Zbl 1115.60001

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Optimal stopping and free-boundary problems. (English)

Lectures in Mathematics, ETH Zürich. Basel: Birkhäuser. xxii, 500 p. EUR 48.00/net; SFR 78.00 (2006). ISBN 3-7643-2419-8/hbk

The book discloses a fascinating connection between optimal stopping problems in probability and free-boundary problems in analysis, and focuses on key examples. The general theory of optimal stopping is exposed at the level of its basic principles in both discrete and continuous time covering martingale and Markovian methods. Methods of solution explained range from change of time, change of space, and change of measure, to more recent ones such as local time-space calculus and nonlinear integral equations. A detailed chapter on stochastic processes makes the material more accessible to a wider cross-disciplinary audience. The book will appeal to those wishing to master stochastic calculus via fundamental examples. Areas of application include financial mathematics, financial engineering, mathematical statistics, and stochastic analysis.

The book consists of eight chapters. Chapter 1 is devoted to general facts of optimal stopping in discrete and continuous time comparing martingale and Markovian approaches. Chapter 2 contains a brief review of stochastic processes including martingales and Markov processes, as well as of basic transformations: change of time, change of space, and change of measure. Chapter 3 is devoted to the connection of optimal stopping problems and free-boundary problems and connections with the Kolmogorov backward equations. Chapter 4 contains the methods of solutions of optimal stopping problems: reduction to free-boundary problems, superharmonic characterization of the value function, the method of time change, the method of space change, and the method of measure change; as well as optimal stopping problems for the maximum process and nonlinear integral equations. Chapter 5 is devoted to optimal stopping problems in stochastic analysis: Wald inequalities, Bessel inequalities, Doob inequalities, Hardy-Littlewood inequalities, and a brief summary of Burkholder-Davis-Gundy inequalities. Chapter 6 is devoted to optimal stopping problems in mathematical statistics: sequential testing problem for Wiener process with infinite and finite horizon and for Poisson process with infinite horizon. Chapter 7 is devoted to optimal stopping problems in mathematical finance: the American option problem, the Russian option problem, and the Asian option problem in Black-Merton-Scholes problem with infinite and finite time horizon. Chapter 8 is devoted to optimal stopping problems in financial engineering, namely, to the problem of stopping Brownian motion (with constant drift) without anticipation as close as possible to its ultimate position, ultimate integral, and ultimate maximum.

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Keywords : optimal stopping problem; free-boundary problem; principles of smooth and continuous fit; local time-space calculus; maximum process; maximal inequalities; sequential testing and quickest disorder detection problems; American option problems; ultimate maximum

Classification :

∗60-02 Research monographs (probability theory)
60G40 Optimal stopping
35R35 Free boundary problems for PDE
45G10 Nonsingular nonlinear integral equations
45G15 Systems of nonlinear integral equations
62C10 Bayesian problems
62L15 Optimal stopping (statistics)
60H05 Stochastic integrals
91B28 Finance etc.
60H10 Stochastic ordinary differential equations