# TED UNIVERSITY

## IE 232 Mathematical Modeling and Optimization I

## Spring 2024-2025

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## Credit Hours: (3+0+0) 3 TEDU Credits, 6 ECTS Credits

Mathematical Programming and Optimization I

Instructor:


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| | | |
|---|---|---|
| Lectures: | 11:00 - 12:50 | Monday (G108) |
| | 15:00 - 15:50 | Tuesday (G003) |
| Office Hours: | 14:30-15:30 | Wednesday |

Teaching Assistant: Ali KOÇ - ali.koc@tedu.edu.tr – H103

Course Description: Linear programming models. Graphical solutions. Interpretation of solutions. The simplex method, duality, sensitivity analysis, and related topics.

Pre-requisites: MATH 203 OR MATH 112

Learning Outcomes: Upon successful completion of this course, a student will be able to

1. Formulate deterministic continuous optimization problems with a single objective as a linear program. (B5)
2. Solve small problems with the simplex method (B3)
3. Solve large problems by using solver software. (B3)
4. Translate a given linear program into dual form (B3)
5. Interpret the dual of a given linear program. (B3)
6. Perform sensitivity analysis on the optimum solution of a given linear program. (B4)
7. Interpret the characteristics of the transportation, assignment and transshipment problems. (B3)

(Bloom's Taxonomy levels are indicated in parentheses, where B3 = Apply, B4 = Analyze, and B5 = Evaluate.)

| Grading : | | |
|---|---|---|
| | Homework | 20% |
| | Exam I | 20% |
| | Exam II | 20% |
| | Final | 30% |
| | ALEs | 10% |
| | Bonus (Attnd.) | 10% |

| Student Workload (estimated) | |
|---|---|
| Lectures | 42 hrs |
| Readings | 30 hrs |
| Homework | 40 hrs |
| Exam I | 12 hrs |
| Exam II | 12 hrs |
| Final Exam | 18 hrs |

*This syllabus is approximate and can be altered at the discretion of the instructor.

Computer Usage: Use of solver software such as GAMS, Gurobi.

Student Feedback Forms: Course feedback form will be conducted in the last two weeks of the courses.

Required Text: Winston W. L. (2004), Operations Research (4th edition), Duxbury.

Recommended Texts:

- Hillier F.S. and Lieberman G.J. (2010), Introduction to Operations Research (9th edition), McGraw-Hill.
- Taha, H.A. (2007), Operations Research (8th edition), Prentice Hall.

## TENTATIVE COURSE SCHEDULE

| Week | Topic | Chapter |
|---|---|---|
| 1 | Introduction to Operations Research. Basic structure and fundamental assumptions behind a linear programming problem. | Chapters 1 & 3 |
| 2 | Graphical solution of a two-variable problem. Alternative optima, infeasibility and unboundedness. Modeling Examples: Work Scheduling, | Chapter 3 |
| 3 | Modeling Examples: Investment Project Selection, Short Term Financial Planning, Blending Problems, Production Process Models, Multiperiod Inventory Models | Chapter 3 |
| 4 | Modeling Examples: Multiperiod Financial Models, Multiperiod Work Scheduling; Standard form of an LP, Preview of the Simplex Algorithm | Chapter 3 |
| 5 | The Simplex Algorithm with the Tableau Representation | Chapter 4 |
| 6 | The Simplex Algorithm: Alternative Optima, Unbounded LPs, Degeneracy | |
| 7 | The Big M Method, Unrestricted in Sign Variables **(Exam I)** | Chapter 4 |
| *No Classes – Ramadan Bayram & Spring Break* | | |
| 8 | Graphical Introduction to Sensitivity Analysis, Representation of an LP with Linear Algebra | Chapter 6 |
| 9 | Sensitivity Analysis | Chapter 6 |
| 10 | Sensitivity Analysis (cont'd) *(No class on April 23 – not affected)* | Chapter 6 |
| 11 | Duality: Dual LP and its economic interpretation, The Dual Theorem and its consequences (*No class on May 1 – not affected)* | Chapter 6 |
| 12 | Shadow prices, duality and sensitivity analysis, complementary slackness | Chapter 6 |
| 13 | Transportation Problems **(Exam II)** | Chapter 7 |
| 14 | Assignment and Transshipment Problems *(No class on May 19 – Monday)* | Chapter 7 |
| 15 | Assignment and Transshipment Problems *(Week 14's Monday class will be held this week)* | Chapter 7 |

