MASTER of SCIENCE PROGRAM
Mathematics in Finance

NEW YORK UNIVERSITY
Courant Institute of Mathematical Sciences

Class of 2022 Resume Book

Mathematics in Finance M.S. Program

Courant Institute of Mathematical Sciences
New York University

For the latest version, please go to
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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 second year students in the Courant Institute's Mathematics in Finance Master's Program. They will graduate from our Master's program in December 2022. We hope you will consider them for possible full time positions at your firm.

We believe our students are the most astute, most capable, and best trained group of students of any program. The resumes you find in the resume book describe their distinguished backgrounds. For the past years we have one of the highest placement records for summer internships and full-time positions of any program. Our students enter into front office roles such as trading, portfolio or risk management, on the buy and the sell side. Their computing, quantitative finance, and machine learning skills, as well as their hands-on practical experience, makes them productive from day one.

Our curriculum is dynamic and challenging. For example, the first semester investment course does not end with CAPM and APT, but is a serious data-driven course that, for example, examines the statistical principles and practical pitfalls of covariance matrix estimation and portfolio construction. As part of our core curriculum, students learn the modern tools of machine learning and data science as they are used in the financial industry today. Our advanced electives cover cutting-edge topics in pricing, algorithmic trading, portfolio management and financial machine learning. Our 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,
Petter Kolm, Director
Deane Yang, Chair
Leif Andersen, Industry Adviser

YIN FU
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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance (Sep. 2021 - Dec. 2022)

- ***Coursework:*** Stochastic calculus, derivative pricing, quantitative portfolio theory, risk management, financial data science and machine learning, time series analysis, interest rate modeling

UNIVERSITY OF WASHINGTON Seattle, WA
BS in Mathematics (Sep. 2017 – Jun. 2021)

- ***Coursework:*** Probability, linear algebra, numerical analysis, statistics, ODEs and PDEs, measure theory
- ***Honors:*** Magna Cum Laude (Top 3.5%), Dean's List

EXPERIENCE

CHINA CONSTRUCTION BANK, NEW YORK BRANCH New York, NY
Quantitative Risk Analyst (Jun. 2022 – Aug. 2022)

- Built a country risk predictor leveraging linear models, boosting, random forest based on S&P data of economics and political factors, and achieved 87.2% in-sample and 78.9% out-of-sample accuracy
- Drafted country risk report for the US collaboratively by analyzing macro risk factors and ML predictions
- Implemented the stock-flow cycle model for the US real estate market, and calibrated parameters to the market data from 1980 to 2022; tuned hyperparameters for model interpretability and performance

WASHINGTON EXPERIMENTAL MATHEMATICAL LAB - WXML Seattle, WA
Research Assistant (Apr. 2020 – Dec. 2020)

- Derived mathematical properties of number operators and Hamiltonians in bosonic quantum field theory
- Proved non-uniqueness of field configuration, given the same observation in Minkowski particle content
- Explained theoretical behavior of number operators' in real-world terms

PROJECTS

NEW YORK UNIVERSITY New York, NY
Simulation of Backward SDEs and Applications to Nonlinear PDEs in Finance *(Python)*

- Implemented deep BSDE and generalized LSMC method for nonlinear PDEs based on ML algorithms
- **Option Pricing:** Priced exotic options by simulation of BSDEs and derived dynamic hedging strategies
- **Optimal Execution:** Leveraged LSMC to solve the HJB-PDEs in equity market impact models presented by Cartea et al. (2015) for optimal inventory processes, and analyzed convergence, numerical stability, etc

Implied and Local Volatility Calibration *(Python)*

- Calibrated SVI parameterization with SPX options data to a continuous implied volatility surface, and computed local volatility surface

Backtesting and Statistical Arbitrage *(Python)*

- Researched and presented the CNN+Transformer model in *Deep Learning Statistical Arbitrage* (2020) and analyzed the out-of-sample performance for 550 largest US stocks with different risk factors.
- Implemented and backtested the Adapted P&Q strategy presented by Fong and Tai (2009) for S&P 500 stocks, calculated performance metrics (ROI, Sharp ratio), and analyzed the impact of market frictions.

Financial Data Science *(Python)*

- **Index Tracking:** Built a dynamic index tracking strategy for S&P 500 leveraging Kalman filter
- **ICA:** Performed pICA on Reuters news to identify the most related articles to specific topics such as earnings, rates, and CPI; analyzed and compared the performance to PCA-based LSA.

UNIVERSITY OF WASHINGTON Seattle, WA
Introduction to Numerical Methods for Solving Large and Sparse Linear Systems *(MATLAB)*

- Elaborated Krylov subspace methods and implemented conjugate gradient method in MATLAB
- Researched numerical limitations of current best sparse linear system solver by Peng and Vampala (2020)

COMPUTATIONAL SKILLS/OTHER

Programming Languages: Python, Java, MATLAB, Mathematica
Languages: English (fluent), Mandarin (native), Japanese (intermediate)

ARJUN KALSI

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
MS in Mathematics in Finance (expected-Dec 2022)

- ***Coursework:*** Monte Carlo methods, Brownian motion, supervised/unsupervised learning, feature map regression, cross-validation, neural networks, data cleaning and web-scraping

UNIVERSITY OF WARWICK Coventry, UK
BS Mathematics, Operational Research, Statistics, Economics (Sep 2018-Jun 2021)

- ***Coursework:*** mathematical analysis, linear algebra, probability, Bayesian statistics and decision theory, MLE, options pricing, linear statistical modeling, stochastic processes

EXPERIENCE

SOFR ACADEMY - *Quantitative Analyst Intern* (Dec 2021-June 2022) New York, NY

- Constructed a publication handbook for the firm's new Across-the-Curve Credit Spread Index (AXI) tool, explaining all automated code related to the data retrieval process via AWS, and presented this to prospective clients
- Applied AXI values to 1 year of historical JPY data using Python for an ongoing non-USD AXI feasibility study aimed at increasing the versatility of the index
- Collaborated with Japanese colleagues to research JPY transaction data sources for short-term money market instruments data, as well as long-term bond transactions data

