IE 311: Operations Research I
Summer 2024

Instructor: Levent Erişkin (levent.eriskin@sabanciuniv.edu)

Lecture Hours: A: Monday 08:40–11:30.
B: Tuesday 13:40–16:30.

Office Hours: Monday 11:30–12:30 and Tuesday 16:30–17:30.

Teaching Assistants:
Deniz Tuncer (dtuncer@alumni.sabanciuniv.edu)
Mert Özçelik (ozcelikmert@alumni.sabanciuniv.edu)

Recitation Hours:

Office Hours: TBA
(TAs)

Catalog Description: Linear and integer programming formulations; convex analysis; algorithmic design and the simplex method; duality and sensitivity; computer implementations.

Objective: The objective of this course is to study the modeling and solution of decision problems with deterministic parameters using operations research techniques with a particular emphasis on solution algorithms and implementation.

Course Topics: This course will cover the following main topics:

1. Introduction to Optimization: Introduction to decision making, modeling, and operations research. Common concepts in optimization.

2. Modeling Linear and Integer Programs:
   (a) Modeling Linear Programs.
   (b) Modeling Integer Programs.

3. Analysis of Linear Programming:
   (a) Preliminaries (basic linear algebra and convex analysis).
   (b) Simplex Method for structured LPs.
   (c) Simplex Method for unstructured LPs.
   (d) Duality.
   (e) Dual Simplex and Revised Simplex Methods.
   (f) Sensitivity and post-optimality analysis.
Lecture Style: Students are required to attend at least 70% of the lectures. On Mondays we will have three hours of theoretical lectures. On Tuesdays, a two-hour computer-based lecture will follow the one-hour theoretical lecture (unless otherwise stated). Each computer-based lecture will involve some implementation assignments. Although they will not be graded, students are required to submit their work through Sucourse at the end of the lecture.

Recitation Style: On Sundays, recitation questions will be posted. The students must have already worked on the recitation questions posted on Sunday and come prepared to these sessions.

Grading: Quizzes (20%)
Midterm 1 (25%) July 23th
Midterm 2 (25%) August 13th
Final (30%)

Quizzes: There will be four quizzes tentative dates of which are given in the weekly schedule. The exact dates and times of quizzes will be announced via Sucourse. The content will primarily be based on the lecture and recitation from the previous week. Three best quizzes will be graded. Therefore, each student should attend at least three of the four quizzes. There will be no make-up quiz for those who miss more than one quiz.
Exams: There will be two midterm exams and a final. Each exam will have a computer-based component. A comprehensive make-up exam will be given for students missing any of these exams due to a medical excuse at the end of the semester. Tentative exam topics are as follows:

- **Midterm 1**
  - Lecture 2a: Modeling Linear Programs
  - Lecture 2b: Modeling Integer Programs

- **Midterm 2**
  - Lecture 3a: Preliminaries for LPs
  - Lecture 3b: Simplex Method for Structured LPs
  - Lecture 3c: Simplex Method for Unstructured LPs

- **Final**
  - Lecture 2: Modeling Linear and Integer Programs
  - Lecture 3d: Duality
  - Lecture 3e: Dual Simplex and Revised Simplex Methods
  - Lecture 3f: Sensitivity and Post-Optimality Analysis

Software: Students will need to model, implement and solve linear and integer programs in lectures and recitations. We will use Gurobi solver with Python interface. A step-by-step installation tutorial is already uploaded to Sucourse.

**Tentative Weekly Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Recitations</th>
<th>Quiz/Exam</th>
<th>Quiz/Exam Date</th>
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<tr>
<td>8-Jul</td>
<td>Lecture 1-2a, 2a</td>
<td>Python/Gurobi Install, Recitation 1</td>
<td>No Quiz/Exam</td>
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<tr>
<td>15-Jul</td>
<td>Lecture 2a, 2b</td>
<td>Recitation 2, 3</td>
<td>Quiz1</td>
<td>16-Jul</td>
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<tr>
<td>22-Jul</td>
<td>Lecture 2b-3a, 3a</td>
<td>Recitation 4, 5</td>
<td>Midterm</td>
<td>23-Jul</td>
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<tr>
<td>29-Jul</td>
<td>Lecture 3a, 3b</td>
<td>Recitation 6, 7</td>
<td>Quiz2</td>
<td>30-Jul</td>
</tr>
<tr>
<td>5-Aug</td>
<td>Lecture 3b, 3c</td>
<td>Recitation 8, 9</td>
<td>Quiz3</td>
<td>6-Aug</td>
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<tr>
<td>12-Aug</td>
<td>Lecture 3d, 3e</td>
<td>Recitation 10, 11</td>
<td>Midterm</td>
<td>13-Aug</td>
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<tr>
<td>19-Aug</td>
<td>Lecture 3f, 3f</td>
<td>Recitation 12, 13</td>
<td>Quiz4</td>
<td>20-Aug</td>
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