IE 311: Operations Research I

Fall 2020

Instructor: Burak Kocuk (burak.kocuk@sabanciuniv.edu)

Office Hours To be announced.

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B: Tuesday 08:40–09:30, Thursday 08:40–10:30.

Recitation Hours:

Graduate Teaching Assistants: To be announced.

Undergraduate Teaching Assistants: To be announced.

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.


**Reference Books**:

**Lecture Style**: All lectures will be live and delivered via Zoom. Students are required to attend at least 70% of the lectures.

On **Tuesdays**, we will have one hour of theoretical lectures (unless otherwise stated).

On **Thursdays**, we will have one hour of theoretical lectures and one hour of computer-based lectures (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 Course at the end of the lecture.

**Recitation Style**: On **Tuesdays**, recitation questions and short videos will be posted.

On **Thursdays at 16:45**, there will be a quiz every week (the topic will be the recitation from the previous week).

On **Fridays**, the TAs will hold online office hours during the recitation hours. The students must have already worked on the recitation questions posted on Tuesday and come prepared to these sessions.
Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Quizzes</td>
<td>25%</td>
</tr>
<tr>
<td>Midterm 1</td>
<td>22.5%</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>22.5%</td>
</tr>
<tr>
<td>Final</td>
<td>30%</td>
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<tr>
<td>Assignments</td>
<td>(Bonus credit)</td>
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A student will receive an NA grade if s/he does not attend:

- at least 70% of the lectures, or
- at least 70% of the quizzes, or
- both of the midterm exams, or
- the final exam.

Quizzes:
Students should be prepared to have a quiz every Thursday at 16:45. The content will primarily be based on the lecture and recitation from the previous week. There are scheduled to be 10 quizzes in total. Two make-up quizzes will be given for all students (dates to be announced later). The best eight quizzes will be taken into consideration in the quiz grade (out of 10+2). Quizzes will be distributed via Sucourse, and recorded via Zoom online meeting platform.

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. Exam questions will be distributed one-by-one via Sucourse, and recorded via Zoom online meeting platform.

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
Assessment Policy:
The students will be informed about the structure and rules of the quizzes and exams via announcements sent through Sucourse. The rules announced will be applied strictly and it is students’ responsibility to get familiar with them. There will be multiple versions of each of the questions (with equal difficulty) directed to the students. **If the student submits the answer of another version, s/he will receive 0 from the WHOLE assessment (quiz/exam) unless s/he has a convincing explanation.** Depending on the severity of the academic misconduct, the instructor will report such students to the Disciplinary Committee. Follow-up meetings will be arranged after each assessment regularly. An invitation to such a meeting does not necessarily mean that the student is under suspicion. In these meetings, the instructor may ask to clarify the submitted answer or ask a completely new question from the same topic. The student’s grade might change after the follow-up meeting.

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Recitations</th>
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<tbody>
<tr>
<td></td>
<td>Tuesday</td>
<td>Thursday</td>
</tr>
<tr>
<td>05-Oct</td>
<td>Lecture 1</td>
<td>Lecture 2a</td>
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<tr>
<td>12-Oct</td>
<td>Lecture 2a</td>
<td>Quiz 0</td>
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<tr>
<td>19-Oct</td>
<td>Lecture 2a</td>
<td>Quiz 1</td>
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<tr>
<td>26-Oct</td>
<td>Lecture 2b</td>
<td>no class</td>
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<tr>
<td>02-Nov</td>
<td>Lecture 2b</td>
<td>Quiz 2</td>
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<tr>
<td>09-Nov</td>
<td>Lecture 2b</td>
<td>Quiz 3</td>
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<tr>
<td>16-Nov</td>
<td>Lecture 3a</td>
<td>Quiz 4</td>
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<tr>
<td>23-Nov</td>
<td>Lecture 3a</td>
<td>Quiz 5</td>
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<tr>
<td>30-Nov</td>
<td>Lecture 3b</td>
<td>Quiz 6</td>
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<tr>
<td>07-Dec</td>
<td>Lecture 3c</td>
<td>Quiz 7</td>
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<td>14-Dec</td>
<td>Lecture 3d</td>
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<td>21-Dec</td>
<td>Lecture 3e</td>
<td>Quiz 9</td>
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<td>28-Dec</td>
<td>Lecture 3f</td>
<td>no class</td>
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<td>04-Jan</td>
<td>Lecture 3f</td>
<td>Quiz 10</td>
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Quiz 0 will not be graded but the attendance is essential to get familiar with the quiz format.

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