Optimization Methods in Finance
Module 3, 2025-2026

Course Information

Instructor: *Xianhua Peng*
Office: PHBS Building, Room 756
Phone: 755-2603-3050
Email: xianhuapeng@phbs.pku.edu.cn
Office Hour: Monday and Tuesday 15:30-17:30, and by appointment

Teaching Assistant: *Xihe Yan*
Email: 2401111342@stu.pku.edu.cn
Office Hour: Tuesday and Friday, 19:30-21:30
Venue: PHBS Building, 213

Lectures:
Lectures: Monday and Thursday, 10:30-12:20
Venue: PHBS Building, Room 319

Course Website:
PHBS school CMS website: cms.phbs.pku.edu.cn

1. Course Description

1.1 Context

Course overview:
The course covers optimization methods and their applications in finance. The course content consists of three parts; the first part is on the theory for solving optimization problems, the second part is on the numerical algorithms for solving optimization problems, and the third part is on the applications of optimization methods in finance. (1) The first part covers convex sets, supporting and separating hyperplanes, convex functions, quasi-convex functions, convex optimization problems, duality, Lagrange dual problem, optimality conditions of optimization problems, theorem of alternatives. (2) The second part covers algorithms for solving unconstrained minimization problems, algorithms for solving equality constrained minimization problems, interior-point algorithms, and algorithms for stochastic optimization problems. (3) The third part covers application of optimization in asset liability management, arbitrage detection, volatility estimation and option pricing model parameter calibration, portfolio selection with various constraints and objectives, etc.

Prerequisites: calculus, linear algebra, and probability

1.2 Textbooks and Reading Materials

Reference book:
Convex Optimization, Stephen Boyd and Lieven Vandenberghe, Cambridge University Press, 2004.

2. Learning Outcomes

2.1 Intended Learning Outcomes

Learning Goals	**Objectives**	**Assessment (YES with details or NO)**
1. Our graduates will be effective communicators.	1.1. Our students will produce quality business and research-oriented documents.	Yes. The students will derive solutions of optimization problems in finance and produce documents of the solutions.
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	Yes. The students will solve optimization problems in finance and present the analysis and results in homework.
2. Our graduates will be skilled in team work and leadership.	2.1. Students will be able to lead and participate in group for projects, discussion, and presentation.	Yes. The students will participate in group discussion of homework problems.
	2.2. Students will be able to apply leadership theories and related skills.	No.
3. Our graduates will be trained in ethics.	3.1. In a case setting, students will use appropriate techniques to analyze business problems and identify the ethical aspects, provide a solution and defend it.	No.
	3.2. Our students will practice ethics in the duration of the program.	No.
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	Yes. The students will learn modern optimization methods developed by internationally renowned scientists.
5. Our graduates will be skilled in problem-solving and critical thinking.	5.1. Our students will have a good understanding of fundamental theories in their fields.	Yes. The students will learn the fundamental theory and methods of optimization.
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	Yes. The students will use sophisticated optimization methods to solve problems in finance.
	5.3. Our students will demonstrate	Yes. The students

	competency in critical thinking.	will learn to critically formulate an optimization model that is appropriate for solving a real finance problem.

2.2 Course specific objectives

After taking the course, the students will master comprehensive knowledge of optimization theory and algorithms and their implementation with Python, and learn how to apply optimization methods in solving finance problems.

2.3 Assessment/Grading Details

There will be three homework sets. The students are encouraged to discuss the homework problems together, but each student need to hand in his or her own solution.

There will be a closed-book and closed-notes midterm exam and final exam. An A4-size double-sided cheat sheet is allowed in the exams.

The grade of the course is given by homework(15%)+midterm(40%)+final(45%).

2.4 Academic Honesty and Plagiarism

It is important for a student's effort and credit to be recognized through class assessment. Credits earned for a student work due to efforts done by others are clearly unfair. Deliberate dishonesty is considered academic misconducts, which include plagiarism; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.

All assessments are subject to academic misconduct check. Misconduct check may include reproducing the assessment, providing a copy to another member of faculty, and/or communicate a copy of this assignment to the PHBS Discipline Committee. A suspected plagiarized document/assignment submitted to a plagiarism checking service may be kept in its database for future reference purpose.

Where violation is suspected, penalties will be implemented. The penalties for academic misconduct may include: deduction of honour points, a mark of zero on the assessment, a fail grade for the whole course, and reference of the matter to the Peking University Registrar.

For more information of plagiarism, please refer to *PHBS Student Handbook*.

AI tools requirements：
Using AI tools to complete assignments without the approval of the course instructor will be regarded as an act of academic dishonesty. Depending on the severity of the situation, penalties will be implemented in accordance with the provisions of the Peking University Graduate Student Handbook.

3. Topics, Teaching and Assessment Schedule

The midterm exam will be held in class during 10:30am-12:20pm on March 30, 2026. The final exam will be held during April 29-30, 2026.