MSFE Curriculum

A Joint Program of the School of Mathematical Sciences
&
The Peter F. Drucker and Masatoshi Ito Graduate School of Management

A Flexible Interdisciplinary Curriculum

Twelve courses totaling 48 units are required for the Master of Science in Financial Engineering Program. The program is generally completed in three semesters of intensive study, or on a part-time basis.

The required courses blend mathematical techniques with management applications. The mathematical component develops the analytical and simulation skills necessary to analyze and evaluate financial products. The management component builds the methods and insights required to interpret organizational needs and goals in designing a portfolio of appropriate financial products.

Required Courses (32 units)

MATH 251 Probability Explores probability spaces, discrete and continuous random variables, conditional and marginal distributions, expectation, independence, generating functions, transformations, central-limit theorem.

MATH 252 Statistics Introduces to students the general theory of statistical inference, including sufficiency, estimation of parameters, confidence intervals, and hypotheses testing.

MATH 256 Stochastic Processes Continues the Probability course in examining the properties of independent and dependent random variables, and conditional expectation. Topics include Markov processes, second order processes, stationary processes, and Martingales.

MATH 358 Mathematical Finance Emphasizes the mathematics used in valuing securities. Covers the tools required to model price fluctuations in the stock market including Brownian motion, simple stochastic differential equations, Ito's lemma, Arbitrage theory, and the Black-Scholes equation.

MGT 326 Financial Accounting The goal of this course is to enable the student to appreciate and understand financial accounting—the language of business—from the perspective of the user/manager. By the end of the course, the student will understand the basic rules governing the preparation of financial statements, the flexibility that exists within these rules, possible incentives for management to make choices from within these rules, and the output from this environment.

MGT 335 Corporate Finance This course is designed to help students develop an understanding of financial decision making, including investment decisions, financing decisions, and their interaction. The course provides the students with the underlying framework of corporate finance including valuation, market efficiency, portfolio theory, agency costs, and information costs. The course will relate financial management to the structure of financial institutions in the U.S. In addition, the course includes a survey of special topics in finance including option pricing, mergers and acquisitions, hedging, and international finance.

MGT 402 Asset Management Practicum Theories of asset management are presented via textbook and other readings, lectures, case studies, and student and guest speaker presentations. Students will be responsible for inviting some of the guest speakers with consultation by the instructor. Asset management firms establish and review investment policy, conduct investment research, determine strategies to be implemented, select securities, enter and track orders, measure and report performance, and manage client relations. We will study all these activities in the course.

MGT 339 Financial Derivatives In this course, students develop an understanding of financial derivative instruments and their applications to corporate strategy and risk management. Throughout the course, we distinguish between using derivatives to appropriately manage risk and using them for speculation. We emphasize the perspective that derivative instruments are problem-solving tools that, when used correctly, can create value for financial and non-financial corporations. We develop the basic mathematical tools necessary for analysis, design, pricing, and implementation of derivatives in a managerial context. We cover forward, future, option, and swap contracts, hedging, arbitrage, and derivatives-pricing models. In addition, we introduce securitization, real options, and risk management. Through case preparation and discussion, students learn to model and evaluate derivative instruments and risk exposure.

Elective Courses (16 units)

The elective courses allow students to round out the program by balancing their interests and experience in developing the skills and insight needed of a professional in financial engineering. Students with strong mathematical backgrounds take management classes as electives, while those with management backgrounds are encouraged to take additional mathematics classes.

ECON 384 Econometrics III. Topics in econometrics, including nonlinear, ARIMA, VAR, distributed lag, and simultaneous equation models. Specification testing, rational expectations, cointegration, ARCH, Markov switching, GMM, and Kalman filtering.

MATH 265 Numerical Analysis. An introduction to the theory and methods for numerical solution of mathematical problems. Core topics include analysis of error and efficiency of methods, solutions of linear systems by Gaussian elimination and iterative methods, interpolation and approximation, numerical integration, and solution of ordinary differential equations.

