

BOOK REVIEW

Simulation Techniques in Financial Risk Management, by Ngai Hang Chan and Hoi Ying Wong, 2006, John Wiley & Sons, Hoboken, NJ, pp. 240. ISBN: 978-0-471-46987-2

Reviewer: Puneet Prakash, Virginia Commonwealth University

The Wiley InterScience "Statistics in Practice" series aims to provide both practitioners and research workers with statistical techniques for their respective disciplines, and this book is no exception. Although the authors' intended audience is practitioners in financial risk management, the book is also a useful tool for graduate students in the field because it provides concise simulation methodologies for many financial risk models.

Simulation is a necessity in financial risk management, allowing practitioners to solve many problems that lack closed-form solutions. The book is perfectly positioned between Ross (2002) and Glasserman (2004) and is a valuable intermediate-level text. It contains a semester's worth of topics in financial risk management, provided the course is taught only through simulations. The book does an excellent job of explaining why simulations are important in general as controlled experiments, as well as why, specifically, they are valued in the financial risk discipline.

Although the authors require basic exposure to probability and statistics at the undergraduate level, prior knowledge of mathematics/statistics at the graduate level would also be helpful. For example, a reader with only the recommended exposure to mathematics/statistics at the Hogg and Tanis (2006) level would have difficulty grasping the difference between Stratonovich and Ito integrals (Chapter 2, exercise 5).

The authors of the text are statisticians, and the book bears their mark. Examples 1.3.1 and 1.3.2 would have fit a math/statistics text (see Hubbard and Hubbard, 1999) very well. Notation and results are usually introduced first, while intuition associated with symbols and their definitions follow later. Because this is a text presumably aimed at first-time readers, a reverse approach might be more suitable.

In the preface, the authors correctly state that the book requires a rudimentary knowledge of finance. However, when the authors say that they aim to strike a balance between theory and applications of risk management, what they really mean by theory is statistical theory. Readers expecting a more rigorous treatment of financial theory will be disappointed. Even though the field of risk management is an amalgamation of disciplines, and the authors mention finance, statistics, mathematics, and computer science,¹ a background on financial risk is missing. Hence, from a purists' viewpoint,

¹ One can add physics and engineering to their list.

the book lacks financial theory but provides excellent computational tools for someone trained in financial economics to pick up valuable skills of simulation-based problem solving. As a financial risk resource, most gaps arise because the book has been written primarily from a statistical perspective rather than a financial economics one.

The book is technically quite sound. However, for readers trained in mathematics or statistics, it whets the appetite but leaves them wanting for more. The strengths of the text lie in the details and explanations of intuitive subtleties behind the equations, which many mathematical/statistical texts fail to highlight. Simple things like why $\frac{dW}{dt}$ is only a notation and not a derivative, explanation of Ito's Lemma from a nonmath/stat student's perspective are nuances that are easy to overlook. However, the authors are conscientious enough to give them due attention, and even harder concepts are sometimes also made to appear very easy. The simulation of look back options in Chapter 7 exemplifies this.

Some concepts are illustrated in a manner that even advanced readers will appreciate. The derivation of the Black–Scholes–Merton model of option pricing from the binomial model is explained extremely well. Nuances like why the mean function alone can be misleading in describing the stock price process are explained, and the material on simulation of the Greeks and exotic options is treated excellently. Similarly, why a geometric Brownian motion assumption at portfolio level gives a different answer when the assets comprising the portfolio are each assumed to follow a geometric Brownian motion is exciting reading for a curious reader. Unlike many texts in the finance area, which deal with value at risk (VaR) through only the normal distribution, this book teaches how to calculate the simulated VaR using generalized error distribution. Finally, when the authors touch upon principal component analysis they provide an insight into why eigenvalues greater than 1 are important, an explanation that is often overlooked in texts that are just application oriented. However, one has to be patient to read the authors' discussion on the finer points because many are provided only toward the end of the section.

