Description. This class is (intended to be) an introduction to the fundamental methods used in “deterministic” operations research. Topics covered will include linear programming, network flows, dynamic programming, and nonlinear programming. While we shall discuss the underlying theory with some (occasional) proofs, the emphasis will be on modeling. Applications of these ideas in various settings will be discussed.

Objectives. Our aim is to provide you with:

- informal and formal modeling skills;
- the ability to build, analyze, and reason logically with models;
- the ability to create and work with large-scale models;
- the skills to design and analyze algorithms, and to distinguish good algorithms from not-so-good ones;
- the ability to understand and appreciate proofs; and
- an appreciation for the capabilities and limitations of deterministic models in operations research.

Textbooks. The required textbook for the course is


All other assigned readings will be made available to the students at the appropriate time. Some useful reference textbooks are:


The textbook and the first two references are on reserve at the Engineering library. The third reference is available online.

Grading. Your final grade will depend on three major components: homework (30%); a mid-term exam (30%), and a final exam (40%). The “homework” component includes weekly problem sets, in-class participation, and may include a project as well.
Lecture Plan. Lectures will be held in 303 Mudd on Tuesdays and Thursdays, 9:10-10:25 a.m. A more detailed (tentative) outline is as follows:

Lecture 01: Course overview; Modeling; Introduction to Optimization Models
Lecture 02: Preview of the Simplex method, Duality
Lecture 03: Formulating problems as mathematical programs
Lecture 04: Mathematical programming formulations (contd.)
Lecture 05: Simplex method for LPs: first steps
Lecture 06: Simplex method for LPs: details, pitfalls
Lecture 07: Duality: motivation, formulation
Lecture 08: Strong duality theorem for LPs; complementary slackness conditions
Lecture 09: Duality: economic interpretation; game theory
Lecture 10: Sensitivity analysis; relationship to duality theory
Lecture 11: Dual simplex method; revised simplex method
Lecture 12: LP theory
Lecture 13: Network models: transportation, assignment, matching
Lecture 14: Network models: shortest paths; spanning trees
Lecture 15: Max flows, Max flow Min cut theorem; min. cost flows
Lecture 16: Cycle canceling algorithm; network simplex algorithm
Lecture 17: Integer programming: formulation techniques, examples
Lecture 18: IP: cutting-plane methods, related topics
Lecture 19: IP: branch-and-bound, related topics
Lecture 20: Dynamic programming: examples, solved problems
Lecture 21: Dynamic programming: solved problems (contd.)
Lecture 22: Nonlinear programming: basics
Lecture 23: Nonlinear programming: algorithms
Lecture 24: Special topics: Decomposition, large-scale optimization
Lecture 25: Special topics: multiobjective optimization; goal programming
Lecture 26: Special topics: constraint programming