MANAGEMENT SCIENCE (MSC)

MSC 511
Mathematics for Management Science I
This is the first of a two-semester sequence in advanced-level mathematical economics. It introduces students to economic models, microeconomics theory, equilibrium analysis and optimization problems. The course examines various market settings such as competitive markets, oligopolies, and monopolies; the course addresses contexts involving the firm decision making under uncertainty, and game theory. Focus is on major topics of economic analysis and the tools used to study them. Some mathematics background, particularly calculus and matrix algebra, is essential.
Lecture: 3 Lab: 0 Credits: 3

MSC 512
Statistics for Management Science I
This course provides a comprehensive introduction to econometrics; linear, nonlinear, semiparametric and nonparametric regression, popular distributions, confidence intervals and joint confidence intervals, hypothesis testing, sample size and power, functional form and structure, endogeneity and instrumental variables estimation, systems of equations, models of panel data, maximum likelihood estimation, likelihood ratio tests, generalized method of moments, simulation based estimation and random parameter models. It will also focus on the mathematics of differential equations, stationary time series models, conditional heteroscedasticity, non-stationary time series, co-integration and non-linear models. Students will also learn techniques like maximum likelihood estimation, likelihood ratio tests, and generalized method of moments estimation. Students will be introduced to stochastic processes and applied probability and become familiar in using STATA and other advanced statistical software and research databases.
Lecture: 3 Lab: 0 Credits: 3

MSC 513
Optimization I
This course introduces optimization techniques with a focus on linear and integer optimization problems. Topics include: the simplex method and its variants, interior point algorithms, duality and sensitivity analysis, integer linear programming, cutting plane method, branch and bound method, Lagrangian relaxation methods, model formulation with integer variables, large scale optimization, and network flow problems.
Lecture: 3 Lab: 0 Credits: 3

MSC 514
Mathematics for Management Science II
This is the second course in the two-course sequence in mathematical economics. It focuses on optimization problems in addition to discussing nonlinear programming, Kuhn-Tucker conditions, and dynamic analysis. In addition, it continues discussion on game theory and explores its use in modern economics and business through examinations of classic and current papers. Students are also introduced to models used in modern macroeconomics.
Prerequisite(s): MSC 511 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 515
Statistics for Management Science II
The course introduces Bayesian estimation, and emphasizes simulation-based inference, statistical computing, discrete choice, limited dependent variables (truncation, censoring and sample selection), time series analysis including advanced forecasting techniques. This course intends to integrate modern theories and empirical applications in a manner that many useful tools will be discussed. The course is heavily project oriented and is organized around Big Data applications and statistical packages. Students will be expected to work with modern statistical packages and large datasets.
Prerequisite(s): MSC 512 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 516
Optimization II
This course introduces dynamic programming and applications of dynamic programming to deterministic and stochastic decision problems. The course also introduces the theory and computation methods of nonlinear programming, convex analysis, and unconstrained methods; Kuhn-Tucker theory, saddle points and duality, quadratic linearly constrained and nonlinear constrained problems, and penalty and barrier methods.
Prerequisite(s): MSC 513 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 517
Analytics for Decision Making
Spreadsheets are a popular model-building environment for managers. Add-ins and enhancements to Excel have made powerful decision-making tools available to the manager. This course covers how to use the spreadsheet to develop and utilize some of these decision-making aids. Visual Basic for Excel allows the nonprogrammer to create modules for functions, subroutines, and procedures. Topics include forecasting (both regression and time series), decision-making under uncertainty and decision trees, using SOLVER for optimization, and probabilistic simulation using @RISK.
Lecture: 3 Lab: 0 Credits: 3

