

# IE 311: Operations Research I

Spring 2022

<b>Instructor</b>	Esra Koca ( <a href="mailto:esra.koca@sabanciuniv.edu">esra.koca@sabanciuniv.edu</a> )
<b>Lecture Hours</b>	A: Tuesday 09:40–10:30 (FENS G032), Thursday 14:40–16:30 (FASS G062) B: Tuesday 08:40–09:30 (FENS G032), Thursday 08:40–10:30 (FENS G032) Zoom links are posted at SuCourse+.
<b>Recitation Hours</b>	A1-A3: Friday 14:40 – 15:30 B1-B3: Friday 17:40 – 18:30 Zoom links are posted at SuCourse+.
<b>Office Hours (Instructor)</b>	Monday 14:00–15:00 (Zoom link is posted at SuCourse+.)
<b>Office Hours (LAs)</b>	Monday 18:40–19:30 (Pinar Tuncay) Wednesday 13:40 – 14:30 (Tuana Rutkay) There will be extra office hours before the exams and they will be announced via SuCourse+. Zoom links are posted at SuCourse+.
<b>Graduate Teaching Assistants</b>	Buket Ozen ( <a href="mailto:bozen@sabanciuniv.edu">bozen@sabanciuniv.edu</a> ) Deniz Tuncer ( <a href="mailto:dtuncer@sabanciuniv.edu">dtuncer@sabanciuniv.edu</a> ) Mosayeb Jalilian ( <a href="mailto:mosayeb.jalilian@sabanciuniv.edu">mosayeb.jalilian@sabanciuniv.edu</a> ) Nozir Shokirov ( <a href="mailto:shokirovnozir@sabanciuniv.edu">shokirovnozir@sabanciuniv.edu</a> ) Sinan Emre Kosunda ( <a href="mailto:sinankosunda@sabanciuniv.edu">sinankosunda@sabanciuniv.edu</a> )
<b>Undergrad. Teaching Assistants</b>	Pinar Tuncay ( <a href="mailto:pinartuncay@sabanciuniv.edu">pinartuncay@sabanciuniv.edu</a> ) Tuana Rutkay ( <a href="mailto:tuanarutkay@sabanciuniv.edu">tuanarutkay@sabanciuniv.edu</a> )
<b>Catalog Description</b>	Linear and integer programming formulations; convex analysis; algorithmic design and the simplex method; duality and sensitivity; computer implementations.
<b>Objective</b>	The objective of this course is to study the <b>modeling and solution of decision problems with deterministic parameters</b> using operations research techniques with a particular <b>emphasis on solution algorithms and implementation</b> .

<b>Course Topics</b>	<p>This course will cover the following main topics:</p> <ol style="list-style-type: none"> <li>1. <b>Introduction to Optimization:</b> Introduction to decision making, modeling, and operations research. Common concepts in optimization.</li> <li>2. <b>Modeling Linear and Integer Programs:</b> <ol style="list-style-type: none"> <li>(a) Modeling Linear Programs.</li> <li>(b) Modeling Integer Programs.</li> </ol> </li> <li>3. <b>Analysis of Linear Programming:</b> <ol style="list-style-type: none"> <li>(a) Preliminaries (basic linear algebra and convex analysis).</li> <li>(b) Simplex Method for structured LPs.</li> <li>(c) Simplex Method for unstructured LPs.</li> <li>(d) Duality.</li> <li>(e) Dual Simplex and Revised Simplex Methods.</li> <li>(f) Sensitivity and post-optimality analysis.</li> </ol> </li> </ol>															
<b>Textbook</b>	<p>Operations Research: Applications and Algorithms, 4th edition. W.L. Winston. Thomson/Brooks/Cole, 2004.</p> <p>Homer Books Link</p>															
<b>Reference Books</b>	<p>Introduction to Operations Research, 9th edition. F.S. Hillier, G.J. Lieberman. McGraw-Hill, 2010.</p> <p>Operations Research: An Introduction, 7th edition. H.A. Taha. Prentice-Hall, 2003.</p>															
<b>Lecture Style</b>	<p>–Most of the <b>Tuesday</b> lectures will be <b>computer-based labs</b> and there will be implementation tasks. These lectures will be delivered via <b>Zoom only</b>.</p> <p>–The other <b>Tuesday</b> lectures that cover <b>theoretical</b> topics will be delivered <b>both in-class and via Zoom</b>. Please see the tentative schedule for the type of the teaching mode on Tuesdays - the changes will be announced on SuCourse+.</p> <p>–On <b>Thursdays</b>, we will have <b>theoretical</b> lectures that will be delivered in-class and broadcasted via Zoom.</p> <p>–Participation and asking questions are welcome during the lectures.</p>															
<b>Recitation Style</b>	<p>–On <b>Tuesdays</b>, <b>recitation questions</b> and <b>short videos</b> will be posted.</p> <p>–On <b>Fridays</b>, the TAs will hold <b>online recitation hours</b>. The students must have already watched the posted videos and worked on the recitation questions posted on Tuesday, and come prepared to these sessions.</p>															
<b>Grading</b>	<table border="0"> <tr> <td>Quizzes</td> <td>(15%)</td> <td></td> </tr> <tr> <td>Midterm 1</td> <td>(25%)</td> <td><b>April 9, 13:40–15:30</b></td> </tr> <tr> <td>Midterm 2</td> <td>(25%)</td> <td><b>May 29, 13:40–15:30</b></td> </tr> <tr> <td>Final</td> <td>(35%)</td> <td></td> </tr> <tr> <td>Labs</td> <td>(3%)</td> <td>(BONUS)</td> </tr> </table>	Quizzes	(15%)		Midterm 1	(25%)	<b>April 9, 13:40–15:30</b>	Midterm 2	(25%)	<b>May 29, 13:40–15:30</b>	Final	(35%)		Labs	(3%)	(BONUS)
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## Labs

