DECISION SCIENCES

UNDERGRADUATE

Bachelor's program

- Bachelor of Science with a major in business analytics (STEM) (https://bulletin.gwu.edu/business/decision-science/bs-business-analytics-stem/)

Concentration

- Business analytics concentration (https://bulletin.gwu.edu/business/decision-science/concentration-business-analytics/)

Minor

- Minor in business analytics (https://bulletin.gwu.edu/business/decision-science/minor-business-analytics/)

Combined program

- Dual Bachelor of Arts or Bachelor of Science and GW School of Business Master's Degree (https://bulletin.gwu.edu/business/dual-ba-bs-and-business-masters/)

GRADUATE

Master's programs

- Master of Science in the field of business analytics (https://next.bulletin.gwu.edu/business/decision-science/ms-business-analytics/)
- Master of Science in the field of project management (STEM) (https://next.bulletin.gwu.edu/business/management/project-management-ms/)

Combined programs

- Dual Master of Business Administration and Master of Science in the field of business analytics (https://next.bulletin.gwu.edu/business/dual-mba-and-business-analytics-ms/)
- Dual Master of Business Administration (STEM) and Master of Science in the field of project m (https://next.bulletin.gwu.edu/business/dual-mba-stem-and-ms-project-management/)anagement

CERTIFICATES

Graduate certificate programs

- Analytics for managers (https://bulletin.gwu.edu/business/decision-science/analytics-for-managers-certificate/)
- Business analytics (https://bulletin.gwu.edu/business/decision-science/business-analytics-certificate/)
- Project management (https://bulletin.gwu.edu/business/decision-science/project-management-certificate/)

FACULTY

Professors: E.H. Forman, M.A. Lejeune, A. Mehrotra, R. Soyer, M.M. Tarimcilar (*Chair*), P.W. Wirtz

Associate Professors: P. Delquie *(Teaching)*, L. He, S. Jain *(Teaching)*, S. Kanungo, J. S. Kettunen, H. Khamooshi *(Teaching)*, Y.H. Kwak, M.E. Matta *(Teaching)*, S.Y. Prasad

Assistant Professors: *S.* Gawankar *(Visiting)*, J. Hall *(Visiting)*, J. Qi

COURSES

Explanation of Course Numbers

- Courses in the 1000s are primarily introductory undergraduate courses
- Those in the 2000s to 4000s are upper-level undergraduate courses that also may be taken for graduate credit with permission and additional work assigned
- Those in the 6000s and 8000s are for master's, doctoral, and professional-level students
- The 6000s are open to advanced undergraduate students with approval of the instructor and the dean or advising office

DNSC 1001. Business Analytics I: Statistics for Descriptive and Predictive Analytics. 3 Credits.
Foundations of probability and statistical methodologies used in business analytics; probability laws, probability models, univariate and bivariate models and their applications, sampling, hypothesis testing, contingency table analysis, simple and multiple linear regression models. Credit cannot be earned for this course and STAT 1051, STAT 1053, STAT 1111.

DNSC 1051. Introduction to Business Analytics. 3 Credits.
Business analytics fundamentals; the information it provides, how and when it is used, and how it affects decision making. Uncertainty; using data of all sizes; making decisions with incomplete data. Simulation of real-life scenarios to support optimal decision making. Students must have achieved a minimum score of 61 on the ALEKS placement examination in order to enroll.

DNSC 1099. Variable Topics. 1-36 Credits.

DNSC 2001. Business Analytics II: Predictive and Prescriptive Analytics. 3 Credits.
Builds on the foundations of probability and statistical methodologies covered in DNSC 1001. Categorical data analysis; design of experiments and analysis of variants (ANOVA); multiple regression; parameter estimation and testing; residual analysis; indicator variables; model selection procedures; logistic regression; and applications of optimization models. Prerequisites: DNSC 1001 or STAT 1051 or STAT 1053 or STAT 1111. Credit cannot be earned for this course and STAT 2112.

