies ___ Continuous Time Finance	Project and Presentation ___ Time Series Analysis & Stat. Arbitrage ___ Adv. Econometrics Models & Big Data
Mathematical Tools		Stochastic Calculus		
Computational Skills		Computing in Finance	Scientific Computing in Finance	Computational Methods for Finance Data Science in Quantitative Finance

Practical Training. In addition to coursework, the program emphasizes practical experience. All students do Masters Projects, mentored by finance professionals. Most full-time students do internships during the summer between their second and third semesters.

See the program web page http://math.nyu.edu/financial_mathematics for additional information.

MATHEMATICS IN FINANCE MS COURSES, 2014-2015

PRACTICAL FINANCIAL APPLICATIONS:

MATH-GA 2752.001 ACTIVE PORTFOLIO MANAGEMENT

Spring term: J. Benveniste

Prerequisites: Risk & Portfolio Management with Econometrics, Computing in Finance.

The first part of the course will cover the theoretical aspects of portfolio construction and optimization. The focus will be on advanced techniques in portfolio construction, addressing the extensions to traditional mean-variance optimization including robust optimization, dynamical programming and Bayesian choice. The second part of the course will focus on the econometric issues associated with portfolio optimization. Issues such as estimation of returns, covariance structure, predictability, and the necessary econometric techniques to succeed in portfolio management will be covered. Readings will be drawn from the literature and extensive class notes.

MATH-GA 2753.001 ADVANCED RISK MANAGEMENT

Spring term: K. Abbott

Prerequisites: Derivative Securities, Computing in Finance or equivalent programming.

The importance of financial risk management has been increasingly recognized over the last several years. This course gives a broad overview of the field, from the perspective of both a risk management department and of a trading desk manager, with an emphasis on the role of financial mathematics and

modeling in quantifying risk. The course will discuss how key players such as regulators, risk managers, and senior managers interact with trading. Specific techniques for measuring and managing the risk of trading and investment positions will be discussed for positions in equities, credit, interest rates, foreign exchange, commodities, vanilla options, and exotic options. Students will be trained in developing risk sensitivity reports and using them to explain income, design static and dynamic hedges, and measure value-at-risk and stress tests. Students will create Monte Carlo simulations to determine hedge effectiveness. Extensive use will be made of examples drawn from real trading experience, with a particular emphasis on lessons to be learned from trading disasters.

MATH-GA 2798.001 INTEREST RATE AND FX MODELS

Spring term: F. Mercurio & T. Fisher

Prerequisites: Derivative Securities, Stochastic Calculus, and Computing in Finance (or equivalent familiarity with financial models, stochastic methods, and computing skills).
The course is divided into two parts. The first addresses the fixed-income models most frequently used in the finance industry, and their applications to the pricing and hedging of interest-based derivatives. The second part covers the foreign exchange derivatives markets, with a focus on vanilla options and first-generation (flow) exotics. Throughout both parts, the emphasis is on practical aspects of modeling, and the significance of the models for the valuation and risk management of widely-used derivative instruments.

MATH-GA.2799-001 SECURITIZED PRODUCTS & STRUCTURED FINANCE

Spring term: R. Sunada-Wong

Prerequisites: Basic bond mathematics and bond risk measures (duration and convexity); Derivative Securities and Stochastic Calculus.

This half-semester course will cover the fundamentals of Securitized Products, emphasizing Residential Mortgages and Mortgage-Backed Securities (MBS). We will build pricing models that generate cash flows taking into account interest rates and prepayments. The course will also review subprime mortgages, CDO's, Commercial Mortgage Backed Securities (CMBS), Auto Asset Backed Securities (ABS), Credit Card ABS, CLO's, Peer-to-peer / MarketPlace Lending, and will discuss drivers of the financial crisis and model risk.

MATH-GA.2800-001 ENERGY MARKETS AND DERIVATIVES

Spring term: D. Eliezer

Prerequisites: Derivative Securities and Stochastic Calculus.