H2 VENTURES - *Venture Capital Intern* (Jul 2020-Aug 2020) London, UK

- Identified 10 promising start-ups in the healthtech industry and built a grading scale function using Python in order to rank them, allocating points based on risk, management, business strategy, and exit opportunities
- Evaluated 4 start-ups in the firm's portfolio using the venture capital method as well as DCF analysis, and pitched investment strategies to peers based on these results

PROJECTS

NEW YORK UNIVERSITY - *Trading Energy Derivatives Project (Python)*

- Used a rolling regression model on USD rates, inflation rates, and storage in order to develop a carry-based strategy for WTI futures
- Leveraged Python modules such as SciPy, NumPy, and Pandas to interpolate storage data, as well as optimize the rolling regression window over the last 10 years of data
- Utilized a Middle Eastern war sentiment index to implement a threshold signal to halt trading which increased the annualized Sharpe Ratio from 0.42 to 0.61

UNIVERSITY OF WARWICK - *Airlines Trading Study with NLP (Python)*

- Cleaned and analyzed 3 months of historical time-series data to backtest a pairs algorithm on a model portfolio focussed on American Airlines and United Airlines
- Used NLP techniques on a US Airline Sentiment Tweets dataset to expand and contract trade volume
- Generated returns of 13% and visualized a distinct relationship in stock performance between two firms in the same industry

COMPUTER SKILLS/OTHER

Programming Languages: Python, SQL, Java, R, MATLAB
Languages: English (native), French (basic)
Interests: Music Producer on Spotify and Apple Music with over 20,000 monthly listeners

YEA JUN KIM

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance *(Dec 2021 – Dec 2022)*

- **Coursework:** Dynamic asset pricing, active portfolio management, market microstructure, advanced topics in equity derivatives, time series analysis, advanced statistical inference

NEW YORK UNIVERSITY New York, NY
B.A. in Mathematics, Minor in Business Studies *(Sep 2014 – Dec 2021)*

- **Graduate Coursework:** Stochastic calculus, risk and portfolio management, financial securities and markets, Black Scholes, computing in finance, Monte Carlo simulation, data driven modeling, machine learning
- **Coursework:** Regression, mathematical statistics, PDEs, probability theory, numerical analysis, OOP, data structure, economics, financial accounting, information system, operations management

EXPERIENCE

HYPHEN New York, NY
Quantitative Analyst Intern *(May 2022 – Aug 2022)*

- Constructed granular portfolios grouped by region and industry, using stocks from MSCI ACWI Index; screened portfolios to satisfy rules of Islamic compliance
- Implemented multivariable regression to predict U.S. GDP and CPI; constructed point-in-time data with vintage data
- Conducted research on applications of PCA to forecast correlations of multiple assets
- Analyzed auto-regressive factor model used to unsmooth and predict returns in private markets
- Preprocessed and handled various time-series asset data from multiple databases, such as Bloomberg, Factset

MCC ECONOMICS & FINANCE London, UK (remote)
Finance Intern *(Nov 2020 – Feb 2021)*

- Implemented beta estimation for UK energy companies using OLS, rolling OLS, and GARCH models; visualized data to enable competitive comparisons
- Collaborated on financial analysis report on UK water companies' performance
- Constructed case studies on strategic planning as well as identifying and assessing financial risk
- Researched and spot-checked gas companies' financial reports for publications

KOREA NATIONAL POLICE AGENCY Daegu, Korea
Sergeant, Analytical Assistant, Public Relations *(Aug 2015 – May 2017)*

- Conducted research on policing trends; measured public reputation of national police; monitored media
- Earned commissioner's commendation; for being #1 military police officer in public relations department
- Led and represented team of 16 administrative police officers as squad leader

PROJECTS

Momentum Investment Strategy on Cryptocurrency Portfolio *(May 2021 – Aug 2021)*

- Constructed dynamic momentum strategy portfolio based on cryptocurrencies' previous daily returns
- Selected cryptocurrencies based on their market capitalization and daily traded volumes; predicted their price trends by using divergence analysis
- Set up specific indicators to decide when to stop loss or take profit; generated 16% returns

Kimchi Premium Trading Strategy *(Feb 2021 – Mar 2021)*

- Implemented long/short trading strategy using Kimchi Premium to determine price gap among cryptocurrencies in South Korean Exchange and those outside Korea
- Researched premium movements and constantly monitored premium rates for major cryptocurrencies
- Constructed strategies for different scenarios (e.g., when premium is high or low)

Equity-Interest Rate Hybrid Option Pricing *(Nov 2020 – Dec 2020)*

- Designed option pricing model using geometric Brownian motion quantoed stock; also, Ho-Lee models that simulated LIBOR
- Used two-factor Monte Carlo simulation to conduct time-dependent simulation of stocks and interest rates

COMPUTATIONAL SKILLS/OTHER

Programming Languages: Java, Python, MATLAB, R, SQL
Languages: Korean (native), English (fluent)

SHENGBO LANG

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EDUCATION

NEW YORK UNIVERSITY- The Courant Institute of Mathematical Sciences New York, NY
MS in Mathematics in Finance Sep 2021 – Dec 2022

- ***Coursework:*** options pricing, volatility models, Black-Scholes formula and Greeks, stochastic calculus, risk and portfolio management, market microstructure

UNIVERSITY OF NOTTINGHAM Nottingham, UK
BSc in Mathematics with Applied Mathematics (Honors) Sep 2017 – Jun 2021

- ***Coursework:*** probability, stochastic processes, time series analysis, numerical analysis, statistical inference
- ***Awards***: School Achievement Prize (top 1% in class)

WORK EXPERIENCE

PUBLIC INVESTMENT FUND New York, NY
Macro Quantitative Research Consultant (May 2022 – Oct 2022)

