

# Management Sciences

## Chair

- Nick Street

**Undergraduate major:** business analytics and information systems (B.B.A.)

**Graduate degrees:** M.S. in business analytics (career, professional); management sciences subprogram for the Ph.D. in business administration

**Graduate certificate:** business analytics

**Faculty:** <https://tippie.uiowa.edu/people?departments=175>

**Website:** <https://tippie.uiowa.edu/management-sciences>

The Department of Management Sciences specializes in using advanced computation and mathematical techniques to solve critical business problems. Its strengths in research and instruction include operations management, business analytics, information systems, and quantitative methods.

The department offers the undergraduate major in business analytics and information systems, with tracks in business analytics or information systems. Off-campus offerings include the part-time Master of Science program in Business Analytics and a graduate Certificate in Business Analytics located in Des Moines, Cedar Rapids, and the Quad Cities. On-campus graduate programs include the full-time Master of Science program in Business Analytics and the Doctor of Philosophy in Business Administration with a management sciences subprogram.

The off-campus business analytics program collaborates with the Professional M.B.A. Program to offer a combined M.S./M.B.A. degree. Separate application to each degree program is required. Applicants must be admitted to both programs before they may be admitted to the combined degree program.

In addition, the department administers the Business Analytics Career Academy in the M.B.A. program; see Master of Business Administration Program in the Catalog.

## Programs

### Undergraduate Program of Study

#### Major

- Major in Business Analytics and Information Systems (Bachelor of Business Administration)

### Graduate Programs of Study

#### Majors

- Master of Science in Business Analytics (career)
- Master of Science in Business Analytics (professional)
- Management sciences subprogram for the Doctor of Philosophy in Business Administration

#### Certificate

- Certificate in Business Analytics

## Courses

### Management Sciences Courses

#### MSCI:1300 First-Year Seminar 1 s.h.

Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities).

#### MSCI:1500 Business Computing Essentials 2 s.h.

Basic proficiency with common business application software (word processing, spreadsheet, presentation software, database); simulation training to achieve requisite skills; additional support available via optional textbook or ebook; online, modular, self-taught course.

#### MSCI:2800 Business Analytics 3 s.h.

Introduction to business decision making using data; students transform data into Insight using visualization, statistics, and optimization; introduction to Excel as a tool for business analytics. Prerequisites: (STAT:1030 or STAT:2010 or STAT:3100 or STAT:3101 or STAT:3120 or STAT:3510 with a minimum grade of B or STAT:4100 or BIOS:4120 or PSQF:4143 with a minimum grade of B) and (MATH:1380 or MATH:1460 or MATH:1550 or MATH:1850 or MATH:1860) and (MSCI:1500 or CS:1020 or CS:1110 or CS:1210 or CS:2110 or ENGR:1300 or ENGR:2730).

#### MSCI:3000 Operations Management 3 s.h.

Strategic, tactical, operational issues that arise in management of production and service operations; product and process design, facilities planning, quality management, materials management, operations planning and scheduling, emerging technologies in production and service management. Prerequisites: STAT:2010 or STAT:3120 or STAT:3101 or STAT:2020 with a minimum grade of B or STAT:3510 with a minimum grade of B or BIOS:4120 or STAT:3100 or PSQF:4143 with a minimum grade of B or STAT:1030 or STAT:4100. Requirements: junior standing.

#### MSCI:3005 Information Systems 3 s.h.

Application of computing principles to solving business problems; information technology in modern organizations; focus on sound data analysis to support decision making; tools used for problem solving (spreadsheets, databases, web applications); role of information systems in organizations; components of information technology; Internet and network economy; basic data analysis and visualization; decision-making logic represented as algorithms; perform what-if analysis with data; emerging technologies. Prerequisites: MSCI:1500 or CS:1020.

#### MSCI:3020 Business Programming 3 s.h.

Introduction to algorithms, data structures, and object-oriented programming constructs to solve business problems. Prerequisites: MSCI:3005 or CS:2110.

#### MSCI:3025 VBA Spreadsheet Programming 3 s.h.

Introduction to programming Visual Basic for Applications in Excel to develop spreadsheet-based, decision-support systems. Prerequisites: MSCI:3005 or CS:2110.

