



**This syllabus will be updated during the semester and will be posted on Brightspace.**

## **ISE 536 Linear Programming and Extensions, Spring 2024**

**Units:** 4

**Time:** Wed 2:00-5:20 pm

**Location:** OHE 100B

**Instructor:** Dr. Monir Sabbagh

**Email Address:** sabbaght@usc.edu

**Office:** Zoom or by appointment

**Office Hours:** By appointment

**Teaching Assistant:** Xiaocheng Liu

**Email Address:** xliu4887@usc.edu

**Office:** To be Scheduled

**Office Hours:** To be Scheduled

**Recitation time and location:** Every other week

### **Course Description**

Linear programming models for resource allocation; simplex method for solving Linear Programming problems; duality; sensitivity; transportation problems; selected extensions to large scale, multiobjective, and special structured models.

### **Learning Objectives**

This course is designed for those with minimal background in this field and concentrates on the application of these techniques. After completing this course, students will be able to:

- Compare operations research (OR) techniques such as deterministic linear mathematical models, and linear programming (LP) including the simplex method
- Construct goal (multi-objective) programming (GP)
- Explain integer programming (ILP), transportation, assignment, transshipment, and traveling salesperson (TSP).

**Prerequisite(s):** none

**Co-Requisite(s):** none

### **Technological Proficiency and Hardware/Software Required**

TBD based on the students' knowledge in this area.

### **Required Readings and Supplementary Materials**

**Required textbook:** W. L. Winston, "Operations Research, Application and Algorithms", 4th Edition, Thomson Learning (Brooks/Cole Publishing Co), 2004, ISBN-10: 0534380581 | ISBN-13: 9780534380588. This book can be purchased from the USC Bookstore or any other source.

### Further Readings Sources (Not Required/Optional)

- 1- Introduction to Linear Optimization by Dimitris Bertsimas and John N. Tsitsiklis, Athena Scientific 1997
- 2- Deterministic Operations Research: Models and Methods in Linear Optimization by David J.Rader, JR

### Description and Assessment of Assignments

The courses will contain a midterm exam, a final exam, and 10 homework assignments. The assignments will be taken mostly from the textbook.

- The midterm exam will cover the material from weeks 1-5 and will take 1.5 hours. A make-up exam is only considered under special situations with the advance approval of the instructor.
- The final exam will cover material from weeks 6-14 and will be held per the University schedule and it takes 2 hours. A make-up exam is only considered under special situations with the advance approval of the instructor.
- Homework: There are 10 homework assignments. Each homework will have 3 points. You have **1 week** to complete each assignment. You will post your answer on Blackboard **before the start of the next class**. Late homework and makeup homework will be considered under special situations with the advance approval of the instructor. Makeup HW will not be the same HW or from the same topic. Homework is expected to be typed as much as possible and professionally done. I strongly recommend students use LaTeX for assignment write-ups because, in this class, it is essential to use clear and precise expressions. For each homework you do in **Latex or Overleaf**, you will get an **extra 0.5 points**.

### Grading Breakdown

Assessment Tool (assignments)	% of Grade
Midterm Exam	35
Final Exam	35
Homework	30
<b>TOTAL</b>	<b>100</b>
<b>Extra Bonus Quizzes</b>	<b>5</b>

### Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Materials	HW, Quiz
<b>Week 1</b>	Introduction to the course, Review of Linear Algebra, LP problem formulation.	Chap: 1,2, 3	
<b>Week 2</b>	LP formulation skills, Linear algebra, Intro to graphical solutions, Parametrization of LP	Chap: 2,3	<b>HW 1</b>

<b>Week 3</b>	Graphical solution, More formulation (diet, Inventory problem dynamic), using Excel to solve diet problems, Parametrization of LP Python, Gurobi	Chap: 3	<b>HW2:</b>
TA recitation end of this week	Python, Gurobi		
<b>Week 4</b>	Simplex method, Formulation skills (Facility location)	Chap: 4	<b>HW 3:</b>
TA Recitation end of this week	Python, Gurobi		
<b>Week 5</b>	finding BFs, Sensitivity analysis concept in Gurobi Python	Chap: 5, 6	<b>HW 4:</b>
<b>Week 6</b>	Duality	Chap: 6	<b>HW 5:</b>
TA Recitation	Solving examples		
<b>Week 7</b>	Duality, Review of midterm Midterm	Chap: 6	<b>HW 6:</b>
<b>Week 8</b>	Review of midterm, Midterm Exam		
TA Recitation			
<b>Week 9</b>	Goal programming Integer Programming, Formulation and applications	Sec:4.16, Sec: 9.1, 9.2	<b>HW 7</b>
<b>Week 10</b>	Spring Recess		
<b>Week 11</b>	Enhanced Branch-and-Bound Method	Sec: 9.3,9.4	
TA Recitation			
<b>Week 12</b>	Structured problems (traveling salesman problem, knapsack), cutting planes	Sec: 9.5, 9.6, 9.8	
<b>Week 13</b>	Transportation Problem, transshipment	Chap: 7	<b>HW 8</b>
TA Recitation			
<b>Week 14</b>	Network models (shortest path, max-flow, minimum cost network flow)	Chap: 8	<b>HW 9</b>

<b>Week 15</b>	Assignment Problems	Chap: 7	<b>HW 10</b>
<b>TA Recitation</b>			
<b>Week 16</b>	Review for final exam		
<b>FINAL Exam</b>	Will be announced		

## Statement on Academic Conduct and Support Systems

### **Academic Integrity:**

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

### **Students and Disability Accommodations:**

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](https://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

### **Support Systems:**

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call  
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086  
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298  
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776  
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411  
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101  
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call  
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call  
Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)  
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)  
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.