

## Book Reviews

**Jorge Nocedal and Stephen J. Wright: Numerical Optimization**, Springer Series in Operations Research, 1999, ISBN 0-387-98793-2

In the preface the authors state . . . *Our goal in this book is to give a comprehensive description of the most powerful, state-of-the-art, techniques for solving continuous optimization problems. By presenting the motivating ideas for each algorithm, we try to stimulate the readers intuition and make the technical details easier to follow. Formal mathematical requirements are kept to a minimum. . . .* This goal is reached by the authors in a full and excellent way.

Due to the wide and growing use of optimization in science, engineering, economics, and industry, the book is addressed to students as well as to practitioners in order to develop an understanding of optimization algorithms. Knowledge of the capabilities and limitations of the algorithms will lead to a better understanding of their impact on various applications, and will point the way to further research on improving and extending optimization algorithms and software.

Although the book is restricted to continuous optimization problems, (important topics such as discrete and stochastic programming are omitted) this does not impair the positive total impression. The wide range of areas in numerical optimization considered by Nocedal and Wright becomes clear looking on the 18 chapters of their book (636 pages.): Introduction, Fundamentals of Unconstrained Optimization, Line Search Methods, Trust Region Methods, Conjugate Gradient Methods, Practical Newton Methods, Calculating Derivatives, Quasi-Newton Methods, Large Scale Quasi-Newton and Partially Separable Optimization, Nonlinear Least-Squares Problems, Nonlinear Equations, Theory of constrained Optimization, Linear Programming: The Simplex Method, Linear Programming: Interior Point Methods, Fundamentals of Algorithms for Nonlinear Constraint Optimization, Quadratic Programming, Penalty, Barrier, and Augmented Lagrangian Methods, Sequential Quadratic Programming. (In the appendix some background material is summarized.)

The authors realize a consequent strategy to handle problems and to develop solution approaches. Based on a critical view of the problems and appropriate goals, often illustrated by examples, their way of thinking becomes evident. At the same time, motives for further explanations are derived. These considerations lead to a deeper understanding of optimization approaches. They are followed by the main theoretical results. Corresponding algorithms are developed and described in detail. Some notes, references, and exercises (without solutions) complete a chapter.

The book looks very suitable to be used in an graduate-level course in optimization for students in mathematics, operations research, engineering, and others. Moreover, it seems to be very helpful to do some self-studies in optimization, to complete own knowledge and can be a source of new ideas. Because of the wide range of optimization problems considered and the large number of algorithms, the book is also of high interest for practitioners.

Consequently, I recommend this excellent book to everyone who is interested in optimization problems.

**Franco Giannessi (ed.): Vector Variational Inequalities and Vector Equilibria,** Kluwer Academic Publishers, 2000, Dordrecht, ISBN 0-7923-6026-5, 523 pp.

The presented volume contains new results on the field of Vector Variational Inequalities, Vector Equilibrium Problems and Vector Optimization. A large number of the contributions reflects progress in mathematical ideas, basic research and models on this field. The results in these areas have been obtained using different kinds of differentiability, certain generalizations of convexity, geometrical methods (cone of feasible directions, normal and tangent cones, etc.), game theory, fixed point theory, topological degree, etc. Recently, equilibrium problems play a central role in the development and unification of diverse areas of mathematics, economics and physics. Thus various problems of practical interest in optimization, variational inequalities, complementarity, economics, Nash equilibria and engineering involve equilibrium in their description.

The aim of the book is to present a deep insight into generalized vector equilibrium problems, which embody at least vector optimization problems and vector variational inequalities. The vector variational inequalities have been widely developed in recent years and various solutions have been characterized and computed. These were first introduced by Giannessi and further developed by many authors in different areas. Recent topics attracting considerable attention are equilibrium problems for vector-valued mappings. Furthermore, different approaches to establish the existence of solutions of equilibrium problems in the vector case are presented.