This half-semester course focuses on energy commodities and derivatives, from their basic fundamentals and valuation, to practical issues in managing structured energy portfolios. We develop a risk neutral valuation framework starting from basic GBM and extend this to more sophisticated multi-factor models. These approaches are then used for the valuation of common, yet challenging, structures. Particular emphasis is placed on the potential pitfalls of modeling methods and the practical aspects of implementation in production trading platforms. We survey market mechanics and valuation of inventory options and delivery risk in the emissions markets.

MATH-GA.2801-001 ADVANCED TOPICS IN EQUITY DERIVATIVES

Spring term: S. Bossu

Prerequisites: Derivative Securities, Stochastic Calculus, and Computing in Finance or equivalent programming experience.

This half-semester course will give a practitioner's perspective on a variety of advanced topics with a particular focus on equity derivatives instruments, including volatility and correlation modeling and

trading, and exotic options and structured products. Some meta-mathematical topics such as the practical and regulatory aspects of setting up a hedge fund will also be covered.

MATH-GA.2802-001 MARKET MICROSTRUCTURE

Spring term: G. Ritter

Prerequisites: Derivative Securities, Risk & Portfolio Management with Econometrics, and Computing in Finance or equivalent programming experience.

This is a half-semester course covering topics of interest to both buy-side traders and sell-side execution quants. The course will provide a detailed look at how the trading process actually occurs and how to optimally interact with a continuous limit-order book market.

We begin with a review of early models, which assume competitive suppliers of liquidity whose revenues, corresponding to the spread, reflect the costs they incur. We discuss the structure of modern electronic limit order book markets and exchanges, including queue priority mechanisms, order types and hidden liquidity. We examine technological solutions that facilitate trading such as matching engines, ECNs, dark pools, multiple venue problems and smart order routers.

The second part of the course is dedicated pre-trade market impact estimation, post-trade slippage analysis, optimal execution strategies and dynamic no-arbitrage models. We cover Almgren-Chriss model for optimal execution, Gatheral's no-dynamic-arbitrage principle and the fundamental relationship between the average response of the market price to traded quantity, and properties of the decay of market impact.

Homework assignments will supplement the topics discussed in lecture. Some coding in Java will be required and students will learn to write their own simple limit-order-book simulator and analyze real NYSE TAQ data.

MATH-GA.2803-001 FIXED INCOME DERIVATIVES: MODELS & STRATEGIES IN PRACTICE

Fall term: L. Tatevossian and A. Sadr

Prerequisites: Computing in Finance (or equivalent programming skills) and Derivative Securities (familiarity with Black-Scholes interest rate models)

This half-semester class focuses on the practical workings of the fixed-income and rates-derivatives markets. The course content is motivated by a representative set of real-world trading, investment, and hedging objectives. Each situation will be examined from the ground level and its risk and reward attributes will be identified. This will enable the students to understand the link from the underlying market views to the applicable product set and the tools for managing the position once it is implemented. Common threads among products – structural or model-based – will be emphasized. We plan on covering bonds, swaps, flow options, semi-exotics, and some structured products.

A problem-oriented holistic view of the rate-derivatives market is a natural way to understand the line from product creation to modeling, marketing, trading, and hedging. The instructors hope to convey their intuition about both the power and limitations of models and show how sell-side practitioners manage these constraints in the context of changes in market backdrop, customer demands, and trading parameters.

MATH-GA.2804-001 CREDIT ANALYTICS: BONDS, LOANS AND DERIVATIVES

Fall term: B. Fleasker

Prerequisites: Derivate Securities and Computing in Finance (or equivalent familiarity with financial models and computing skills)

This half-semester course introduces the institutional market for bonds and loans subject to default risk and develops concepts and quantitative frameworks useful for modeling the valuation and risk

management of such fixed income instruments and their associated derivatives. Emphasis will be put on theoretical arbitrage restrictions on the relative value between related instruments and practical applications in hedging, especially with credit derivatives. Some attention will be paid to market convention and related terminology, both to ensure proper interpretation of market data and to prepare students for careers in the field.

