Book reviews

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BOOK REVIEWS

Mircea Grigoriu: STOCHASTIC CALCULUS. Applications in Science and Engineering. Birkhäuser, Basel, 2002, xii + 774 pages, ISBN 0-8176-4242-0, price EUR 100.–.

If one looks at the list of contents of this very useful book M. Grigoriu, then one sees a long list of eight chapters (plus Introduction) divided into a total of 67 sections and even more subsections. This is indeed an impressive list and the actual content of the book proves this first insight to be correct. Chapter 2 of the book under review is devoted to the background in the Probability Theory, starting from description of a sample space finishing Radon-Nikodym Theorem and martingales inequalities. In agreement with author's intentions one can find basic information about a manifold of fundamental notions, ideas and many sketches of proofs. For example, the author discusses (with proofs) the stopping time. Relationship between stochastic analysis and partial differential equations are discussed over many sections. In particular, the celebrated Feynman-Kac formula is presented in section 6. Many applications to physics, ecology, engineering and other sciences are discussed in the last chapter. Each chapter is finished with a Problems section. I believe many will find it useful to have this book on their shelf, because one can find almost everything about stochastic analysis in it. The book is supplemented by quite a long bibliography, so that an interested reader can pursue his study further. The book will be useful to both theoretical and applied scientists. In order to justify my claim that this is a very interesting book let me simply list titles of the remaining 7 sections and of some subsections.

3. Stochastic Processes. 3.9.4.4 Karhunen-Loève representation. 3.11.2 Stopped martingales. 3.14.2 The Lèvy decomposition.

4. The Itô formula and Stochastic Differential Equations. 4.4.2 Simple predictable integrands. 4.6.3 Fisk-Stratonovich integral. 4.7.3 Euler and Milstein numerical solutions.

5. Monte Carlo Simulation 5.3.2.3. Fourier series. Random fields. 5.3.3.3. Point and related processes.

6. Deterministic System and Input 6.2 Random walk method. 6.3 Sphere walk method.

7. Deterministic System and Stochastic Input 7.2.2 Semimartingale input. 7.3 Nonlinear systems. 7.3.1.3 Fokker-Planck-Kolmogorov equations. 7.4.1.1 Earth climate.

8. Stochastic System and Deterministic Input 8.3.1.1 Monte Carlo simulation method. 8.5.1.3 Effective conductivity.

9. Stochastic System and Stochastic Input 9.3.1 Variational Principles 9.4.2 Ising Model 9.4.3 Noise induced transitions 9.5.1 Rainfall runoff model 9.7 Seismology.

Zdzisław Brzeźniak, Hull

Bernhelm Booß-Bavnbek, Jens Høyrup (eds.): MATHEMATICS AND WAR. Birkhäuser, Basel, 2003, 424 pages, EUR 39.–.

The relationship between mathematics and war dates back to ancient times—recall the stories about Archimedes' war inventions, or the use of mathematics in the design of fortifications, sea navigation and ballistics. However, the ideas involved did not go far beyond elementary geometry and calculus. The book *Mathematics and War* focuses on the 20th century when the situation changed rapidly. The cooperation between mathematicians and engineers led to the discovery of modern aerodynamics, cryptography, atomic bomb or digital computers. Of course we are refering to mathematics as a broader discipline encompassing mathematically supported technology (e.g. computer science), too.

The volume consists of articles that have been presented at the *International Meeting on Mathematics and War* held in Sweden, 2002. Among the authors there are mathematicians, army officers as well as philosophers; each describes the relation of mathematics and war from a different perspective. The topics discussed can be roughly divided into three categories:

1. *The role of mathematicians in war research.* During the world wars, many scientists turned from theoretical research to applied mathematics. This is demonstrated on the personal stories of mathematicians including names such as A. Turing, J. von Neumann, N. Bohr or A. N. Kolmogorov. The role of mathematics in Japan is discussed, too.