The published papers could be grouped in the following way:

- Theory of Vector Optimization, Vector Equilibrium Problems and Vector Variational Inequalities  
(A. H. Ansari; G.-Y. Chen, C.-J. Goh, X. Q. Yang; X. H. Gong, W. T. Fu, W. Liu; G. M. Lee and S. Kum; S. J. Li, X. Q. Yang and G.-Y. Chen; G. Mastroeni; T. Rapsak; X. Q. Yang; X. Q. Yang and G.-Y. Chen; X. Q. Yang and C.-J. Goh; W. Song; N. D. Yen, T. D. Phuong; H. Yin, C. Xu)
- Existence of Solutions for Generalized Vector Variational Inequalities and Complementarity Problems  
(S.-S. Chang, H. B. Thompson and G. X.-Z. Yuan; G.-Y. Chen and S.-H. Hou; G.-Y. Chen and X. Q. Yang; G. Isac and G. X. Z. Yuan; K. R. Kazmi; H. Yin and C. Xu; L. Qun)
- Vector Variational Inequalities and Vector Equilibrium Problems with Set-Valued Mappings  
(X. P. Ding and E. Tarafdar; J. Fu; W. Song)
- Vector Variational Inequalities and Scalarization  
(A. H. Ansari, A. H. Siddiqi and J.-C. Yao; F. Giannessi, G. Mastroeni and L. Pellegrini; C. J. Goh and X. Q. Yang;)
- Stability of the Solution Sets  
(N. D. Yen and T. D. Phuong; G. M. Lee, D. S. Kim, B. S. Lee and N. D. Yen; P. Loridan, J. Morgan)
- Monotone Vector Variational Inequalities  
(X. P. Ding and E. Tarafdar; N. D. Yen and G. M. Lee)
- Modelling  
(P. Daniele, G. Maugeri)

The book is a very good survey of the topic with a high scientific standard which earn attention by all those who are interested in Nonlinear Analysis, Optimization Theory, Control Theory and Operations Research.

Christiane Tammer

Halle

**Jean-Pierre Fouque, George Papanicolaou, K. Ronnie Sinclair: Derivatives in Financial Markets with Stochastic Volatility.** Cambridge University Press (2000), ISBN 0-521-79163-4

Financial mathematics gained a lot of interest from both the academic and the applied side over recent years. Especially the area of derivatives pricing was and still is at the heart of research in financial mathematics. As one result the list of book publications in this area has grown enormously during recent years. However, most of the books are more or less based on modelling in the standard Black-Scholes framework and so in particular assume a complete market setting and constant volatility.

In contrast to the many introductory books on the mathematics of financial derivatives, the above book can be seen as a “second generation” book on financial derivatives as its main focus is on option pricing under stochastic volatility. It is divided into the following sections:

1. The Black-Scholes Theory of Derivatives Pricing
2. Introduction to Stochastic Volatility Models
3. Scales in Mean-Reverting Stochastic Volatility
4. Tools for Estimating the Rate of Mean Reversion
5. Asymptotics for Pricing European Derivatives
6. Implementation and Stability
7. Hedging Strategies
8. Application to Exotic Derivatives
9. Application to American Derivatives
10. Generalizations
11. Applications to Interest-Rate Models

Although mainly based on the authors' own research the book provides a good overview to the theoretical and practical problems when dealing with stochastic volatility. It starts with an introduction to the now nearly classical Black-Scholes theory of option pricing which contains all necessary facts on derivatives, replicating strategies, risk-neutral pricing, pricing partial differential equations and complete markets. The second section collects both practical problems and some theoretical models for stochastic volatility. In particular the role and different versions of implied volatility is stressed. Section 3 concentrates on modelling mean-reverting stochastic volatility and on its justification via empirical data. With the concentration on mean-reverting volatility processes section 4 collects versions of and statistical tools for such models. The principal method proposed by the authors for dealing with stochastic volatility is an asymptotic expansion of the Black-Scholes partial differential equation (corresponding to some empirical martingale measure for mean-reverting stochastic volatility models) as described in great detail in section 5. This method yields correction terms to the usual Black-Scholes

price in a complete market setting due to the presence of stochastic volatility. Section 6 then contains a detailed description of the implementation of this expansion while the remaining sections deal with applications of the asymptotic expansion method to more complicated problems such as the pricing of exotic and American derivatives and to interest rate models. All in all the presentation of the material is appealing and proves that the authors have a very good feeling for the scope of the problem and the methods presented in the book.

The book provides no complete overview over different models for option pricing under stochastic volatility or for the even more general problem of option pricing and hedging in incomplete markets. However, due to the concentration on the asymptotic expansion method the authors are able to write a complete book from another point of view: It really succeeds in helping both the practitioner and the scientist to go all the steps from understanding the theoretical background via estimating parameters to the implementation of a pricing method. This feature makes the book a really valuable one.

Ralf Korn

Kaiserslautern