- Built Dynamic Factor Model that forecasted US recession probability with factors constructed based on economic activities and financial-market indicators (Pseudo R-squared 0.85 in 30-year backtest)
- Conducted macroeconomic and asset data exploratory analysis to identify 14 significant predictors for GDP and CPI forecasting (lead correlation > 0.5)
- Developed multiple regression models using these predictors; backtested models on various windows to ensure test robustness (actual vs. predicted correlation 0.55, MSE <0.0001)

GUOEN CAPITAL Shenzhen, China
Quantitative Analyst Intern (Mar 2022 – June 2022)

- Constructed value and momentum factors for China A-share market, based on cross-sectional rank
- Developed and deployed backtesting infrastructure for portfolio's trading strategy using Python; implemented strategy's execution and risk management

RESEARCH PROJECTS

NEW YORK UNIVERSITY New York, NY
Portfolio Construction Using Graph Sampling (Python)

- Applied PCA to stock features and constructed graphs based on outcomes; used graph sampling methods for stock selection; backtested (results: 2% tracking error with S&P 500 from 2017-2022)

Energy Trading Strategies (Python)

- Developed carry and momentum strategies for crude oil and petroleum futures
- Backtested rolling $1M futures cumulative returns with equity line (results: 0.7 Sharpe ratio and 26% annualized returns from 1993-2020)

Option Pricing with Monte-Carlo Simulation (Python)

- Designed Monte-Carlo framework to price Asian and European options; improved results using variance reduction techniques
- Implemented least squares Monte Carlo for American option pricing with optimal exercise boundary

TECHNICAL SKILLS

Programming Languages: Python, Tableau, SQL, R, MATLAB, Java

HENGKAI MA

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance (expected December 2022)

- ***Coursework:*** dynamic and nonlinear derivatives pricing, advanced risk and portfolio management, stochastic calculus (Girsanov, Feynman-Kac), OOP in Java, Python in finance (tailored machine learning, scientific computing, model selection, simulations and validations), fixed income, capital and credit derivatives, SVA, energy derivatives, financial alternative data.

UNIVERSITY OF TORONTO Toronto, ON
Bachelor of Science
Mathematical Applications in Economics and Finance Specialist & Statistics Major (June 2021)

- ***Coursework:*** Applied math including calculus, linear algebra, convex optimization, microeconomic and macroeconomic theory, corporate finance, computer science, time series analysis (ARIMA, TFN, VAR models), statistical methods (Monte Carlo, Markov Chain)
- ***Awards:*** Winters of 2018, 2019, 2020: Dean's List Scholar; New College Council In-Course Scholarship

EXPERIENCE

TCW GROUP New York, US
Emerging Market Equities Quantitative Analyst Intern (June 2022 - August 2022)

- Conducted research on factors introduced by research papers on predicting future stock return, backtested factors using past 9 years data from bloomberg.
- Collaborated with analysts to combine factors that perform well in backtesting into current quantitative model and value model screening.

CHINA ZHESHANG BANK Jiangsu, China
Investment Banking Research and Analyst Intern (December 2020 - January 2021)

- Conducted research and statistical analyses on several industries; participated in due diligence; accurately predicted immediately impending direction of Chinese real estate market
- Liaised with multi-million-dollar clients on M&As and other corporate financing transactions; built relationships; prepared project proposals; took initiative to organize documents

MONEST FINANCIAL INC. Toronto, Canada
Equity Research Analyst Intern (May 2020 - September 2020)

- Modeled Canadian and US stock market trends; produced research reports, projections, and recommendations concerning companies and stocks
- Built discounted cash flow models and evaluated business value under different scenarios

PROJECT

UNIVERSITY OF TORONTO Toronto, ON
Canadian Bond Analysis (February 2021)

- Constructed yield, spot rate, and 1-year forward rate curve for forthcoming 5 years.
- Conducted PCA on daily log return of yield and forward rates

Sex Ratio at Birth Affected by Trump's Election (April 2020)

- Used dataset from government institution about Ontario population trend to analyze whether and which group got influenced by Trump's election in 2016 in their birth ratio using R
- Utilized GAM model to show increased severity in discrimination over Hispanic rather than Trump's election affected birth ratio in this group through increased stress

COMPUTATIONAL SKILLS/OTHER

Programming Languages: Python, R, Stata, MATLAB
Languages: Mandarin (native), English (fluent), Japanese (basic)
Certification: MCM Successful Participant Certificate in 2019

JING (KALO) QIAN

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance (Sep 2021-Dec 2022)

- ***Coursework:*** time series models (e.g., ARIMA, GARCH, MEM, Kalman filter), machine learning models (e.g., PCA, KNN, LSTM), stochastic calculus (e.g., Ito's lemma), Black-Scholes formula, derivative pricing, Monte Carlo, python programming, FX derivatives

THE OHIO STATE UNIVERSITY Columbus, OH
BS in Mathematics (Aug 2017-May 2021)

- ***Coursework:*** Partial and ordinary differential equations, programming in MATLAB, Java; mathematical induction, linear algebra, design/analysis of algorithms and data structures, SQL
- ***Honors:*** Dean's List for 7 terms; Summa Cum Laude

EXPERIENCE

QUANTIMA LLC New York, NY
Data Analyst / Researcher – Java & MySQL (Jul 2022-Sep 2022)

- Reconciled cryptocurrency data in Google Big Query with OpenSea transactions
- Managed retrieval, storage, and analysis of high frequency cryptocurrency data to derive factor models of highly discontinuous, noisy data sets; used Java and MySQL for data warehousing
- Applied alternative factor analysis techniques, most notably robust clustering as replacement for more commonly used PCA and RMT cleaning, to solve low-data quality

Noah Holdings *(China's first private wealth management firm, with $245B AUM)* Zhejiang, China
Data Analyst Intern –Python (Jun 2021-Jul 2021)

- Classifying financial products with KNNs to identify high-risk portfolios and insurances
- Analyzed financial products (e.g.,stocks, fixed income, and alternative investments) and created reports for manager and sales team to effectively communicate key points to clients

Zhejiang Hailiang Co., Ltd *(Aluminum manufactory company)* Zhejiang, China
Data Analyst Intern – Python & MySQL (May 2020-Jun 2020)

- Built DCF models in collaboration with other interns for company's valuation process in assessing potential aluminum production acquisition targets
- Managed SQL database of accounting vouchers that tracked transactions

PROJECTS

NEW YORK UNIVERSITY New York, NY
Volume Forecast – Python (July 2022-Dec 2022)

- Used machine learning and time series models to predict intraday trading volumes
- Improved forecasting accuracy of an LSTM model by adding features from ARIMA and MEM models

Quantitative Strategy Backtest – python (July 2022-Dec 2022)

- Developed a CTA futures trading strategy based on roll yield and market volatilities
- Implemented a daily ranking system by roll yield to decide on long or short positions
- Used market volatility to adjust daily leverage levels and completed a 10-year back test with a 8.88% annual return, 1.62 Sharpe ratio, and 1.58 Calmar ratio.