2. *The moral responsibility of scientists engaged in war.* Ethical issues arising from the application of mathematical theories in war are examined. It is a common statement that mathematicians do not decide on application of their theories, or that if they rejected the military work they would be replaced by someone else. To what extent are these arguments justified?

3. *Mathematical models of war.* Apart from the historical studies the book contains some mathematics, too. The classical approach to describing war in a mathematical way is the Lanchester combat model based on differential equations. As might be expected, this simple model doesn't yield very accurate solution; better results can be obtained using a stochastic description based e.g. on Markovian processes. The book doesn't forget to mention the theory of linear programming (and its connection with game theory) which emerged at the end of the World War Two.

Most of the material presented is related to the events of both world wars; however, it includes examples from Napoleonic wars as well as from more recent history such as the Vietnam war or the war in Yugoslavia. Readers might appreciate the article devoted to breaking the Enigma code which contains some notes on relations between Poland, France and Czechoslovakia during the Nazi occupation.

Antonín Slavík, Praha

Ronald Meester: A NATURAL INTRODUCTION TO PROBABILITY THEORY. Birkhäuser, Basel, 2003, xi+191 pages, ISBN 3-7643-2188-1, EUR 24.–.

It seems that a task to provide an introductory course on probability fulfilling the following requirements arises not so rarely: (A) The course should be accessible to students having only very modest preliminary knowledge of calculus, in particular, with no acquaintance with measure theory. (B) The presentation should be fully rigorous. (C) Nontrivial results should be given. (D) Motivation for further study of measure theoretic probability ought to be provided, hence to content oneself to countable probability spaces is undesirable. R. Meester's book is an attempt to show that all these demands may be fulfilled in a reasonable way, however incompatible they may look at first sight.

The author decided to work only with random variables that are either defined on countable spaces (Chapters 1 to 4) or whose laws have Riemann integrable densities (Chapters 5 to 8) and to show that in this restrictive setting it is still possible to state and prove sufficiently interesting versions of some classical theorems. For example, he proves the arcsine law for a random walk on $\mathbb{Z}$ in Chapter 3, weak laws of large numbers and the central limit theorem for both discrete and continuous random variables, or introduces the Poisson process and studies its basic properties (Chapter 7). He even finds his way how to define infinite sequences of independent random variables (either by binary expansions, or by a special construction in $\mathbb{R}^\infty$ that makes it possible to define quite general sets of probability zero), thus the strong law of large numbers and recurrence of the random walk may be discussed as well (Chapter 6).

Of course, the necessity to do all this with the rather limited tools the author has at his disposal leads sometimes to a bit awkward constructions; sometimes results like the Fourier inversion formula must be invoked in proofs (while usually much more elementary results are given a proof or at least recalled as an exercise); in a few cases I would appreciate a more lucid argument. However, in general the presentation is very clear, the results are well motivated and interesting examples are provided. A detailed discussion of conditional probabilities with well chosen examples showing how the "common sense" may mislead us is particularly worth being mentioned. The text is densely filled with exercises ranging from providing details missing in the proofs to Buffon's needle problem or a definition of a Poisson random field.

Altogether, if you have to read a probability course fulfilling (A) to (D) above, Meester's text might be a good choice. At least, it is certainly not boring.

Jan Seidler, Praha

A. Guzman: DERIVATIVES AND INTEGRALS OF MULTIVARIABLE FUNCTIONS. Birkhäuser, Boston, 2003, x + 319 pages.

The book consists of the following chapters: 1. Differentiability of multivariable functions, 2. Derivatives of scalar functions, 3. Derivatives of vector functions, 4. Integrability of multivariable functions, 5. Integrals of scalar functions and 6. Vector integrals and the vector-field theorems.

The book *Continuous Functions of Vector Variables* of the same author forms the prerequisites of the present volume.

In the first three chapters concerning differentiability of scalar and vector functions connections to partial derivatives and directional derivatives are given, the concept of gradient is introduced and used for studying curves, surfaces and vector fields. Differentiability of the inverse functions is presented and the implicit function theorem is given. Everything is done in a precise and classical fashion.

