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BOOK REVIEWS

Handbook of Computational and Numerical Methods in Finance, **Svetlozar T. Rachev and George A. Anastassiou** (Eds.), Birkhäuser Verlag 2004, VI+435 p., 15 illus., Hardcover ISBN 0-8176-3219-0.

Svetlozar Todorov Rachev, one of the editors of this book, belongs both to the Department of Statistics and Applied Probability from University of California USA and to the Department of Economics and Business Engineering from Universität Karlsruhe Germany.

The merit of the editors was that they collected twelves articles, each of them treating a computational or a numerical method applied in finance.

Many years the Nobel prize for economics was awarded to mathematicians who applied their knowledge of probability theory, numerical analysis, partial derivatives equations, statistics, in one word the mathematics, to find models in economics. After the establishing of the economical models, some of them become difficult to solve and, as a consequence, impossible to performed their results.

As in other fields of science, i.e. mechanics, where computational and numerical methods were successfully applied, it is the turn of finance to be the „reason" of research for mathematicians and a field in which those who work with applied mathematics find a fertile ground to develop them ideas.

In this book are fruitfully putted together themes from financial analysis like: computation of complex derivatives; market credit and operational risk assessment, asset liability management, optimal portfolio theory, financial econometrics, as well as recent studied themes from computational and numerical methods in finance, and risk management like: Genetic Algorithms, Neural Networks, Monte-Carlo methods, Finite Difference Methods, Stochastic Portfolio Optimization and others.

As the editor Svetlozar Rachev mentioned, the subject of computational and numerical methods in finance has recently emerged as a new discipline at the intersection of probability theory, finance and numerical analysis. The methods employed bridge the gap between financial theory and computational practice and provide solutions for complex problems that are difficult to solve by traditional analytical methods.

The book presents some of the current research collected by the editor and survey articles focusing on various numerical methods in finance. The articles and the authors, in order of appearance are:

1. O.J. Blaskowitz, W.K. H Kärdle and P. Schmidt, *Skewness and Kurtosis Trades*; 2. D.D' Souza, K. Amir-Atefi and B. Racheva-Jotova, *Valuation of a Credit Spread Put Option: The Stable Paretian model with Copulas*; 3. I. Khindanova, Z. Atakhanova, and S. Rachev, *GARCH - Tupe Processes in Modeling Energy Prices*; 4. Kohatsu-Higa and M. Monteri, *Malliavin Calculus in Finance* ; 5. P. Kokoszka and A. Parfionovas, *Bootsfrap Unit Root Tests for Heavy-Tailed Time Series*; 6. S. Ortobelli, S. Rachev, I. Huber and A. Briglova, *Optimal Portfolio Selection and Risk Management: A Comparison between the Stable Paretian Approach and the Gaussian One*; 7. G. Pages, H. Pham, and J. Printems, *Optimal Quantization Methods and Applications to Numerical Problems in Finance*; 8. S. Stoianov and B. Racheva - Jotova, *Numerical Methods for Stable Modeling in Financial Risk Management;* 9. F. Schlotttman and D. Seese, *Modern Heuristics for Finance Problems: A Survey of Selected Methods and Applications*; 10. C. E. Testuri and S. Uryasev, *On Relation Between Expected Regret and Conditional Value-at-Risk*; 11. S. Trück and E. Özturkmen, *Estimation Adjustment and Application of Transition Matrices in Credit Risk Models*; 12. Z. Zheng, *Numerical Analysis of Stochastic Differential Systems and its Applications in Finance.*

Diana Andrada Filip

Songmu Zheng, ***Nonlinear Evolution Equations***, Monographs and Surveys in Pure and Applied Mathematics, Vol. 133, Chapman & Hall/CRC, Boca Raton, London, New York, Washington DC, 2004, xiv +287 pp., ISBN 1-58488-452-5.

Nonlinear evolution equations are partial differential equations with time t as one of the independent variables. Beside their presence in various fields of mathematics, nonlinear evolution equations are also important for their applications in physics, mechanics, material science. For instance, the Navier-Stokes and Euler equations in fluid mechanics, the nonlinear Klein-Gordon equations in quantum mechanics, the Cahn-Hilliard equations in material science are particular cases of nonlinear evolution equations.