- There will be a lab session on **most Tuesdays**. These sessions will be organized via **Zoom Breakout Rooms**. A group of five students will attend a pre-assigned room and work together on the implementation task assigned. A TA or LA will frequently visit the room to help the group. Each group needs to submit their answer (typically a Python file) at the end of the session.
- Students are allowed to form their own groups.
- Each group should designate one member as the *lead student* in every lab session.
- The lead student is responsible for sharing his/her screen, writing the code with the assistance of other group members and submitting the group's answer to Sucourse+.
- The lead student duty should be rotated every week.
- The group's answer will be graded on a 0-1 scale. The group will get 1 if the grader is convinced that the group has worked on the assignment (partially correct or completely incorrect answers can still get 1 if there is evidence in this direction).
- Joining the Zoom meeting is not sufficient to get the grade. The grader should be convinced that the student is really participating the group work.
- The lab grades will be considered as 3% BONUS in total.

## Quizzes

- There will be a quiz on most **Fridays** during the **recitation hours** reserved for the quizzes:
- A1-A3: Friday 15:40 - 16:30
  - B1-B3: Friday 16:40 - 17:30
- The content will primarily be based on the lectures and recitations after the previous quiz.
- There are scheduled to be **6 quizzes** in total, and the **best 5** of them will be considered. Each quiz will have the same weight.
- Quizzes will be distributed via Sucourse+, and recorded via Zoom online meeting platform. The students should read the Online Assessment Policy posted on Sucourse + carefully.
- There will be **no make-up quiz**.

## Exams

- There will be two midterm exams and a final, all **in-person** and **closed-book**.
- 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: Lectures 2a - 2b
  - Midterm 2: Lectures 3a - 3d
  - Final: Lectures 2a - 2b, Lectures 3a - 3f

**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.

**Tentative Weekly Schedule**

Week	Lectures		Recitations (Friday)	
	Tuesday	Thursday	Quiz	Recitation
28-Feb	Lecture 1	Lecture 2a	–	Recitation 0
7-Mar	Lab 0	–	Quiz 0	Recitation 1
14-Mar	Lecture 2a	Lecture 2a	Quiz 1	Recitation 2
21-Mar	Lab 1	Lecture 2b	Quiz 2	Recitation 3
28-Mar	Lab 2	Lecture 2b	Quiz 3	Recitation 4
4-Apr	Lab 3	Lecture 2b	–	Recitations 1-4
11-Apr	Lab 4	Lecture 3a	–	Recitation 5
18-Apr	Lecture 3a	Lecture 3a	–	Recitation 6
25-Apr	Lecture 3b	Lecture 3b	–	Recitation 7
9-May	Lab 5	Lecture 3c	Quiz 4	Recitation 8
16-May	Lecture 3d	–	–	–
23-May	Lecture 3d	Lecture 3e	–	Recitation 9
30-May	Lecture 3f	Lecture 3f	Quiz 5	Recitation 10
6-Jun	Lab 6	–	Quiz 6	Recitation 11

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+.