

Preface

Why have we written this book? In recent decades the field of financial risk management has developed rapidly in response to both the increasing complexity of financial instruments and markets and the increasing regulation of the financial services industry. This book is devoted specifically to *quantitative* modelling issues arising in this field. As a result of our own discussions and joint projects with industry professionals and regulators over a number of years, we felt there was a need for a textbook treatment of quantitative risk management (QRM) at a technical yet accessible level, aimed at both industry participants and students seeking an entrance to the area.

We have tried to bring together a body of methodology that we consider to be core material for any course on the subject. This material and its mode of presentation represent the blending of our own views, which come from the perspectives of financial mathematics, insurance mathematics and statistics. We feel that a book combining these viewpoints fills a gap in the existing literature and emphasises the fact that there is a need for quantitative risk managers in banks, insurance companies and beyond to have broad, interdisciplinary skills.

What is new in this second edition? The second edition of this book has been extensively revised and expanded to reflect the continuing development of QRM methodology since the 2005 first edition. This period included the 2007–9 financial crisis, during which much of the methodology was severely tested. While we have added to the detail, we are encouraged that we have not had to revise the main messages of the first edition in the light of the crisis. In fact, many of those messages—the importance of extremes and extremal dependence, systematic risk and the model risk inherent in portfolio credit models—proved to be central issues in the crisis.

Whereas the first edition had a Basel and banking emphasis, we have added more material relevant to Solvency II and insurance in the second edition. Moreover, the methodological chapters now start at the natural starting point: namely, a discussion of the balance sheets and business models of a bank and an insurer.

This edition contains an extended treatment of credit risk in four chapters, including new material on portfolio credit derivatives and counterparty credit risk. There is a new market-risk chapter, bringing together more detail on mapping portfolios to market-risk factors and applying and backtesting statistical methods. We have also extended the treatment of the fundamental topics of risk measures and risk aggregation.

We have revised the structure of the book to facilitate teaching. The chapters are a little shorter than in the first edition, with more advanced or specialized material

now placed in a series of “Special Topics” chapters at the end. The book is split into four parts: (I) An Introduction to Quantitative Risk Management, (II) Methodology, (III) Applications, (IV) Special Topics.

Who was this book written for? This book is primarily a textbook for courses on QRM aimed at advanced undergraduate or graduate students and professionals from the financial industry. *A knowledge of probability and statistics at least at the level of a first university course in a quantitative discipline and familiarity with undergraduate calculus and linear algebra are fundamental prerequisites.* Though not absolutely necessary, some prior exposure to finance, economics or insurance will be beneficial for a better understanding of some sections.

The book has a secondary function as a reference text for risk professionals interested in a clear and concise treatment of concepts and techniques that are used in practice. As such, we hope it will facilitate communication between regulators, end-users and academics.

A third audience for the book is the community of researchers that work in the area. Most chapters take the reader to the frontier of current, practically relevant research and contain extensive, annotated references that guide the reader through the vast literature.

Ways to use this book. The material in this book has been tested on many different audiences, including undergraduate and postgraduate students at ETH Zurich, the Universities of Zurich and Leipzig, Heriot-Watt University, the London School of Economics and the Vienna University of Economics and Business. It has also been used for professional training courses aimed at risk managers, actuaries, consultants and regulators. Based on this experience we can suggest a number of ways of using the book.

A taught course would generally combine material from Parts I, II and III, although the exact choice of material from Parts II and III would depend on the emphasis of the course. Chapters 2 and 3 from Part I would generally be core taught modules, whereas Chapter 1 might be prescribed as background reading material.

A general course on QRM could be based on a complete treatment of Parts I–III. This would require a minimum of two semesters, with 3–4 hours of taught courses per week for an introductory course and longer for a detailed treatment. A quantitative course on enterprise risk management for actuaries would follow a very similar selection, probably omitting material from Chapters 11 and 12, which contain Basel-specific details of portfolio credit risk modelling and an introduction to portfolio credit derivatives.

For a course on credit risk modelling, there is a lot of material to choose from. A comprehensive course spanning two semesters would include Part I (probably omitting Chapter 3), Chapters 6 and 7 from Part II, and Chapters 10–12 from Part III. Material on counterparty credit risk (Chapter 17) might also be included from Part IV.

A one-semester, specialized course on market risk could be based on Part I, Chapters 4–6 from Part II, and Chapter 9 from Part III. An introduction to risk

management for financial econometricians could follow a similar selection but might cover all the chapters in Part II.

It is also possible to devise more specialized courses, such as a course on risk-measurement and aggregation concepts based on Chapters 2, 7 and 8. Moreover, material from various chapters could be used as interesting examples to enliven statistics courses on subjects like multivariate analysis, time-series analysis and generalized linear modelling. In Part IV there are a number of potential topics for seminars at postgraduate and PhD level.

What we have not covered. We have not been able to address all the topics that a reader might expect to find under the heading of QRM. Perhaps the most obvious omission is the lack of a section on the risk management of derivatives by hedging. Here we felt that the relevant techniques, and the financial mathematics required to understand them, are already well covered in a number of excellent textbooks. Other omissions include modelling techniques for price liquidity risk and models for systemic risk in national and global networks of financial firms, both of which have been areas of research since the 2007–9 crisis. Besides these larger areas, many smaller issues have been neglected for reasons of space but are mentioned with suggestions for further reading in the “Notes and Comments” sections, which should be considered as integral parts of the text.

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We are delighted that the first edition appeared in a Japanese translation and thank the translation team (Hideatsu Tsukahara, Shun Kobayashi, Ryoza Miura, Yoshinori Kawasaki, Hiroaki Yamauchi and Hidetoshi Nakagawa) for their work on this project, their valuable feedback on the book and their hospitality to A.M. at the Japanese book launch.

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Further resources. Readers are encouraged to visit the book’s homepage at

www.pupress.princeton.edu/titles/8056.html

and the site

www.qrmtutorial.org

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where they will find supplementary resources for this book. We are particularly grateful to Marius Hofert, not only for his proofreading, but also for his help in developing slides, exercises and R libraries and scripts to illustrate many of the topics in the book.

Special abbreviations. A number of abbreviations for common terms in probability are used throughout the book; these include “rv” for random variable, “df” for distribution function, “iid” for independent and identically distributed and “se” for standard error.