# MS Finance-Quantitative (MSFQ) 2018-2019 Academic Year

## MSFQ Three-Semester Course Plan

### Preprogram Foundations Requirements
Online workshops begin in July (these are in addition to required credits and do not affect GPA)

<table>
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<th>Course Code</th>
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<tbody>
<tr>
<td>FIN 510</td>
<td>Introduction to Finance</td>
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<tr>
<td>ACCT 560</td>
<td>Introduction to Accounting</td>
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<tr>
<td>ACCT 562</td>
<td>Financial Accounting (Intermediate Accounting)</td>
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### Fall Semester (15 required and 1.5 elective credits)

**Fall A**
- FIN 524 Options & Futures (1.5)
- FIN 532 Investment Theory (1.5)
- FIN 538 Stochastic Foundations for Finance (1.5)
- MGT 537 Invest in Your Career (0)

**Fall B**
- FIN 524B Derivative Securities (1.5)
- FIN 532B Data Analysis for Investments (1.5)
- **Choose one:**
  - FIN 527 Financial Markets (1.5) (preferred)
  - FIN 521 Financial Intermediation (1.5) (offered in 3rd semester Fall A term)
  - MGT 560F Professional Business Communication (1.5)
  - MEC 537 Data Analysis, Forecasting and Risk Analysis (3)
  - CSE 501N Programming Concepts and Practices, plus lab (Java programming) (3)

### Spring Semester (13.5 required and 3 elective credits)

**Spring A**
- FIN 525 Fixed Income Securities (1.5)
- FIN 534 Advanced Corporate Finance I – Valuation (1.5)
- FIN 539 Mathematical Finance (1.5)

**Spring B**
- FIN 534B Advanced Corporate Finance II – Financing (1.5)
- FIN 551 Advanced Fixed Income & Credit Risk Modeling (1.5)
- FIN 500Q Quantitative Risk Management (3)
- FIN 537 Advanced Derivative Securities (3)
- **Choose one:**
  - MKT 500S Predictive Analytics for Business Decision Making (3)
  - CSE 502N Fundamentals of Computer Science (3)
  - CSE 503S Rapid Prototype Development and Creative Programming (3)
  - CSE 504N Object-Oriented Software Development Laboratory (3)
  - CSE 511A Introduction to Artificial Intelligence (3)
  - CSE 514A Data Mining (3)
  - CSE 530S Database Management Systems (3)

### Second Fall Semester (6 required credits)

**Fall A**
- FIN 500R Topics in Quantitative Finance (1.5)
- FIN 552 Fixed Income Derivatives (1.5)

**Fall B**
- FIN 500K Finance Consulting Projects (3)

**If FIN 527 not taken in first Fall B term:**
- FIN 521 Financial Intermediation (1.5)

### Total: 39 credits (34.5 required credits and 4.5 elective credits)

Under the flat tuition rate, students may take up to 19.5 credits in the first fall and spring semesters, and up to 12 credits in the final fall semester. Additional courses are charged per-credit.

The degree requirements and policies in this document apply to MSFQ students entering Washington University during the 2018-19 academic year. Every effort is made to ensure that the information is accurate and correct as of the date of publication (3/6/18). Washington University reserves the right to make changes at any time without prior notice. Therefore, this curriculum document may change from time to time without notice. The governing document at any given time is the then-current version, as published online.
MSF Quantitative Finance Courses

Summer Online Foundations Workshops

**FIN 510 Introduction to Finance**
The main topics to be covered in this course are (1) principles of investments, (2) financial analysis of corporate projects, (3) cost of capital, and (4) capital structure and financing policies. The objective of the company is assumed to be shareholder value maximization. Shareholder value is created by earning more than the cost of capital. The cost of capital is an opportunity cost – what investors could expect to earn on comparable investments in the financial markets. To understand the cost of capital, we need to understand the viewpoint of investors. Furthermore, to understand whether a project earns more than the cost of capital, we need to know how to estimate and discount project cash flows. So, the first three topics are closely connected. The main question in the fourth topic is whether we can create shareholder value through the financial structure of the firm. For example, we will ask whether we can lower the cost of capital by financing with debt instead of equity, or vice versa.

