

# MASTER OF SCIENCE IN FINANCE (MSF)

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## MSF 501

### Mathematics with Financial Applications

This course provides a systematic exposition of the primary mathematical methods used in financial economics. Mathematical concepts and methods include logarithmic and exponential functions, algebra, mean-variance analysis, summations, matrix algebra, differential and integral calculus, and optimization. The course will include a variety of financial applications including compound interest, present and future value, term structure of interest rates, asset pricing, expected return, risk and measures of risk aversion, capital asset pricing model (CAPM), portfolio optimization, expected utility, and consumption capital asset pricing (CCAPM).

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 502

### Statistical Analysis in Financial Markets

This course presents and applies statistical and econometric techniques useful for the analysis of financial markets. Ordinary least squares, maximum likelihood, time series analysis, GARCH volatility modeling, and simulation methods are covered. Hypothesis testing is covered in detail. Particular attention is placed on the properties of various estimators when model assumptions do not hold. Students not familiar with matrix algebra and elementary statistics should plan to make up the deficit early in the course. See MSF 501 on these topics.

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 503

### Financial Modeling

Financial modeling in a spreadsheet environment is a pervasive feature of the modern workplace. In this course, students will learn how to implement financial models using spreadsheet modeling and basic programming via Microsoft Excel and VBA. Financial models will include project valuation, bond pricing and hedging, option pricing, and portfolio optimization. The course will also cover basic numerical techniques that are essential to financial modeling including Monte Carlo simulation and linear optimization.

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 504

### Valuation and Portfolio Management

The course is a survey of asset pricing theory. The fundamentals of bond and option pricing are covered as well as the CAPM, APT, and the Fama-French models. Excel spreadsheet modeling is used to illustrate and understand the concepts of Markowitz's Mean Variance Optimization, equity valuation, option pricing, and utility theory. The course places a special emphasis on the relationship between macroeconomic conditions and investment opportunities.

**Prerequisite(s):** MSF 501 with min. grade of C and MSF 503 with min. grade of C and MSF 502 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 505

### Futures, Options, and OTC Derivatives

This course provides the foundation for understanding the price and risk management of derivative securities. The course starts with simple derivatives, e.g., forwards and futures, and develops the concept of arbitrage-free pricing and hedging. Based upon the work of Black, Scholes, and Merton, the course extends their pricing model through the use of lattices, Monte Carlo simulation methods, and more advanced strategies. Mathematical tools in stochastic processes are gradually introduced throughout the course. Particular emphasis is given to the pricing of interest rate derivatives, e.g., FRAs, swaps, bond options, caps, collars, and floors.

**Prerequisite(s):** MSF 501 with min. grade of C and MSF 503 with min. grade of C and MSF 502 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 506

### Financial Statement Analysis

After reviewing the content of the major financial statements, the course examines ratios, inventories, long-lived assets, income taxes, debt, leases, and pensions, among other topics. U.S. practices are compared to practices in other major countries. This course is intended for those who will examine financial statements of outside organizations.

**Prerequisite(s):** MSF 501 with min. grade of C and MSF 503 with min. grade of C and MSF 502 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

## MSF 524

### Models for Derivatives

The practice of financial engineering requires skill in financial theory and practice, mathematics and programming. This course includes instruction in all of these areas. In this class, students will learn mathematical and computational methods that are applicable to the pricing and risk management of derivatives. The class provides an introduction to options pricing theory, covering stochastic calculus, the Black-Scholes partial differential equation, risk-neutral valuation and hedging portfolio replication. The course will focus on important numerical techniques used in finance, including variance reduction techniques in Monte Carlo Simulation and finite difference methods applied to partial differential equations. These methods will be applied to the pricing of exotic options. In this class, students will learn to program and implement financial models in Matlab.

**Prerequisite(s):** MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 525****Term Structure Modeling and Interest Rate Derivatives**

Upon completion of this course, students should know the strengths, weaknesses, appropriate uses, and ways of implementing the major term structure models that are in common use. The course will begin with bootstrapping of forward curves, principal component analysis, and a review of basic fixed income derivatives (swaps, swaptions, caps, and floors). We will then implement short rate models, such as Ho-Lee, Black-Derman and Toy, and extended Vasicek/Hull-White, followed by the Helath-Jarrow-Morton model and market rate models. Students will implement these term structure models in Excel/VBA and Matlab.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 526****Computational Finance**

The use of computers makes modern finance possible. Most of the mathematics behind the risk management techniques and pricing models would be of no practical use without automated solvers, scenario builders, and other algorithms. This class concentrates on translating from ideas and mathematics to the practicalities of implementation. We will begin with a brief motivating discussion and then address various kinds of financially relevant algorithms, paying special attention to the two most important features of any scheme: (1) how it can go wrong and (2) how it can be calibrated. Our topic list will include optimizers, quadrature, fast fourier transforms, grid PDE solvers, and Monte Carlo techniques.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 534****Corporate Finance**

This course is an advanced introduction to modern corporate finance. Topics include cash flow forecasting, optimal dividend policies, mergers and acquisitions, structured finance, capital at risk, and the risk of adjusted return on capital. The philosophical foundation of the course is the concept of shareholder value added. Students will learn how financial decisions can contribute to the value of a modern corporation.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 535****Investment Banking**

