IEORE 4004: Optimization Models and Methods Fall 2025

Syllabus

IEOR, Columbia University

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Content. This course provides an application-oriented introduction to basic optimization models and algorithms. We will investigate problems that can be modeled via Linear Programming, Integer Programming, Combinatorial and Network Optimization, Convex Optimization, and learn to solve them using commercial solvers. In particular, we plan to cover:

- Linear Programming (LP):
  - Basics of LP models;
  - LP formulations for financial, flow, and game-theoretical models;
  - Using Gurobi to solve LPs;
  - Duality of LPs with applications to pricing and sensitivity analysis.
- Integer Programming (IP):
  - Modeling with IPs;
  - The Branch-and-Bound algorithm to solve IPs;
  - Greedy algorithms and applications;
  - Dynamic programming and applications.
- Convex programming:
  - Modeling;
  - Applications in finance.

AI Policy. Please refer to each assignment and project for the corresponding AI policy. If no AI policy is present, then the following applies: you can use AI-assisted tools, but: 1) you are required to explain in your report how they were used; 2) you should have full understanding and knowledge of everything that you submit individually or as a team, including any code, modeling decisions, etc., whether it was produced by you, another member of your team, or the AI. You will not be allowed to use AI tools (or any electronic device) during quizzes.

Grading. Grading will be based on:

10% Assignments (one every 1-2 weeks).

20% A group project on linear programming.

20% A group project on integer programming.

5% Your highest score between the two projects.

20% A first in-person quiz.

20% A second in-person quiz.

5% Your highest score between the two quizzes.

Assignment Policy.
Collaboration: Collaboration between students during assignments is encouraged. Write down on your solutions who you collaborated with.
Cheating: Bluntly copying solutions is considered cheating and as such is not allowed. Notice that assignments account for a small percentage of the total score, and should be taken as an opportunity to practice your knowledge and your critical thinking, en route towards the quizzes and projects.
Late submission policy: Unless otherwise specified, penalties for late submission of homeworks are the following:

- Up to 30 minutes late: 5%;
- More than 30 minutes late, but less than 24 hours late: 20%;
- No submission will be accepted more than 24 after the deadline.

No exception to the above policy will be granted, unless it is caused by a predictable delay, see below, or as dictated by the university policy.
Unforeseen delays & homework average policy: we are aware that students have to juggle between multiple deadlines. So, when computing the average score for the assignments, the lowest score will be dropped. Said otherwise, you have a free voucher to skip the submission of one assignment. No additional accommodation will be granted, unless caused by a predictable delay, see below, or as dictated by the university policy.

Additional policies.
Cheating: Cheating will be punished severely.
Special Accommodation: We will grant all and only the special accommodations that will be communicated to us by the Student Disability Services. If you think you are entitled to special accommodations, please reach out to them.
Predictable delays: In case you have to miss any of the deadlines because of religious holidays or other predictable circumstances, let me know no later than Sept. 13 for the dates reported in this syllabus, and no later than 48 hours after the publication of a new deadline for assignments, etc. Together, we will work out an alternative evaluation plan.

Prerequisites. Basic linear algebra and calculus.

Important Dates.

- Quiz #1: October 27, in person and during class hours
- Quiz #2: December 08, in person and during class hours
- Project #1: Tentative deadline on November 05
- Project #2: Tentative deadline on December 03

Study materials. A useful book is: *Introduction to Mathematical Programming: Operations Research*, Vol. 1 by Wayne L. Winston and Munirpallam Venkataramanan. However, the book is not required. We will release lecture notes covering most material seen in class (and sometimes more).