

FINANCIAL OPTIMIZATION

Lecture 0: Course Perspectives

Philip H. Dybvig
Washington University
Saint Louis, Missouri

What is Optimization?

Optimization is a “scientific” approach to decision-making. The focus of optimization is a **choice problem** that specifies **decision variables** to be chosen, an **objective function** to be maximized or minimized, and **constraints** that must be satisfied by the choice variables and tell us what is **feasible**. Optimization is related to many academic disciplines, for example:

about optimization

Choice Theory: how people should and do make choices

Operations Research: how to compute optimal choices

Game Theory: how to make choices when multiple agents are involved

fields applying optimization

Economics **Strategy**

Finance **Marketing**

Statistics **Econometrics**

Operations

Operations Research Tradition

In the 1960's, Operations Research was an important department that was the center of quantitative research in business schools. Many people believed that Operations Research would revolutionize business by bringing precise scientific optimization tools to improve decision-making in all aspects of business. Over time all academic disciplines in business schools became more quantitative and the mathematical comparative advantage of Operations Research declined while scholars in the individual disciplines had an advantage in understanding the institutions and economics of the problems they faced. As a result, most Operations Research groups have transformed into Operations and Manufacturing groups and have specialized more on the applied problems that are their comparative advantage. These groups retain their strong mathematical foundations, but emphasize less the development of numerical algorithms for optimization.

Nonetheless, the numerical optimization tools traditionally taught in Operations Research courses are still important in practice, and their application to financial problems is the core of what we will study in this course.

Course Text

Optimization Methods in Finance by Gerard Coruejols and Reha Tütüncü, Cambridge University Press, 2007.

This is a book organized like a traditional Operations Research course in optimization, but with a focus on financial applications. Since this is a new book, it also includes modern improvements (and fads that may or may not be improvements) in optimization. This course was designed for the Carnegie-Mellon's quantitative master's program in finance. The authors of the book come from backgrounds in Operations Research and Applied Mathematics, but one of the authors has experience on Wall Street and they have consulted a lot with financial economists in choosing examples and topics to cover. Overall, it is a good book.

Since my background is in finance (with training in pure mathematics and economics), I will have my own perspective on topics in the book, especially since most of the topics are close to my own research (and sometimes came from my research). However this should not be a problem for using the book.

Not emphasizing algorithms

One difference between the approach in the course and the book is that I will spend less time on specific algorithms, which are step-by-step procedures for computing optimal solutions. This is a necessary compromise given the time constraint of a mini course, and the importance of understanding the financial modeling issues. For a simple understanding, not understanding algorithms is not so bad since most practitioners use professional optimization programs and do not write their own computer code to solve these problems. I encourage students with superior background or motivation to study the algorithms carefully, since this deeper understanding will help to diagnose problems and to write custom applications should the need arise.

Summary

The optimization tools described in this course are at the foundation of modern finance and are powerful tools for financial engineering. Like other powerful tools, they can do great good if applied well and great damage if misapplied. This course will introduce you to these powerful tools and help you to apply them well.