DNSC 3288W. Big Data, Predictive Analytics, and Ethics. 3 Credits.
How data is collected, stored, analyzed, and acted upon. Safeguards in place (or not in place) to protect individual freedoms. Ethical quandaries posed by the advent of recent technological advances. Knowledge of R is preferred. Includes a significant engagement in writing as a form of critical inquiry and scholarly expression to satisfy the WID requirement.

DNSC 3401. Introduction to Business Analytics. 3 Credits.
Fundamentals of business analytics: what information it provides, how and when that information is used, and how it affects decision making. Working with uncertainty; understanding the dynamic nature of decision making; using data, regardless of its size; and making decisions with incomplete data. The simulation of real-life scenarios to support optimal decision making. Prerequisites: APSC 3115 or STAT 1051 or STAT 1053 or STAT 1111.

DNSC 3402. Data Mining. 3 Credits.
The practice of exploring and discovering actionable business intelligence from large amounts of data; concepts, methods, and tools; supervised and unsupervised data mining techniques for discovering relationships in large data sets and building predictive models; regression models, decision trees, neural networks, clustering, and association analysis. Prerequisites: APSC 3115 or STAT 1051 or STAT 1053 or STAT 1111; Math 1231 or Math 1252.

DNSC 3403. Decision Models. 3 Credits.
Designing and developing decision models using Microsoft Excel and specialized decision support add-ins; interpreting the models' outputs. Equivalent courses may be substituted for the prerequisites. Prerequisites: DNSC 2001 or STAT 2112 or STAT 2118 or ECON 2123 or STAT 2123.

DNSC 4211. Programming for Analytics. 3 Credits.
Handling and preparing data for business analytics; descriptive, predictive and prescriptive analytics; creating data stories in collaboration with and for end users and information consumers; scripting, publishing, and collaborating for data products. Prerequisites: DNSC 1001 and DNSC 2001. Recommended background: Some prior knowledge of a programming. Credit cannot be earned for this course and DNSC 6211.

DNSC 4219. Forecasting Analytics. 3 Credits.
Predictive analysis and use of black-box models for time-series forecasting. Emphasis on identifying hidden patterns and structures in univariate and multivariate time-series data and using these for forecasting. Prerequisites: DNSC 4211; and DNSC 2001 or ECON 2123 or STAT 2112 or STAT 2118 or STAT 2123; and MATH 1221 or MATH 1231 or MATH 1252.

DNSC 4233. Social Network Analytics. 3 Credits.
Introduction to the theories, methods, and procedures of network analysis with emphasis on applications to organizations and management.

DNSC 4279. Data Mining. 3 Credits.
The practice of exploring and discovering actionable business intelligence from large amounts of data. Prerequisites: DNSC 2001 or ECON 2123 or STAT 2112 or STAT 2118 or STAT 2123; and DNSC 4211; and MATH 1221 or MATH 1231 or MATH 1252. Credit cannot be earned for this course and DNSC 6279.

DNSC 4280. Machine Learning. 3 Credits.
Machine learning techniques. Topics include supervised learning (classification, regression), unsupervised learning (clustering, dimensionality reduction) and techniques associated with both types of learning. Restricted to students in the BS in business analytics program. Prerequisites: DNSC 4279.

DNSC 4281. Revenue Management Analytics. 3 Credits.
Methodologies used in pricing and revenue management. Tactical optimization of pricing and capacity allocation decisions to ensure the right prices are in place for all products, to all customers, through all channels, at all times. Prerequisites: DNSC 3403. Recommended background: A basic understanding of probability, probability distributions, expected value calculations, and basic optimization, and some knowledge of spreadsheet modeling.

DNSC 4282. Supply Chain Analytics. 3 Credits.
Mathematical modeling techniques used to design, analyze, execute, and integrate supply chains.

