



# Viterbi School of Engineering

**As of Aug 17**

## **ISE 536 Linear Programming and Extensions**

Units: 3

Fall 2022, Wed 3:30-6:20 pm

Location: The Center for International and Public Affairs, CPA 102

**Instructor: Dr. Parisay**

<https://ise.usc.edu/directory/faculty/profile/?lname=Parisay&fname=Sima>

**Office:** online, Zoom link on the course's Blackboard

**Office Hours:** Wed 11 am-12 noon, and by appointment

**Contact Info:** [parisay@usc.edu](mailto:parisay@usc.edu)

**Teaching Assistant:** Vaishnavi Guntupalli

**Office:** online, Zoom link on the course's D2L

**Office Hours:** TBA, and by appointment

**Contact Info:** [vg11249@usc.edu](mailto:vg11249@usc.edu)

**IT Help:**

**Hours of Service:**

**Contact Info:**

### **Catalog Course Description**

Linear programming models for resource allocation; simplex and revised simplex methods; duality; sensitivity; transportation problems; selected extensions to large scale, multi-objective, and special structured models.

### **Learning Objectives**

This course is designed for those with minimum background in this field and concentrates on application of these techniques.

Operations Research (OR) techniques to be covered are all deterministic linear mathematical models. Techniques to be covered: linear programming (LP) including simplex method, dual of LP, goal (multi-objective) programming (GP), integer programming (ILP), transportation, assignment, transshipment, and travel sales person (TSP).

<b>Learning Objective</b>	<b>Assignment/Assessment tools used</b>
By the end of this course, students should be able to:	This learning objective and skill is measured by:
Reproduce knowledge of several OR techniques (OR knowledge)	Quizzes at the beginning of each class based on the pre-recorded video lectures and handouts. Quiz can be as multiple-choice or short written essay
Employ OR software (Software skill)	Assigned homework
Formulate several styles of LP problems (Formulation skill)	Math formulation in exam and project
Analyze software output (Analysis skill)	Essay in exam and project, in-class work
Detect extra information (Critical thinking)	Presenting extra higher-level information in project, optional and self-developed extra credit
Compile a well-structured final report (Communication skill)	Essay in project

**Prerequisite(s):** EE 441 (Applied Linear Algebra for Engineering), Math 225 (Linear Algebra and Linear Differential Equations)

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

**Concurrent Enrollment:** None

**Recommended Preparation:** None

### **Course Notes**

This course will be conducted as a **Flipped Classroom**. There will be 1 or 2 pre-recorded video lectures each week that students have to watch and learn before the class. These videos will be accessible from the course web site. Each video will be around half-an-hour and will cover the basic knowledge about each topic. There will be handouts on the course web site to accompany these pre-recorded video lectures. The course materials (handouts and video lectures) will be on the course web site. There may be some pre-class work (activity) to enforce the learned material from the pre-recorded video.

We will use class meetings (sessions) for lectures on Wednesdays to concentrate on more practice, answering common questions, and higher level of discussions. There will be in-class work during these meetings. **IT IS REQUIRED TO BRING YOUR LAPTOP TO THE CLASS MEETINGS.**

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

You will use a software of your choice to solve the problems. AMPL software will be covered for those interested.

## Required Readings and Supplementary Materials

Required: Course Handouts and video lectures on Blackboard by Dr. Parisay.

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 Book store or any other sources.

## Description and Assessment of Assignments

- **Midterm exam** will be based on the schedule and will take 1.5 hours. Make up exam is only considered under special situations with advance approval of instructor. There will be one midterm exam.
- **Final exam** will be held at the completion of all classes based on the University schedule and it takes 2 hours. Make up exam is only considered under special situations with advance approval of instructor.
- **Homework** will be assigned each week on Thursdays. You will post your answer as a Word file on Blackboard before the next class by 2 pm on Wednesdays (unless otherwise indicated). Late homework and makeup homework will be considered under special situations with advance approval of 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. Homework on average will take about 1.5 hours each week, depending on your background. The homework can be at different level of difficulty and take different amount of time. I will select **five** homework randomly for grading. Each homework will have 3 points. The two lowest grades for homework will be dropped. The final total grade from homework will be at most 9 points.
- **Project/Case study:** The project in this class is a team activity. I will assign the teams and the project in week 5. Some information in respect to your project will be posted on Blackboard later on. The purpose of the project is for you to utilize information you have learned during this class and to prepare a professional report. The project is delivered as one Word file per each team that is posted on Blackboard. There will be an initial report and a final report.
- **Quiz:** Quiz will be conducted at the beginning of each class on Wednesdays. Quiz will be based on the assigned pre-recorded video lecture and posted handouts on Blackboard. It will take about 10-15 min. It will require a few short answers or multiple choice. Makeup quiz will be considered under special situations with advance approval of instructor. Makeup quiz will not be the same quiz or from the same topic. The quizzes can be at different level of difficulty and take different amount of time. I will select **seven** quizzes randomly for grading. Each quiz will have 2 points. The two

lowest grades for quizzes will be dropped. The final total grade from quizzes will be at most 10 points.

### Grading Breakdown

Assignment	Points	% of Grade
Midterm exam	20	20
Final Exam	31	31
Project (initial and final report)	30	30
Homework (3*3)	9	9
Quiz	10	10
<b>Total</b>	<b>100</b>	<b>100</b>

Total points will be curved for the final letter grade. Letter grade with minus and plus are also considered. Please refer to another file called "Grading Scale and Policy" on Blackboard for more details.

