

Master of Science in Quantitative Finance

D'Amore-McKim School of Business

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Program Description

The D'Amore-McKim School of Business (DMSB) proposes a new quantitative track to the Master of Science in Finance (MSF) degree program with STEM designation to address the changes in demand in the financial industry. The financial industry is changing rapidly with the introduction of new technology. With fintech - computer programs and other technology used to support or enable banking and financial services – globalization, new regulations, emerging technologies, and other industry innovations, the financial industry has become a more technology intensive industry and is now looking for an increasing number of employees with computer science, engineering, mathematics, statistics and econometrics training. New positions in the financial industry now require not just knowledge of finance but also quantitative and technical skills.

DMSB MSF Program History-to-Date

The MSF program was conceived primarily as a program for working professionals in 1994. The program was targeted to students working in the financial industry who were seeking to increase their knowledge of finance. Incoming students made use of their increased knowledge of finance to gain professional standing such as the Chartered Financial Analyst (CFA) designation and to advance in their careers. Students, while still enrolled in the program, reported both promotions and new positions resulting from the knowledge and skills gained.

In the fall of 2013 D'Amore-McKim enrolled the first full time cohort of MS Finance students. Today the program is primarily attracting international students, Northeastern undergraduates (Plus One students) and students enrolled in a joint MSF/MBA program. Quantitative and technical skills are more critical for a large portion of this changing student body, yet there have been very limited changes to the curriculum since 1994.

Need for Change

Competitors, such as Boston College, MIT, Babson and Bentley, offering MSF programs in the Boston area have already made the change to either offering only a more quantitative MSF program or offering an additional quantitative track and all are STEM designated. This is primarily a response to changes in demand coming from the financial industry and changes in the composition of prospective students for MSF degree programs. Without a quantitative track, the DMSB is realizing its competitive disadvantage. Competitor enrollment has been increasing, yet DMSB MSF program enrollment has dropped from its peak in 2016-2017.

Program Goals

The quantitative track to the MSF program is designed to prepare students for careers in the financial industry requiring analytical rigor. While a traditional program draws from economics,

finance and accounting, the curriculum for this track integrates economics, mathematics, statistics, and computer science with the theories and applications of finance. Students will learn advanced modelling techniques and data analytics applied to financial markets. The rigorous program combines in-depth study of quantitative techniques with practical business problem solving.

Proposed Curriculum

The proposed curriculum includes substantial changes to both program required courses and program electives. The major changes to the core required courses are the following: Analysis of Financial Institutions, International Financial Management, Financial Strategy and Finance Seminar are replaced with Fundamentals of Financial Mathematics and Financial Markets, Derivatives and Risk Analysis, Data Analytics in Finance, and Financial Econometrics and Statistics. The new courses substantially increase the quantitative rigor of the curriculum.

Entirely new elective courses have been added to the program. The new elective courses also draw content from computer science, econometrics, and mathematics. New courses include the following: Quantitative Portfolio Management, Computational Methods in Finance, Foundations of Artificial Intelligence, Database Management Systems, and Applied Econometrics.

Appendix A provides a side-by-side comparison of the current MS Finance curriculum and the proposed MS Finance, Quantitative Finance Track curriculum. The table highlights three categories of courses, unchanged, updated, and new courses.

Appendix B provides the curricula of several competitor schools. Clearinghouse data confirms our competitor schools, those to whom our applicants also apply and where they enroll when not enrolling at Northeastern. The curricula in this table further demonstrate that we are losing students to programs with more quantitative financial content.

Course Descriptions

1) Required Courses

FINA 6331 Corporate Finance

Introduction to the basic framework of corporate finance and financial decision making. Topics include capital budgeting, capital investment decisions, complex valuations, security issues, dividend policy, static and dynamic capital structure, real option analysis, restructuring, bankruptcy, corporate control and governance, and the legal, ethical, and regulatory environment of financial management.