DNSC 4289. Capstone in Business Analytics. 3 Credits.
Designed to apply the knowledge gained in the classroom to real world problems by working in teams on an industry project. Students develop significant expertise in a set of analytical tools. Restricted to Seniors. Prerequisites: DNSC 3288W, DNSC 3403, DNSC 4211, DNSC 4219, DNSC 4279, DNSC 4280, and ISTM 4212.

DNSC 4403. Decision Models. 3 Credits.
Design and development of decision models using spreadsheet software with decision support add-ins; interpreting decision model outputs; commonly used classes of models; decision analysis spanning business disciplines. Restricted to juniors and seniors.

DNSC 4404. Essentials of Project Management. 3 Credits.
Theoretical foundations of and practical insights into project management; the role of project management in contemporary business and government organizations; the link between projects and strategy. Project design and development.

DNSC 4900. Special Topics. 3 Credits.

DNSC 4995. Independent Study. 1-4 Credits.
Students undertake research in an area of particular interest under the direction of a decision sciences faculty member. May be repeated for credit. Faculty and department chair approval are required prior to enroll.

DNSC 5099. Variable Topics. 1-99 Credits.

DNSC 6201. Introduction to Business Analytics. 1.5 Credit.
An introduction to business analytic concepts, methods, and tools with concrete examples from industry applications; Big Data and the opportunities it has created for businesses to store, organize, and analyze vast amounts of information. Completion of a basic course in statistics prior to enrollment is recommended.

DNSC 6203. Statistics for Analytics I. 1.5 Credit.
Foundations of statistical methodologies in business analytics; statistical inference and probability models; estimation, hypothesis testing, contingency table analysis, analysis of regression models; logit and probit analysis. Restricted to students in the MS in business analytics and graduate certificate in business analytics programs or with departmental permission. Corequisites: DNSC 6206.

DNSC 6206. Stochastic Foundation: Probability Models. 1.5 Credit.
Introduces the foundations of probability, along with the commonly used probability models (binomial, normal, and poisson) in predictive analytics. Restricted to students in the MS in business analytics and graduate certificate in business analytics programs or with departmental permission.

DNSC 6207. Applied Probability Models. 1.5 Credit.

DNSC 6208. Computational Optimization. 3 Credits.

DNSC 6209. Forecasting for Analytics. 1.5 Credit.
Predictive analysis and use of blackbox models for time-series forecasting. Identifying hidden patterns and structures in the data and exploiting these for forecasting. Prerequisites: MBAD 6224.

DNSC 6210. Decision and Risk Analytics. 1.5 Credit.
Concepts, methods, and practical tools to analyze managerial decisions involving risk and uncertainty. Restricted to students in the master of science in business analytics degree program or with program approval. Prerequisites: DNSC 6206 and DNSC 6203.

DNSC 6211. Programming for Analytics. 3 Credits.
Accessing, preparation, handling, and processing data that differ in variety, volume, and velocity. Development of a theoretical grounding in emerging paradigms like schema-less data. Python and R typically used. Restricted to students in the MS in business analytics and graduate certificate in business analytics programs or with departmental permission. Credit cannot be earned for this course and DNSC 4211.

DNSC 6212. Optimization Methods and Applications. 3 Credits.
Linear, network, integer, and nonlinear models and their fundamental underlying analytic concepts and solution methods; model development, formulation, solution and interpretation of results using powerful commercial software; intuitive understanding of solution methods and their underpinning theoretical paradigms for effective use of optimization models. Restricted to students in the master of science in business analytics degree program or with the permission of the instructor.

DNSC 6213. Statistics for Analytics II. 1.5 Credit.
Statistical methodologies for business analytics in real world scenarios; introduction of high-level analytical techniques such as hierarchical linear modeling and mixed-effects modeling. Restricted to students in the MS in business analytics and graduate certificate in business analytics programs or with permission of the department. Prerequisite: DNSC 6203.