**ACCT 560 Introduction to Accounting**
In this course, we will study the three fundamental financial accounting issues, including (1) recognition, (2) measurement/valuation, and (3) classification/disclosure and consider how business transactions are reflected on the financial statements using generally accepted accounting principles (GAAP). We will cover the four primary financial statements (balance sheet, income statement, statement of stockholders’ equity, and statement of cash flows), the supporting footnotes to these statements, and several reports (annual reports, proxy statements, and press releases). The course incorporates both a preparer’s perspective (i.e., GAAP requirements for recording and presenting financial information) and a user's perspective (i.e., how an investor or analyst can interpret and use financial statement information).

**ACCT 562 Financial Accounting II (Intermediate Accounting)**
Primary subject matter includes asset and liability valuation and income measurement addressed at a deeper level than in introductory financial accounting. Recent additions to the professional accounting literature and the conceptual underpinnings of corporate financial reporting are emphasized, and articles from the popular business press are used to illustrate the factors that motivate corporate reporting decisions. Financial reporting issues related to a variety of topics not covered in earlier accounting coursework, such as segment reporting, securitization, and convertible securities, are introduced.

Fall Semester

**FIN 500K Finance Consulting Seminar**
Students returning from summer internship and research project experiences will conduct academic research in the areas of their summer experiences and will write papers on research topics as appropriate, under the direction of the supervising faculty member. In addition, students will be required to make presentations about their work experiences and research findings to their classmates. The timing of the course will be the second fall semester for Quantitative Finance students in the 17-month version of the program. Prerequisites: Completion of the first year of the MSF program. Other students may apply to participate with the permission of the instructor. 3 credits.

**FIN 500R Topics in Quantitative Finance**
The main objective of this course is to familiarize students with the current cutting-edge techniques implemented by the quantitative finance industry. The contents of this course can vary from year to year. Topics may include risk management, statistical arbitrage, and derivative pricing and hedging. Some practical projects may be used for implementation of these techniques. 1.5 credits.

**FIN 521 Financial Intermediation**
Discussion centers on the role of banking institutions and credit markets, the design of financial contracts and institutions and the public regulation of financial markets. After establishing a framework for analyzing financial institutions and markets, we turn to a current topic of special interest. Students will research and present a report advocating a particular point of view. 1.5 credits.

**FIN 524 Options and Futures**
Focuses on futures with an introduction to options. Discusses forward and futures pricing, and the use of various futures contracts to hedge commodity price risk, interest risk, currency risk, stock portfolio risk, and other risk exposures. 1.5 credits.
FIN 524B Derivative Securities
Provides an in-depth analysis of valuation and trading strategies for options and other derivative securities which have applications across areas of finance such as hedging, swaps, convertible claims, mortgage payments, index arbitrage, insurance, capital budgeting and corporate decision making, and are responsible for many new innovations and developments of the financial markets. Prerequisites: FIN 524. 1.5 credits.

FIN 527 Financial Markets
This course will facilitate further learning in the finance track by providing insights into various financial markets, financial institutions, associated market participants, select representative transactions and industry conventions. Students will examine the role of regulators, rating agencies, commercial and investment banks, and investors in the debt, equity and derivatives markets. In addition, in the context of the Financial Crisis, the role of regulation, monetary policy, leverage and human behavior will be discussed as possible root causes of the crisis with an emphasis on the various market failures in specific markets and their impact on market participants. Lastly, the role of revised regulations and the future of financial innovation will be debated. 1.5 credits.

FIN 532 Investment Theory
A course in the theory of risk and return in capital markets. Topics covered correspond to those which are covered in the CFA level 1 exam. We will cover the CAPM and APT models of asset pricing and will discuss various measures of mutual fund performance evaluation which arise from these models. We will discuss interest rate determination and also introduce the concepts of price and reinvestment risk in fixed income securities. 1.5 credits.

