IE 311: Operations Research I

Spring 2024

Instructor: Burak Kocuk (burakkocuk@sabanciuniv.edu)
Please address the instructor as “Burak Hoca”, “Dr. Kocuk” or “Prof. Kocuk”.

Lecture Hours: A: Tuesday 08:40–09:30 (FENS G032), Thursday 08:40–10:30 (FENS G032).
B: Tuesday 09:40–10:30 (FENS G032), Thursday 14:40–16:30 (FENS G032).

Office Hours Tuesday and Thursday 10:40-11:30 (FENS 2095).
(Instructor):

Recitation Hours:
A1: Friday 14:40–16:30 (FENS G032).
A2: Friday 14:40–16:30 (FMAN G013-14).
B2-B3: Friday 16:40–18:30 (FASS G022).
C: Friday 16:40–18:30 (FENS G035).

Office Hours: Wednesday 13:40-15:30 (FMAN G056).
(LAs):

Graduate Teaching Assistants:
Buket Özen (bozen@sabanciuniv.edu)
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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**: Most weeks, the instructor will deliver two hours of theoretical lectures, and one hour will be reserved for computer-based lectures.

The students NEED to attend computer-based lectures with their laptops. The schedule of the computer-based lectures might be different in each week (see the Tentative Schedule in the last page of the syllabus).

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

On **Fridays**, the TAs and LAs will hold the recitation hours. Recitations are meant to be active learning environments, therefore, the students must have already worked on the recitation questions posted on Tuesday and come prepared to these sessions. There will be a quiz at the end of most recitation hours.

The students NEED to attend recitations with their laptops.

**Grading**: Quizzes (20%)

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Midterm 1</td>
<td>25%</td>
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<tr>
<td>Midterm 2</td>
<td>25%</td>
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<tr>
<td>Final</td>
<td>30%</td>
</tr>
<tr>
<td>Labs</td>
<td>5%</td>
</tr>
<tr>
<td>Assignment</td>
<td>2%</td>
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</tbody>
</table>

**Passing grade is 40%**.
Labs: Each computer-based lecture, in other words lab, will involve some implementation assignments. Students are required to submit their work through Sucourse+ at the end of the lecture. Students can work in groups of 2–3 students. The group’s answer will be graded on a 0.0–0.5 scale. The group will get 0.5 if the grader is convinced that the group has worked on the assignment (partially correct or completely incorrect answers can still get 0.5 if there is evidence in this direction). The groups will be able to ask their questions to the instructor, TAs or LAs. There are scheduled to be ten labs in total. A student can earn at most 5 bonus points from the labs in total, which will be added to the overall course grade. Absence will automatically yield a 0 grade (no excuses).

Quizzes: Students should be prepared to have a quiz almost every Friday during recitation hours. The content will primarily be based on the lecture and recitation from that week or the previous one. There are scheduled to be ten quizzes in total. The best seven quizzes will be taken into consideration in the quiz grade. Absence will automatically yield a 0 grade (no excuses).

Exams: There will be two midterm exams and a final exam. 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 date: June 11th at 09:00).

Optional Assignment: There will be an optional assignment during the semester for bonus credit. This is meant to be a challenging implementation task. Students can work individually or can work in groups of two. The assignment grade will be determined after a follow-up meeting with the instructor. The assignment can be worth 2% of the overall course grade.

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 might 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.
### Tentative Weekly Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Feb</td>
<td>no lecture</td>
<td>Lecture 2a</td>
<td>Recitation 0</td>
</tr>
<tr>
<td>19-Feb</td>
<td>Lecture 2a</td>
<td>Lecture 2a</td>
<td>no quiz</td>
</tr>
<tr>
<td>26-Feb</td>
<td>Lecture 2a, Lab 1</td>
<td>Lecture 2a</td>
<td>Recitation 1</td>
</tr>
<tr>
<td>04-Mar</td>
<td>Lecture 2a, Lab 2</td>
<td>Lecture 2b</td>
<td>Quiz 1</td>
</tr>
<tr>
<td>11-Mar</td>
<td>Lecture 2b, Lab 3</td>
<td>Lecture 2b</td>
<td>Recitation 2</td>
</tr>
<tr>
<td>18-Mar</td>
<td>Lecture 2b, Lab 4</td>
<td>Lecture 3a</td>
<td>Quiz 2</td>
</tr>
<tr>
<td>25-Mar</td>
<td>Lecture 3a, Lab 5</td>
<td>Lecture 3a</td>
<td>Recitation 3</td>
</tr>
<tr>
<td>01-Apr</td>
<td>Lecture 3b</td>
<td>Lecture 3b</td>
<td>Quiz 3</td>
</tr>
<tr>
<td>08-Apr</td>
<td>no lecture</td>
<td>no lecture</td>
<td>no quiz</td>
</tr>
<tr>
<td>15-Apr</td>
<td>Lecture 3b, Lab 6</td>
<td>Lecture 3c</td>
<td>Recitation 4</td>
</tr>
<tr>
<td>22-Apr</td>
<td>no lecture</td>
<td>Lecture 3c, Lab 7</td>
<td>Quiz 4</td>
</tr>
<tr>
<td>29-Apr</td>
<td>Lecture 3d</td>
<td>Lecture 3d</td>
<td>Recitation 5</td>
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<tr>
<td>06-May</td>
<td>Lecture 3d, Lab 8</td>
<td>Lecture 3e</td>
<td>no quiz</td>
</tr>
<tr>
<td>13-May</td>
<td>Lecture 3e</td>
<td>Lecture 3f, Lab 9</td>
<td>Recitation 6</td>
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<tr>
<td>20-May</td>
<td>Lecture 3f</td>
<td>Lecture 3f, Lab 10</td>
<td>Quiz 6</td>
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<tr>
<td>27-May</td>
<td>Review</td>
<td>no lecture</td>
<td>no quiz</td>
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**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+. 

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