DNSC 6214. Pricing and Revenue Management. 1.5 Credit.
Methodologies for addressing pricing issues; tactical optimization of pricing and capacity allocation decisions; quantitative models of consumer behavior and constrained optimization. For the prerequisites, DNSC 6206 must be taken before DNSC 6203. Prerequisites: DNSC 6206 and DNSC 6203; and DNSC 6202 or MBAD 6224.

DNSC 6215. Social Network Analytics. 1.5 Credit.
Concepts, methods, and applications of network science; analyzing real networks and related phenomena such as organizational analysis, social power, fraud detection, and disease propagation. Prerequisites: DNSC 6202 or the permission from the instructor. Recommended background: Prior exposure to Python and R scripts.

DNSC 6216. Business Analytics Skills Workshops. 1.5 Credit.
Practical workshop designed to develop the student's application-related skills for the analytics realm. Programming skills, computing environments (e.g. cloud or enterprise computing), and data ethics and security. Restricted to students in the master of science in business analytics degree program.

DNSC 6217. Business Analytics Practicum. 1.5 Credit.
Working in small teams, students apply their analytics skills to projects sponsored by public or private institutions. Each team is advised by a faculty member, and the practicum sponsor designates a mentor to provide guidance to the team for the duration of the project. Prerequisite: MSBA degree candidacy.

DNSC 6219. Time Series Forecasting for Analytics. 3 Credits.
Predictive analysis and blackbox models for time series and econometric forecasting. If chosen for the prerequisite, DNSC 6206 must be taken before DNSC 6203. Restricted to students in the master of science in business analytics degree program or with the permission of the department. Prerequisites: DNSC 6206 and DNSC 6203; or DNSC 6202; or MBAD 6224.

DNSC 6225. Business Process Simulation. 1.5 Credit.
Approaches and issues involved in business process design; basic tools used to analyze and improve processes; process modelings using a powerful discrete-event simulation tool. If DNSC 6206 and DNSC 6203 are taken as prerequisites, they must be completed in that order. Prerequisites: DNSC 6206 and DNSC 6203; or DNSC 6202 or MBAD 6224.

DNSC 6231. Consulting for Analytics. 1.5 Credit.
Practical tools used by analysts and managing analysts, within an organization or for an external consulting-focused organization, for integrating analytical skills into problem solving. Prerequisites: DNSC 6203, DNSC 6206, and DNSC 6211 or permission of the instructor.

DNSC 6232. Machine Learning for Managers. 3 Credits.
Machine learning. Supervised: regression, subsets, regularization, bagging, boosting, support vector machines, ensemble. Unsupervised: principal components analysis, clustering. Reinforcement: Q-learning, deep learning. Prerequisites: MBAD 6224.

DNSC 6233. Social Network Analysis for Managers. 3 Credits.
Concepts, theories, and applications associated with network data; concepts at micro, meso, and macro levels, including connectedness, homophily, transitivity, and clustering. Power, roles, social position, and social capital.

DNSC 6234. Procurement and Contracting. 3 Credits.
Principles and concepts essential to effecting large procurement programs. Planning, sourcing, and contractual design for diverse acquisitions. Emphasis on federal government policy with comparison of buying at other governmental levels and the private sector.

DNSC 6235. Communication Strategies in Project Management. 3 Credits.
Communication leadership and management practices that facilitate successful project management; strategies and practices related to communication, change management, and performance reporting.

DNSC 6236. Project Quality Management. 3 Credits.
Current theories and practices regarding quality management as applied to manufacturing and the service industry, the application to project systems, and the application to individual projects. Prerequisite: None.

DNSC 6237. International Project Management. 1.5 Credit.
Augments the basics of project management with theory, practice, and methodology related to global project environment; practical investigation of the cultural environment in the context of managing global projects.

DNSC 6238. Project Management and Organizational Context. 1.5 Credit.
Organizational influences on project management practices; definition and classification of organizations; organizational culture; organizational strategy; project management practices that take place during initiation, planning, execution, monitoring and controlling, and closing processes.