For university's regulation on Grading Policies please refer to the link below:

[http://arr.usc.edu/wp-content/uploads/2021/03/ARR\\_Grade\\_Handbook.pdf](http://arr.usc.edu/wp-content/uploads/2021/03/ARR_Grade_Handbook.pdf)

Please pay attention to page 7 of this handbook about:

"The grade of IN exists so there is a remedy for illness or emergency which occurs after the deadline to withdraw." And "No student is allowed to retake a final examination or do extra work in a course after the semester has ended for purposes of improving his/her grade."

## Course Schedule: A Weekly Breakdown

**Readings and Homework:** They will be posted on Blackboard on Thursdays, as lecture proceeds. Homework is due on Wednesdays by 2 pm. HW means homework.

Week, date	ISE 536 Weekly Topics Tentative Plan as June 9, 2022	pre-recorded videos (min)	Text-book	Due
1, Aug 24	Introduction to the course, Review of linear algebra and Gauss-Jordan method, LP problem formulation		Chap: 2, 3	
2, Aug 31	Graphical solution versions, Elementary Row Operation, LP formulation skills	Linear equation (13), Graphical LP (17)	Chap: 3, 4	HW quiz
3, Sept 7	Simplex method versions, LP formulation skills, Motivation for sensitivity analysis	Simplex LP (25)	Chap: 3	HW quiz
4, Sept 14	LP Sensitivity Analysis, Introduction to AMPL	LP Sensitivity (61)	Chap: 3, 5	HW Quiz
5, Sept 21	LP sensitivity analysis, LP formulation skills		Chap: 5, 6	HW
6, Sept 28	Dual Problem of LP LP report writing	Dual LP (42)	Chap: 6	HW quiz
7, Oct 5	LP sensitivity analysis LP Formulation skills	Software comparison (27)		HW quiz
8, Oct 12	Review for midterm Formulation style			Initial Project Report
9, Oct 19	<b>Midterm</b> (1.5 hour beginning of class) Project discussion			

<b>Week</b>	<b>ISE 536 Weekly Topics Tentative Plan as of Jan 12, 2022</b>	<b>Pre-recorded video</b>	<b>Text- book</b>	<b>Due Dates</b>
10, Oct 26	Goal Programming (GP) motivation, formulation, Sensitivity Analysis and Report Writing	GP-1 (43)	Sec: 4.16	quiz
11, Nov 2	Goal Programming (GP) discussions, Integer Programming (ILP), Branch- and-Bound Method	GP-2 (23), ILP (39)	Sec: 9.3	HW quiz
12, Nov 9	Transportation Problem and simplex transportation, Transportation Sensitivity Analysis	Transportation (43) FYI:GP Simplex (25)	Chap: 7	HW Quiz
13, Nov 16	Transshipment Problems	Transshipment (29)	Chap: 7	HW quiz
14, Nov 23	Assignment Problems Travel Sales Person problem	TSP (33)	Chap: 7 Sec: 9.6	Final project report
15, Nov 30	Review of final exam			HW
<b>Monday</b> Dec 12	<b>Final Exam, 2-4 pm</b>			

**You need to have your computer with you in class for quizzes and other activities.**

## ISE 536 COURSE SPECIFIC POLICIES

We all come from different backgrounds and hope for an excellent learning experience in a great learning environment. This section is to clear MY EXPECTATIONS and POLICIES for this course.

### **Intellectual property policies:**

This is a clarification that any misuse, inappropriate dissemination, or attempted sale of class recordings and handouts, as well the appropriation of intellectual property is not acceptable. It is student's responsibilities towards the appropriate use and handling of these recordings under existing SCampus policies regarding class notes (<https://policy.usc.edu/scampus-part-c/>). Students are not permitted to create their own class recordings without the instructor's permission. Violations of these policies will be met with the appropriate disciplinary sanction.

### **Communication Policies**

- Students are required to **use their USC email account** for any contact with instructor through email. It is required to include the course number (**ISE 536**) **in the subject** of the email. The instructor will reply to emails within 24 hours. It may take longer over weekends and holidays. The instructor does not respond to emails sent from non-USC accounts or email that does not have the course number on its subject.
- Instructor's office hours are open to all students and there is no need for prior appointment. However, if a student would like to have a private appointment, he/she can request it by sending an email. Provide several time windows that works for you so that I can select the one that works for me.
- Simple questions will be answered by email, but for more complex discussions students may need to make an appointment for meeting or ask during office hours.
- To promote independence and critical thinking, students are encouraged to try to find their answers by checking the video lectures on Blackboard, the posted handouts on Blackboard, and your textbook. If you do not find the answer you need, email the instructor.

## USC'S STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEM

### **Academic Conduct:**

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior

Violating University Standards” [policy.usc.edu/scampus-part-b](https://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](https://policy.usc.edu/scientific-misconduct).

### **Support Systems:**

*Counseling and Mental Health* - (213) 740-9355 – 24/7 on call  
[studenthealth.usc.edu/counseling](https://studenthealth.usc.edu/counseling)

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

*National Suicide Prevention Lifeline* - 1 (800) 273-8255 – 24/7 on call  
[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP)* - (213) 740-9355(WELL), press “0” after hours – 24/7 on call  
[studenthealth.usc.edu/sexual-assault](https://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED)* - (213) 740-5086 | Title IX – (213) 821-8298  
[equity.usc.edu](https://equity.usc.edu), [titleix.usc.edu](https://titleix.usc.edu)

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  
[usc-advocate.symplicity.com/care\\_report](https://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs* - (213) 740-0776  
[dsp.usc.edu](https://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention* - (213) 821-4710  
[campussupport.usc.edu](https://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.



*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

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*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

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) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.