The remaining chapters are devoted to integration based on the classical concept of Riemann. Fubini theorem and the basic Stokes and Gauss theorems are presented.

The book is evidently intended for undergraduate courses and opens the way for abstract generalization and exploring analysis, differential geometry and maybe also physics.

The book is written very carefully and rigorously. The style is easily understandable with many comments supporting understanding.

Problems with solutions at the end of the book are included.

This book together with the above mentioned volume of A. Guzman is a nice source for a one year course at the undergraduate level.

Štefan Schwabik, Praha

Evariste Giné, Christian Houdré, David Nualart (eds.): STOCHASTIC INEQUALITIES AND APPLICATIONS. Progress in Probability 56, Birkhäuser, Basel, 2003, 276 pages, hardcover, ISBN 3-7643-2197-0, CHF 220.–/EUR 148.– .

These proceedings from the conference on Stochastic Inequalities and their Applications held in Barcelona in June 2002 are a sample of recent advances in endeavour of mathematicians to obtain sharp or, at least, sharper estimations in various fields in statistics and probability.

The book is organized into four parts where the first is devoted to geometric inequalities and contains four contributions on large deviations of linear functionals on an isotropic convex set with unconditional basis, on concentration inequalities on the Riemannian path space and on product spaces (including tail estimates of Brownian motion on a manifold and Khinchine-Kahane inequalities for random series with non-symmetric Bernoulli coefficients), and on unified error exponents in hypothesis testing, data compression and measure concentration.

The second part contains eight papers covering some topics in the theory of martingales, Lévy processes, chaos and independent random variables, such as exponential inequalities, almost sure unconditional convergence of random series in Banach spaces, moment and tail estimates for multidimensional chaoses, an exponential martingales approach to the law of large numbers, moving average processes, speed of entropic convergence in a central limit theorem, non-symmetric Khinchine-Kahane inequality, and improvements in estimating moments of linear combinations of vectors with random coefficients.

The third part contains four articles on empirical processes, namely, moderate deviations, concentration inequalities via an entropy method, ratio limit theorems, and asymptotic distributions of trimmed Wasserstein distances between a true and an empirical distribution function are dealt with.

The last part contains four papers on stochastic differential equations, in particular, a rate of convergence of splitting-up approximations for SPDEs, lower bounds for densities of uniformly elliptic non-homogeneous diffusions, Lyapunov exponents of non-linear stochastic differential equations with jumps, and SDEs with additive fractional noise and locally unbounded drift are studied.

The book will be of interest for researchers in the theory of probability and statistics.

Martin Ondreját, Praha

S. G. Krantz: A HANDBOOK OF REAL VARIABLES. With Applications to Differential Equations and Fourier Analysis. Birkhäuser, Boston, 2004, ISBN-0-8176-4329-X.

The book reviews the most fundamental notions and theorems of the theory of functions of one real variable. Chapter 1 gets us acquainted with fundamental notions of the set theory. Chapter 2 is devoted to sequences. Chapter 3 deals with series. Convergence tests are given. Particular series and operations on series are studied. Chapter 4 is devoted to the topology of the real line. Chapter 5 studies limits and continuous functions. Chapter 6 is devoted to derivatives of functions. In Chapter 7 the Riemann integral and the Riemann-Stieltjes integral are introduced. This chapter contains a brief summary of their properties. Chapter 8 is devoted to sequences and series of functions, especially to their uniform convergence. Chapter 9 proceeds with the study of series of functions. Power series and Fourier series are studied here. Some special functions are defined (the exponential function, trigonometric functions, logarithms, Gamma function). Chapter 10 briefly sketches the theory of metric spaces including Baire's theorem and the Ascoli-Arzela theorem. In Chapter 11 some applications to the solution of differential equations are indicated.

Dagmar Medková, Praha