DNSC 6239. Project Governance. 1.5 Credit.
An overview of project governance; models, practices and case studies.

DNSC 6240. Decision Models for Managers. 3 Credits.
Introduction to analytical models for decision making that have a wide range of business applications, from operations/supply chain, production, transportation, scheduling, and location, to finance, marketing, human resources, and policy analysis. Prerequisites: MBAD 6224.

DNSC 6247. Organization, Management, and Leadership. 3 Credits.
Fundamentals of human resource management for project managers. Tools and techniques for success in managing and leading people in a project environment. Prerequisites: None.

DNSC 6250. Project Economics and Finance. 3 Credits.
Concepts, theories, and mathematical methods of project economic analysis and evaluation; fundamentals of project financing. Time value of money concepts, project feasibility, evaluation models, and techniques. Restricted to students in the MS in project management program.

DNSC 6251. Optimization Models for Decision Making. 1.5 Credit.
Optimization modeling techniques, including linear programming, sensitivity analysis, networks, integer programming, multiple objective optimization, and nonlinear and evolutionary programming. Prerequisites: DNSC 6202 or MBAD 6224.

DNSC 6252. Risk Analysis for Decision Making. 1.5 Credit.
Probabilistic modeling techniques with spreadsheet implementation. The concept of risk and methods for its analysis; risk attitudes, risk measures, decision trees, simulation models, game theory, real options approach, and risk communication. Recommended background: Working knowledge of basic statistics.

DNSC 6254. Risk Measurement and Management. 1.5 Credit.
Concepts and principles of risk management including identifying, analyzing, managing, and communicating risks Restricted to Restricted to Graduate Students in Master's of Science in Project Management. Prerequisites: DNSC 6252 and MBAD 6224, or equivalent.

DNSC 6257. Cost Estimation and Control. 1.5 Credit.
Methods of developing project estimates during the planning stages of project and updating the estimates throughout the life of project. Monitoring, reporting, controlling, and managing project costs using earned value management (EVM). Prerequisites: DNSC 6261 and MBAD 6224.

DNSC 6258. Collaborative Decision Making and Portfolio Optimization. 3 Credits.
Multi-objective choice decisions, portfolio management, choice decisions under conditions of uncertainty, and business factor investment theory. Restricted to students in the MS in project management program.

DNSC 6259. Project Portfolio Management. 1.5 Credit.
Management of an organization’s portfolio of projects for the overall success of the enterprise; alignment of projects with an organizations strategy and goals and consistency with values and culture. Prerequisites: DNSC 6202 or MBAD 6221, MBAD 6222 or MBAD 6224.

DNSC 6261. Project Management Principles. 3 Credits.
Overview of project and program management. Culture, principles, and basic techniques. Basic tools, including work breakdown structure, scheduling, earned value analysis, and risk management. Restricted to students in the MS in project management program.

DNSC 6262. Integrated Project Analytics. 3 Credits.
Development of skills and expertise in application of a project management software platform for planning, scheduling, monitoring and control of projects. Performance management and measurements. Implementation of a project management model. Prerequisites: DNSC 6254, DNSC 6257, DNSC 6261, and DNSC 6267.

DNSC 6263. Managing External Projects. 3 Credits.
Fundamentals of contract management from a project manager's perspective. The outsourcing process, associated project strategies, and legal elements. Acquisition planning, vendor selection, contract formulation, and performance control.

DNSC 6267. Planning and Scheduling. 3 Credits.
Integrated planning, scheduling, and control systems for planning the scope of a project; optimizing time, cost, and resources; and monitoring and controlling schedules, including those for delayed projects. Prerequisites: DNSC 6261; and DNSC 6202 or MBAD 6221; and MBAD 6222 or MBAD 6224.

DNSC 6269. Project Management Application. 3 Credits.
Students are expected to demonstrate integration of the knowledge accumulated in their study plan and apply integrated knowledge and experience to best practices, a project case history, and a handbook. Prerequisites: MSPM candidacy or permission of instructor/advisor.

