# BOOK REVIEWS

## Financial Markets in Continuous Time

BY ROSE-ANNE DANA AND MONIQUE JEANBLANC

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A growing number of mathematics graduates take up a career in companies dealing with financial markets. According to a recent survey, over 50% of mathematics graduates in some countries take their jobs in the finance sector. One of the most important tasks given to mathematicians is 'risk management'. Risk is an inherent part of business, and mathematicians have the training in analysing uncertainties using stochastic calculus and statistical methods. Business strategy is, in mathematical terms, really nothing more than optimising long-term and short-term profits under given conditions. So there is usually a good mathematical method for approaching these problems and finding the optimal winning solution.

In the finance world, the importance of mathematics grows all the time. This is in part due to the revolutionary growth in the financial derivatives markets over the last three decades. The total outstanding notional value of derivatives contracts today has grown to trillions of dollars. Pioneering work by Black, Merton and Scholes, showed that these markets could be studied and understood in terms of mathematical models. Merton and Scholes shared the 1997 Nobel prize in Economics. Black, who got a PhD in Applied Mathematics at Harvard, died before his work was recognized by the Nobel Committee. The construction of a theoretical framework for the pricing of derivative products is one of the major challenges for mathematicians in this field. Although derivatives often come in fancy names, there are really two basic types of financial instruments: forward contracts and options. A forward commits the user to buying or selling an asset at a specific time in the future for a price agreed now. No money changes hands initially, although the buyer has to put up a form of surety to cover potential losses. Options are basically insurance contracts. An option gives the buyer the right but not the obligation to sell or buy a particular asset at a given price on or before a specified time in the future.

In this book, Dana and Jeanblanc have successfully converted a finance problem into a completely mathematical form. For instance, an arbitrage, which involves locking in a risk-free profit by entering simultaneously into transactions in two or more markets, is nicely defined in mathematical terms: An arbitrage is a portfolio with a non-positive initial value and a non-negative value at time 1. No Arbitrage Opportunity (NAO) is an important assumption to derive a fair price for a financial product as this would be the equilibrium solution in the market. Mathematically, the assumption of NAO is equivalent to the existence of a probability measure under which discounted prices are martingales. In proceeding chapters, the mathematics extends and develops, reaching a peak in Chapters 7, 8 and 9. This book is suited to an advanced mathematics students who want to develop mathematics within the framework of finance. In the Preface, the authors say that this book is aimed at graduate students in mathematics or finance. In my opinion, the authors were too ambitious to include finance students as possible audience for this book. Even the notations will be so new to them. For example, infimum and supremum are notations comprehensible only to those who have been to advanced pure physics courses. It would have been extremely useful to have a glossary of mathematical notation as is the case even for a mathematics textbook.

It is not surprising to see more or less one and a half chapters devoted to the derivation of the Black–Scholes equation as it is the most important equation in financial mathematics. Dana and Jeanblanc show various ways to derive the Black–Scholes formula. Discrete and continuous time models are well explained with a detailed work on the Brownian motion in the Appendix. How to optimize the wealth of a portfolio is well illustrated with the optimization theory before the uncertainty attached to interest rates is tackled with stochastic models.

This book reminds me of how compact mathematical signs and equations can be. Here, I would like to draw a comparison between theoretical physics and financial mathematics as I think there is a good similarity. There are many types of approaches in theoretical physics. Some theoretical physicists like very much abstract ideas. For example, string theory is not very different from pure mathematics but the results are somehow dressed with physics terms. Some theoretical physicists work more closely with experimentalists by suggesting realistic experimental setups and analyzing experimental data. Experimental physicists may correspond to practitioners in finance while theoretical physicists to analysts and researchers in financial mathematics. This book looks like mathematics dressed with some financial terms. However, this dressing is so nice that each chapter sounds really interesting.

This book is undoubtedly academically orientated. An extensive list of references will be extremely useful. I would like to recommend this book to postgraduate students or researchers in mathematics or theoretical physics when they want to re-direct their research in finance. However, this book does not seem to be the best buy to a practitioner or anybody who wants to develop a career in real financial market, except those who have been to most of the high-level mathematics courses.

## Computer Algebra Handbook

edited by J. Grabmeier, E. Kaltofen and V. Weispfenning

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This handbook, of over 600 pages, containing almost 200 separate articles and involving as many authors, is an expanded version of a report produced in German in 1993 by the *Fachgruppe für Computeralgebra.* Its aim is to serve as a reference for all aspects of computer algebra and apart from its text it contains a bibliography of over 2,100 items that the editors admit is probably incomplete and which they intend to update on the web. This bibliography is reproduced in several formats on a CD that accompanies the handbook, which also contains links to additional material on some of the packages described. Clearly producing this handbook was a major exercise.

What is not so clear to the reviewer is what exactly this work sets out to be and what its intended audience is. It is divided into five chapters, the first basically historical; the second dealing with technical details of writing computer algebra software; the third treating applications in Physics, Mathematics, Computer Science, Engineering, Chemistry and Education; the fourth contains brief descriptions of some computer algebra software, both general and special purpose, whilst the fifth lists conferences and textbooks on the subject.

One obvious problem of any such work is that it will rapidly become dated. The bibliography is but one obvious such item, but others are the material in chapters four and five. The material in chapter two will presumably remain valid, but in time need supplementing, whilst that in chapter three is merely a few illustrative examples so will have a much longer life.

Any one individual is going to be interested in only a small part of this whole work and the shortness of the articles (averaging less than 3 pages, with some being much less than a page) means that the coverage does tend to be quite superficial. Any work like this, dealing with software that is still under development, will either quickly become dated or else the content will have to be left rather vague and general. This is well illustrated by the article on *Mathematica* (four and a half pages of text and two and a half of graphics) which refers to version 3, whilst version 5.0 has just been released, but is couched in such general terms that the version referred to does not really matter.

Chapter two might be a starting point for someone who wanted to learn about writing computer algebra software or to learn about the mathematics involved in doing so, but I strongly suggest that anyone interested in *using* computer algebra systems will gain more detailed and up-to-date information from the judicious use of a good search engine on the web.