FINA 6332 Fundamentals of Financial Mathematics and Financial Markets

Provides an introduction to the essential fundamental mathematics needed for the study of modern finance: probability, stochastic processes, statistics, and regression analysis. The course also focuses on theory and empirical evidence useful for investment decisions. Course content includes financial risk factors, financial models, financial markets and equilibrium models of security prices, market efficiency, and the empirical behavior of security prices.

FINA 6203 Investment Analysis

Familiarizes students with domestic and international financial markets and the securities traded therein. Discusses a variety of techniques for valuation of financial assets and relies heavily on quantitative methods. Critically analyzes such qualitative concepts as market efficiency, intrinsic value, and risk. The contents of this course, descriptive, theoretical, and applied, should provide students with the ability to build unique valuation models to suit the particular investment alternative they wish to scrutinize. Also provides students with an understanding of how investment theory and investment practice relate.

FINA 6335 Data Analytics in Finance

Python has gradually become one of the most widely used open-source, cross-platform programming languages. This course is designed to introduce students to Python and its use as a financial data analytics tool. The first part of the course will introduce the basics of programming in Python and key libraries (NumPy, Pandas, Matplotlib etc.) used in data analytics. The second part of the course will focus on implementing various financial models in Python. Topics covered include but are not limited to Single and Multifactor Portfolio Models, Portfolio Theory and the Efficient Frontier, Algorithmic Trading, Options and Futures, and Value at Risk.

FINA 6333 Financial Econometrics and Statistics

The course introduces a set of modern analytical tools to solve practical problems in finance. The goal is to build operational models, test them with data, and then use them to aid financial decision making. Topics include regression, event studies, the empirical behavior of security prices, market efficiency, and performance evaluation.

FINA 6334 Derivatives and Risk Analytics

Provides an introduction to derivative assets, financial engineering, and risk management. Explores specific hedging use of options, forwards, and futures. The course focuses on the

determinants of forwards, futures, options and swaps, and various exotic derivatives prices using computer-based numerical methods in a Monte Carlo setting and in close-form using elements of stochastic calculus. The course also explores risk management strategies using positions in derivative securities, static hedging, and dynamic hedging in continuous time.

2) Elective Courses

FINA 6204 International Financial Management

Students analyze international financial markets and instruments. Topics include currency markets, exchange rate determination, statistical properties of exchange rates, currency futures and options, hedging foreign exchange risk and managing foreign exchange exposure.

FINA 6207 Financial Modeling

Introduces financial modeling applications in the fields of risk management, statistics applied to finance, investments, and portfolio management. Financial modeling is used for performing financial analysis facilitating business decision making in virtually any business. Enables students to effectively and efficiently understand and implement the quantitative aspects of financial topics covered in the various financial courses taught in the MSF program and to learn how to use a variety of tools and techniques to enhance their overall analytical skill set, including to program finance formulas using Visual Basic for Applications (VBA).

FINA 6336 Fixed Income Securities and Derivatives

Exposes students to theory, applications, and evidence concerning highly sensitive interest rate products. Designed for students seeking to develop understanding of fixed income valuation and hedging methods and familiarity with major markets and instruments. Emphasizes tools for quantifying, hedging and speculation. Topics include duration, convexity, approaches to modelling the yield curve, interest rate forward, futures, swaps and options, credit risk and credit derivative, mortgages, and securitization.

FINA 6214 Mergers, Acquisitions and Private Equity

Explores the environments that have recently given rise to a large number of corporate mergers and the business factors underlying these corporate combinations. Examines the financial,

managerial, accounting, and legal factors affecting mergers. Explores three aspects of the merger and acquisition process: the strategic decision to acquire, the valuation decision of how much to pay, and the financing decision on how to fund the acquisition.