We will draw on the fundamental theory of derivatives valuation in complete markets and the probabilistic representation of the associated valuation operator. As required, this will be extended to incomplete markets in the context of doubly stochastic jump-diffusion processes. Specific models will be introduced, both as examples of the underlying theory and as tools that can be (and are) used to make trading and portfolio management decisions in real world markets.

MATH-GA.2805-001 COUNTER PARTY CREDIT: VALUATION ADJUSTMENTS, CAPITAL, AND FUNDING

Fall term: L. Andersen

Prerequisites: Advanced Risk Management, Derivative Securities (or equivalent familiarity with market and credit risk models), and Computing in Finance (or equivalent programming experience)

This class explores technical and regulatory aspects of counterparty credit risk, with an emphasis on model building and computational methods. The first part of the class will provide technical foundation, including the mathematical tools needed to define and compute valuation adjustments such as CVA and DVA. The second part of the class will move from pricing to regulation, with an emphasis on the computational aspects of regulatory credit risk capital under Basel 3. A variety of highly topical subjects will be discussed during the course, including: funding costs, XVA metrics, initial margin, credit risk mitigation, central clearing, and balance sheet management. Students will get to build a realistic computer system for counterparty risk management of collateralized fixed income portfolios, and will be exposed to modern frameworks for interest rate simulation and capital management.

FINANCIAL THEORY AND ECONOMETRICS:

MATH-GA 2707.001 TIME SERIES ANALYSIS AND STATISTICAL ARBITRAGE

Fall term: F. Asl and R. Reider

Prerequisites: Derivative Securities, Scientific Computing, and familiarity with basic probability.

The term "statistical arbitrage" covers any trading strategy that uses statistical tools and time series analysis to identify approximate arbitrage opportunities while evaluating the risks inherent in the trades (considering the transaction costs and other practical aspects). This course starts with a review of Time Series models and addresses econometric aspects of financial markets such as volatility and correlation models. We will review several stochastic volatility models and their estimation and calibration techniques as well as their applications in volatility based trading strategies. We will then focus on statistical arbitrage trading strategies based on cointegration, and review pairs trading strategies. We will present several key concepts of market microstructure, including models of market impact, which will be discussed in the context of developing strategies for optimal execution. We will also present practical constraints in trading strategies and further practical issues in simulation techniques. Finally, we will review several algorithmic trading strategies frequently used by practitioners.

MATH-GA 2708.001 ALGORITHMIC TRADING AND QUANTITATIVE STRATEGIES

Spring term: P. Kolm and L. Maclin

Prerequisites: Computing in Finance, and Capital Markets and Portfolio Theory, or equivalent. In this course we develop a quantitative investment and trading framework. In the first part of the course, we study the mechanics of trading in the financial markets, some typical trading strategies, and how to work with and model high frequency data. Then we turn to transaction costs and market impact

models, portfolio construction and robust optimization, and optimal betting and execution strategies. In the last part of the course, we focus on simulation techniques, back-testing strategies, and performance measurement. We use advanced econometric tools and model risk mitigation techniques throughout the course. Handouts and/or references will be provided on each topic.

MATH-GA 2751.001 RISK AND PORTFOLIO MANAGEMENT WITH ECONOMETRICS
Fall term: P. Kolm. Spring term: M. Avellaneda
Prerequisites: univariate statistics, multivariate calculus, linear algebra, and basic computing (e.g. familiarity with Matlab or co-registration in Computing in Finance).
A comprehensive introduction to the theory and practice of portfolio management, the central component of which is risk management. Econometric techniques are surveyed and applied to these disciplines. Topics covered include: factor and principal-component models, CAPM, dynamic asset pricing models, Black-Litterman, forecasting techniques and pitfalls, volatility modeling, regime-switching models, and many facets of risk management, both theory and practice.

