

IE 311: Operations Research I

Spring 2023

Disclaimer: The instructor may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.

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

Lecture Hours: A: Tuesday 08:40–09:30 (FENS L045), Thursday 08:40–10:30 (FENS L045).
B: Tuesday 09:40–10:30 (FENS L045), Thursday 14:40–16:30 (FENS L045).
Zoom link is posted on Sucourse+.

Office Hours Thursday 10:40–11:30 (FENS 2095).
(Instructor): Zoom link is posted on Sucourse+.

Recitation Hours: A1–A3: Friday 14:40–16:30.
B1–B2: Friday 16:40–18:30.
Zoom links are posted on Sucourse+.

Office Hours Tuesday 16:40–18:30 and Wednesday 14:40–16:30.
(LAs): Zoom link is posted on Sucourse+.

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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.

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: All lectures will be live and delivered via Zoom. The instructor will use the facilities in FENS L045 for teaching. Students are encouraged to attend in-person. 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).

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

On **Fridays**, the TAs will hold online office hours during 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.

Grading: (Online) Labs (4%)
Quizzes (21%)
Midterm (30%)
Final (45%)
Assignment (Bonus credit)

Passing grade is 40%.

(Online) Labs: Each computer-based lecture, in other words (online) 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 3-5 students. 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). The groups will be able to ask their questions to the instructor, TAs or LAs. There are scheduled to be nine labs in total. The best eight labs will be taken into consideration in the lab grade.

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.

There are scheduled to be nine quizzes in total. The best six quizzes will be taken into consideration in the quiz grade.

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.

Exams: There will be a midterm exam 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 exam topics are as follows:

- Midterm (3-hour ONLINE exam on April 27th between 18:40–21:40)
 - Lecture 2a: Modeling Linear Programs
 - Lecture 2b: Modeling Integer Programs
 - Lecture 3a: Preliminaries for LPs
 - Lecture 3b: Simplex Method for Structured LPs
- Final (3-hour IN-CLASS exam)
 - Lecture 2: Modeling Linear and Integer Programs
 - Lecture 3c: Simplex Method for Unstructured LPs
 - Lecture 3d: Duality
 - Lecture 3e: Dual Simplex and Revised Simplex Methods
 - Lecture 3f: Sensitivity and Post-Optimality Analysis

Optional Assignments: There will be two optional assignments during the semester for bonus credit. These are meant to be *challenging* implementation tasks. Students can work individually or can work in groups of 2. The assignment grade will be determined after a follow-up meeting with the instructor. Each 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:

Week	Lectures		Recitations	
	Tuesday	Thursday	Friday	
28-Feb	Lecture 1	Lecture 2a	Recitation 0	no quiz
07-Mar	Lecture 2a	Lecture 2a, Lab 0	Recitation 1	Quiz 0
14-Mar	Lecture 2a	Lecture 2a, Lab 1	Recitation 2	Quiz 1
21-Mar*	Lecture 2b	Lecture 2b, Lab 2	Recitation 3	Quiz 2
28-Mar**	Lecture 2b	Lecture 3a	Recitation 4	Quiz 3
04-Apr	Lecture 3a	Lecture 3a, Lab 4	Recitation 6	Quiz 5
11-Apr	Lecture 3b	Lecture 3b, Lab 5	Recitation 7	Quiz 6
18-Apr	Lecture 3b	no lecture	no recitation	no quiz
25-Apr	Lecture 3c	Lecture 3c, Lab 6	Recitation 8	no quiz
02-May	Lecture 3d	Lecture 3d	Recitation 9	Quiz 7
09-May	Lab 7	Lecture 3e	Recitation 10	Quiz 8
16-May	Lecture 3e	Lecture 3e, Lab 8	no recitation	no quiz
23-May	Lecture 3f	Lecture 3f, Lab 9	Recitation 11	Quiz 9
30-May	Lecture 3f	no lecture	no recitation	no quiz

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

*** An additional class on March 25th, Saturday: Lecture 2b, Lab 3**

*** An additional recitation on April 1st, Saturday: Recitation 5, Quiz 4**

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+.