THE OHIO STATE UNIVERSITY Columbus, OH
Bookstore Information Management – MySQL (Jan 2021-Apr 2021)

- Developed database to store suppliers' and customers' information, record details of every transaction, and provide descriptions of each product

COMPUTATIONAL SKILLS/OTHER

Programming Languages and Software: Python, Java, MATLAB, SQL
Languages: English (Fluent), Chinese (Native)
Hobbies: Working out, Cantonese songs, Pokemon games

YI QIN

(517) 703-6571 ■ yiqin@nyu.edu ■ linkedin.com/in/yi-qin-damon/

EDUCATION

NEW YORK UNIVERSITY New York City, NY

The Courant Institute of Mathematical Sciences

M.S. in Mathematics in Finance (expected Dec 2022)

- ***Completed Coursework:*** data cleaning, Black-Scholes formula, linear regression, risk-neutral valuations, risk measures (VaR and expected shortfall), portfolio optimization, Monte Carlo simulation
- ***Current Coursework:*** Runge Kutta and collocation methods, risk-neutral valuations, Time Series analysis, dynamic asset pricing, gradient descent, bootstrap bagging, random forest, neural network

THE OHIO STATE UNIVERSITY Columbus, OH

B.S. in Mathematics (Aug 2016-May 2020)

- ***Coursework:*** Calculus, differential equations, linear algebra, probability and statistics, real analysis, binomial asset pricing model, measurement of interest, Markov Process, Red-Black Tree, data structure
- ***Achievements:*** 3-year Dean's List, Merit and Need-based Awards in 2019, Latin Honors, magna cum laude

EXPERIENCE

THE AMERICAN COLLEGE OF FINANCIAL SERVICE King of Prussia, PA

Quantitative Research Intern (Jun 2022-Sep 2022)

- Generated the transition matrix of ten states based on a decade of data using R; ran the Markov Chain model to estimate the future market share of titles; traced career progression for selected top broker dealer firms
- Performed the exploratory analysis on market data using Python; analyzed the distribution of important fields; conducted the statistical inference
- Chose indicative factors, created segments and grouped the clients data to find the most promising group; estimated the potential revenue

DACHENG FUND CO., LTD Beijing, CN

Quantitative Research Intern (Jun 2019-Jul 2019)

- Managed SQL database; built simulated portfolio model using Java; evaluated results with net value charts; annualized Sharpe ratio and maximum drawdown to generate best-performing portfolios
- Conducted research on 10 financial firms' AI investment algorithms; wrote report demonstrating trend of AI assisting and even replacing portfolio managers

AVIC SECURITIES CO., LTD Zhengzhou, CN

Investment Analysis Intern (Jun 2018-Aug 2018)

- Analyzed daily financial news reports with investment consultants; liaised with high-net-worth clients to communicate investment recommendations
- Monitored total assets and liabilities of clients' margin trading; calculated maintenance guarantee ratio and ensured it stayed above 130%

PROJECTS

NEW YORK UNIVERSITY New York City, NY

Portfolio Construction Using Graph Theory - Cointegration (Sep 2022)

- Calculated cointegration of selected 200 stocks from S&P 500; Created MST (Minimum Spanning Tree) and PMFG (Planar Maximally Filtered Graph) based on absolute value of t-statistics of cointegration
- Combined some measures like centrality and subgraph sampling methods to select several stocks from graphs
- Constructed equal weight, low volatility, and Markowitz min-variance portfolios; Tracked performances with cumulative return of S&P 500 from 06/2019 to 06/2022; Replicated S&P 500 with 0.0012 tracking errors

NEW YORK UNIVERSITY New York City, NY

Systematic Energy Trading Strategy for WTI (Mar 2022)

- Conducted systematic carry-momentum strategy in python; combined exponential moving averages based on WTI futures and SPY index to build signal of trading
- Built pipeline of data preprocessing; performed long-term backtesting of strategy; achieved 16% average annualized excess returns and 0.76 annualized Sharpe ratio

THE OHIO STATE UNIVERSITY Columbus, OH

Media Manager Database System for Local Library (Oct 2019-Dec 2019)

- Mapped enhanced entity relation model to relational schema
- Collaborated with team to build SQL database system

COMPUTATIONAL SKILLS/OTHER

Programming Languages: Java, Python, R, SQL

Languages: Mandarin (native), English (fluent)

YAO (GRACE) TONG

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance (expected December 2022)

- ***Recent Coursework:*** Derivative pricing, Black-Scholes, Monte Carlo, risk evaluation, stochastic calculus, factor model, risk and portfolio management, computing in finance, MBS
- ***Upcoming Coursework:*** dynamic & nonlinear derivatives pricing, advanced risk and portfolio management, fixed income, capital and credit derivatives, SVA, financial alternative data

UNIVERSITY OF VIRGINIA Charlottesville, Virginia
B.A. in Mathematics (Financial Concentration) and Economics (2017-2021)

- ***Minor:*** French
- ***Honors:*** Degree with Distinction, Dean's List

EXPERIENCE

TRUVALUE ASSET MANAGEMENT Remote
Quantitative and International Research Summer Intern (6/2022 - 8/2022)

