

IE524B Optimization in Finance (2022)
Syllabus

Instructor: Qiong Wang (qwang04@illinois.edu)
Lecture time: TB112, 3-4:20pm MW
office hour: after the lecturer or by appointment
TA: Lang Yin (langyin2@illinois.edu)
office hour: TBD.

Teaching Arrangements:

1. Given the class size, lectures will be more interactive. Slides will be posted on Canvas (<https://canvas.illinois.edu/courses/30602>).
2. Homework will be posted on Canvas, which includes both regular problem sets and take-home projects.

Course Objectives: Develop understanding of concepts and basic approaches of dynamic, stochastic, and robust optimization methods, and the ability to implement these techniques for financial engineering applications: exercising options, computing TVaR, designing MBS, etc.

Reference (recommended but not required): Optimization Methods in Finance, Gerard Cornuejols and Reha Tütüncü., Cambridge University Press, 3rd printing (2011) (Available online).

Software: Students should be prepared to use computer programs to solve linear programs. There is no specific requirements on which language to use. A teaching copy of AMPL (<http://www.ampl.com/REFS/amplmod.pdf>) is available on Compass in the folder “Software”.

Homework

1. Assignments will be posted weekly on COMPASS with due date marked.
2. Late homework will receive 15% point deduction and will not be accepted after its solution has been posted on Compass.
3. 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: 30 % homework, 70% final project (due by on Dec 5).

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)

Week of Oct 17: Dynamic Programming and Its Application in Finance

We will start with an overview of basics of dynamic optimization, followed by the discussions on several financial engineering models: Kelly's problem, Baumol-Tobin Model, and Optimal Stopping for exercising options (we may not have enough time to finish everything in one week, in which case we will use some class time of the next week).

Suggested reading: C&T, chapter 1. C&T, chapter 13-14.
Also <https://www.jstor.org/stable/pdf/1925776.pdf>

Week of Oct 24: Collateralized Mortgage Obligation

We will go through the process of designing CMOs and discuss the use of dynamic optimization techniques to optimize the choice of tranches.

Suggested reading: C&T, chapter 15.

Week of Oct 31: Stochastic Programming for TVaR

We will introduce Stochastic Programming models and their linear program solutions for problems with two stages and a finite number of scenarios. We will then discuss the use of the latter methods for computing TVaR.

Suggested reading: C&T, chapter 17-18

Week of Nov 7: Robust Optimization We will first present toy models to illustrate different types of robustness and discuss how these notions are incorporated in the optimization models. We will then discuss the applications of these models on arbitrage and portfolio management.

Suggested reading: C&T, chapter 19-20.

Week of Nov 14: Order Execution

We will review the work by Almgren and Chriss on the control of portfolio transactions and the role of optimization to balance the tradeoff between volatility risk and transaction costs.

Suggested reading: <https://www.smallake.kr/wp-content/uploads/2016/03/optliq.pdf>

Week of Nov 28: Conclusion of the Class and Project Work