- MSCI:3030 Business Process Analysis** 3 s.h.  
Data-driven approach to improve business processes; value-stream map analysis of industrial and service-oriented business processes to identify improvement opportunities; discrete-event simulation tools utilized to model business processes and demonstrate effect of variability on process performance metrics; role of information systems to increase an organization's efficiency and sustainability; application of lean principles to support environmental integrity and economic viability; meets a requirement for the sustainability certificate. Prerequisites: MSCI:3000.
- MSCI:3050 Business Analytics and Information Systems Professional Preparation** 1 s.h.  
Information on career opportunities in the fields of business analytics and information systems; introduction to the many career avenues available to a BAIS major and how to position oneself for success in those careers.
- MSCI:3070 Management Sciences Topics** arr.  
Special topics in management sciences and information systems.
- MSCI:3100 Accounting Information Systems** 3 s.h.  
Application of computer technology to accounting and transaction processing systems; information systems infrastructure and trends; problem solving with microcomputer spreadsheets, databases; accounting cycle operations. Prerequisites: (MSCI:3005 or CS:2110) and ACCT:2200 and ACCT:2100. Same as ACCT:3600.
- MSCI:3200 Database Management** 3 s.h.  
Design and implementation of a database using relational DBMS; emphasis on issues of logical and physical design, database administration, concurrency control, maintenance. Prerequisites: MSCI:3005 or CS:2110 or CS:2230 or CS:3330 or ENGR:2730.
- MSCI:3250 Analyzing Data for Business Intelligence** 3 s.h.  
Introduction to methods and tools of processing, manipulating, analyzing, and visualizing data for descriptive analytics and insights that can aid business decision making. Corequisites: MSCI:3200.
- MSCI:3300 Software Design and Development** 3 s.h.  
Design and implementation of an information system; emphasis on programming and management of the software development life cycle. Corequisites: MSCI:3020 or CS:2230, MSCI:3030, and MSCI:3200; if not taken as prerequisites.
- MSCI:3400 Data Communications** 3 s.h.  
Computer communications: computer-communication system, hardware, data transmission principles; examples of existing communication networks; related managerial issues. Prerequisites: MSCI:3005 or CS:2110 or CS:1210.
- MSCI:3500 Data Mining** 3 s.h.  
Introduction to predictive analytics methods motivated by problems in operations, marketing, finance and accounting; data and text mining techniques, including classification, clustering, and association analysis. Prerequisites: MSCI:2800 or STAT:2020 with a minimum grade of B or ECON:2800 or STAT:4101 or ECON:4800.
- MSCI:3800 Optimization and Simulation Modeling** 3 s.h.  
How to leverage data and apply spreadsheet optimization software and Monte Carlo simulation to form optimal decision policies. Prerequisites: MSCI:2800 or STAT:4101 or ECON:4800 or ECON:2800 or STAT:2020 with a minimum grade of B.
- MSCI:3920 Supply Chain Management** 3 s.h.  
Key issues in design and management of global supply chains; issues in integration of business processes across organizations that are concerned with movement of goods, delivery of services, and information flow along the supply chain in order to create value for the customer; issues in coordinating production and logistics within a firm and with outside suppliers and customers in the supply chain. Prerequisites: MSCI:3000.
- MSCI:4050 Directed Readings** arr.
- MSCI:4150 Business Analytics Capstone** 3 s.h.  
Individual or team senior project incorporating track-specific knowledge and skills from business analytics curriculum; projects from real-world customer involving descriptive, predictive, and prescriptive; outcomes include client presentation and project report. Prerequisites: MSCI:3200 and MSCI:3030 and MSCI:3250 and MSCI:3500.
- MSCI:4220 Advanced Database Management and Big Data** 3 s.h.  
Advanced database management topics; basics of semi-structured data and web services; how to retrieve real-world big datasets from web services; use of SQL and PL/SQL to analyze data in relational databases; big data related topics such as Hadoop and Hive. Prerequisites: MSCI:3200. Same as IGPI:4220.
- MSCI:4280 Data Security** 3 s.h.  
Data and network security topics to ensure confidentiality, integrity, and availability of information and assets including cryptography, access control, physical security, network and application security, and management issues surrounding information security.
- MSCI:4350 Information Systems Capstone** 3 s.h.  
Individual or team senior project incorporating track-specific knowledge and skills from information systems curriculum; projects from real-world customer involving development of software applications and information system infrastructure; outcomes include written documentation, presentation, and project report. Prerequisites: (MSCI:3020 or CS:2230) and MSCI:3030 and MSCI:3200 and MSCI:3300.
- MSCI:4480 Knowledge Discovery** 3 s.h.  
Knowledge discovery process, including data reduction, cleansing, transformation; advanced modeling techniques from classification, prediction, clustering, association; evaluation and integration. Same as CS:4480, ECE:4480, IGPI:4480.
- MSCI:4900 Academic Internship** arr.  
Professional internship experience with associated academic content.
- MSCI:4999 Honors Thesis in Management Sciences** 3 s.h.  
Independent student project directed by faculty or staff advisor; culminates in thesis that conforms to University Honors Program guidelines; may include empirical research, library research, applied projects. Requirements: admission to the Tippie College of Business honors program.
- MSCI:6050 Data Management and Visual Analytics** 3 s.h.  
Understanding how data is stored in databases and learning the tools used to access the data is key to creating datasets used to answer many business questions; how to manage and access data in relational databases using Structured Query Language (SQL); basic principles of visual analytics and techniques for presenting data retrieved from databases. Requirements: enrollment in graduate business analytics program.