This course covers the financing and formation process of private companies from product concept and angel investors to the Initial Public Offering. Exit strategies for private investments are discussed, including IPOs, mergers and acquisitions. Strategic and financial buyers play a key role in the valuation of a newly public or recently acquired firm. All of the players are discussed, including venture capitalists, entrepreneurs, investment bankers, attorneys, public shareholders, merger partners, institutional investors and private equity/buyout firms. Students will discuss business models; construct staffing and compensation schemes; practice valuation analysis; compare and contrast alternative financial sources; structure business plans; review the types of securities to offer; examine private placement processes; analyze negotiation strategies; and review the implications of financing terms and the role of venture capital and private equity investment in institutional portfolios. The challenges of completing mergers and integrating merged companies are also discussed. Sarbanes-Oxley, anti-trust requirements and other regulatory issues will be presented.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 543****Alternative Investments**

Alternative investments include real estate, hedge funds, managed futures, and emerging markets. They are attractive to institutional investors because they exhibit a low correlation with traditional investments in stocks and bonds. However, they must be approached cautiously because of specific difficulties in valuing these assets. This course will explore a variety of alternative investments and their role in investment strategies.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 544****Equity Valuation**

This course covers the various models available for equity valuation. It includes discussions of the dividend discount model, Porter analysis, DuPont decomposition of ROE, sustainable growth rates, earnings quality, and accounting fraud. It also covers relative valuation measures such as price/earnings and price/sales ratios. The valuation techniques taught in the course will be applied to the valuation of equity shares, corporate bonds, and derivatives such as stock options and convertible bonds. Completion of a comprehensive analysis of a public company is a requirement for the course. This course is recommended for students who are planning on sitting for Certified Financial Analyst (CFA) qualification.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 545****Structured Fixed Income Portfolios**

This course will cover the characteristics, valuation and risk management of fixed income instruments. These instruments include bonds, repos, interest rate derivatives, inflation indexed securities, mortgage-backed and asset-backed securities, CDOs and default swaps. The focus will be on understanding how these instruments are structured and used. Term structure modeling and hedging techniques will be presented, with a minimum of mathematics.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 546****Quantitative Investment Strategies**

This course develops the primary quantitative tools used in the portfolio selection process. The applied focus of the course centers on the process of moving from a data set of historical information to the formulation of a forecasting model, the estimation of mean-variance efficient portfolios, and the testing of efficiency hypotheses within an in-sample and post-sample setting. The course covers the estimation of efficient portfolios, factor models, forecasting models, and risk analysis.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 549****Commodities and Managed Futures**

Commodity markets have experienced dramatic growth and increased institutional investment in recent years. This course explores cash and futures markets in energy, grains, metals and soft commodities, as well as equity investments in commodity related firms. Students will explore the role of hedgers, speculators and institutional investors in commodity markets. The value of commodities in the institutional portfolio will be presented, which may allow hedging against inflation and the risks of declining stock and bond prices. Commodity trading advisers, commodity pool operators and the managed futures industry will be discussed. These fund managers initiate both long and short positions in futures markets, typically constructing portfolios from either a systematic or discretionary perspective.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 554****Market Risk Management**

This course introduces the importance of financial risk management by developing practical risk measurement tools. The risk measurement aspect of the course begins with the development of the Value-at-Risk (VaR) methodology for financial instruments traded in open markets including equities, bonds, foreign currencies and their derivatives. The course develops analytic VaR models for instruments with non-linear payoffs and non-normal distributions and it also develops simulation methodologies for risk analysis. Statistical tools in volatility forecasting, tail events, and expected shortfall are introduced as appropriate. The emphasis of the course is on market risk, but in addition to the traditional analysis of trading rooms, the course also considers regulatory and compliance risk, corporate risk and risk analysis for investment managers.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 555****Credit Risk Management**

The extensive use of leverage by individuals, corporations, hedge funds and private equity managers has led to a significant increase in the demand for models that analyze credit risk exposures. For many users, the credit risk function has evolved from models used to analyze the quality of an individual borrower to models that aggregate exposure across borrowers, industries and geographic regions. This course provides an extended overview of the exciting and rapidly developing field of credit risk analysis.

**Prerequisite(s):** MSF 554 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 566****Time Series Analysis**

This course develops a portfolio of techniques for the analysis of financial time series. Distribution theory covers the normal, student T, chi-squared, and mixture of normal models. Technical analysis covers a variety of trading rules including filters, moving averages, channels, and other systems. The first two topics are then combined into an analysis of non-linear time series models for the mean. The course concludes with a review of volatility models including GARCH, E-Garch and stochastic volatility models.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 567****Bayesian Econometrics**

Most statistical applications in finance require that the forecasting models be revised in response to the arrival of new information. This course develops the Dynamic Linear Model (DLM) as an updating model based upon Bayesian decision theory. Applications of the DLM including regressions, autoregressions, and exponential trend models will be covered. Special emphasis will be given to the development of intervention and monitoring systems and the use of simulation methodologies. Students not familiar with matrix algebra and elementary statistics should plan to make up the deficiency early in the course.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 574****.NET and Database Management**