- Researched the prospects of Vietnam's economy and securities market, and prepared for the establishment of Vietnam's national QDII; researched areas include but are not limited to macroeconomics, currency markets, regulatory policies, exchange rates, commodities, etc.
- Analyzed Vietnam Stock Exchange indexes with volatility models and applied GARCH-type models; completed the work of document collection, data collection, and ppt writing
- Reported results to senior management and made final presentations

KPMG CHINA Shenzhen, China
Risk Advisory Summer Intern (7/2020 - 8/2020)

- Reached out to managers to seek out information to develop improved risk monitoring/warning system for major Chinese commercial bank client, which adopted it
- Created 37 support materials (in Visio, Excel, PowerPoint, Word) with detailed explanations about new system for client review; presented them to senior manager
- Took initiative in researching risk monitoring and warning systems of other Chinese commercial banks; reported findings to senior management team

WIGNER IMAGING AND FEMTOGRAPHY AT UVA Charlottesville, Virginia
Research Assistant, Data Analyst (6/2019 - 4/2021)

- Used Python to extract GPDs and compton form factors (CFFs) from data/error analysis to single out which measurements had greatest impact on determining CFFs
- Built research group website inWordPress; created 16 pages and 52 pictures for roster, gallery, Q&A, and Github
- Collaborated with master's and Ph.D. candidates to create loss function for neural networks based on scattering cross-sections

SHANGHAI SECURITIES CO., LTD *(Middle market investment bank)* Shanghai, China
Research Intern (5/2018 - 6/2018)

- Researched and analyzed solvency and profitability data from 36 investment management firms and associated websites; presented results to senior managers
- Evaluated qualification of bonds seeking issuance under Shanghai Securities' supervision; reported results weekly to associates and managers

COMPUTATIONAL SKILLS/OTHER

Programming Languages: Python (NumPy, pandas), R, Mathematica, MATLAB, STATA
Languages: Mandarin (native), English (fluent), French (fluent), Cantonese (basic), Korean (basic)
Interests: Flutist, Shanghai International Youth Orchestra; Horseback Riding(Virginia Riding club)

DAOMING ZHANG

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EDUCATION

NEW YORK UNIVERSITY New York, NY
THE COURANT INSTITUTE OF MATHEMATICAL SCIENCES
Master of Science in Mathematics in Finance Expected Dec 2022
UNIVERSITY OF MARYLAND College Park, MD
Bachelor of Science in Applied Mathematics & Computer Science May 2021
Awards: Dean's List (bestowed during all semesters due to academic excellence)

SKILLSET

Programming Skills: Java, Python (pandas, sklearn), SQL (MySQL, PostgreSQL), MATLAB
Coursework: Time Series Analysis, Machine Learning, Computational Finance, Systematic Trading Strategies

EXPERIENCES

HUIJIN ASSET MANAGEMENT Jun 2021-Aug 2021
Intern, Assistant Product Manager Shanghai, China

- Produced summary spreadsheets on disclosed related parties through fundamental, competitor and industry analysis, facilitating the IPO process for the Investment Banking Department
- Track daily P&L of existing funds with basic VBA functions on price data from WIND-Economic database, monitor abnormal value changes and signaled potential risks to operation managers

GUOSHEN SECURITIES Jan 2020-Feb 2020
Intern, Fixed Income Risk Management Analyst Shanghai, China

- Evaluated default risk of debtors based on their operation status and market environment presented in financial reports, and drafted risk disclosure document for the due diligence report
- Researched on economic compatitiveness and financial development across regions in China

PROJECTS

NEW YORK UNIVERSITY, COURANT INSITUTE
Portfolio Construction using Graph Sampling (Python) Sep 2022-Current

- Create S&P500 tracking portfolio using graph-based approaches with lower expense
- Apply PCA to reduce dimensions of each stock's technical and fundamental indicator data
- Build stocks' network through Minimum Spanning Tree and Planar Maximally Filtered Graph, whose edges among nodes represent correlations of the results of PCA
- Backtest S&P500 active components (2017-2022), and construct portfolio with 10 central stocks and 10 peripheral stocks to reach minimum absolute tracking error regarding quartly returns

Risk Premium Strategy on WTI Futures (Python) Mar 2022-May 2022

- Backtested carry-momentum strategy, reaction-function-based momentum strategy, and a combination of both on WTI Futures (2010-2021), with a buy-and-hold rolling portfolio as benchmark
- Optimized signal performance and reached annualized Sharpe Ratio of 0.95, transaction cost considered

UNIVERSITY OF MARYLAND
Analysis of San Francisco Crime Dataset (Python) Oct 2020-Dec 2020

- Explore relationships among multiple criminal criteria on San Francisco crime data set (2016) with pandas and visualized crime occurrences and risk levels by interactive heat map with folium and seaborn
- Predicted crimes by machine learning models (e.g. Random Forest) on imbalanced data and evaluated models by multiple standards (e.g ROC curve)

ACTIVITIES

Volunteer: ESL Program**,** 2018 (high-school level English reading and writing tutoring)

ZIYUAN (ALICE) ZHAO

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EDUCATION

NEW YORK UNIVERSITY New York, NY
The Courant Institute of Mathematical Sciences
M.S. in Mathematics in Finance (expected May 2023)

- ***Coursework:*** *OOP in Java, test-driven development, Black-Scholes model, stochastic calculus, ARMA & GARCH models, LASSO & ridge regression*

UNIVERSITY OF MICHIGAN (Sep 2019-Aug 2021) Ann Arbor, MI
B.S. in Mathematics of Finance and Risk Management, Minor in Computer Science

- ***Coursework:*** *Probability and statistics, linear algebra, algorithms and data structures (C++, Python), PCA & SVD, LDA & QDA, dynamic programming, numerical analysis*
- ***Honors:*** *University Honor (2020); Outstanding Achievement in Mathematics Award (2021)*

RENMIN UNIVERSITY OF CHINA (Sep 2016-Jun 2019) Beijing, China
Major in Chemistry, Minor in Finance