MATH-GA 2755.001 PROJECT AND PRESENTATION
Fall term and spring term: P. Kolm
Students in the Mathematics in Finance program conduct research projects individually or in small groups under the supervision of finance professionals. The course culminates in oral and written presentations of the research results.

MATH-GA 2791.001 DERIVATIVE SECURITIES
Fall term: M. Avellanda. Spring term: B. Flesaker
An introduction to arbitrage-based pricing of derivative securities. Topics include: arbitrage; risk-neutral valuation; the log-normal hypothesis; binomial trees; the Black-Scholes formula and applications; the Black-Scholes partial differential equation; American options; one-factor interest rate models; swaps, caps, floors, swaptions, and other interest-based derivatives; credit risk and credit derivatives.

MATH-GA 2792.001 CONTINUOUS TIME FINANCE
Fall term: A. Javaheri & S. Ghamami. Spring term: B. Dupire and F. Mercurio
Prerequisites: Derivative Securities and Stochastic Calculus, or equivalent.
A second course in arbitrage-based pricing of derivative securities. The Black-Scholes model and its generalizations: equivalent martingale measures; the martingale representation theorem; the market price of risk; applications including change of numeraire and the analysis of quantos. Interest rate models: the Heath-Jarrow-Morton approach and its relation to shortrate models; applications including mortgage-backed securities. The volatility smile/skew and approaches to accounting for it: underlyings with jumps, local volatility models, and stochastic volatility models.

MATHEMATICAL TOOLS:
MATH-GA 2706.001 PARTIAL DIFFERENTIAL EQUATIONS FOR FINANCE
Spring term: R. Kohn
Prerequisite: Stochastic Calculus or equivalent.
An introduction to those aspects of partial differential equations and optimal control most relevant to finance. Linear parabolic PDE and their relations with stochastic differential equations: the forward and backward Kolmogorov equation, exit times, fundamental solutions, boundary value problems, maximum principle. Deterministic and stochastic optimal control: dynamic programming, Hamilton-Jacobi-Bellman equation, verification arguments, optimal stopping. Applications to finance, including portfolio optimization and option pricing -- are distributed throughout the course.

MATH-GA 2902.001 STOCHASTIC CALCULUS
Fall term: P. Bourgade. Spring term: A. Kuptsov
Prerequisite: Basic Probability or equivalent.
Discrete dynamical models: Markov chains, one-dimensional and multidimensional trees, forward and backward difference equations, transition probabilities and conditional expectations. Continuous processes in continuous time: Brownian motion, Ito integral and Ito's lemma, forward and backward partial differential equations for transition probabilities and conditional expectations, meaning and solution of Ito differential equations. Changes of measure on paths: Feynman-Kac formula, Cameron-Martin formula and Girsanov's theorem. The relation between continuous and discrete models: convergence theorems and discrete approximations.

COMPUTATIONAL SKILLS:

MATH-GA 2041.001 COMPUTING IN FINANCE
Fall term: E. Fishler and L. Maclin
This course will introduce students to the software development process, including applications in financial asset trading, research, hedging, portfolio management, and risk management. Students will use the Java programming language to develop object-oriented software, and will focus on the most broadly important elements of programming - superior design, effective problem solving, and the proper use of data structures and algorithms. Students will work with market and historical data to run simulations and test strategies. The course is designed to give students a feel for the practical considerations of software development and deployment. Several key technologies and recent innovations in financial computing will be presented and discussed.

MATH-GA 2043.001 COMPUTATIONAL METHODS FOR FINANCE
Fall term: J. Guyon & B. Liang
Prerequisites: Scientific Computing or Numerical Methods II, Continuous Time Finance, or permission of instructor.
Computational techniques for solving mathematical problems arising in finance. Dynamic programming for decision problems involving Markov chains and stochastic games. Numerical solution of parabolic partial differential equations for option valuation and their relation to tree methods. Stochastic simulation, Monte Carlo, and path generation for stochastic differential equations, including variance reduction techniques, low discrepancy sequences, and sensitivity analysis.