- MSCI:6060 Data Programming in R** 3 s.h.  
Introduction to principles and practices of handling, cleaning, processing, and visualizing data using R programming language; basic programming skills that can be applied to software development in any programming language; variables and data types, control structures, functions and subroutines, arrays and other simple data structures.
- MSCI:6070 Data Science** 3 s.h.  
Underlying concepts and practical computational skills of data-mining tools including penalty-based variable selection (LASSO), logistic regression, regression and classification trees, clustering methods, principal components and partial least squares; analysis of text and network data; theory behind most useful data mining tools and how to use these tools in real-world situations; software for analysis, exploration, and simplification of large high-dimensional data sets. Prerequisites: MSCI:9100 or MBA:8150.
- MSCI:6100 Text Analytics** 3 s.h.  
Concepts and techniques of text mining; practice of using statistical tools to automatically extract meaning and patterns from collections of text documents; topics include document representation, text classification and clustering, sentiment analysis and topic modeling. Prerequisites: (MSCI:6060 or MSCI:9060) and (MSCI:6070 or MSCI:9110).
- MSCI:6110 Big Data Management and Analytics** 3 s.h.  
Introduction to advanced techniques for managing and analyzing "big" data; non-relational data models, such as semi-structured (e.g., XML) and unstructured (e.g., key-value) data; state-of-the-art big data tools for non-relational data management, such as noSQL databases and distributed databases (e.g., Hadoop); query languages such as HIVE; design and implementation of data analysis methods on these platforms; through exercises and course projects, students will be trained to use the tools introduced to implement analysis tasks on big data sets. Prerequisites: (MSCI:6050 or MSCI:9050) and (MSCI:6060 or MSCI:9060).
- MSCI:6120 Analytics Experience** 3 s.h.  
Students work in groups to complete semester-long projects pertaining to business analytics; all project stages are addressed including problem definition, data cleaning, analysis, and final presentation; appropriate tools from required courses used throughout. Prerequisites: MSCI:9100 and MSCI:6050 and MSCI:9110 and MSCI:6060 and MSCI:6070. Requirements: all CER courses and at least one master's course.
- MSCI:6130 Applied Optimization** 3 s.h.  
Use of optimization (also called prescriptive analytics or mathematical programming) to make tactical and strategic decisions; advanced optimization skills including data collection and preparation, logical modeling, and solution interpretation and implementation within a software environment; applications in the various functional areas of business are discussed throughout. Prerequisites: (MSCI:9100 or MBA:8150) and (MSCI:9060 or MSCI:6060).
- MSCI:6140 Information Visualization** 3 s.h.  
Instruments for reasoning about quantitative information; analyzing and communicating statistical information; main typologies of data graphics (data-maps, time-series, space-time narrative, relational diagrams, graphs and methods for dimensionality reduction); language for discussing data visualizations combined with knowledge of human perception of visual objects; how to visualize information effectively by using statistical methods, knowledge of human perception, and basics of data graphics. Prerequisites: (MSCI:6060 or MSCI:9060) and (MSCI:9100 or MBA:8150).
- MSCI:6150 Financial Analytics** 3 s.h.  
Businesses as well as investors are affected by fluctuating treasury bond rates, equity prices, and foreign exchange rates, and the risk must be measured; students focus on gaining knowledge of the classic financial models and statistical and risk metrics and scaling them up with analytics techniques (sorting with thresholds, portfolio optimization, decision trees, and database programming) to find the best investments based on historical datasets; beginning with descriptive analytics and pushing into predictive and prescriptive analytics, students build a software simulation laboratory using R. Prerequisites: (MSCI:9100 or MBA:8150) and (MSCI:6060 or MSCI:9060).
- MSCI:6160 Big Data Analytics** 3 s.h.  
Principles of data mining and machine learning in the context of big data; basic data mining principles and methods (pattern discovery, clustering and ordering); analysis of different types of data (sets and sequences); machine learning topics including supervised and unsupervised learning, tuning model complexity, dimensionality reduction, nonparametric methods, comparing and combining algorithms, and applications of these methods; development of analytical techniques to cope with challenging and real big data problems; introduction to graphics processing unit (GPU) computing tools. Prerequisites: (MSCI:9100 or MBA:8150) and (MSCI:6060 or MSCI:9060).
- MSCI:6170 Directed Readings - Graduate Business Analytics** arr.  
Project and/or research with a faculty member as part of the graduate business analytics program. Requirements: enrollment in graduate business analytics program.
- MSCI:6180 Healthcare Analytics** 3 s.h.  
Clinical data management is essential for evaluating evidence-based practice/performance-improvement projects; a high quality data management plan provides key stakeholders with information necessary to make decisions; plan components include identified processes and outcomes linked to variables and data sources, adequate statistical power, data cleaning and manipulation techniques, statistical methods, and meaningful presentation of variables that address stakeholder concerns and questions; students gain knowledge and skills necessary to develop and execute a data management plan within a final project. Prerequisites: (MSCI:9100 or MBA:8150) and MSCI:6050.
- MSCI:6300 Dynamic Programming** 3 s.h.  
Fundamentals of discrete sequential dynamic programming with special focus on situations in which outcomes are uncertain; formulation and analysis of deterministic and stochastic dynamic programs under several objective criteria; emphasis on rapidly expanding field of approximate dynamic programming; applications including inventory control, vehicle routing, and resource allocation.
- MSCI:6500 Social Network Analytics: Models and Algorithms** 3 s.h.  
Preparation for future research in computational network analysis; introduction to methodology for analyzing various types of complex networks including social networks, information networks, and business networks; basic concepts of networks, models for network structures and dynamics, computational algorithms for analyzing networks; hands-on experience with analyzing real-world networks using third-party software or programming APIs.

