PATHWAY

MSFQ Three-Semester Course Plan

PREPROGRAM FOUNDATIONS REQUIREMENTS
Preparatory work begins in July, is in addition to required credits, and does not affect GPA.

FIN 510: Introduction to Finance
ACCT 560: Introduction to Accounting
ACCT 562: Financial Accounting II – Intermediate Accounting

FALL 1 REQUIRED COURSES

REQUIRED CREDITS: *16.5*

MGT 560F: Professional Business Communication
1.5 credits

DAT 537: Data Analysis, Forecasting & Risk Analysis
3 credits

DAT 561: Introduction to Python & Data Science
3 credits

Fall A

FIN 524: Options & Futures
1.5 credits

FIN 532: Investment Theory
1.5 credits

FIN 538: Stochastic Foundations for Finance
1.5 credits

Fall B

FIN 524B: Derivative Securities
1.5 credits

FIN 527: Financial Markets
*1.5 credits***

FIN 532B: Data Analysis for Investments
1.5 credits

MGT 537: Invest in Your Career
0 credit

SPRING REQUIRED COURSES

REQUIRED CREDITS: *13.5*

FIN 500Q: Quantitative Risk Management
3 credits

FIN 537: Advanced Derivative Securities
3 credits

Spring A

FIN 525: Fixed Income Securities
1.5 credits

FIN 534: Advanced Corporate Finance I – Valuation
1.5 credits

FIN 539: Mathematical Finance
1.5 credits

Spring B

FIN 534B: Advanced Corporate Finance II – Financing
1.5 credits

FIN 552: Fixed Income Derivatives
1.5 credit

FALL 2 REQUIRED COURSES

REQUIRED CREDITS: *1.5*

Recommended semester for Experiential Learning course

Fall A

FIN 500R: Topics in Quantitative Finance
1.5 credits

Fall B

FIN 527: Financial Markets
*1.5 credits***

EXPERIENTIAL LEARNING REQUIREMENT

COMPLETE 1 COURSE:

MGT 551E: Internship, Business, & Application *1.5 credits*
FIN 500K: Financial Consulting Project *3 credits*
FIN 556: Quantitative Finance Projects *3 credits*
MGT 501V: Applied Problem Solving for Orgs *1.5 credits*

FALL OR SPRING RECOMMENDED ELECTIVE COURSES

ELECTIVE CREDITS: *7.5*

DAT 560G: Database Design & SQL
*1.5 credits**

DAT 500S: Machine Learning for Prediction of Business Outcomes
*3 credits**

CSE 502N: Data Structures & Algorithms
*3 credits**

CSE 514A: Data Mining
*3 credits**

CSE 511A: Intro to AI
*3 credits**

* Elective courses offered either in Fall or Spring semesters

** FIN 527: Financial Markets can be taken in Fall 1 or Fall 2, or replaced by FIN 521: Financial Intermediation in Fall 2, if available.

TOTAL CREDITS: *39* Required: *31.5* MSFQ Elective: *7.5*

Academic Year 2021-2022 The degree requirements in this document apply to students entering Washington University during the 2021–2022 academic year.

WashU Olin Business School

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

DAT 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.

DAT 561 Introduction to Python and Data Science
This course provides students the necessary skill set to extract reliable insights from large datasets prevalent in various business applications, such as supply chain management, marketplace operations, healthcare analytics, and financial engineering, using Python. In this course, students will develop basic tools to understand Python programs and implement data processing pipelines using Python. In particular, students will learn how to acquire, clean, analyze and visualize data in Python, which they will then use to improve decision-making processes. Throughout the course, students will use the Python programming language, which is very effective for data manipulation, reporting, and complex optimization. Topics covered include introduction to Python programming, data acquisition and cleaning, data manipulation, current multi-source data collection technology used in practice, basic data visualization using Matplotlib, ggplot2, and Bokeh. 3 credits.

FIN 500K Finance Consulting Projects
In this course, mentored engagements will help students to develop sophistication in the transfer of cutting edge techniques from the academic environment into practice. Students are placed in teams, and each team does a project with a company. The associated instructor helps the team to manage the relationship and make the bridge between the academic tools the students have learned and the practical projects provided by the companies. 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. 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.

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.

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 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 and FIN 537. 1.5 credits.

DAT 500S Machine Learning Tools for Prediction of Business Outcomes
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 in to robust actionable predictions for decision-making. 3 credits.

DAT 560G Database Design and SQL
Databases are at the foundation of every organization's information strategy. Understanding the structure of databases and mastering the tools to analyze data are essential skills in any role. The tools developed in this course assist students in implementing a company's data management strategy and developing well-grounded analytical recommendations. In this course we focus on understanding how data is structured in relational databases. With vast amounts of data available, from disparate sources, effective organization of the data is essential to its utilization. To complement this, we utilize SQL (Structured Query Language) as the primary tool to extract data for managerial reports and for advanced analytical models. Practical experience with current relational database software is developed throughout the course. 1.5 credits.

DAT 560M Big Data and Cloud Computing
The growth in available data is a challenge to many companies. This presents an opportunity for companies to conquer the vast and various data available to them. The growth in data includes traditional structured data, as well as unstructured data created by both people and machines. It is essential for analysts to be comfortable in the new technologies and tools that are being developed to store, retrieve, analyze, and report, using the vast data resources available. This course introduces students to the technologies currently deployed to overcome the challenges of Big Data. Prerequisite: MGT 560G. 1.5 credits.

CSE 417T: Introduction to Machine Learning
The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience. This course is a broad introduction to machine learning, covering the foundations of supervised learning and important supervised learning algorithms. Topics to be covered are the theory of generalization (including VC-dimension, the bias-variance tradeoff, validation, and regularization) and linear and non-linear learning models (including linear and logistic regression, decision trees, ensemble methods, neural networks, nearest-neighbor methods, and support vector machines). Prerequisite: CSE 502N (can be taken concurrently). 3 credits.

CSE 427S Cloud Computing with Big Data Applications
This course provides a comprehensive introduction to applied parallel computing using the MapReduce programming model facilitating large scale data management and processing. There will be an emphasis on hands-on experience working with the Hadoop architecture, an open-source software framework written in Java for distributed storage and processing of very large data sets on computer clusters. Further, we will make use of related big data technologies from the Hadoop ecosystem of tools, such as Hive, Impala, and Pig in developing analytics and solving problems faced by enterprises today. Prerequisites: CSE 502N and CSE 503S (or basic knowledge in relational databases (RDMS and SQL). 3 credits.

CSE 502N Data Structures and Algorithms
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 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.