MATH 283 Mathematical Modeling. Introduction to the construction and interpretation of deterministic and stochastic models in the biological, social, and physical sciences, including simulation studies. Students are required to develop a model in an area of their interest.

MATH 359 Simulation. This course will introduce the students to the general concepts and tools of simulation analysis using pseudo random numbers generated on a computer. Starting with a background in calculus-based probability theory, the students will learn how to combine the mathematics of probability with the utility of the computer to find approximate solutions to a variety of mathematical problems arising in analysis, probability and statistics, stochastic processes, optimization, and general modeling. In undertaking this study, students will discover that many otherwise intractable problems can often be attacked using simulation techniques that are relatively easy to implement, thus adding to their general problem solving capabilities.

MATH 361 Numerical Methods for Finance. This course focuses on pricing derivatives and calibrating interest rate models, but some topics of risk management are also covered. Whereas the Mathematical Finance Math 358 course shows the student how to price instruments using closed-form (analytical) formulae, this course focuses on the instruments that can be best analyzed with numerical methods: structured loans, mortgage-backed securities, …Topics include binomial and trinomial tree (lattice), finite differences, Monte Carlo simulation, and an introduction to copulate.

MATH 364 Introduction to Scientific Computing (online course). This 4 unit module is intended to help students develop a basic competence in scientific computing in a PC/workstation environment, thus preparing them for the mathematics clinic and other work in industrial applied mathematics. Students will be given a high level introduction to computing in MATLAB and compiled high-level languages such as C and FORTRAN. A broad collection of basic numerical techniques will be presented including iterative methods for solving nonlinear equations, approximate integration and differentiation, interpolation, and numerical linear algebra. Additional topics will be covered depending on the interests of the students. By working examples on the computer that illustrate these techniques, students will develop proficiency in the basics of MATLAB and at least one high-level programming language under both Windows and LINUX environments.

MATH 368 Advanced Numerical Analysis. Prepares students for practical work applying numerical methods and includes coverage of selected topics from approximation theory, numerical differentiation and integration, Monte Carlo method, and the numerical solution of differential equations.

MGT 340 Strategy. The focus of this course is on how general managers enhance and sustain business performance. The course covers analytical and conceptual tools that are aids to the development of decision. Its fundamental focus, however, is not on tools but on sharpening skills at developing robust judgments in the face of uncertainty and complexity. The central concept of this course is that of strategy. Strategy is enabled and constrained by the underlying economic and political conditions that prevail in an industry or a country, as well as by the resources available to management.

MGT 373 Financial Policy & Strategy. Identifies investment and financing strategies that enhance corporate value and competitive advantage, and develops a framework of analysis and sensitivity to issues of transaction and implementation. This course covers financial choices of a corporation and their impact on the overall strategy of the firm, payout policy, IPO, M&A, and corporate governance policies.

MGT 376 The Global Economy. This course is designed to provide a framework for understanding and managing the impact of changing international economic environments and international competition. In particular, this course has the following objectives: (1) To develop a conceptual framework for business managers that will improve their ability to compete internationally; (2) To examine the sources of international competitive advantage available to firms--competitive advantages from their country bases, their specific capabilities, and their governments' policies; and (3) To provide an understanding of the impacts of changing international economic environments on competitive strategy - emerging trade blocs (the European Union and NAFTA), fluctuations of foreign exchange rates, and the emergence of new markets.

MGT 475 Selected Topics in Finance-Fixed Income Investment Management. This course introduces the practical, real world approach to bond investing, with detailed presentations of bonds and a wide range of interest-rate instruments. The class will discuss investment characteristics of bonds and interest-rate instruments, state of the art technology for valuing them, and portfolio strategies for using them. Specific topics include pricing, measuring yield, price volatility, municipal securities, non-U.S. bonds, performance measurement and evaluation, and interest-rate options evaluation.

MGT 307 Game Theory. Studies the strategic interaction between individuals, firms, governments, or other groups of people. Topics covered include decision trees, matrix games, bargaining, cooperative games, utility theory and fair division. Game theory has been widely used in the study of economics, and more recently applied to a host of strategic interactions in all areas.