ISE 530 Optimization Methods for Analytics
Course Syllabus: Fall 2023, Section 31742D

Lecture	Taper Hall (THH) 208, Tuesday 6:00PM-9:40PM
Instructor	Shaoning Han Email: shaoning@usc.edu Office hours: Monday 11AM, TBD
Teaching Assistant	Sina Baharlouie Email: baharlou@usc.edu Office hours: TBD, TBD

Reference Books

- Richard W. Cottle and Mukund N. Thapa, *Linear and Nonlinear Optimization*, ISBN 978-1-4939-7053-7, Springer New York (2017).
- Gerard Cornuejols and Reha Tütüncü, *Optimization Methods in Finance*, Fourth Printing, Cambridge University Press (2013).
  - Available at: `http://web.math.ku.dk/~rolf/CT_FinOpt.pdf`
- Robert Fourer, David M. Gay, and Brian W. Kernighan, *AMPL: A Modeling Language for Mathematical Programming*, Second edition.
  - Available at: `https://ampl.com/resources/the-ampl-book/`

Course Description: ISE 530 is a 4-unit core course for Master in Data Analytics. This course covers classes of optimization problems (linear, quadratic, nonlinear, and integer), their mathematical models, a touch of theory, and basic methods for their numerical solution. The topics provide a set of fundamental tools for the understanding and solution of a variety of data-analytic problems including those arising from operations, statistics, machine learning, financial engineering, and decision making.

Recommended Background: This course makes heavy use of linear algebra and matrix operations and assumes that you are comfortable with college-level mathematical reasonings typical of an engineering curriculum. If you are not comfortable with these background materials, either quickly review them or postpone taking the course until you are ready.

Homework Assignments:

- All homework assignments are **due by 11:59am** on the date indicated.
- Homework assignments must be submitted via **Blackboard**. Only **one pdf file** should be submitted for each homework assignment. You can submit latex pdf files, word converted pdfs, or scanned images which are converted to pdf format.
- Late homework submissions are accepted **under any circumstances**. Start your homework assignments early.
- There will be almost **bi-weekly** homework assignments. Typically, all notifications including homeworks and their solutions will be announced on Blackboard. The lowest scored homework assignments will note be considered in your final grade.
- You are encouraged to discuss and collaborate on homework assignments with other students. However, each student is required to submit his/her own personal work. If you do have collaborators, you are required to list their names on your submitted homework.

Grade Distribution:

- In-class exercise (10%)
- Homework assignments (25%)
- Midterm on **October 17** (30%)
- Final exam on **TBD** (35%)

Tentative Course Plan: Most of the lectures are based on the two texts; additional materials are drawn from other sources where appropriate.

- **Introduction and Preliminaries (1 week)**
- **Linear Programming (3 weeks)**
  - modeling
  - simplex method and modeling language (AMPL)
  - LP duality
- **Unconstrained Optimization (1 week)**
  - optimality conditions
  - basic descent methods
  - Newton methods
- **Quadratic Programming (2 weeks)**
  - applications (least-squares regression, portfolio optimization, support vector machines)
  - the LASSO estimator and extensions
  - a touch of theory
  - feasible direction method
- **Review:** Tuesday October 10 (Note: October 12-13 is Fall recess)
- **In-class Midterm:** Tuesday October 17
- **Nonlinear Programming (3 weeks)**
  - applications (logistics regression/classification, neural networks, clustering, principle component analysis)
  - convex optimization
  - basic algorithms
- **Integer Programming (2 weeks)**
  - selected problem classes and modeling techniques
  - basic branch&bound and cutting planes methods
  - convex relaxations
- **Selected Topics and Review (1 week)**
  - brief introduction to other applications of mathematical optimization in data science (decision tree and dynamic programming, matrix completion, image processing, anomaly detection etc.) if schedule allows
  - final review
- **Final Exam: TBD**

Email Policy:

- Subject line: ISE 530
- Try to keep your email short and direct.
- Do not expect immediate responses to emailed questions. The instructor will try to respond to all emails within 48 hours.
- For questions regarding homework, please contact the teaching assistant first.

University policies

• *Statement for Students with Disabilities.* Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to your course instructor (or TA) as early in the semester as possible. DSP is located in STU 301 and is open from 8:30am to 5:00pm, Monday through Friday. Website and contact information for DSP: `http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html`, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX), ability@usc.edu.

• *Statement on Academic Integrity.* USC seeks to maintain an optimal learning environment. General Principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus, The Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: `http://usc.edu/dept/publications/SCAMPUS/gov/`. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review should there be any suspicion of academic dishonesty. The Review process can be found at: `http://usc.edu/student-affaris/SJACS/`. Information on intellectual property at USC is available at: `http://usc.edu/academe/acsen/issues/ipr/index.html`.

• *Emergency Preparedness/Course Continuity in a Crisis.* In case of emergency, when travel to campus is difficult, if not impossible, USC executive leadership will announce a digital way for instructors to teach students in their residence halls or homes using a combination of the Blackboard LMS (Learning Management System), teleconferencing, and other technologies. Instructors should be prepared to assign students a "Plan B" project that can be completed "at a distance". For additional information about maintaining your classes in an emergency, please access: `http://cst.usc.edu/services/emergencyprep.html`.