MGNT 622: Prescriptive Analytics and Modeling
Course Syllabus

Course Description

This course aims to enhance students' ability to obtain actionable decisions in business employing mathematical modeling and simulation in Prescriptive Analytics. It will train students how to approach to the best decision via modeling with logical thinking and ultimately reconstruct their thinking process in decision making. Students will be exposed to a variety of practical business cases in various fields such as operations, supply chain, marketing, human resource, and finance. In each case, students will practice soft skills - partnering with clients and team members, framing problems, and communicating to decision makers - in order to figure out decision problems (decision variables) and required data. Then, students will learn various modeling skills and efficient solution methods with a proper selection of software. Once a solution is found from models, students will analyze solutions applying sensitivity analysis and simulation to look beyond simple solutions of models. The cases are closed with a discussion of the final decision and effective deployment methods. The course mainly consists of mathematical optimization models (linear, nonlinear, and integer programs) and Monte Carlo simulation, and other useful techniques (regression analysis, forecasting, and machine learning) for modeling will be covered. This course requires extensive hands-on practices with various data sets and models. Exams and projects that integrate multiple aspects of modeling are used for assessment. Software used will include Excel, SAS, JMP, and IBM CPLEX.

Topics Covered

- Introduction to Modeling and Simulation
- Mathematical Modeling
  - Linear Programming (Sensitivity Analysis, Budget Allocation, Scheduling, DEA)
  - Nonlinear Programming (Pricing, Facility Location, Portfolio Selection)
  - Integer Programming (Logical constraints, Project Selection, Set Covering)
  - Network Models (Transportation, Logistic, Supply Chain, Bidding, Shortest Path)
- Practical Skills in Regression & Forecasting for Modeling
  - Review of Regression Analysis
  - Seasonal, Non-seasonal, Stationary, and Non-stationary Forecasting Techniques
- Simulation
  - Probability Distributions and Random Number Generation
  - Monte Carlo Methods
  - Statistical Analysis of Simulation Output and Decision Making
- Machine Learning integrated with Modeling
  - Review of Data Partitioning, Dimension Reduction, Over Fitting, Over Sampling
  - Logistic Regression and Artificial Neural Networks
  - Classification (K-NN, DA) and Clustering (K-means)