IE524A Optimization in Finance (2025)
Syllabus

Instructor:	Qiong Wang (qwang04@illinois.edu)
Lecture time/room:	3:00-4:30pm, Tuesday and Thursday, 144 Loomis Laboratory
office hour:	TB201C, 3:00-4:00 pm, Wednesday
course website:	https://canvas.illinois.edu/courses/62008
Teaching Assistant:	Mingxuan Cui (mc96@illinois.edu)
Office hour:	TBD
online	https://illinois.zoom.us/j/86319721163?pwd=bntbhe6Jfc2yrkYiM752JfBvAbfijt.1
meeting ID	863 1972 1163
password:	032852

Teaching Arrangements:

1. Slides will be posted on course website, in the directory "Files/Slides".
2. Homework will be posted on Canvas, in the directory "Files/Homework". There will be two subdirectories: you will find problem sets in "Assignments", and solutions in "Solutions".
3. You are encouraged to share your questions and thoughts on the discussion board on Canvas. TA and I will check in and respond regularly.

Course Objectives:

- Develop a general understandings of optimization theory and relevant techniques.
- Acquire the ability of formulating optimization models for addressing common problems in financial engineering.
- Practice optimization techniques and tools.
- Analyze optimization models and solutions for making financial decisions and gaining relevant business insights.

Reference (recommended but not required): Optimization Methods in Finance, Gerard Cornuejols and Reha Tütüncü,, Cambridge University Press, 3rd printing (2011) (https://www.andrew.cmu.edu/user/gc0v/webpub/book.pdf).

Software: The course requires the use of computer programs to solve financial optimization problems. Students are free to choose software or write their own code. AMPL (http://www.ampl.com/REFS/amplmod.pdf) is a popular optimization interface language that is easy to learn and useful to master. I

have obtained free copies for teaching use from the company and uploaded them to the directory "Software" on Canvas. You may download and install "AMPL_MasOS.pkg" on Mac machines and ''AMPL_MsWin.exe" on Windows machines.

Homework

1. Assignments will be posted weekly on Canvas, usually after Thursday's class, with due date marked, usually midnight Friday the week after. Please submit your completed homework electronically to Canvas.
2. Solutions will be posted a week after the submission deadline.
3. Late homework will not be accepted after its solution has been posted on Canvas. You can have one late homework, submitted before the solution has been posted without penalty. Afterwards, a late homework, submitted before the solution is online, will be accepted with 15% point deduction.
4. While discussions are allowed, plagiarism is forbidden and will be punished by receiving zero point on homework and a low or fail final grade.

Grading: homework 40%, exam (tentatively scheduled on Oct 16): 60%

Important!

We will strictly enforce university's academic integrity policies to protect the quality of our education and the reputation of MSFE program. Please familiarize yourself with these rules and procedures (ignorance is not a defense).

http://studentcode.illinois.edu/

Course Schedule (subject to change)

Aug 26, 28: Introduction

We will first give an overview of the subject area, followed by opening our discussion on the most fundamental topic in optimization: Linear Program. We will define LP models, show how to formulate them in standard forms, and describe the underlying idea of finding optimal LP solutions.

Suggested reading: C&T, chapter 1. C&T, chapter 2.1 and 2.4.

September 4: Applying and Solving LP Models:

We will present several examples to show the application of LP to financial problems: how to manage cash flows and credit lines in a corporation, how to use the technique on certain type of mean-risk portfolio management problem.

We will then practice the method by using LP solvers to find optimal solutions to these problems.

Suggested reading: C&T, chapter 3.

September 9, 11: Dual LP

On Wednesday's class, we will introduce an interesting and very useful technical development of LP, the dual LP models and several relevant theorems, duality and complimentary slackness conditions, which, as we will see later, have very important implications in trading and other financial transactions.

Suggested reading: C&T, chapter 2.2-2.3

September 16, 18: Applications of Dual LP in Financial Transactions

We will discuss financial applications of LP duality theory. Specific topics are how to use optimal solutions to price financial instruments, how to detect the existence of arbitrage opportunities, and how find risk-neutral probabilities by formulating and solving the LP.

Suggested reading: C&T, chapter 4.

September 23, 25: Nonlinear Optimization Model

We will discuss the next topic, Nonlinear Optimization. We will start from a classical example in finance to motivate the development of nonlinear optimization models, followed by formal formulation and classification of models. We will then discuss the KKT condition and its use as a fundamental approach for solving a large class of nonlinear optimization models.

Suggested reading: C&T, chapter 5.1 and 5.5.

September 30, October 2: Application of Nonlinear Optimization Model

We will discuss the most important application of nonlinear optimization model, portfolio management. We will show how to use the KKT condition to show different types of mean-risk models are equivalent to each other. We will discuss the efficient frontier from the perspective of nonlinear optimization, and use the method to compute Sharpe Ratio.

Suggested Reading: C&T, chapter 8.1-8.3

October 7, 9:

We will discuss the third and the last topic of the course: integer programming. We will focus on the use of binary variables to characterize logical conditions in financial transactions, such as index funds and electronic trading. We will also give a brief overview on how to solve Integer Programming models.

Suggested reading: C&T, chapter 11-12.

Review and Q&A on October 14 and final exam October 16: regular class times and at TB101.