EXPERIENCE

MOYI TECH (Fin-tech firm that automates market research and data analysis) New York, NY
Quantitative Analyst Intern (full-time, Jul 2020-Aug 2020; part-time, Sept 2020-Aug 2021)

- Established factor pools for stocks based on WorldQuant "101 Formulaic Alphas" paper; developed feature-selection framework using Alphalens Python package
- Simulated performance of stock portfolio built using weighted sum of factor values as asset allocation; analyzed outcome using Pyfolio Python package
- Recognized stock candlestick patterns using TA-Lib Python package to generate trading signals; back-tested strategy based on top five predictive signals selected by Sharpe ratio
- Developed MMAC and mean reversion strategies on Bitcoin, achieving annual Sharpe ratio of 1.95 and max drawdown of 11.3% (using data from 2018 to 2020)
- Constructed AR model on Bitcoin by using ACF/PACF/AIC analyses; applied white noise test and built GARCH model to explain fat tail and volatility clustering
- Designed multifactor model to predict fund return based on Treynor-Mazuy model and max drawdown; wrote research report about constructing fund of funds

GALAXY SECURITIES Beijing, China
Analyst Intern, Commercial Retail Industry (Dec 2018-Mar 2019)

- Built up DCF and comparable analysis models for company valuations; ranked stocks based on estimated price/market price, P/S, P/E and P/B; selected top and bottom deciles
- Designed market-neutral long/short strategy by longing top decile and shorting bottom decile with monthly rebalancing; obtained annual Sharpe ratio of 1.52
- Modeled shopping center industry life cycle based on historical sales data in mature Japan market; analyzed status of shopping centers and predicted their development in China
- Researched and analyzed development of Amazon's services; compared its online shopping platform to those of online retailers in China

PROJECT

Handwritten Digit Recognition (Apr 2020) (Python)

- Built neural network modelto project 2-dimensional image samples onto hidden 3-dimensional layers; classified with 2-dimensional softmax output classifier, achieving 96% accuracy

COMPUTATIONAL SKILLS

Programming Languages: *Python, C++, Java, SQL, R, VBA*
Github Work: *https://github.com/alicezhzy/Top-companies-in-11-industry-sectors.git*

The Mathematics in Finance Masters Program
Courant Institute, New York University
Academic Year 2021-2022

The curriculum has four main components:

1. **Financial Theory, Statistics and Financial Data Science**. These courses form the core of the program, covering topics ranging from equilibrium theory, Black-Scholes, Heath-Jarrow- Morton, linear regressions, covariance matrix estimation to modern machine learning techniques and how they are used in quantitative finance.
2. **Practical Financial Applications**. These classes are taught by industry specialists from prominent Wall Street firms. They emphasize the practical aspects of quantitative finance, drawing on the instructor's subject matter 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 in Java and Python, and facility with computational methods such as optimization, Monte Carlo simulation, EM-type algorithms and the numerical solution of partial differential equations.

		First Semester	*Second Semester*	*Third Semester*
Practical Financial Applications			Advanced Topics in Equity Derivatives (1/2 Semester) ___ Algorithmic Trading & Quant. Strategies ___ Advanced Risk Management ___ Interest Rate and FX Models ___ Market Microstructure (1/2 Semester) ___ Modeling and Risk Management of Bonds and Securitized Products (1/2 Semester) _____ Trading Energy Derivatives (1/2 Semester)	Alternative Data in Quantitative Finance (1/2 Semester) ___ Credit Analytics: Bonds, Loans & Derivatives (1/2 Semester) ___ Fixed Income Derivatives: Models & Strategies in Practice (1/2 Semester) ___ Project and Presentation ___ Trends in Sell-Side Modeling: XVA, Capital and Credit Derivatives

		First Semester	*Second Semester*	*Third Semester*
Financial Theory, Statistics and Financial Data Science		Financial Securities and Markets Risk and Portfolio Management	Active Portfolio Management Dynamic Asset Pricing (1/2 Semester) Machine Learning & Computational Statistics (1/2 Semester)	Advanced Statistical Inference and Machine Learning Trends in Financial Data Science Time Series Analysis & Stat. Arbitrage
Mathematical Tools		Stochastic Calculus		Nonlinear Problems in Finance: Models and Computational Methods
Computational Skills		Computing in Finance Data Science and Data-Driven Modeling (1/2 Semester)	Scientific Computing in Finance	

Practical Training. In addition to coursework, the program emphasizes practical experience. All students do a capstone project (the Project and Presentation course), 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, 2021-2022

PRACTICAL FINANCIAL APPLICATIONS:

MATH-GA 2752-001 ACTIVE PORTFOLIO MANAGEMENT

(3 Points) Spring term: J. Benveniste

Prerequisites: Computing in Finance, and Risk & Portfolio Management.

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
(3 Points) Spring term: K. Abbott
Prerequisites: Financial Securities and Markets, and Computing in Finance or equivalent programming experience.

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.

Textbook: Allen, S.L. (2003). Wiley Finance [Series, Bk. 119]. *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk*. Hoboken, NJ: John Wiley & Sons.

MATH-GA 2801-001 ADVANCED TOPICS IN EQUITY DERIVATIVES
(1.5 Points) Spring term: S. Bossu
Prerequisites: Financial Securities and Markets, 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 2804-001 CREDIT ANALYTICS: BONDS, LOANS AND DERIVATIVES (Not Offered Fall 2021)
(1.5 Points) Fall term: B. Fleasker
Prerequisites: Financial Securities and Markets, 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 2803-001 FIXED INCOME DERIVATIVES: MODELS & STRATEGIES IN PRACTICE

(1.5 Points) Fall term: L. Tatevossian

Prerequisites: Computing in Finance, or equivalent programming skills; and Financial Securities and Markets, or equivalent 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 2798-001 INTEREST RATE AND FX MODELS

(3 Points) Spring term: F. Mercurio & T. Fisher

Prerequisites: Financial Securities and Markets, 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 2802-001 MARKET MICROSTRUCTURE

(1.5 Points) Spring term: TBA

Prerequisites: Financial Securities and Markets, Risk and Portfolio Management, 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 2799-001 MODELING AND RISK MANAGEMENT OF BONDS AND SECURITIZED PRODUCTS

(1.5 Points) Spring term: R. Sunada-Wong

Prerequisites: Financial Securities and Markets, Risk and Portfolio Management, and Computing in Finance or equivalent programming experience.