FIN 532B Data Analysis for Investments
The objective of this course is to obtain an in-depth understanding of some of the major empirical issues in investments. Based on recent research articles and cases, students are required to learn the facts, theories and the associated statistical tools to analyze financial data. The topics for this course include models of stock returns, Bayesian and shrinkage estimations for expected returns and covariances, multifactor asset pricing models, GARCH models, principal components, asset allocation, stock screening, predictability, performance evaluation, anomalies, limits to arbitrage and behavioral finance. Prerequisite: FIN 532. 1.5 credits.

FIN 538 Stochastic Foundations for Finance
This is a foundations course, which is designed as a prerequisite to FIN 539, Mathematical Finance. It is therefore mainly designed for students in the Masters in Finance program who aim at quantitative positions in investment banks, hedge funds and consulting firms. While financial examples will be given, the primary focus will be on stochastic process and stochastic calculus theory. Students interested in applications of the theory are expected to take follow-on courses. Topics to be covered include: general probability theory; Brownian motion and diffusion processes; martingales; stochastic calculus including Ito’s lemma; and jump processes. 1.5 credits.

FIN 552 Fixed Income Derivatives
This course builds on the materials developed in FIN 537, Advanced Derivative Securities. Here we will cover market-model pricing of LIBOR caps and floors, swap market model pricing of swaptions, Hull-White and Heath-Jarrow-and-Morton models, and the LIBOR market model for pricing swap derivatives via Monte Carlo techniques. We will also consider how to use these models to price various types of exotic interest rate derivatives commonly seen in practice. Prerequisites: FIN 525, FIN 537, and FIN 551. 1.5 credits.

MGT 537 Invest in Your Career
This is a customized career preparation course to help assess strengths and weaknesses and professional interests to best position students with regard to careers in areas of choice such as: securities research, securities and commodities quant-based trading, investment management, corporate finance, finance-focused government jobs, investment banking and academia, including Ph.D. programs and other pure research pursuits and/or teaching. The course also will provide opportunities to learn how to enhance business communication skills, networking and interviewing skills. 0 credits.

MGT 560F Professional Business Communication
Communication is the process of sending and receiving messages, however, communication is effective only when the message is understood and when it stimulates action or encourages the receiver to think in a new way. This course will introduce students to fundamental best practices in business writing and business speaking that will ensure effective communication. Students will participate in activities that will develop professional business communication skills in both writing and speaking. These will include: preparing, writing and delivering presentations, composing clear concise business messages in a variety of formats, understanding emotional intelligence to reach the audience and utilizing critical thinking as a basis for communication strategies. 1.5 credits.
MEC 537 Data Analysis, Forecasting & Risk Analysis
Course develops the methods and techniques of econometrics that are of particular relevance to students of business and economics. A range of models, namely single equation regression models, time series models and models for discrete response data are studied. The purpose of building these models is described within the context of aggregate data, and micro data at the level of firms and individuals. Procedures to evaluate the estimated models are discussed, and emphasis is placed on the interpretation of results and the forecasting of future observations. Students are expected to complete an individual (non-group) project in which the technique developed in the course are applied to real world problems. The course should be valuable for a variety of students including those with primary interest in finance, marketing, operations, and accounting. 3 credits.

CSE 501N Programming Concepts and Practice (Java Programming) plus lab
An introduction to software concepts and implementation, emphasizing problem solving through abstraction and decomposition. Introduces processes and algorithms, procedural abstraction, data abstraction, encapsulation, and object-oriented programming. Recursion, iteration, and simple data structures are covered. Concepts and skills are mastered through programming projects, many of which employ graphics to enhance conceptual understanding. Java, an object-oriented programming language, is the vehicle of exploration. Active-learning sessions are conducted in a studio setting in which students interact with each other and the professor to solve problems collaboratively. An evening exam at which attendance is required will be on Monday, March 4th from 6:30-8:30 p.m. Prerequisites: Comfort with algebra and geometry at the high school level is assumed. Patience, good planning, and organization will promote success. This course assumes no prior experience with programming. 3 credits.

