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# **Monte Carlo Simulation And Finance**

Stochastic Simulation and Applications  
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explains the fundamentals of Monte  
Carlo simulation techniques, their use

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in the numerical resolution of stochastic differential equations and their current applications in finance. Building on an integrated approach, it provides a pedagogical treatment of the need-to-know materials in risk management and financial engineering.

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The book takes readers through the basic concepts, covering the most recent research and problems in the area, including: the quadratic resampling technique, the Least Squared Method, the dynamic programming and Stratified State Aggregation technique

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to price American options, the extreme value simulation technique to price exotic options and the retrieval of volatility method to estimate Greeks. The authors also present modern term structure of interest rate models and pricing swaptions with the BGM

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market model, and give a full explanation of corporate securities valuation and credit risk based on the structural approach of Merton. Case studies on financial guarantees illustrate how to implement the simulation techniques in pricing and

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confidence in using and adapting specific ways to solve problems involving stochastic processes in finance.

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increasing power of computers and practitioners' aim to simulate more and more complex systems, and thus use random parameters as well as random noises to model the parametric uncertainties and the lack of knowledge on the physics of these systems. The



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error analysis of these computations is a highly complex mathematical undertaking. Approaching these issues, the authors present stochastic numerical methods and prove accurate convergence rate estimates in terms of their numerical parameters (number of

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simulations, time discretization steps). As a result, the book is a self-contained and rigorous study of the numerical methods within a theoretical framework. After briefly reviewing the basics, the authors first introduce fundamental notions in stochastic

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calculus and continuous-time martingale theory, then develop the analysis of pure-jump Markov processes, Poisson processes, and stochastic differential equations. In particular, they review the essential properties of Itô integrals and prove

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fundamental results on the probabilistic analysis of parabolic partial differential equations. These results in turn provide the basis for developing stochastic numerical methods, both from an algorithmic and theoretical point of view. The book combines advanced

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mathematical tools, theoretical analysis of stochastic numerical methods, and practical issues at a high level, so as to provide optimal results on the accuracy of Monte Carlo simulations of stochastic processes. It is intended for master and Ph.D. students in the field

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of stochastic processes and their numerical applications, as well as for physicists, biologists, economists and other professionals working with stochastic simulations, who will benefit from the ability to reliably estimate and control the accuracy of their

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across a wide array of subject areas, such as engineering, statistics, computer science, mathematics, and the physical and life sciences. The book begins with a modernized introduction that addresses the basic concepts of probability, Markov

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Management at Technion-Israel Institute of Technology. He served as a consultant at numerous large-scale organizations, such as IBM, Motorola, and NEC. The author of over 100 articles and six books, Dr. Rubinstein was also the inventor of the popular

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score-function method in simulation analysis and generic cross-entropy methods for combinatorial optimization and counting. Dirk P. Kroese, PhD, is a Professor of Mathematics and Statistics in the School of Mathematics and Physics of The University of

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the variance is too high. A technique of variance reduction is the solution to reduce the variability of the estimators and consequently reduce the simulation time. A reduction of the variance can

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**sampling. Some numerical tests are conducted through the Dothan bond pricing model, which shows the method achieves a significant variance**

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**reduction. Secondly, we study the convergence of a quasi-regression Monte Carlo method proposed by Glasserman and Yu (2004) that is a variant of least-squares method**

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and Schwartz (2001) for  
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Glasserman and Yu  
(2004) showed that the  
method converges to an  
approximation to the true**



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: Portfolio optimization is a widely studied problem in finance. The common question is, how a small investor should invest his wealth in the market to attain certain



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goals, like a desired payoff or some insurance against unwished events. The starting point for the mathematical treatment of this is the work of Harry Markowitz in the 1950s.

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His idea was to set up a relation between the mean return of a portfolio and its variance. In his terminology, an efficient portfolio has minimal variance of return among

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others with the same mean rate of return.

Furthermore, if linear combinations of efficient portfolios and a riskless asset are allowed, this leads to the market

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portfolio, so that a linear combination of the risk-free asset and the market portfolio dominates any other portfolio in the mean-variance sense. Later, this theory was

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extended resulting in the CAPM, or capital asset pricing model, which was independently introduced by Treynor, Sharpe, Lintner and Mossin in the 1960s. In this model,

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every risky asset has a mean rate of return that exceeds the risk-free rate by a specific risk premium, which depends on a certain attribute of the asset, namely its  $\beta$ . The

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so-called  $\beta$  in turn is the covariance of the asset return normalized by the variance of the market portfolio. The problem of the CAPM is its static nature, investments are

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made once and then the state of the model changes. Due to this and other simplifications, this model was and is often not found to be realistic. An impact to



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this research field were the two papers of Robert Merton in 1969 and 1971. He applied the theory of Ito calculus and stochastic optimal control and solved the

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corresponding Hamilton-Jacobi-Bellman equation. For his multiperiod model, he assumed constant coefficients and an investor with power utility. Extending the

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mean-variance analysis, he found that a long-term investor would prefer a portfolio that includes hedging components to protect against fluctuations in the

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