The task of striking a balance between theory and applications in a text like this will always be difficult. In the earlier chapters, the authors whet the appetite of a curious reader with some theoretical details that are then omitted in some parts in the latter half of the text. For example, when dealing with Markov chain Monte Carlo simulations, the authors refer to the Markov chain limit theorems without providing an intuitive explanation for them. Similarly, the duality between stochastic differential equations and partial differential equations via the Feynman–Kac formula is an important result that could have been provided as part of the chapter rather than an exercise for the reader to prove (Chapter 3).

A reader with more exposure to the subject might find reference to finance theory desirable. Risk neutrality deserves more explanation than is currently provided. The concept goes beyond just a change of measure; and its link to arbitrage pricing theory is missing. Again, in Chapter 5, the authors start with application of simulation techniques to financial risk with an example of the number of newspapers to purchase. A financial risk example would be more suitable to start the topic. In the same chapter,

while introducing VaR, the authors make the classic mistake of defining it as worst loss rather than a point estimate.

The absence of links to financial risk theory is felt the most in Chapter 6, related to variance-reduction techniques. The authors fail to mention why it is needed in this risk management text. Reference to the stochastic volatility problem is a good start (Hull and White, 1987) on the issue. The authors then delve straight into the application of the antithetic variables to a “straddle,” a derivative instrument that requires knowledge of finance beyond “rudimentary exposure.” When authors discuss the control variate technique of variance reduction, the link to stochastic volatility can only be deduced.

Readers who are interested in managing financial risk through insurance (e.g., mortgage indemnity insurance) or interested in insurance applications may be disappointed. The book concentrates on managing financial risk through derivatives alone. Powerful simulation techniques employed in frequency-severity analysis are not even mentioned. Still, some techniques might be useful for insurance practitioners and researchers. The acceptance–rejection algorithm in Chapter 4 that is used to generate a given probability distribution can be applied to loss models. Application of tilted densities to value deep out of the money options in Chapter 6 can be utilized in the field of insurance for extreme loss events with significant tail probabilities.

The book does a very good job in providing computer code for many of the examples discussed in the text. For example, the algorithm for generating a multivariate normal distribution using Visual Basic (VBA) is very useful. Pictorial illustrations at required places help with understanding. Still, the textbook’s reach could be extended to a wider audience if the authors focused on VBA or MS Excel instead of S-PLUS.

The exercises are judiciously chosen to test the understanding of the concepts and integrate well with the material in the chapter. However, because the authors are trained statisticians, the exercises revolve around both simulations and analysis. In Chapter 1, all but one problem is analytical and as the book progresses, the number of analytical problems decreases. By Chapter 7, all but one problem is simulation based. However, by the end of the book (Chapter 10), the mix of analytical to simulations problems reaches the same proportion as in Chapter 1.

Finally, a word on the organization of the text. Chapter 11 is not really a chapter because it contains answers to selected exercises. Discussions on the Metropolis–Hastings algorithm in Chapter 10 and random number generators could be moved to the Appendix, where the vacated space may be used for more discussion of financial risk theory. The book is otherwise well researched in its area and an excellent first edition on the subject at its targeted level.

REFERENCES

- Glasserman, P., 2004, *Monte Carlo Methods in Financial Engineering* (New York: Springer-Verlag).
- Hogg, R. V., and E. A. Tanis, 2006, *Probability and Statistical Inference* (Upper Saddle River, NJ: Pearson).

Hubbard, J. H., and B. B. Hubbard, 1999, *Vector Calculus, Linear Algebra, and Differential Forms: A Unified Approach* (Upper Saddle River, NJ: Prentice Hall).

Hull, J. C., and A. D. White, 1987, The Pricing of Options on Assets With Stochastic Volatilities, *Journal of Finance*, 42: 281-300.

Ross, S. M., 2002, *Simulation* (Boston, MA: Academic Press).

Copyright of Journal of Risk & Insurance is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.