Spring Semester

FIN 500Q Quantitative Risk Management
Risk management is an increasingly important, but often misunderstood, aspect of corporate financial policy. This course is designed to provide solid theoretical and technical foundations for financial risk management with applications to a variety of different industries and firms. Measures of risk, regulatory requirements for risk control, and risk management strategies employing derivative securities against market and credit risks will be analyzed. In addition, risk management methods and tools that are commonly used in practice will be introduced. Prerequisite: FIN 524 and FIN 524B. 3 credits.

FIN 525 Fixed Income Securities
This course analyzes investment in bonds and related fixed-income instruments. Major topics are bonds, interest rate risk, and derivative securities. Bond topics include interest rate compounding conventions, yield curves, and forward interest rates. Risk analysis covers duration, convexity, and immunization. Derivative securities are analyzed using an option-theoretic approach to valuing interest rate contingent claims. Prerequisites: FIN 524 and FIN 524B. 1.5 credits.

FIN 534 Advanced Corporate Finance I – Valuation
This course considers a broad range of issues faced by corporate financial managers with respect to the valuation of projects, divisions, and entire companies. The prime focus will be on assessing the profitability of different business alternatives in a forward-looking sense. It will explicitly consider the impact of financing decisions on the valuation of business alternatives. Other topics covered include an examination of EVA as both a valuation and performance measurement tool, and a brief introduction to Real Options as an alternative to discounted cash flow analysis. The course is designed to be "hands-on", and will heavily focus on direct applications of the theory and the individual development of spreadsheet modeling skills. Students who successfully complete the course should possess a set of cutting-edge valuation skills. 1.5 credits.

FIN 534B Advanced Corporate Finance II – Financing
This course considers a broad range of issues faced by corporate financial managers with respect to the financing of investment opportunities. In this course, we turn to the right-hand side of the balance sheet as a direct follow up to the skills acquired in the Advanced Corporate Finance I - Valuation, a course that focused on the left-hand side of the balance sheet. The course is designed to be "hands-on", and we will heavily focus on direct applications of the theory of financing to business practice. To that end, we will cover topics related to the valuation of bond and convertible securities, estimating the costs of financial distress, the reorganization of firms in financial distress, deriving an optimal capital structure, and the effects of management stock option grants on valuation. Prerequisite: FIN 534. 1.5 credits.
FIN 537 Advanced Derivative Securities
This course focuses on implementation of models for pricing and hedging derivative securities in the equity, currency, and fixed-income markets. Students will learn to write programs in a programming environment such as MATLAB to implement the Black-Scholes model, binomial models, Monte-Carlo methods and finite-difference methods. The derivatives studied will include exotic equity and currency derivatives and caps, floors and swaptions. The goals of the course are to learn more about the various instruments that are traded, the various assumptions and methods that may be chosen in modeling them, and the importance of the assumptions in determining the prices and hedges that are chosen. The course will be especially useful to students pursuing careers in sales and trading who will interact with research departments and students pursuing careers in asset management. Prerequisites: FIN 524 and 524B. 3 credits.

FIN 539 Mathematical Finance
This course focuses on continuous-time derivative pricing and optimal security trading. In the first half of the course, students will learn how to derive partial differential equations and pricing formulas for various derivative securities including options with stochastic volatility, options with jump diffusion, and American style options. In the second half of the course, students will learn how to solve optimal portfolio selection problem with or without portfolio constraints through both the Hamilton-Jacob-Bellman equation approach and the martingale approach. The course is mainly designed for students in the Masters in Finance program who aim at quantitative positions in investment banks, hedge funds and consulting firms. The course might also be of interest to those who want a more theoretical approach to analyze embedded derivatives and risk management issues at corporations. Prerequisites: FIN 524 and FIN 538. 1.5 credits.

