

Book Review

Stochastic Methods in Economics and Finance

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Amsterdam: North-Holland Publishing Co., 1982. Pp. xviii + 303. \$35.00.

Stochastic Methods in Economics and Finance is the first textbook to cover several important probabilistic methods that have found, during the last decades, useful applications in financial economics. The subject matter of the book is motivated by a desire to provide a sufficient mathematical background for certain probabilistic treatments of economic phenomena and to supply a large number of applications from finance and economics.

At least since Bachelier in 1900, researchers have been confronted with difficult mathematical questions arising from the modeling of uncertainty in economics and finance. The solution of these problems had to wait for mathematical breakthroughs and their assimilation by economics and finance researchers. The development of several important probabilistic methods, in particular Ito's calculus, was essentially completed in the early fifties. A decade later researchers began to apply these methods to problems in economics and finance. By now the literature on these applications is enormous, mostly scattered in journals. This book undertakes the difficult task of assembling the relevant mathematical background and of reviewing representative applications from the enormous mathematical-economic-financial literature.

The book is organized in four chapters. The first chapter collects several important definitions and theorems from modern measure-theoretic probability. The concepts of σ -field, probability space, random variable, various definitions about convergence, expectation, and conditional probability are presented. The repeated use of these concepts in chapter 1 and in other parts of the book reinforces the reader's initial understanding. More specifically, the concepts mentioned are used in three detailed sections on martingales, stochastic processes, and optimal stopping, which essentially conclude the contents of chapter 1. These three sections present both the mathematical material and several applications illustrating conditions under which the futures price is a martingale, conditions under which the discounted expected value of a stock is a martingale, the martingale property of the marginal utility of consumption in a model of intertemporal stochastic optimization, basic results from job search, and, finally, a recent approach to capital theory under uncertainty.

The second chapter covers initially stochastic integration as a necessary mathematical background for the presentation of Ito's lemma and differential

equation. The section on stochastic integration, one of the nicest sections in this book, uncovers some obscurities present in most applications utilizing stochastic calculus. Ito's lemma is carefully stated and the standard proof is presented to illuminate for the reader why the lemma is true. Theorems on existence and uniqueness and on properties of stochastic differential equations are stated and references are cited for proofs. Finally, the subject of stochastic control is explicated by appealing to intuition and heuristics, thereby circumventing some formidable mathematical technicalities.

The remaining two chapters collect a host of applications in economics and finance. Chapter 3 reports economics applications primarily in the areas of economic growth under uncertainty, price theory under uncertainty, and stochastic capital theory.

Chapter 4 consists essentially of two parts; in the first part we find a representative class of applications of stochastic calculus that includes the Black-Scholes option pricing model, a term structure model of interest rates, and a cash balances application. The first part also has applications of stochastic control that refer to consumption and portfolio rules and the demand for index bonds. The second part, organized in six sections, follows Brock's recent work to develop an intertemporal general equilibrium theory of capital asset pricing.

The book should appeal to graduate students, teachers, and researchers in economics, finance, and applied mathematics. Its value as a reference book is enhanced by detailed comments on the current literature at the end of each chapter, the detailed bibliography, and the author index. The exercises prod the reader to study this literature further. Supplemented with journal articles, the book could form the basis of Ph.D. courses on the theory of finance, mathematical economics, and stochastic methods.

Undoubtedly, other books will be written, at either a higher or a lower level, and with either more or less emphasis on various applications. But for the time being, *Stochastic Methods in Economics and Finance* is an excellent textbook that expounds well several advanced probabilistic methods and their applications.

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