

Book Review

Stochastic Interest Rates, Daragh McNerney and Tomasz Zastawniak, Cambridge University Press, Cambridge, August 2015, 169pp. (paperback), ISBN: 9780521175692

Modelling the evolution of interest rates, interest rate derivative pricing and the uses of this in the assessment of market risk can be crucial for actuaries in the insurance world. *Stochastic Interest Rates* by McNerney and Zastawniak is a significant volume in the Mastering Mathematical Finance Series, which focusses on unravelling the complexities of stochastic interest rate modelling through a balance between mathematical rigour, insightful discussion and practical application.

The aim of the book is to give the reader a firm grounding in several stochastic interest rate models so as to equip them with the required skills to use these models practically.

The book commences by introducing basic financial concepts and instruments, which become essential reading in later chapters not only from a conceptual perspective, but also because of how they are presented mathematically. For example, the bootstrapping method that is explained early on continues to be used as a tool throughout the book, especially in relation to the Libor Market Model (LMM). In fact, the structure of the book provides a natural progression for the reader in terms of how stochastic interest rate models have evolved over time and, as would be expected, how they have become more complex.

This is seen as the first two chapters discuss fixed-income instruments and vanilla interest rate options, which then form the basis of the following chapters in which short-rate and forward-rate models are explored. After this build up, McNerney and Zastawniak concentrate on the LMM and delve deeply into how it functions, how to calibrate and implement the model and its use in the valuation of interest rate derivatives thus forming the core of the book. The final chapter can be seen as an extension to the LMM, as constant elasticity of variance and displaced diffusion models are introduced (although this should not be taken as an appendage as some of the concepts presented here have been seen in recent interest rate model developments by market leading Economic Scenario Generator providers).

The focus on the LMM is most certainly justified, given it is the market standard interest rate model used within the insurance industry. (In a recent industry survey, it was found that 75% of insurance companies use the LMM as their interest rate model within their risk-neutral Economic Scenario Generator.) McNerney and Zastawniak bring out the LMM's importance and strengths very clearly through transparent examples and comparisons with the one-factor Hull–White and HJM models. There is also a good balance between those ideas that are developed thoroughly (e.g. ratchet floaters within the LMM) and other more obscure ones that are touched upon to whet the appetite but which are not followed into examples or discussion (e.g. Constant Maturity Swap (CMS) caps).

A solid mathematical foundation is likely to be critical to how successful a Masters student would be in adapting to the mathematical intricacies that *Stochastic Interest Rates* presents. For example, whereas the book introduces some of the applications of the mathematics behind various

instruments, in most cases, the reader is required to pick up the underlying mathematical content quickly in order to make steady progress; however, one could argue that this knowledge would be assumed for any student embarking upon a Masters course in quantitative finance and, in addition, further guidance would naturally be available where this book is being used as part of a university course. The book's regular use of exercises and examples certainly contribute to a significant difference in the learning process.

In fact, the ways in which the exercises and examples are presented are a major strength of *Stochastic Interest Rates*. Where a concept within a model can be difficult to understand or visualise, the exercises and examples allow the reader to see it in action. For example, the volatility hump within the Mercurio–Moralada model is clearly presented through an exercise that lets the reader produce this for himself and understand why this is happening. An extensive numerical example is also presented within the chapter on implementation and calibration of the LMM, which shows an example of European option pricing by Monte Carlo simulation. This allows the reader to see how a calibration could practically take place on a simple scale. Furthermore, underlying MatLab code and spreadsheet outputs are available as online resources (as well as full solutions to all exercises in the book).

Sections within chapters also have paragraphs labelled “propositions” and “remarks”, which are effectively used, for example, to summarise long proofs or distinguish limitations in an approach presented. This allows the book to flow through discussion and let the reader comprehend the nuances of the model from a practical perspective, rather than getting bogged down by the theory.

Given the practical element to this book, it is surprising to see that the real-world equivalents of some of the stochastic interest rate models presented have not been discussed. Although it is made clear from the start that the models will be presented on a risk-neutral basis, some of the fundamental differences, implications and market practice around the treatment of real-world interest rate models could have been an interesting topic of discussion. In addition, a well-known drawback of the classic LMM is “lognormal blowup”. This term reflects the fat upper tail of the lognormal distribution, which results in a relatively high probability of large interest rates. This concept is not developed within the book (among other LMM limitations).

Overall, *Stochastic Interest Rates* is highly efficient in its delivery and provides the reader with a unique balance of mathematical rigour with practical application in a very niche area. Along with the exercises and examples, it is the natural flow, deep discussion and structure of the book that allows the reader to learn new and cutting-edge concepts steadily, provided they have an inquisitive mind and taste for mathematical formalism.

Advait Kapadia
ALM Actuary at Prudential