



Simulation and Inference for Stochastic Differential Equations: With R Examples (Springer Series in Statistics)

By Stefano M. Iacus

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This book covers a highly relevant and timely topic that is of wide interest, especially in finance, engineering and computational biology. The introductory material on simulation and stochastic differential equation is very accessible and will prove popular with many readers. While there are several recent texts available that cover stochastic differential equations, the concentration here on inference makes this book stand out. No other direct competitors are known to date. With an emphasis on the practical implementation of the simulation and estimation methods presented, the text will be useful to practitioners and students with minimal mathematical background. What's more, because of the many R programs, the information here is appropriate for many mathematically well educated practitioners, too.

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Editorial Review

Review

From the reviews:

"It is a pleasure to strongly recommend the text to the intended audience. The writing style is effective, with a relatively gentle but accurate mathematical coverage and a wealth of R code in the sde package." (Thomas L. Burr, *Technometrics*, V51, N3)

"The book focuses on simulation techniques and parameter estimation for SDEs. With the examples included a detailed program code in R. It is written in a way so that it is suitable for (1) the beginner who meets stochastic differential equations (SDEs) for the first time and needs to do simulation or estimation and (2) the advanced reader who wants to know about new directions on numerics or inference and already knows the standard theory.... There is also an interesting small chapter on miscellaneous topics which contains the Akaike information criterion, non-parametric estimation and change-point estimation. Essentially all examples are complemented by program codes in R. The last chapter focuses on aspects of the language that are used throughout the book. Generally the codes are, without much effort, translatable into other languages." (Roger Pettersson, *American Mathematical Society* 2009, MR2410254 (Review) 60H10 (62F10 65C30))

"This book succeeds at giving an overview of a complicated topic through a mix of simplified theory and examples, while pointing the reader in the right direction for more information.... This would be a good introductory or reference text for a graduate level course, where the instructor's knowledge extends substantially beyond the book.... data examples are abundant and give the book the feeling of being practical while showcasing when methods succeed and fail." (Dave Cambell, *Biometrics*, 65, 326-339, March 2009)

"Overall, this is a good book that fills in several gaps. In addition to collecting and summarizing an enormous quantity of theory, it introduces some novel techniques for inference. Statisticians and mathematicians who work with time series should find a place on their shelves for this book." (*Journal of Statistical Software* - Book Reviews)

"Diffusion processes, described by stochastic differential equations, are extensively applied in many areas of scientific research. There are many books of the subject with emphasis on either theory or applications. However, there is not much literature available on practical implementation of these models. Therefore, this book is welcome and helps fill a gap. ... the thorough coverage of univariate models provided by the book is also useful. These models are building blocks for larger models, and it is good to have a handy reference to their properties, such as parameter restrictions and stationary distributions." (Arto Luoma, *International Statistical Review*, 2009, 77, 1)

"In summary, this book is indeed quite unique: it gives a concise methodological survey with strong focus on applications and provides many ready-to-use recipes. The theory is always illustrated with detailed examples incorporating various parametric diffusion models. This text is a recommended acquisition for practitioners both in the industry and in applied disciplines of academia." (Marco Frei, ETH Zurich, JASA March 2010, v105(489))

"To summarize, this book fills several gaps in the literature, summarizing the theory of stochastic processes and introducing some new estimation techniques. The main strength of the book is the breadth of its scope. It covers the basic theory of the stochastic processes, applications, an implementation in concrete computer codes. An empirical economist would find Chapter 3 most important, while for a theorist it will be useful to concentrate on Chapter 1." (Suren Basov, La Trobe University, *Economic Records*, v86(272), March 2010)

"...This book is indeed quite unique; it gives a concise methodological survey with strong focus on applications and provides many ready-to-use recipes. The theory is always illustrated with detailed examples incorporating various parametric diffusion models. This text is a recommended acquisition for practitioners both in the industry and in applied disciplines of academia." (Journal of the American Statistical Association, Vol. 105, No. 489)

"This book focuses on simulation techniques and parameter estimation for SDEs. It gives an overview of these topics through a mix of simplified theory and examples. The book is written in a way to be suitable for the beginner and the advanced reader who want to know about new directions in numerics or inference." (Rainer Schlittgen, *Zentralblatt MATH*, Vol. 1210, 2011)

From the Back Cover

This book is unique because of its focus on the practical implementation of the simulation and estimation methods presented. The book will be useful to practitioners and students with only a minimal mathematical background because of the many R programs, and to more mathematically-educated practitioners.

Many of the methods presented in the book have not been used much in practice because the lack of an implementation in a unified framework. This book fills the gap.

With the R code included in this book, a lot of useful methods become easy to use for practitioners and students. An R package called "sde" provides functions with easy interfaces ready to be used on empirical data from real life applications. Although it contains a wide range of results, the book has an introductory character and necessarily does not cover the whole spectrum of simulation and inference for general stochastic differential equations.

The book is organized into four chapters. The first one introduces the subject and presents several classes of processes used in many fields of mathematics, computational biology, finance and the social sciences. The second chapter is devoted to simulation schemes and covers new methods not available in other publications. The third one focuses on parametric estimation techniques. In particular, it includes exact likelihood inference, approximated and pseudo-likelihood methods, estimating functions, generalized method of moments, and other techniques. The last chapter contains miscellaneous topics like nonparametric estimation, model identification and change point estimation. The reader who is not an expert in the R language will find a concise introduction to this environment focused on the subject of the book. A documentation page is available at the end of the book for each R function presented in the book.

Stefano M. Iacus is associate professor of Probability and Mathematical Statistics at the University of Milan, Department of Economics, Business and Statistics. He has a PhD in Statistics at Padua University, Italy and in Mathematics at Université du Maine, France.

He is a member of the R Core team for the development of the R statistical environment, Data Base manager for the Current Index to Statistics, and IMS Group Manager for the Institute of Mathematical Statistics. He has been associate editor of the *Journal of Statistical Software*.

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