- MSCI:6600 Linear Programming** 3 s.h.  
Mathematical programming models; linear and integer programming, transportation models, large-scale linear programming, network flow models, convex separable programming. Requirements: calculus and linear algebra. Same as IE:6600, IGPI:6600.
- MSCI:6700 Discrete Optimization** 3 s.h.  
Introduction to modeling and solving discrete optimization problems; integer programming, network flows, dynamic programming. Prerequisites: MSCI:6600. Same as IGPI:6700.
- MSCI:6800 Web Mining** 3 s.h.  
Techniques for mining the web and other unstructured or semi-structured, hypertextual, distributed information repositories; crawling, indexing, ranking, filtering algorithms.
- MSCI:6900 Heuristic Search** 3 s.h.  
Design of heuristic search algorithms to find good (near-optimal) solutions to difficult (NP-hard) optimization problems that occur in many disciplines; basic heuristic concepts (local search, greedy search, problem decomposition) which serve as fundamental constructs for metaheuristics, including simulated annealing, genetic algorithms, tabu search, variable neighborhood search; introduction to various optimization problems and survey of various heuristic approaches; underlying theoretical structure of several heuristic methods; how to implement a heuristic algorithm.
- MSCI:7000 Management Sciences Topics** 3 s.h.  
Same as IGPI:7000.
- MSCI:7850 Research Seminar in Management Sciences** 1 s.h.  
Current research topics. Requirements: Ph.D. enrollment.
- MSCI:7900 Special Topics in Management Sciences** arr.
- MSCI:7950 Directed Readings** arr.
- MSCI:7975 Thesis in Management Sciences** arr.  
Requirements: Ph.D. enrollment.
- MSCI:9010 Contemporary Topics in Analytics** 1-3 s.h.  
Content from cutting edge topics in business analytics, operations, and project management; topics vary.
- MSCI:9050 Data Management and Visual Analytics** 3 s.h.  
Understanding how data is stored in databases and learning the tools used to access the data is key to creating datasets to answer many business questions; how to manage and access data in relational databases using Structured Query Language (SQL); basic principles of visual analytics and techniques for presenting data retrieved from databases.
- MSCI:9060 Data Programming in R** 2-3 s.h.  
Introduction to principles and practices of handling, cleaning, processing, and visualizing data using R programming language; basic programming skills that can be applied to software development in any programming language; includes topics such as variables and data types, control structures, functions and subroutines, arrays and other simple data structures. Prerequisites: MBA:8150 or MSCI:9100.
- MSCI:9070 Data Science** 2 s.h.  
Underlying concepts and practical computational skills of data-mining tools including penalty-based variable selection (LASSO), logistic regression, regression and classification trees, clustering methods, principal components and partial least squares; analysis of text and network data; theory behind most useful data mining tools and how to use these tools in real-world situations; software for analysis, exploration, and simplification of large high-dimensional data sets. Prerequisites: MBA:8150 or MSCI:9100.
- MSCI:9080 Business Analytics in Practice** 3 s.h.  
Application of theory from classroom to real world context through an experiential learning project; company-sponsored project applying analytics to solve problems in a variety of contexts; including supply chain and operations, marketing, finance, or health care. Prerequisites: MSCI:6050 and MSCI:6060 and MSCI:6070.
- MSCI:9100 Business Analytics** 3 s.h.  
Introduction to analytical techniques for making business decisions; utilizing Excel for application of descriptive and predictive analytical tools to solve practical business problems using real world data; dealing with uncertainty in decision making; formal probability concepts and statistical methods for describing variability (decision trees, random variables, hypothesis testing); application of techniques (linear regression, Monte Carlo simulation, linear optimization) to model, explain, and predict for operational, tactical, and strategic decisions.
- MSCI:9110 Advanced Analytics** 2-3 s.h.  
Development of data-driven, problem-solving skills for prediction of uncertain outcomes and prescription of business solutions; linear and nonlinear regression, Monte Carlo simulation, forecasting, data mining, and optimization utilizing spreadsheets and dedicated software packages. Prerequisites: MSCI:9100 or MBA:8150.
- MSCI:9120 Managing the Supply Chain** 2-3 s.h.  
Design, operation, and management of a supply chain; supplier and customer partnerships, supply base management, transportation and logistics, supply chain innovation, supply chain sustainability; supply chain risk management and performance metrics. Prerequisites: MBA:8190 or MBA:8240.
- MSCI:9130 Lean Process Improvement** 3 s.h.  
Lean principles across the enterprise; real-world applications and case studies in manufacturing and service sectors. Prerequisites: MBA:8190 or MBA:8240.
- MSCI:9135 Strategy Deployment and Lean Enterprise** 3 s.h.  
How organizations transform themselves into Lean enterprises that maximize customer value through the elimination of waste; focus on how manufacturing and service organizations successfully align their process improvement efforts to strategic goals of the organization (policy deployment); A3 thinking, strategic planning, balanced scorecard, Lean supply chain, employee engagement, and cultural transformation. Prerequisites: MBA:8190 or MBA:8240.
- MSCI:9140 Rapid Continuous Improvement** 3 s.h.  
Hands-on experience working on rapid continuous improvement (RCI) teams sponsored by industrial affiliates of the business college involved in using RCI. Offered spring break.
- MSCI:9160 Supply Chain Analytics** 2-3 s.h.  
Supply chain analytics applications for decision making, including demand forecasting, inventory management, capacity planning, and supply chain coordination. Prerequisites: MBA:8150 or MSCI:9100.

