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# BOOK REVIEW

Viva Hammer<sup>1</sup>

## METHODS OF MATHEMATICAL FINANCE

Ioannis Karatzas, Steven E. Shreve

Springer-Verlag 1998

The book under review is a research monograph, suitable for people with a sophisticated understanding of mathematics. The authors use as a reference a previous work of theirs throughout, *Brownian Motion and Stochastic Calculus* (Springer-Verlag 1991), and it is really necessary to read *Mathematical Finance* in conjunction with *Brownian Motion*.

Chapter 1 of *Mathematical Finance* sets up a Brownian model for stocks and the money market. It discusses portfolio and gains processes, income and wealth processes. The authors introduce the concepts of "complete" and "incomplete markets" within the standard market framework. The theory of European and American contingent claim (option) valuations within a complete market is the main subject of Chapter 2. The authors discuss the pricing and hedging of various derivative contracts, including options and futures contracts.

Chapter 3 applies stochastic calculus and second order parabolic partial differential equations to solve optimization problems for investments and for the maximization of the growth rate of wealth. The theory is related to Markowitz' mean-variance analysis, which was developed to understand how markets operate. Chapter 4 continues these themes, and

the main topic is the existence and uniqueness of equilibrium securities prices in a complete market when there are several agents, within the model of a pure exchange economy.

Chapters 5 and 6 introduce issues which arise due to portfolio constraints, namely incomplete markets. The authors address within this context the pricing and hedging of contingent claims, using the methods of convex analysis and duality theory. The final chapter addresses the problems of optimal consumption and investment applying the duality theory.

Readers of this book have to have a firm grasp of the probability theory, stochastic process, Brownian motion and second order partial differential equations. It would have been helpful if the editors had included the first three chapters of *Brownian Motion* as an appendix to *Mathematical Finance*, because the notations used are the same and the authors presume a thorough understanding of the former book when reading the latter. The authors confess that the material presented in the book is not necessarily a balanced presentation of the area, but rather develops themes that they have direct research interest in. To compensate, at the end of each chapter, there is a notes section which provides a broader perspective on the subject addressed in that chapter, with an excellent current list of references. At the end of the book, there is an extremely comprehensive bibliography, including 657 books and papers.

1. PricewaterhouseCoopers, New York.