Important Dates: Exam I: Week 7 (March 24) - Exam II: Week 13 (May 12)

## Other Course Policies

Policy on Syllabus Change: This course schedule is tentative, and it will be adapted to the pace of the class in agreement with the students.

Makeup Policy: Make-up exams will be given only for medical excuses documented by medical reports that are approved by the Student Health Center or other documented excuses approved by the university's executive branches. All make-up examination(s) for all exams will be given at the end of the semester. No make-ups for ALE's.

Late Submission Policy: Late submissions of the assignments will not be graded.

Plagiarism: "All of the following are considered plagiarism:
- Turning in someone else's work as your own
- Copying words or ideas from someone else without giving credit
- Failing to put a quotation in quotation marks
- Giving incorrect information about the source of a quotation
- Changing words but copying the sentence structure of a source without giving credit
- Copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not" (www.plagiarism.org)

Plagiarism is a very serious offense and will be penalized accordingly by the university disciplinary committee. The best way to avoid accidentally plagiarizing is to work on your own before you ask for the help of other resources.

Cheating: Cheating has a very broad description which can be summarized as "acting dishonestly". Some of the things that can be considered as cheating are the following: copying answers on exams, projects and homework, using prohibited material on exams, lying to gain any type of advantage in class, providing false, modified or forged data in a report, plagiarizing, modifying graded material to be re-graded, causing harm to colleagues by distributing false information about an exam, project or homework.

Cheating is a very serious offense and will be penalized accordingly by the university disciplinary committee. For more information on TEDU policy on intellectual integrity, please see the following link. https://student.tedu.edu.tr/en/principles-academic-integrity

Assignment Rules: Written homework is a vital component of this course, significantly enhancing your understanding of the material. Adherence to the following guidelines is crucial.

For physical submissions:
Utilize standard size paper measuring 21cm x 29.7cm. Avoid using paper torn from spiral notebooks.
Ensure multiple pages are securely stapled together. Avoid paper clips, loose sheets, or folded corners.
Maintain readability. If the grader cannot decipher your work, credit may be forfeited.

For online submissions:
Format your file to align with the above rules, facilitating easy printing without additional formatting requirements.

ONCE AGAIN, LATE HOMEWORK WILL NOT BE ACCEPTED.

Calculator Policy: You may use a calculator unless instructed not to do so. You may not use a cellular device as a calculator during exams.

Attendance: You are expected to attend all classes. Classes start on the hour. Please be respectful of your classmates and the instructor by being on time. Cell phones should be turned off and kept out of sight. Please do not use your computers during class time.

## STUDENT SERVICES INFO:

### Student Development and Psychological Counseling Center:

*Student Development and Psychological Counseling Center* conducts individual psychological counseling, group psychological counseling, preventive and developmental services such as workshops and seminars for all students in need. You may apply to our Center in order to deal with all your current problems.

**For General Information:** https://csc.tedu.edu.tr/

**For Application:** https://anket.tedu.edu.tr/index.php/761882?lang=en

### TEDU Without Barriers Unit:

Please inform the *TEDU Without Barriers* Unit and the instructor of the course about the specific issues in case you have a physical or mental disability and are having trouble with anything related to this course—such as accessing the material, participating in the class, taking notes, preparing for, attending or managing to complete the exams. Your situation will be reviewed by commission, in accordance with the principle of confidentiality, and if deemed appropriate, facilitating measures will be taken so that you can take the course more efficiently.

**For further information and/or questions:**

https://engelsiz.tedu.edu.tr/ or engelsiz@tedu.edu.tr