The course provides students with a comprehensive knowledge of .NET (VB and C#) programming, relational database design and SQL as they apply to quant finance and real-time trading. Specifically, topics covered include the .NET framework and libraries, ADO.NET, OOP, generics, market data feeds, XML and the Unified Modeling Language, as well as an overview of the hardware and network infrastructure necessary to enable electronic trading.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 575****C++ with Financial Markets**

This course presents the C/C++ programming language. Students learn the language from the ground up, from data types, to functions, arrays, classes, dynamic memory management, data structures and the Standard Template Library. Object-oriented programming is also discussed, including a review of commonly used design patterns. The focus is to understand C/C++ as it applies to financial mathematics and several practical examples from computational finance are presented.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 576****OOP and Algorithmic Trading Systems**

In this course, students learn advanced programming topics in .NET for real-time financial applications and automated trading systems, including multithreading, sockets, APIs, synchronization, the FIX and FAST protocols, and object oriented design for event-driven applications. Also, project management and software quality are covered in depth. Lastly, topics related to latency in real-time financial applications and alternative network architectures are also discussed. Students are expected to propose, design, document and develop an original project combining concepts from quantitative finance and trading strategy (presented in other courses) into a working software application.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 577****High Frequency Finance**

High frequency trading is concerned with the development of robotic trading algorithms within a real time market environment. This course will be concerned with the development of high frequency models and the assessment of their performance.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 584****Equity and Equity Derivatives Trading**

This course will provide students with an opportunity to learn the latest Equity Trading Strategies used by large banks, brokerages and hedge funds. The instructor will present strategies on equity option trading, pairs trading, program and basket trading, risk arbitrage trading, structured product trading, and dispersion trading (time permitting). Equity trading theory and practical examples will be discussed. Students will be required to structure and adapt equity trading positions based on a range of actual and theoretical market conditions. In addition, students will collaborate with each other and the course instructor to analyze and evaluate the implementation of the above-mentioned strategies.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 585****Foreign Exchange Market and Fixed Income Strategies**

The foreign exchange market is the largest and most liquid financial market in the world. Some trading strategies utilize foreign exchange as an independent asset class while others utilize foreign exchange as a component of a global strategy in equities and fixed income instruments. This course starts with strategies specific to the foreign exchange market and evolves to include short term interest rate instruments and global bonds. Fixed income trading will focus on yield curve strategies, basis trading, and various types of spread trading. Swaps, swaptions, caps, collars, and floors will be introduced.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 591****Global Financial Markets**

This course will enable the student to understand the basics of financial markets and how they function in the global arena. The student will learn how the equities market, the bond market, the money market, the foreign exchange market and the derivatives markets are set up and operate. We will focus on the instruments, the players, the jargon, the details of the trade, and the institutional framework for each market. We cover both OTC and exchange-traded markets, and explore the dramatic transformation of these markets. The student will learn how each of these markets operates in the US, but will also learn how practices differ in Europe, Asia and Latin America.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 593****Market Microstructure**

Market microstructure is one of the youngest but most rapidly growing areas of finance. It focuses on the organization of traded markets, including those for equities, bonds, money market instruments, foreign exchange and derivatives (including futures, options and swaps). It explores the concepts of liquidity, transparency, the information content of bids, offers and trades, information asymmetries, order flow externalities, principal-agent problems, the design of markets, the rules of markets, the volatility of markets, the failure of markets, the regulation of markets and the costs of trading. Empirical work in this area typically involves huge datasets. Students will leave this course with a thorough understanding of the structure of the markets in which they will likely spend their careers.

**Prerequisite(s):** MSF 505 with min. grade of C and MSF 504 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 595****Entrepreneurial Finance**

Most new ventures are not created by financial analysts. However, the success of a new venture is vitally dependent upon the strength of its financial controls. Knowledge of finance is also an important determinant of an entrepreneur's ability to convey information about his company to banks, regulators, and potential investors. This course provides entrepreneurs with the financial knowledge that they require to create successful new ventures.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 596****The Venture Capital Process**

Venture capitalists are involved with the funding of new enterprises. The funding process begins with the review of a business plan submitted by the enterprise. If the business plan is accepted, the venture capitalist must then decide on the form of financing, the participation in the enterprise, and the compensation structure for the new enterprise. The course will introduce students to the process of venture capital financing and will allow them to participate in the process by reviewing actual business plans submitted by the entrepreneurs. Students will be required to evaluate the business plans and determine the type and quantity of financing to be provided.

**Prerequisite(s):** MSF 504 with min. grade of C and MSF 506 with min. grade of C and MSF 505 with min. grade of C

**Lecture: 3 Lab: 0 Credits: 3**

**MSF 597****Independent Study in Finance**

MSF 597 Independent Study allows students to undertake research projects under the supervision of a full time faculty member.

**Credit:** Variable

**MSF 599****Special Topics in Finance**

Special topics in finance.

**Lecture: 3 Lab: 0 Credits: 3**