MSC 518
Marketing Research and Engineering
The course is roughly divided into thirds which track the standard market research process: define the problem and design a research plan; develop appropriate primary research tools (primarily survey design and implementation); and execute an analysis and presentation. Marketing engineering focuses on specific data-driven marketing tools, regression, cluster analysis, conjoint, etc., and their application to specific marketing problems (segmentation and targeting, new product design, and forecasting). The market research process will be taught backwards from analysis to data acquisition with the aim that students will have a working understanding of their analytical goals by the time they begin their projects and can therefore establish sensible research objectives with an eye to expected use for the data.
Lecture: 3 Lab: 0 Credits: 3
MSC 611  
**Philosophy of Management**  
This course introduces doctoral students to the history and evolution of thinking in the management discipline. It focuses attention on theories of leadership and innovation, and showcases contributions of influential thought leaders in management. It also includes epistemological perspectives with substantial potential for enhancing business research. Finally, it will address fundamental approaches and criteria for successful theory development.  
**Prerequisite(s):** MSC 515 with min. grade of C and MSC 512 with min. grade of C  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 612  
**Advanced Research Methods**  
This course is a required course for all PhD students at the Stuart School of Business. It offers a comprehensive overview of the General Linear Model at both univariate and multivariate research levels. The course will review measurement issues (reliability, types of validity), multiple regression analysis, ANOVA, MANOVA, step-down analysis, factor analysis, structural equation models (exploratory and confirmatory factor analysis), discriminant analysis, redundancy analysis, canonical correlation analysis, repeated measures analysis, categorical data analysis, contingency table analysis, cluster analysis, multidimensional scaling, correspondence analysis, choice models, and relatively new areas such as multi-level analysis, meta-analysis, data warehousing, data mining, and neural networks. Additionally, nonlinear models will also be discussed. Students will be introduced to SAS and other software packages.  
**Prerequisite(s):** MSC 611 with min. grade of C  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 613  
**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.  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 614  
**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.  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 615  
**Predictive Analytics**  
The digital enterprise captures significantly more data about its customers, suppliers, and partners. The challenge, however, is to transform this vast data repository into actionable business intelligence. Both the structure and content of information from databases and data warehouses will be studied. Basic skills for designing and retrieving information from a database (e.g., MS Access) will be mastered. Data mining and predictive analytics can provide valuable business insights. A leading data mining tool, e.g., IBM/SPSS Modeler, will be used to investigate hypotheses and discover patterns in enterprise data repositories. Analysis tools include decision trees, neural networks, market basket analysis, time series, and discriminant analysis. Both data cleaning and analyses will be discussed and applied to sample data. Applications of data mining in a variety of industries will be discussed. Software exercises, case studies, and a major project will prepare the students to use these tools effectively during their careers.  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 616  
**Social Media Marketing Analytics**  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 621  
**Corporate Finance**  
The primary objective of this course is to provide doctoral students an overview of introductory topics in corporate finance including capital structure, agency theory, corporate governance, payout policy, compensation, mergers and acquisitions, diversification, equity issuance, private equity, and financial intermediation. We will focus on both theories and empirics of financial economics in the area of corporate finance. Students should expect a rigorous course with substantial academic rather than applied content, and expect an intensive reading list. Another objective is to train students to read, understand, and present background papers in corporate finance and recognize the interesting/important problems in corporate finance in the "right" institutional structure.  
**Prerequisite(s):** MSC 511 with min. grade of C  
**Lecture:** 3 Lab: 0 **Credits:** 3

MSC 622  
**Enterprise Risk Management**  
This course focuses on the two main silos of risk in the financial industry, namely, credit risk and operational risk. The course will also discuss asset and liability management, interest rate risk management, integration of credit risk and market risk, regulatory and compliance issues and performance measurement and capital management. The quantitative aspects of the course include: volatility and correlation modeling, Monte Carlo simulation, stress-testing scenarios analysis, and extreme and tail events modeling.  
**Prerequisite(s):** MSC 631 with min. grade of C and MSC 512 with min. grade of C  
**Lecture:** 3 Lab: 0 **Credits:** 3
MSC 623
Investments
The world of investments is changing rapidly as investment responsibilities and power move into the hands of individuals. This course discusses the properties of investment instruments, different investment theories, and the professional investors. Topics include the characteristics of various financial assets, the time series and cross-sectional returns, asset pricing theory and empirical methods, mutual funds and hedge funds. Moreover, there is a reading list of the most influential academic papers in the investment field, students are required to understand and follow the most advanced development in the investment field.
Prerequisite(s): MSC 511 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 631
Theory of Finance I
This course is intended as an in-depth review of the following areas of finance: (1) utility theory and expected utility valuation techniques; (2) the Markowitz portfolio problem and the CAPM model; (3) the APT theory and general linear arbitrage factor model; (4) single period consumption-based asset pricing models; (5) state preference theoretical approaches; (6) multi-period discrete time utility-based models and associated mathematical techniques; (7) equilibrium and price bubbles in the preceding model (the "Lucas" model); (8) basic binomial derivative pricing; and (9) Itô's Lemma, Black-Scholes, and related models.
Lecture: 3 Lab: 0 Credits: 3