The first question in the study of nonlinear evolution equations is that of existence and uniqueness of the solution (at least locally), which is that of the existence and uniqueness of the solution (at least locally) which is usually solved by fixed point methods (the contraction principle and Leray-Schauder fixed point theorem). Another fundamental question, which is vital in applications, is that of global existence and uniqueness and the long time behavior of a solution as the time goes to infinity.

The aim of the present book is to develop in a detailed and accessible manner the basic methods and tools for the treatment of nonlinear evolution equations – the semigroup method, compactness and monotone operators method, monotone iterative methods. These are developed in the six chapters of the boo: 1. *Preliminaries;* 2. *Semigroup Method;* 3. *Compactness method and Monotone Operator Method;* 4. *Monotone Iterative Methods and Invariant Regions;* 5. *Global Solutions and Small Initial Data;* 6. *Asymptotic Behavior of Solutions and Global Attractors.*

Most of the included material appears for the first time in book form, some of it being based on the research work of the author.

The prerequisites for the reading of the book are familiarity with Sobolev spaces and embedding theorems, distribution theory, elements of functional analysis. The required results are enounced at the beginning of each chapter with exact references.

The bibliography counts 171 items.

The book is well written and provide the reader with a good introduction to this area of investigation.

Treating a topic of great importance in nonlinear science, with applications to mechanics, material science and biological sciences, the book is of interest for mathematician (graduate students and researchers) working in this area, as well for people working in the applied domains mentioned above.

Radu Precup

Daniel Li, Hervé Queffelec, ***Introduction à l'étude des espaces de Banach – Analyse et probabilités,*** Cours Spécialisés 12, Société Mathématique de France, 2004, xxiv + 627 pp., ISBN 1-58488-452-5.

The aim of the present book is to show how probabilistic methods can be used to solve difficult problems in Banach space theory and, at a same time, to emphasize the interplay between Banach space theory and classical analysis. It is an advanced course, so the reader is supposed familiar with basic results in functional analysis, real analysis, measure theory and complex analysis. But modulo these standard results (taught in the 2nd cycle of French universities) the book is fairly selfcontained, one of the main targets of the authors being to avoid the use of "by a well known result" or references to other places. To this end some special results in classical analysis, which are not usually taught in general courses as, for instance, Rademacher's theorem on a.e. differentiability of Lipschitz functions, Riesz-Thorin and Marcinkiewicz interpolation theorems, M. Riesz theorem, F. and M. Riesz theorem, and others of this kind, are included with full proofs. Also, Chapter 0, *Notions fondamentales de probabilités,* contains an introduction to classical probability theory, and the *Annexe* to the book is concerned with harmonic analysis on compact abelian groups. Some probabilistic results in Banach spaces, needed in the rest of the book, are developed in Chapters 3, *Variables aléatoires* and 10, *Processus gaussiens.* As the authors point out in the introduction, the book is not on probability in Banach spaces but rather on their applications to the study of Banach spaces.

In the following we shall present some highlights of the book. Chapters 1 and 2 are concerned with bases and unconditional bases in Banach spaces, including Maurey's proof of Gowers' dichotomy theorem.

Type and cotype are discussed in the fourth chapter, culminating with the proof of Kwapien's result that a Banach space which is both of type and cotype 2 is isomorphic to a Hilbert space. Stegall's proof of Lindenstrauss-Rosenthal local reflexivity principle is also included.

Chapter 5 deals with p-summing operators, emphasizing the key role Grothendieck's theorem (every linear operator from ℓ_1 to ℓ_2 is 1-summing) played in the development of the subject initiated by Pietsch. This chapter contains also a proof of Dvoretzky-Rogers theorem on unconditionally convergent series and an introduction to Sidon sets. In fact, Sidon sets and, more generally, thin sets in harmonic analysis and their interplay with Banach space theory form one of the central themes of the book.

Chapter 6 is concerned with the spaces L^p – Vitali-Hahn-Saks and Dunford-Pettis theorems in L^1, the Haar basis in L^p, and a new proof of the Grothendieck's theorem based on a result of Paley. The space ℓ_1 is studied in Chapter 7, having as central result Rosenthal's theorem on Banach spaces containing ℓ_1 and some of its consequences. The main result of chapter 8, *Sections euclidiennes,* is the famous theorem of Dvoretzky on almost spherical sections of convex bodies in finite dimensional spaces. There are included two proofs of this result – one by Gordon (1985) covering only the real case, and the other one by Pisier (1986), based on the phenomenon of concentration of measures developed by Maurey and Pisier, and valid in both real and complex cases.

