

# DECISION SCIENCES (DS)

# Course numbers with the # symbol included (e.g. #400) have not been taught in the last 3 years.

## DS 801 - Business Intelligence

**Credits:** 3

This course is designed to introduce students to the skills needed to succeed in today's big data environment through the application of data management techniques, business-oriented hands-on cases and exercises. Students will acquire concepts and application of data management techniques, business-oriented hands-on cases and exercises. Students will acquire concepts and techniques in the theory, design, and implementation of relational databases and Data Warehousing (DW) systems, queries in Structured Query Language (SQL), next generation query language (NoSQL).

## DS 802 - Probability and Simulation

**Credits:** 3

The course is designed to provide an introductory understanding of the fundamentals of uncertainty quantification in business decision making. The course will serve as a building block for subsequent course work in inferential statistics, predictive analytics, and time series analysis. The topics include the axioms of probability theory, random variables, probability distributions, random variable generation using simulation methods, and system simulation for relevant business applications (e.g. inventory management, supply chain management, and staffing in call centers). An introduction to the programming language R will be part of the learning experience.

## DS 803 - Fundamentals of Statistical Analysis

**Credits:** 3

The course is designed to introduce the fundamentals of statistics needed for solving business analytics problems. The course will mainly cover the broadly defined subjects of random sampling, likelihoods, estimation using maximum likelihood, Bayesian inference using priors, computational statistics methods, interval estimation, hypothesis testing for continuous/categorical data, and Gaussian linear models. The course will conclude with a brief introduction to nonparametric analysis. Prereq: DS 802.

## DS 804 - Exploration and Communication of Data

**Credits:** 3

The goal of this course is to expose students to techniques and technologies that will enable them to collect, harvest and transform unstructured and structured data into useful business insights. The first half of the course deals with data management and provides an introduction to data types and sources, data acquisition and harvesting tools and techniques and effective strategies and methods for data aggregation and analysis. In the second half of the course, students learn about the theoretical underpinnings of data visualization and use a variety of software tools to visualize business data in order to generate insightful information that facilitates effective business decision making.

## DS 805 - Statistical Learning

**Credits:** 3

This course introduces students to statistical tools for modeling and identifying patterns in complex data sets. The goal of statistical learning is to develop predictions informed by data. Topics to be covered include Gaussian linear models, model diagnostics, cross-validation techniques, penalized regression methods such as ridge and LASSO, nonlinear models, logistic regression, random forests, and support vector machines. Application areas include Marketing (e.g., effectiveness of advertising and customer satisfaction), Financial economics (valuation), and Operations Management (resource allocation). The course delivery will be a mix of lectures, readings with discussion, and hands on data analyses. Prereq: DS 803.

## DS 806 - Optimization Methods I

**Credits:** 3

This course introduces students to fundamental quantitative methods for modeling, analyzing, and determining the best course of action in complex decision-making situations. Topics to be covered include decision trees and tables, price of uncertainty, utility theory, linear programming, LP sensitivity analysis, and network flow optimization. Application areas include Marketing and Operations management (e.g., advertising, production and inventory planning, project or personnel scheduling, shipping and distribution, routing, ride matching, etc.)

## DS 807 - Modeling Unstructured Data

**Credits:** 3

This course introduces students to statistical and machine learning tools for modeling unstructured data; including emails, documents, text messages, and social media data. Topics to be covered include generalized linear models, decision trees for discrete data, k-means clustering, mixture models, and topic models. The course integrates numerous case studies to demonstrate practical approaches to analyzing large unstructured collections of data. Application areas include Marketing (Yelp and Trip Advisor reviews), Human Resources (healthcare plan analysis), Social media (Twitter, YouTube, and Instagram). The course delivery will be a mix of lectures, readings with discussion, and hands-on data analysis. Prereq: DS 805.

## DS 808 - Optimization Methods II

**Credits:** 3

This course introduces students to more advanced concepts and modeling techniques in mathematical programming. Topics to be covered include integer programming, nonlinear programming, multi-objective optimization, goal programming, and Monte Carlo simulation. Application areas include Marketing (e.g., pricing and revenue optimization), Finance (capital budgeting and portfolio optimization), and Operations management (e.g., production and inventory planning, shipping and distribution, routing, location selection, etc.). The course delivery will be a mix of lectures, hands-on problem solving, and case discussions. Prereq: DS 806.

## DS 809 - Time Series Analysis

**Credits:** 3

The course is designed to introduce analytical techniques needed in the analysis of temporal data in various business disciplines. The first half of the course focuses on traditional stationary univariate and multivariate time series models and the second half will focus on non-stationary (state space) models. Both classic and Bayesian inference points of view are considered. Some examples of the business application areas include demand forecasting in ride-sharing platforms, stochastic volatility modeling of financial indexes, mortgage default risk assessment, online webpage click-rate modeling, customer demand forecasting, and call center volume forecasting for optimal staffing. Prereq: DS 803.

**DS 810 - Enterprise Level Analytics**

**Credits:** 3

This course is designed to be a capstone experience with emphasis on the integration of materials covered in prior courses. In addition, the course provides students with the necessary knowledge and skills to manage vast quantities of business data. By the end of the course students will understand how big data systems are developed and used to support the operations and decision-making functions within a business organization. The course begins with a framework for understanding big data systems are developed and used. It continues with an emphasis on "experiential learning" where students build big data systems using contemporary technologies such as Hadoop, MapReduce, Spark etc. Finally, students learn how to analyze large-scale data sets and reveal valuable business insights. As part of the capstone experience, students develop these systems in groups, make several presentations and discuss cases during the semester. Prereq: DS 801, DS 804, and DS 807.