DNSC 6271. Agile Project Management. 1.5 Credit.
Principles, theories, and methods related to agile project management (APM) as a flexible and dynamic methodology. Different phases of managing a project in an APM environment from inception to development and execution and control until closing. Restricted to graduate students.

DNSC 6274. Statistical Modeling and Analysis. 3 Credits.
The process of specifying, analyzing, and testing models of human and systemic behavior. Formalization of models; statistical test comparison and selection; computer implementation of univariate, bivariate, and multivariate tests. General linear model: linear regression, analysis of variance, and analysis of covariance. Prerequisite: MBAD 6221 and MBAD 6222 .

DNSC 6275. Advanced Statistical Modeling and Analysis. 3 Credits.
Advanced topics associated with the general linear model. Testing for and remediation of assumption violations. Detection of outliers, influential observations, and multicollinearity. Alternative design strategies in the analysis of variance; latent growth analysis; hierarchical linear modeling; testing for interactions and parallelism. Prerequisite: DNSC 6274 or permission of instructor.

DNSC 6276. Exploratory and Multivariate Data Analysis. 3 Credits.
Methods for exploratory and multivariate data analysis. Application and comparison of advanced multivariate analytical procedures. Multivariate and discriminant analysis, LISREL analysis, and canonical correlation. Prerequisite: DNSC 6274 or permission of instructor.

DNSC 6277. Applied Forecasting and Time-Series Analysis for Managers. 3 Credits.
Introduction to various forecasting techniques, including time-series regression models, cyclical trends, exponential smoothing methods, seasonal and nonseasonal ARIMA processes, and the Box–Jenkins approach. Application of forecasting methods in economics, finance, and marketing. Prerequisite: MBAD 6222 or permission of instructor.

DNSC 6278. Big Data Analytics. 3 Credits.
Practical workshop-style course using cloud computing resources to analyze and manipulate data too large to fit on a single machine and/or analyze with traditional tools. Spark, MapReduce, the Hadoop Ecosystem, and other tools. Prerequisites: DNSC 6302, DNSC 6303, and DNSC 6305. Recommended background: Understanding of and experience with Linux/OSX; programming concepts; R, Python, SQL, or other programming language; remote computing via SSH; shell executables; version control tools such as Git/GitHub.

DNSC 6279. Data Mining. 3 Credits.
How organizations make better use of increasing amounts of collected data and convert that data into information to support managerial decision making; data mining and data analysis methods and tools for exploring and analyzing data sets; state-of-the-art software tools for developing novel applications. Note that the prerequisite courses must be taken in the order listed. Restricted to students in the master of science in business analytics and graduate certificate in business analytics programs. Prerequisites: DNSC 6203 and DNSC 6206. Credit cannot be earned for this course and DNSC 4279.

DNSC 6280. Supply Chain Analytics. 3 Credits.
Analytical framework for how supply chains function for decision making. Decision models studied include inventory management, integrated transportation, risk pooling, network coordination, and supplier management. Prerequisites: DNSC 6202; or DNSC 6203 and DNSC 6206; or MBAD 6224.

DNSC 6290. Special Topics. 3 Credits.
Experimental offering; new course topics and teaching methods. May be repeated once for credit.

DNSC 6298. Directed Readings and Research. 3 Credits.

DNSC 6300. Thesis Seminar. 3 Credits.

DNSC 6301. Analytics Edge and Data Ethics. 1.5 Credit.
Introduction to the benefits and risks of predictive modeling, machine learning, and AI (AI/ML) systems. Topics are addressed using a variety of cased-based technical and business examples. Restricted to students in the MS in business analytics program.

DNSC 6302. Programming for Analytics I. 1.5 Credit.
Based on the R programming language and environment. Concepts, techniques, and tools needed to access and prepare data to apply statistical and basic machine learning techniques Restricted to students in the MS in business analytics program or with the permission of the instructor.