This half-semester course is designed for students interested in Fixed Income roles in front-office trading, market risk management, model development ("Quants", "Strats"), or modelvalidation.

We begin by modeling the cash flows of a generic bond, emphasizing how the bond reacts to changes in markets, how traders may position themselves given their views on the markets, and how risk managers think about the risks of a bond. We then focus on Mortgages, covering the fundamentals of Residential Mortgages, and Mortgage-Backed Securities. Students will build pricing models for mortgages, pass-throughs, sequentials and CMO's that generate cash flows and that take into account interest rates, prepayments and credit spreads (OAS). The goals are for students to develop: (1) an understanding of how to build these models and how assumptions create "model risk", and (2) a trader's and risk manager's intuition for how these instruments behave as markets change, and (3) a knowledge of how to hedge these products. We will graph cash flows and changes in market values to enhance our intuition (e.g. in Excel, Python or by using another graphing tool).

In the course we also review the structures of CLO's, Commercial Mortgage Backed Securities (CMBS), Auto Asset Backed Securities (ABS), Credit Card ABS, subprime mortgages and CDO's and credit derivatives such as CDX, CMBX and ABX. We discuss the modeling risks of these products and the drivers of the Financial Crisis of 2008. As time permits, we touch briefly on Peer-to-peer / MarketPlace Lending.

MATH-GA 2800-001 TRADING ENERGY DERIVATIVES

(1.5 Points) Spring term: I. Bouchouev

Prerequisites: Financial Securities and Markets, and Stochastic Calculus.

The course provides a comprehensive overview of most commonly traded quantitative strategies in energy markets. The class bridges quantitative finance and energy economics covering theories of storage, net hedging pressure, optimal risk transfer, and derivatives pricing models.

Throughout the course, the emphasis is placed on understanding the behavior of various market participants and trading strategies designed to monetize inefficiencies resulting from their activities and hedging needs. We discuss in detail recent structural changes related to financialization of energy commodities, cross-market spillovers, and linkages to other financial asset classes.

Trading strategies include traditional risk premia, volatility, correlation, and higher-order options Greeks. Examples and case studies are based on actual market episodes using real market data.

MATH-GA 2805-001 TRENDS IN SELL-SIDE MODELING: XVA, CAPITAL AND CREDIT DERIVATIVES

(3 Points) Fall term: L. Andersen

Prerequisites: Advanced Risk Management, Financial Securities and Markets, 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 a 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, STATISTICS AND FINANCIAL DATA SCIENCE:

MATH-GA 2708-001 ALGORITHMIC TRADING AND QUANTITATIVE STRATEGIES

(3 Points) Spring term: P. Kolm and L. Maclin

Prerequisites: Computing in Finance, and Risk and Portfolio Management, or equivalent.

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 2793-001 DYNAMIC ASSET PRICING

(1.5 Points) Spring term: B. Dupire & M. Essid

(1.5 Points) Fall term: A. Javaheri & S. Ghamami

Prerequisites: Calculus-based probability, Stochastic Calculus, and a one semester course on derivative pricing (such as what is covered in Financial Securities and Markets).

This is an advanced course on asset pricing and trading of derivative securities. Using tools and techniques from stochastic calculus, we cover (1) Black-Scholes-Merton option pricing; (2) the martingale approach to arbitrage pricing; (3) incomplete markets; and (4) the general option pricing formula using the change of numeraire technique. As an important example of incomplete markets, we discuss bond markets, interest rates and basic term-structure models such as Vasicek and Hull-White.

It is important that students taking this course have good working knowledge of calculus-based probability and stochastic calculus. Students should also have taken the course "Financial Securities and Markets" previously. In addition, we recommend an intermediate course on mathematical statistics or engineering statistics as an optional prerequisite for this class.

MATH-GA 2791-001 FINANCIAL SECURITIES AND MARKETS
(3 Points) Fall term: M. Avellanda
Prerequisites: Multivariate calculus; linear algebra; and calculus-based probability.

This course provides a quantitative introduction to financial securities for students who are aspiring to careers in the financial industry. We study how securities traded, priced and hedged in the financial markets.

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; clearing; valuation adjustment and capital requirements.

It is important that students taking this course have good working knowledge of multivariate calculus, linear algebra and calculus-based probability.

MATH-GA 2071-001 MACHINE LEARNING & COMPUTATIONAL STATISTICS
(1.5 Points) Spring term: I. Dimov
Prerequisites: Multivariate calculus, linear algebra, and calculus-based probability. Students should also have working knowledge of basic statistics and machine learning (such as what is covered in Data Science and Data-Driven Modeling).

This half-semester course (a natural sequel to the course "Data Science & Data-Driven Modeling") examines techniques in machine learning and computational statistics in a unified way as they are used in the financial industry.

We cover supervised learning (regression and classification using linear and nonlinear models), specifically examining splines and kernel smoothers, bagging and boosting approaches; and how to evaluate and compare the performance of these machine learning models. Cross-validation and bootstrapping are important techniques from the standard machine learning toolkit, but these need to be modified when used on many financial and alternative datasets. In addition, we discuss random forests and provide an introduction to neural networks.

Hands-on homework form an integral part of the course, where we analyze real-world datasets and model them in Python using the machine learning techniques discussed in the lectures.

It is important that students taking this course have good working knowledge of multivariate calculus, linear algebra and calculus-based probability. Students should also know basic statistics and machine learning (such as what is covered in the "Data Science & Modeling" course at NYU Courant) and be familiar with the standard "Python stack".

MATH-GA 2755-001 PROJECT AND PRESENTATION
(3 Points) 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 2751-001 RISK AND PORTFOLIO MANAGEMENT
(3 Points) Fall term: K. Winston
Prerequisites: Multivariate calculus, linear algebra, and calculus-based probability.