FINA 6216 Corporate Valuation and Fundamental Analysis

The course focuses on cash-flow oriented models of the valuation of the firm. Topics include enterprise value, free cash flow, economic value added, and risk/reward analysis. Explores recent developments in financial management and financial analysis through the use of modern finance theory to make capital allocation decisions that lead to long-run value maximization for the corporation. Focuses on applications and financial model building, risk analysis for valuation applications, and business strategies to measure and manage corporate value and value creation. Topics are relevant to value consultants, corporate managers, and securities analysts.

FINA 6217 Real Estate Finance and Investment

Provides students with a comprehensive understanding of real estate finance. Emphasizes factors affecting real estate investment. Topics include the basics of real estate financial analysis and financial statements, valuation (appraisal), market analysis, development, taxation, ownership types, permanent loans, construction loans, equity financing and joint ventures, institutional real estate, Real Estate Investment Trusts (REITs), mortgages and markets, Commercial Mortgage-Backed Securities (CMBS), and investment strategies.

FINA 6219 Quantitative Portfolio Management

The course provides an introduction to portfolio management with a focus on quantitative methods. Major topics include portfolio construction, revision, and performance measurement. Portfolio construction using constrained mean-variance optimization is covered as well as performance evaluation using factor models such as the Fama-French three-factor model. Additional topics include the effects of diversification on risk reduction, and the costs of inflation, taxes, and transaction costs on management of fixed income and equity security portfolios. Quantitative approaches to manage specific sources of risk are also covered. Students will employ historical data to construct backtests to assess the performance of various portfolio strategies.

FINA 6260 Entrepreneurial Finance and Venture Capital

Covers qualitative and quantitative aspects of entrepreneurial finance, such as venture capital and angel financing. Introduces students to valuation aspects in entrepreneurial finance, including valuation of startups, using real options to value innovation-intensive firms; and valuation in staged financing. Emphasizes the practical aspects of qualitative and quantitative issues related to venture capital financing, entrepreneurship, and innovation from the perspective of the

financier and the startup firm. Also covers many issues related to the venture capital industry, such as the limited partnership structure of the venture capital/private equity industry, venture capital term sheets and contracts, exit of portfolio firms, and international investments.

FINA 6337 Computational Methods in Finance

Study various computational methods in Finance. Analyze market data and build trading strategies. Tools, such as interpolation methods, solver, and optimization methods, are used to calibrate discount curve and volatility surfaces to market prices. Analyze market data and apply dimension reduction techniques such as Principal Component Analysis (PCA). Apply time series analysis and PCA to implement and back test trading strategies. Programming with Python is used in many classes.

FINA XXXX Alternative Investments

Covers alternative investments, including real assets such as real estate and real estate investment trusts, hedge funds, commodities, private equity, and structured products. The course is highly quantitative and focuses on methods for understanding risk, return, and benchmarking these investments.

CS 5100 Foundations of Artificial Intelligence

Introduces the fundamental problems, theories, and algorithms of the artificial intelligence field. Topics include heuristic search and game trees, knowledge representation using predicate calculus, automated deduction and its applications, problem solving and planning, and introduction to machine learning. Required course work includes the creation of working programs that solve problems, reason logically, and/or improve their own performance using techniques presented in the course. Requires experience in Java programming.

CS 5200 Database Management Systems

Introduces relational database management systems as a class of software systems. Prepares students to be sophisticated users of database management systems. Covers design theory, query language, and performance/tuning issues. Topics include relational algebra, SQL, stored procedures, user-defined functions, cursors, embedded SQL programs, client-server interfaces, entity-relationship diagrams, normalization, B-trees, concurrency, transactions, database security, constraints, object-relational DBMSs, and specialized engines such as spatial, text, XML conversion, and time series. Includes exercises using a commercial relational or object-relational database management system.

ECON 5140 Applied Econometrics

Offers an intensive study of econometric techniques applied to cross-section, time-series, and panel data. Applies the fundamentals of econometrics to analyzing structural economic models, forecasting, and policy analysis. Computer applications and an empirical research project are an integral part of the course.