Chapter 9 is devoted to Davie's construction of a separable Banach space without approximation theory and related results.

Chapter 11 is concerned with reflexive subspaces of L^1, characterizations in terms of the convergence in measure, relations to sets closed in measure and other results. In Chapter 12, *Quelques exemples d'utilisations de la méthode des sélaecteurs,* selectors obtained from independent Bernoulli random variables (ϵ_n) by the condition $I_\omega = \{n \geq 1 : \epsilon(\omega) = 1\}$ are used to study Sidon sets, the vector Hilbert transform, and K-convexity. The results of this chapter belong, in essence, to Bourgain.

The last chapter of the book, Chapter 13, *Espaces de Pisier des fonctions presque sûrement continues. Applications,* is concerned with Pisier spaces $\mathcal{C}^{ps}$.

Each chapter of the book ends with a section of Exercises with results completing those from the main text. They are accompanied by hints, meaning that the proof is decomposed in several steps and the reader has to fill in the details.

By collecting a lot of fundamental results in modern Banach space theory and exposing them in an accessible way, with full details and auxiliary results, the authors have done a great service to mathematical community. The book can be used for advanced graduate or postgraduate course or as a reference text as well.

S. Cobzaş

Elias M. Stein & Rami Shakarchi, ***Real Analysis – Measure Theory, Integration and Hilbert Spaces***, Princeton Lectures in Analysis III, Princeton University Press, Princeton and Oxford 2005, xix + 402 pp., ISBN 0-691-11386-6.

This is a third one of a four-volume treatise on analysis, based on four one-semester courses taught at the Princeton University, and having as purpose to emphasize the organic unity between various parts of the subject and, at a same time, to illustrate its wide applicability to other fields of mathematics and science. The first two volumes were concerned with Fourier Analysis (Part I) and Complex Analysis (Part II). A fourth volume on functional analysis, distribution theory and probability theory is planned. The emphasis in the presentation is on the historical order in which the main ideas and results emerged and shaped the field. For this reason some results are reconsidered and reexamined at various stages, with interconnections and applications to other areas. A typical example is that of Fourier series considered in the first volume within the framework of Riemann integration with applications to the infinitude of prime numbers in arithmetic progression and to X-ray and Radon transform, and which reappear in the third volume (within Lebesgue integration this time) with applications to Besicovich sets and Fatou theorem on the boundary values of bounded holomorphic functions.

Let us pass to a detailed description of the content. Chapters 1, *Measure theory,* and 2, *Integration theory,* are concerned with the Lebesgue measure and integral in $\mathbb{R}^N$. As applications, one proves the Brunn-Minkowski inequality and the inversion formula for the Fourier transform. The third chapter, *Differentiation and integration,* is devoted to a presentation of the deep results on the differentiation of functions with bounded variation and of absolutely continuous functions and the relations with integrability. After presenting in the fourth chapter, *Hilbert spaces: An introduction,* the basic results on Hilbert spaces and Hilbert space operators, the authors study in Chapter 5, *Hilbert spaces: Several examples,* the Fourier transform on L^2, the Hardy space on the upper half-plane and some applications to PDEs. The results on Lebesgue measure and integration from chapters 1 and 2 are reconsidered in Chapter 6, *Abstract measure and integration theory,* from an abstract point of view, with applications to ergodic theory and spectral theory of Hilbert space operators. The last chapter of the book, Chapter 7, *Hausdorf measure and fractals,* contains a short presentation of these topics with applications to space-filling curves and Besicovich like sets.

Each chapter ends with a set of exercises and problems. The exercises are accompanied by hints, smoothing the way to their solutions. The "Problems" sections contain more challenging problems, some of them, marked by an asterisk, of higher difficulty.

The result is a fine book, which together with the previous one and the forthcoming fourth volume, will give a comprehensive and well motivated approach to a lot of core results of analysis. It can be used for graduate or advanced graduate courses on analysis and its applications.

S. Cobzaş