Risk management is arguably one of the most important tools for managing investment portfolios and trading books and quantifying the effects of leverage and diversification (or lack thereof).
This course is an introduction to portfolio and risk management techniques for portfolios of (i) equities, delta-1 securities, and futures and (ii) basic fixed income securities.

A systematic approach to the subject is adopted, based on selection of risk factors, econometric analysis, extreme-value theory for tail estimation, correlation analysis, and copulas to estimate joint factor distributions. We will cover the construction of risk measures (e.g. VaR and Expected Shortfall) and portfolios (e.g. portfolio optimization and risk). As part of the course, we review current risk models and practices used by large financial institutions.

It is important that students taking this course have good working knowledge of multivariate calculus, linear algebra and calculus-based probability.

MATH-GA 2707-001 TIME SERIES ANALYSIS AND STATISTICAL ARBITRAGE
(3 Points) Fall term: F. Asl and R. Reider
Prerequisites: Financial Securities and Markets, Scientific Computing in Finance (or 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 2903-001 STOCHASTIC CALCULUS
(1.5 Points) Fall term: J. Goodman
Prerequisite: Multivariate calculus, linear algebra, and calculus-based probability.

The goal of this half-semester course is for students to develop an understanding of the techniques of stochastic processes and stochastic calculus as it is applied in financial applications. We begin by constructing the Brownian motion (BM) and the Ito integral, studying their properties. Then we turn to Ito's lemma and Girsanov's theorem, covering several practical applications. Towards the end of the course, we study the linkage between SDEs and PDEs through the Feynman-Kac equation. It is important that students taking this course have good working knowledge of calculus-based probability.

COMPUTATIONAL SKILLS:
MATH-GA 2049-001 ALTERNATIVE DATA IN QUANTITATIVE FINANCE
(1.5 Points) Fall term: G. Ekster
Prerequisites: Risk and Portfolio Management, and Computing in Finance. In addition, students should have a working knowledge of statistics, finance, and basic machine learning. Students should have working experience with the Python stack (numpy/pandas/scikit-learn).

This half-semester elective course examines techniques dealing with the challenges of the alternative data ecosystem in quantitative and fundamental investment processes. We will address the quantitative tools and technique for alternative data including identifier mapping, stable panel creation, dataset evaluation and sensitive information extraction. We will go through the quantitative process of transferring raw data into investment data and tradable signals using text mining, time series analysis and machine learning. It is important that students taking this course have working experience with Python Stack. We will analyze real-world datasets and model them in Python using techniques from statistics, quantitative finance and machine learning.

MATH-GA 2046-001 ADVANCED STATISTICAL INFERENCE AND MACHINE LEARNING (3 Points) Fall term: G. Ritter
Prerequisites: Financial Securities and Markets, Risk & Portfolio Management, 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 2041-001 COMPUTING IN FINANCE
(3 Points) Fall term: E. Fishler and L. Maclin
Prerequisites: Procedural programming, some knowledge of Java recommended.

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 2070-001 DATA SCIENCE AND DATA-DRIVEN MODELING
(1.5 Points) Fall term: M. Noguer I Alonso
Prerequisites: Multivariate calculus, linear algebra, and calculus-based probability.

This is a half-semester course covering practical aspects of econometrics/statistics and data science/ machine learning in an integrated and unified way as they are applied in the financial industry. We examine statistical inference for linear models, supervised learning (Lasso, ridge and elastic-net), and unsupervised learning (PCA- and SVD-based) machine learning techniques, applying these to solve common problems in finance. In addition, we cover model selection via cross-validation; manipulating, merging and cleaning large datasets in Python; and web-scraping of publicly available data.

MATH-GA 2047-001 TRENDS IN FINANCIAL DATA SCIENCE
(3 Points) Fall term: P. Kolm and I. Dimov
Prerequisites: The following four courses, or equivalent: (1) Data Science and Data-Driven Modeling, (2) Financial Securities and Markets, (3) Machine Learning & Computational Statistics, and (4) Risk and Portfolio Management. It is important you have experience with the Python stack.

This is a full semester course covering recent and relevant topics in alternative data, machine learning and data science relevant to financial modeling and quantitative finance. This is an advanced course that is suitable for students who have taken the more basic graduate machine learning and finance courses Data Science and Data-Driven Modeling, and Machine Learning & Computational Statistics, Financial Securities and Markets, and Risk and Portfolio Management.
For the syllabus for the course, click HERE.

MATH-GA 2045-001 NONLINEAR PROBLEMS IN FINANCE: MODELS AND COMPUATIONAL METODS
(3 Points) Fall term: J. Guyon and B. Liang
Prerequisites: Scientific Computing in Finance (or Scientific Computing), Continuous Time Finance, or permission of instructor.

The classical curriculum of mathematical finance programs generally covers the link between linear parabolic partial differential equations (PDEs) and stochastic differential equations (SDEs), resulting from Feynmam-Kac's formula. However, the challenges faced by today's practitioners mostly involve nonlinear PDEs. The aim of this course is to provide the students with the mathematical tools and computational methods required to tackle these issues, and illustrate the methods with practical case studies such as American option pricing, uncertain volatility, uncertain mortality, different rates for borrowing and lending, calibration of models to market smiles, credit valuation adjustment (CVA), portfolio optimization, transaction costs, illiquid markets, super-replication under delta and gamma constraints, etc.

We will strive to make this course reasonably comprehensive, and to find the right balance between ideas, mathematical theory, and numerical implementations. We will spend some time on the theory: optimal stopping, stochastic control, backward stochastic differential equations (BSDEs), McKean SDEs, branching diffusions. But the main focus will deliberately be on ideas and numerical examples, which we believe help a lot in understanding the tools and building intuition.

MATH-GA 2048-001 SCIENTIFIC COMPUTING IN FINANCE
(3 Points) Spring term: R. Lindsey and M. Sonthonnax
Prerequisites: Risk and Portfolio Management, Financial Securities and Markets, and Computing in Finance.

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.