IE 311: Operations Research I

Fall 2021

Instructor:	Burak Kocuk (burak.kocuk@sabanciuniv.edu)
Lecture Hours:	A: Tuesday 09:40–10:30 (online), Thursday 14:40–16:30 (UC G030 & online). B: Tuesday 08:40–09:30 (online), Thursday 08:40–10:30 (UC G030 & online). **No rotation is needed for the in-person lectures on Thursdays.** Zoom links are posted on Sucourse+.
Recitation Hours:	A1–A2: Friday 16:40–18:30 (online). B1–B2: Friday 14:40–16:30 (online). Zoom links are posted on Sucourse+.
Office Hours (Instructor):	Monday 11:30–13:00 (online). Zoom links are posted on Sucourse+.
Office Hours (LAs):	Wednesday 13:40–15:30 (online). Google Meet link is posted on Sucourse+. There will be extra office hours before each exam.
Graduate Teaching Assistants:	Bahar Okumuşoğlu (okumusoglu@sabanciuniv.edu) Nozir Shokirov (shokirovnozir@sabanciuniv.edu) Zeynep Küçüksarı (zkucuksari@sabanciuniv.edu)
Undergraduate Teaching Assistants:	Alperen Akgöz (alperenakgoz@sabanciuniv.edu) Göksu Özcan (goksuozcan@sabanciuniv.edu) Kıvılcım Eylül Tuyun (kivilcimt@sabanciuniv.edu) Pınar Tunçay (pinartuncay@sabanciuniv.edu)
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.

Textbook: Operations Research: Applications and Algorithms, 4th edition. W.L. Winston. Thomson/Brooks/Cole, 2004.

Homer Books Link

Reference Books: Introduction to Operations Research, 9th edition. F.S. Hillier, G.J. Lieberman. McGraw-Hill, 2010.
Operations Research: An Introduction, 7th edition. H.A. Taha. Prentice-Hall, 2003.

Lecture Style: **Tuesday** lectures will be delivered via Zoom only. Most of these lectures will be computer-based labs and there will be implementation tasks to be graded.
On **Thursdays**, we will have theoretical lectures to be delivered in-person, which will be also broadcasted via Zoom. Attendance (either in-person or online) is highly encouraged and will be monitored via online tools.
Participation and asking questions are welcome during the lectures. However, online attendees should only ask their questions through Zoom chat, which will be monitored and answered by the instructor.

Recitation Style: On **Tuesdays**, recitation questions and short videos will be posted.
On **Fridays**, the TAs will hold online recitation hours. The students must have already watched the posted videos and worked on the recitation questions posted on Tuesday, and come prepared to these sessions.

Grading:

Labs	(7/200)	
Quizzes	(28/200)	
Midterm 1	(45/200)	**November 8th at 19:40**
Midterm 2	(45/200)	**December 13th at 19:40**
Final	(75/200)	

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 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).
Overall lab grade will be computed as

$$LAB = \min\left\{7, \sum_{i=1}^{10} Lab_i\right\}.$$

Quizzes: There will be a quiz on most **Fridays** during the recitation hours. The content will primarily be based on the lectures and recitations after the previous quiz.
There are scheduled to be eight quizzes in total. Each quiz will be graded on a **0–5 scale**. Overall quiz grade will be computed as

$$QUIZ = \min\left\{28, \sum_{i=1}^{8} Quiz_i\right\}.$$

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: Lecture 2a–2b (To be graded on a **0–45 scale**)
- Midterm 2: Lecture 3a–3c (To be graded on a **0–45 scale**)
- Final: Lecture 2a–2b, Lecture 3a–3f (To be graded on a **0–75 scale**)

Overall Grade: The overall grade (over 200) will be simply computed as

$$OVERALL = LAB + QUIZ + MIDTERM_1 + MIDTERM_2 + FINAL.$$

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 online 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:

	Lectures		Recitations	
Week	Tuesday	Thursday	Quiz	Friday
27-Sep	Lecture 1	Lecture 2a	no quiz	Recitation 0
4-Sep	Lab 0	Lecture 2a	Quiz 0	Recitation 1
11-Sep	Lab 1	Lecture 2a	Quiz 1	Recitation 2
18-Sep	Lab 2	Lecture 2b	Quiz 2	Recitation 3
25-Sep	Lab 3	no lecture	no quiz	no recitation
1-Nov	Lab 4	Lecture 2b	Quiz 3	Recitation 4
8-Nov	Lecture 3a		no quiz	Recitation 5
15-Nov	Lab 5	Lecture 3a	Quiz 4	Recitation 6
22-Nov	Lecture 3b		Quiz 5	Recitation 7
29-Nov	Lab 6	Lecture 3c	no quiz	Recitation 8
6-Dec	Lab 7	Lecture 3d	Quiz 6	Recitation 9
13-Dec	Lecture 3d	Lecture 3e	Quiz 7	Recitation 10
20-Dec	Lab 8	Lecture 3e, Lecture 3f	Quiz 8	Recitation 11
27-Dec	Lab 9	Lecture 3f, Lab 10	no quiz	Recitation 12

Lab 0 and Quiz 0 will not be graded but the attendance is essential to get familiar with the lab and quiz format.

Software:

Students will need to model, implement and solve linear and integer programs in lectures, recitations and labs. We will use Gurobi solver with Python interface.
A step-by-step installation tutorial and videos are uploaded to Sucourse+.