DNSC 6303. Programming for Analytics II. 1.5 Credit.
Based on the Python programming language. Data management (ingestion, including web scraping, and cleaning), command line arguments, and basic prescriptive and predictive workflows. Restricted to students in the MS in business analytics program. Restricted to students in the MS in business analytics program. Corequisites: DNSC 6302.

DNSC 6305. Data Management for Analytics. 3 Credits.
Managing data for analytics using tools for data ingestion, wrangling, databases, and data warehousing with a focus on schema design and dimensional modeling. Hands-on experience for managing and analyzing data at scale. Restricted to students in the MS in business analytics program.

DNSC 6306. Decision Models. 1.5 Credit.
Designing and developing decision models to aid decision making in a wide range of practical business context: formulation of decision problems and interpretation of the results in an intuitive and practical manner. Restricted to students in the MS in business analytics program. Corequisites: DNSC 6303.

DNSC 6307. Optimization I. 1.5 Credit.
Optimization problems in business context, such as resource allocation, work shift planning, selecting portfolio of investments, or projects to develop. Restricted to students in the MS in business analytics program.

DNSC 6308. Optimization II. 1.5 Credit.
Optimization problems in business context with an emphasis on the problem formulation and interpretation of the results in an intuitive and practical manner. Restricted to students in the MS in business analytics program. Prerequisites: DNSC 6307.

DNSC 6311. Stochastic Foundation: Probability Models. 1.5 Credit.
Introduction to the foundations of probability, along with the commonly used probability models (binomial, normal, and poisson) in predictive analytics. Restricted to students in the MS business analytics program or with the permission of the instructor. Corequisites: DNSC 6302. Credit cannot be earned for this course and DNSC 6206.

DNSC 6312. Statistics for Analytics I. 1.5 Credit.
Foundations of statistical methodologies in business analytics; statistical inference and probability models; estimation, hypothesis testing, contingency table analysis, analysis of regression models; logit and probit analysis. Restricted to students in the MS business analytics program or with permission of the instructor. Corequisites: DNSC 6311. Credit cannot be earned for this course and DNSC 6203.

DNSC 6313. Statistics for Analytics II. 1.5 Credit.
Statistical methodologies for business analytics in real world scenarios; introduction of high-level analytical techniques such as hierarchical linear modeling and mixed-effects modeling. Restricted to students in the MS business analytics program or with permission of the instructor. Prerequisites: DNSC 6311 and DNSC 6312. Credit cannot be earned for this course and DNSC 6213.

DNSC 6314. Machine Learning I. 1.5 Credit.
Various data preprocessing, statistics, and machine learning techniques used to discover relationships in large data sets and build predictive models. Restricted to students in the MS in business analytics program. Prerequisites: DNSC 6303 and DNSC 6313.

DNSC 6315. Machine Learning II. 1.5 Credit.
Builds on the theoretical and practical aspects covered in DNSC 6314 and introduces new techniques featuring penalized regression, neural networks and deep learning, ensemble models, matrix factorization, model validation, and model interpretation. Restricted to students in the MS in business analytics program. Prerequisites: DNSC 6307. Corequisites: DNSC 6314.

DNSC 6317. Business Analytics Practicum. 3 Credits.
A workshop-style course providing opportunities to use the tools and techniques from the MSBA program. Practical tools for integrating analytical skills into problem solving for businesses and organizations. Department approval required. Restricted to students in the MS in business analytics program. Credit cannot be earned for this course and DNSC 6217.

DNSC 6319. Time Series Forecasting for Analytics. 3 Credits.
Predictive analysis and blackbox models for time series and econometric forecasting. Restricted to students in the master of science in business analytics program or with departmental permission. Prerequisites: DNSC 6311 and DNSC 6312. Credit cannot be earned for this course and DNSC 6219.