MSC 632
International Finance Theory
International Finance Theory.
Prerequisite(s): MSC 631 with min. grade of C and MSC 605 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 633
Theory of Finance II
This course is intended as an in-depth review of the following areas of finance: (1) continuous time risk neutral pricing; (2) jump diffusion models; (3) continuous time utility optimization modeling (with dynamic programming); (4) consumption CAPM modeling; (5) non-time separable utility modeling; and (6) behavioral finance.
Lecture: 3 Lab: 0 Credits: 3

MSC 651
Quantitative Marketing Models
This seminar will acquaint students with quantitative models used in marketing research literature. It will survey a variety of econometric models ranging from basic choice models to the latest structural models which have been used to analyze problems in the marketing domain. In summary, the course will provide an overview of the quantitative modeling field in marketing. The emphasis will be on understanding the estimation procedure employed to estimate these models.
Prerequisite(s): MSC 515 with min. grade of C and MSC 512 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 652
Supply Chain Analytics
This course focuses on modeling and analytical skills by introducing (1) an integrated view of the production and logistics functions in organizations by discussing models such as facility location, capacity allocation, warehousing, transportation, forecasting, inventory management, and risk-pooling models and (2) how firms interact with each other in a supply chain by discussing topics such as value of information, supply chain contracting and coordination, price-based and quantity-based revenue management. In addition to developing quantitative modeling skills, this course focuses on data analytics in the supply chain context and the interface of supply chain analytics and customer analytics. The course will help students (1) gain an understanding of various aspects, issues, and initiatives in contemporary supply chain practice and (2) develop their ability to conduct quantitative research in supply chain management using recent literature published in top tier journals.
Prerequisite(s): MSC 515 with min. grade of C and MSC 512 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 653
Current Topics in Marketing Analytics
This course focuses on modeling and analytical skills by introducing (1) an integrated view of the production and logistics functions in organizations by discussing models such as facility location, capacity allocation, warehousing, transportation, forecasting, inventory management, and risk-pooling models and (2) how firms interact with each other in a supply chain by discussing topics such as value of information, supply chain contracting and coordination, price-based and quantity-based revenue management. In addition to developing quantitative modeling skills, this course focuses on data analytics in the supply chain context and the interface of supply chain analytics and customer analytics. The course will help students (1) gain an understanding of various aspects, issues, and initiatives in contemporary supply chain practice and (2) develop their ability to conduct quantitative research in supply chain management using recent literature published in top tier journals.
Prerequisite(s): MSC 515 with min. grade of C and MSC 512 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3

MSC 654
Social Network Analytics
This course focuses on the following: (1) analyzing social networks through statistical descriptors of networks (link analysis, centrality, and prestige), network clustering (modularity and community detection), dynamics of information and epidemics spreading (threshold and information cascade models), and network visualization algorithms (spring-like layouts, multidimensional scaling, Gephi). (2) applications of text and document analysis using natural language processing and part-of-speech tagging, sentiment analysis, and topic modeling. (3) assessing collective intelligence using recommender systems, collaborative filtering, and machine learning, in particular deep learning.
Prerequisite(s): MSC 511 with min. grade of C and MSC 512 with min. grade of C and MSC 516 with min. grade of C and MSC 514 with min. grade of C and MSC 515 with min. grade of C and MSC 513 with min. grade of C
Lecture: 3 Lab: 0 Credits: 3
MSC 691
Research and Thesis PhD
Credit: Variable

MSC 697
Special Research Issues
This course is in lieu of MSC 691 that PhD-MSC legacy students can register for after they have already completed the MSC 691 credit requirements for graduation.
Credit: Variable