MATH-GA 2046.001 ADVANCED ECONOMETRICS AND BIG DATA
Fall term: G. Ritter
Prerequisites: Derivative Securities, Risk & Portfolio Management with Econometrics, and Computing in Finance (or equivalent programming experience).
A rigorous background in Bayesian statistics geared towards applications in finance, including decision theory and the Bayesian approach to modeling, inference, point estimation, and forecasting, sufficient statistics, exponential families and conjugate priors, and the posterior predictive density. A detailed treatment of multivariate regression including Bayesian regression, variable selection techniques, multilevel/hierarchical regression models, and generalized linear models (GLMs). Inference for classical time-series models, state estimation and parameter learning in Hidden Markov Models (HMMs) including the Kalman filter, the Baum-Welch algorithm and more generally, Bayesian networks and belief propagation. Solution techniques including Markov Chain Monte Carlo methods, Gibbs Sampling, the EM algorithm, and variational mean field. Real world examples drawn from finance to include stochastic volatility models, portfolio optimization with transaction costs, risk models, and multivariate forecasting.

MATH-GA.2047-001 DATA SCIENCE IN QUANTITATIVE FINANCE

Fall term: P. Kolm and I. Dimov

Prerequisites: Risk & Portfolio Management with Econometrics, Scientific Computing in Finance (or Scientific Computing) and Computing in Finance (or equivalent programming experience.

This is a full semester course focusing on practical aspects of alternative data, machine learning and data science in quantitative finance. Homework and hands-on projects form an integral part of the course, where students get to explore real-world datasets and software.

The course begins with an overview of the field, its technological and mathematical foundations, paying special attention to differences between data science in finance and other industries. We review the software that will be used throughout the course.

We examine the basic problems of supervised and unsupervised machine learning, and learn the link between regression and conditioning. Then we deepen our understanding of the main challenge in data science – the curse of dimensionality – as well as the basic trade-off of variance (model parsimony) vs. bias (model flexibility).

Demonstrations are given for real world data sets and basic data acquisition techniques such as web scraping and the merging of data sets. As homework each student is assigned to take part in downloading, cleaning, and testing data in a common repository, to be used at later stages in the class.

We examine linear and quadratic methods in regression, classification and unsupervised learning. We build a BARRA-style implicit risk-factor model and examine predictive models for county-level real estate, economic and demographic data, and macro economic data. We then take a dive into PCA, ICA and clustering methods to develop global macro indicators and estimate stable correlation matrices for equities.

In many real-life problems, one needs to do SVD on a matrix with missing values. Common applications include noisy image-recognition and recommendation systems. We discuss the Expectation Maximization algorithm, the L1-regularized Compressed Sensing algorithm, and a naïve gradient search algorithm.

The rest of the course focuses on non-linear or high-dimensional supervised learning problems. First, kernel smoothing and kernel regression methods are introduced as a way to tackle non-linear problems in low dimensions in a nearly model-free way. Then we proceed to generalize the kernel regression method in the Bayesian Regression framework of Gaussian Fields, and for classification as we introduce Support Vector Machines, Random Forest regression, Neural Nets and Universal Function Approximators.

MATH-GA 2048.001 SCIENTIFIC COMPUTING IN FINANCE

Spring term: Y. Li and

Prerequisites: multivariable calculus, linear algebra; programming experience strongly recommended but not required.

A practical introduction to scientific computing covering theory and basic algorithms together with use of visualization tools and principles behind reliable, efficient, and accurate software. Students will program in C/C++ and use Matlab for visualizing and quick prototyping. Specific topics include IEEE arithmetic, conditioning and error analysis, classical numerical analysis (finite difference and integration formulas, etc.), numerical linear algebra, optimization and nonlinear equations, ordinary differential equations, and (very) basic Monte Carlo.