FIN 551 Advanced Fixed Income and Credit Risk Modeling
This course is an advanced course in fixed-income. This means that a basic knowledge of fixed-income markets and concepts is assumed. The focus of the course is on the modeling of fixed-income securities. We will examine the behavior of the yield curve and discuss what this suggests for hedging liabilities. We will cover models of the term structure and of various types of fixed-income derivatives including caps, floors, and swaptions. We will also introduce credit-risk modeling, credit-default swaps, and collateralized debt obligations. Prerequisites: FIN 525, 538, and 539. 1.5 credits.

MKT 500S Predictive Analytics for Business Decision Making
Predictive Analytics deals with the employment of formal learning from business experience, using business data, to predict the future behavior of customers or other critical organizational elements in order to drive better business decisions. This course emphasizes data situations that students are likely to face in marketing, finance, manufacturing and consulting jobs. Students will analyze real-world business datasets using various advanced analytic techniques such as logistic regression, decision trees, neural networks, stochastic gradient boosting, MARSplines, Ensembles, Clustering, Associations etc. The focus of the course lies in the conversion of raw and messy business data into robust actionable predictions for decision-making. 3 credits.

CSE 502N Fundamentals of Computer Science
Study of fundamental algorithms, data structures, and their effective use in a variety of applications. Emphasizes importance of data structure choice and implementation for obtaining the most efficient algorithm for solving a given problem. A key component of this course is worst-case asymptotic analysis, which provides a quick and simple method for determining the scalability and effectiveness of an algorithm. Prerequisite: CSE 501N. 3 credits.

CSE 503S Rapid Prototype Development and Creative Programming
This course uses web development as a vehicle for developing skills in rapid prototyping. Students acquire the skills to build a Linux web server in Apache, to write a web site from scratch in PHP, to run an SQL database, to perform scripting in Python, to employ the AngularJS web framework, and to develop modern web applications in client-side and server-side JavaScript. The course culminates with a creative project in which students are able to synthesize the course material into a project of their own interest. The course implements an interactive studio format: after a formal presentation of a topic, students develop a related project under the supervision of the instructor. Prerequisite: CSE 501N. 3 credits.

CSE 504N Object-Oriented Software Development Laboratory
Intensive focus on practical aspects of designing, implementing and debugging software, using object-oriented, procedural, and generic programming techniques. The course emphasizes familiarity and proficiency with a wide range of C++ language features through hands-on practice completing studio exercises and lab assignments, supplemented with readings and summary presentations for each session. Prerequisite: CSE 502N. 3 credits.
CSE 511A Introduction to Artificial Intelligence
The discipline of artificial intelligence (AI) is concerned with building systems that think and act like humans or rationally on some absolute scale. This course is an introduction to the field, with special emphasis on sound modern methods. The topics include knowledge representation, problem solving via search, game playing, logical and probabilistic reasoning, planning, machine learning (decision trees, neural nets, reinforcement learning, and genetic algorithms) and machine vision. Programming exercises will concretize the key methods. The course targets graduate students and advanced undergraduates. Evaluation is based on written and programming assignments, a midterm exam, and a final exam. Prerequisites: CSE 502N and CSE 347. 3 credits.

CSE 514A Data Mining
Many scientific computing problems are, by nature, statistical. Such problems appear in many domains, such as text analysis, data mining on the web, computational biology and various medical applications. Another source of the statistical nature of such problems is the lack of sufficient information of the problem domains as well as the specific problems at hand. What is available for a typical application is usually a set of data from observation or experiments. The main objective of this course is to gain experience of dealing with statistical data analysis problems by studying various statistical methods that can be used to make sense out of data, by reading and reviewing literature as well as by working on a specific statistical problem in a selected application domain. Prerequisite: CSE 502N. 3 credits.

CSE 530S Database Management Systems
A study of data models and the database management systems that support these data models. The design theory for databases is developed and various tools are utilized to apply the theory. General query languages are studied and techniques for query optimization are investigated. Integrity and security requirements are studied in the context of concurrent operations on a database, where the database may be distributed over one or more locations. The unique requirements for engineering design databases, image databases, and long transaction systems are analyzed. Prerequisite: CSE 502N. 3 credits.