ISYE 4034B DECISION AND DATA ANALYSIS

Concentration Depth elective for Analytics and Data Science

Credit: 3-0-3

Prepared Xiao Liu, Fall 2026

Prerequisite(s): ISYE 3133 Engineering optimization, CS 4400 Intro to Data Base. ISyE 4031 Regression and Forecasting with concurrency.

Textbooks
An Introduction to Statistical Learning with Applications in R by James, G. Witten, D., Hastie, T. and Tibshirani, R.
An Introduction to Statistical Learning with Applications in Python by James, G. Witten, D., Hastie, T. and Tibshirani, R

Data, Models, and Decisions by Bertsimas, D. and Freund, R.

Catalog Description:
Integrate statistical modeling and optimization.

Course description:
Class materials will be divided into the following two components:

Component 1: Data Analytics
Linear and nonlinear regression, regularization, tree-based method, principal component analysis, support vector machine, clustering and association, neural network, etc.

Component 2: Decision
Multi-objective optimization, nonlinear programming, decision in uncertain environment, game-theoretic models, etc.

Topical Outline

Topics
Introduction to statistical learning • Review of linear regression
Linear model selection and regularization • Subset selection • Lasso and Ridge regression, Regularization • Dimension reduction method
Resampling methods • Cross-validation • Bootstrap
Moving Beyond Linearity

• Polynomial regression • Regression splines • Smoothing splines • Location regression • Generalized Additive Models
Tree-based methods • Classification and Regression Trees • Random Forests • Boosting
Support Vector Machines • Maximal Margin Classifier • Support Vector Classifiers • Support Vector Machines
Optimization Component • Linear optimization • Multi-objective optimization, nonlinear programming, decision in uncertain environment, game-theoretic models, etc.

Outcomes and their relationships to ISyE Program Outcomes

At the end of this course, students will be able to:

1. Formulate real life problems into analytics goals technically;
2. Construct decision and optimization mathematical models to meet business and analytics goals. Understand assumption and limitations of decision models;
3. Establish data-analytic models to meet needs of decision and optimization models. Understand assumption and limitations of data-analytic models;
4. Collect appropriate data with APIs to estimate parameters in data-models. Use statistical software to build and validate models;
5. Employ decision and optimization software to solve decision problems;
6. Understand issues involved in system dynamics and process integration for making the developed system sustainable;
7. Experience how to work in a team environment efficiently and effectively to prepare semester project reports and presentation slides.

Grading Policy

- **Three Exams:** 25% + 25% + 25%
- **Homework:** 25% (*late submission will receive zero point)