Book Review

Optimization Methods in Finance
Gerard Cornuejols and Reha Tütüncü
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Optimizing often appears as a major and challenging issue. This book presents a wide range of optimization methods illustrated by numerous examples from finance and risk management practice. Practical optimization problems can be very complicated, but this book can be read without a solid background in mathematics. The authors are concerned to show how each theoretical result can be successfully applied to solve practical issues. Mathematical results (such as simplex method, duality, static, dynamic, and stochastic programming and optimization robustness) are shown through simple numerical examples and various case studies. This book contains 20 chapters (mostly independent of one another). The reader can identify his or her problem in the introduction (Chapter 1) and easily find out which method is adequate and which chapter will be useful for solving it thanks to the explicit title of each chapter. Current issues in enterprise risk management are investigated: among others, volatility estimation, integer optimization, Value-at-Risk estimation, and robustness. The authors also insist on the practical implementation of algorithms; they give references to standard routines existing in most software. More important, they also underline that understanding how these routines operate is important and will avoid a possible misinterpretation of the programming outputs.

The book is organized as follows: static optimization techniques are given in the first part (Chapters 2–12), dynamic problems are then investigated (Chapter 13–18), and the last two chapters deal with the robustness issue.

In Chapters 2 to 4 the authors investigate linear programming (optimization when objective function and constraints are linear). Even though linearity assumptions are restrictive, some simple case studies are solved such as maximizing the yield from the investment by finding a portfolio allocation with budget constraints (Chapter 2) or maximizing wealth and asset liability cash flow matching when investment opportunities and borrowing conditions are given (Chapter 3). Chapter 4 is devoted to asset pricing and arbitrage and presents original examples about how to detect an arbitrage on the market and how to perform bond portfolio management with tax constraints, for instance. In the real world, objective functions, such as expected utility maximization, risk minimization (e.g., variance), cost/tax minimization, as well as concrete constraints such as taxes, costs, and regulation constraints (Value-at-Risk, Conditional Value-at-Risk), are not linear. Nonlinear optimization is then examined in Chapters 5 to 10. Cornuejols and Tütüncü detail, for instance, mean variance optimization and volatility estimation (with the GARCH process), which is often an underlying problem in pricing, risk management, quantifying risks, and fitting data. Chapters 11 and 12 deal with integer programming: this issue is often neglected, although in practice decisions involve numbers of shares and units and not real numbers.

Beginning in Chapter 13 dynamic programming methods are investigated. Bellman's principle of optimality is first discussed and then illustrated with many examples: option pricing, asset-backed securities structuring, and stochastic programming. Concrete examples are given to show the importance of looking at the dynamic problem rather than the static one. Chapters 17 and 18 deal with current issues of regulators and managers: estimating VaR, CVaR, and Asset Liability Management optimization.

Finally, the two last chapters discuss how to test the robustness of the optimization method. An illustration is given in Chapter 20 with a financial problem involving portfolio selection. Again this issue is often ignored in the literature, and most academic researchers conclude by giving solutions in their stated framework without discussing the robustness and sensitivities of their results to parameter estimations and model misspecifications. With the implementation of Solvency II in Europe, for instance, this problem is part of the heavy task of insurers and regulators who have to test internal models.

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