**MSCI:9180 Statistical Methods for Process Improvement 3 s.h.**

Strategies to improve quality of products, effectiveness of processes; managerial issues, statistical methods, quality, customer needs, customer satisfaction, quality measures and standards; understanding and reducing variability; builds on MBA:8150; data-based management, statistical process control, control charts, capability indexes, design of experiments. Prerequisites: MSCI:9100 or MBA:8150.

**MSCI:9185 Project Management 2-3 s.h.**

Preparation for managing projects and project portfolios; project selection, project planning and budgeting, scheduling, resource allocation, project control; integration of project planning tools, including project management software.

**MSCI:9190 Advanced Project Management 3 s.h.**

Expands on the study of project management by examining why 70 percent of all projects fail to meet established requirements and what project managers can do to ensure success; elements of the Project Management Institute's *Guide to the Project Management Body of Knowledge* are reviewed including the 47 key processes; concepts are presented for improving project outcomes, including thinking well through creative and innovative methods, developing an organizational environment for successful projects, and using alternative methodologies such as Agile. Prerequisites: MSCI:9185.

**MSCI:9200 Business Programming 3 s.h.**

Introduction to algorithms, data structures, and object-oriented programming constructs to solve business problems. Corequisites: MSCI:3005.

**MSCI:9210 Introduction to Modeling with VBA 2-3 s.h.**

Introduction to programming Visual Basic for Applications in Excel; case studies in finance, marketing, operations, accounting.

**MSCI:9220 Introduction to Information Systems 3 s.h.**

Effective ways for business firms to harness the power of information technology for strategic purposes; conventional and emerging architectures of information systems; integrated perspective on structural relationships among IT components; emphasis on case studies.