DNSC 6320. Pricing and Revenue Management. 1.5 Credit.
Methodologies for addressing pricing issues; tactical optimization of pricing and capacity allocation decisions; quantitative models of consumer behavior and constrained optimization. Restricted to . Prerequisites: DNSC 6311 and DNSC 6312; or MBAD 6224. Credit cannot be earned for this course and DNSC 6214.

DNSC 6321. Social Network Analytics. 1.5 Credit.
Introduction to concepts, techniques, and applications of network science. Students develop a working knowledge of network analysis. Credit cannot be earned for this course and DNSC 6215.

DNSC 6323. Visualization for Analytics. 1.5 Credit.
Use of data visualization software technology in the context of exploratory and reporting capabilities. SAS Visual Analytics/ Statistics and other methodologies. Various graphical approaches to preparing and visualizing data. Credit cannot be earned for this course and DNSC 6403.

DNSC 6325. Business Process Simulation. 1.5 Credit.
Introduction to the approaches and issues involved in business process design. Basic tools used to analyze and improve processes; process modelings using a powerful discrete-event simulation tool. Prerequisites: DNSC 6311 and DNSC 6312; or MBAD 6224. Credit cannot be earned for this course and DNSC 6225.

DNSC 6327. Sports Analytics. 1.5 Credit.
Analyzing and leveraging information throughout a sports organization. Strategies for gaining competitive advantage on the field of play; player analysis; and business operations. Credit cannot be earned for this course and DNSC 6404.

DNSC 6330. Responsible Machine Learning. 1.5 Credit.
A technical, nuts-and-bolts course about increasing transparency, fairness, security, and privacy in machine learning. Prerequisites: DNSC 6314 and DNSC 6315; or DNSC 6232.

DNSC 6401. Sustainable Supply Chains. 1.5 Credit.
Introduction to integrating environmental management and sustainability concepts into the operations and supply chain management fields.

DNSC 6403. Visualization for Analytics. 1.5 Credit.
Use of data visualization software technology in the context of exploratory and reporting capabilities. SAS Visual Analytics/ Statistics and other methodologies. Various graphical approaches to preparing and visualizing data. Prerequisites: DNSC 6311 or MBAD 6224.

DNSC 6404. Sports Analytics. 1.5 Credit.
Analyzing and leveraging information throughout a sports organization. Strategies for gaining competitive advantage on the field of play; player analysis; and business operations. Prerequisites: DNSC 6311 and DNSC 6312.

DNSC 6500. Analytic Skills for Managers. 1 Credit.
Topics vary by semester. May be repeated for credit provided the topic differs. Consult the Schedule of Classes for more details. Restricted to students in the MBA program.

DNSC 8328. Special Topics in Decision Making. 3 Credits.
Special topics and advanced applications, such as catastrophe theory, Markovian decision processes, and Bayesian statistics. May be repeated once for credit.

DNSC 8385. Special Topics in Research Methods. 3 Credits.
Research problems and issues related to student dissertations form topics for readings, group discussions, and assigned papers.

DNSC 8392. Computational Optimization. 3 Credits.
The description, design, and programming of efficient computational methods for large-scale optimization problems; introduction to software, optimization solvers, and programming languages used by professionals to code and model industry-size optimization problems.

DNSC 8393. Applied Stochastic Models for Business. 3 Credits.
In-depth coverage of stochastic models and their applications in business and industry; applications to marketing, call center modeling, finance, queuing systems, and operations.

DNSC 8394. Stochastic Programming. 3 Credits.
The intersection of probability theory and statistics with mathematical programming for modeling optimization problems that involve uncertainty. Basic knowledge of linear programing, elementary analysis and probability. Emphasis on algorithmic methods to solve stochastic programming instances.

DNSC 8397. Advanced Special Topics. 1-3 Credits.
Current research and scholarly issues in management science.

DNSC 8998. Advanced Readings and Research. 1-12 Credits.
May be repeated for credit. Restricted to doctoral candidates preparing for the general examination.

DNSC 8999. Dissertation Research. 1-12 Credits.
May be repeated for credit. Restricted to doctoral candidates.