FE-646-A
Optimization Models and Methods in Finance

Spring 2023

Instructor:	Somayeh Moazeni	**Lecture Days**:	Thursdays
Office:	Babbio 519	**Lecture Time**:	TBD
Phone:	(201) 216-8723	**Class Location:**	TBD
Email:	smoazeni@stevens.edu	**Office hours**:	Weds 5:30 PM-6:30 PM, or by appointment.

1   Course Description

Optimization models play an important role in financial decisions. This course introduces the approach of modeling financial decisions as optimization problems and then developing appropriate optimization methodologies to solve these problems. The course discusses the main classes of optimization problems encountered in financial engineering including linear optimization, quadratic optimization, nonlinear continuous optimization, integer programming, mixed integer linear programming, robust optimization, stochastic optimization, and dynamic programming. For each class of problems, after introducing the relevant theory, efficient solution methods, several examples in financial engineering, and software packages to use are discussed. Several optimization solvers are introduced.

2   Course Objectives

This course will help students to develop skills in optimization modeling and then selecting an appropriate optimization approach to solve decision making problems in financial engineering.

3   Recommended References

[*] Gerard Cornuejols and Reha Tütüncü, **Optimization Methods in Finance**, Cambridge University Press (2007).

[*] Jorge Nocedal and Stephen Wright, **Numerical Optimization**, Springer Series in Operations Research and Financial Engineering (2006).

- Stavros A. Zenios and Harry M. Markowitz, **Practical Financial Optimization: Decision Making for Financial Engineers**, Wiley-Blackwell (2008).

- Frank J. Fabozzi, Petter N. Kolm, Dessislava Pachamanova, Sergio M. Focardi, **Robust Portfolio Optimization and Management**, Wiley (2007).

- Jean-Luc Prigent, **Portfolio Optimization and Performance Analysis**, Chapman & Hall/CRC Financial Mathematics Series (2007).

- William T. Ziemba and Raymond G. Vickson, **Stochastic Optimization Models in Finance**, World Scientific Pub Co Inc (2006).

4   Prerequisites

Background in Probability and Statistics at the level of FE 540 is assumed. FE 630 (Portfolio Theory and Applications) is recommended.

5   Lectures

Unless scheduled in the Lab the course will be held in the usual classroom on Tuesdays. You are expected to attend and participate in the lectures. Part of the grade will be determined by overall class participation.

6   Course Website

Lecture slides, homework assignments, solutions, and announcements will be posted on `Canvas`. Urgent information will be sent by mass-email via `Canvas`. **Email** is the official way of communication for this course, so be sure to check your email often.

Students are encouraged to post questions in the discussion group/forum on the `Canvas` site. In general, this encourages students to exchange ideas, view points on issues related to assignments and projects. Posting solutions is not appropriate but discussing the main points of the problems is.

7   Grading and Homework Assignments

There will be 3 or 4 homework assignments (each weighted equally toward your final homework grade) during the course of the semester. You will have about two or three weeks to finish each assignment. Late assignments will not be accepted under any circumstances without prior notice and permission of the instructor. If outside circumstances are affecting your ability to perform in the course, you must contact me <u>before</u> you fall behind. For homework with computer exercises, along with your written answers to the question, give in appendix your commented code as well as the output of your code when you run it.

In addition, there will be one final exam and a course project. The final grade will be fully determined upon the student's performance in the Homework assignments, final exam, the project, and class participation. An approximate grading scheme is as follows:

$$40\% \text{ Homework}$$
$$20\% \text{ Midterm Exam}$$
$$20\% \text{ Final Exam}$$
$$20\% \text{ Final Project}$$

8   Tentative Course Schedule

The following class schedule is tentative. We reserve the right to change it.

Week	Date	Topics
1	Jan. 19	Intro. and Optimization Problems
2	Jan. 26	Optimization Models in Finance and Data Analysis
3	Feb. 2	Integer Optimization
4	Feb. 9	Fundamentals of Optimization
5	Feb. 16	Optimization Algorithms
6	Feb. 23	Optimization Methods in Machine Learning
7	Mar. 2	Convex Optimization
8	Mar. 9	Conic Optimization
9	Mar. 23	Midterm Exam
10	Mar. 30	Robust Optimization
11	Apr. 6	Stochastic Optimization
12	Apr. 13	Risk Measures
13	Apr. 20	Dynamic Optimization
14	Apr. 27	Reinforcement Learning

9 Learning styles

There are various styles of learning such as listening to oral explanations or reading written material. I do my best to accommodate various styles of learning. However, feel free to let me know what your learning style is so that I can take that into account when determining the future direction of the course.

10 Policies for the course

10.1 Attendance

Attendance at lectures is strongly recommended. Contact me in advance if you require special accommodations. Provide feedback about the lectures, so that we can make the best use of our time during class.

10.2 Academic Integrity

Each student in this course is expected to abide by the principles of the Academic Integrity at the Stevens Institute of Technology. Any submitted academic work by a student must be the result of student's own work and thought.

10.3 Electronic Devices

You are allowed to use your laptop during class for the purpose of this course. Audio or video recording may be done only with the approval of everyone in the classroom. Please let me know in advance if you need to use audio or video recording.

10.4 Accommodations for Students with Disabilities

If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Student Counseling and Disability Services, as early as possible in the semester.