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BOOK REVIEWS

IONESCU, D.C., LIMNIOS, N. (Eds.) – *Statistical and Probabilistic Models in Reliability*, With a foreword by Marius Iosifescu, Birkhäuser, Boston, Basel, Berlin, 1999, xxxvi+352 pp., ISBN 0-8176-4068-1, 3-7643-4068-1.

This volume consists of twenty–four papers selected by the editors from the sixty-one papers presented at the 1^{st} International Conference on Mathematical Methods in Reliability, held at the 'Politehnica' University of Bucharest on September 16-19, 1997. The conference was co–initiated by the 'Politehnica' University of Bucharest – Romania and the Technological University of Compiègne – France. It is edited within the series "Statistics for Industry and Technology" of the prestigious Birkhäuser Scientific Publishing House.

The analysis and evaluation on the reliability in various types of engineering systems have been extensively developped during the recent decades. The increasing complexity of systems met anywhere (from a huge electrical power plant to a radio receiver) has brought the need for methods and models able to predict the lifetime or service life of such systems, to decide for the best decisions in planning repair/replacement strategies and even inspection/maintenance policies. Such reliability models and methods are necessary (and widely used) in both design stage and during exploitation of the systems. The wide variety of the systems which need reliability analysis and evaluation, together with their increased complexity and sophistication, required more and more advanced mathematical methods and models to be devised. An important issue regards the level to which such methods/models are still applicable while remaining realistic enough. This issue is very well addressed in the Foreword by Prof. Marius Iosifescu.

The variety of practical problems where the reliability concepts are involved naturally implies a rather large variety of the theoretical (mathematical) models. That is why it is not easy to see (and state) what is common to such models. However, a rather general definition of the reliability is a common item. It may be defined as *a measure of the capacity of a system to behave/perform adequately during a specified period of time in a*

given environment. Another common feature of the mathematical methods and models for reliability studies consists in the *extensive use of statistical, probabilistic and stochastic concepts*. Simulation/sampling techniques, representation "tools" for complex failure events (such as various kinds of nets, graphs, event trees, fault trees a.o.) are also often met in the area of reliability based design/engineering. A large enough range of both theoretical models and application problems is covered by the contributions included in the volume we are reviewing. The 24 papers were grouped into three sections: Part I: Statistical methods, Part II – Probabilistic methods, Part III – Special techniques and applications. We cannot do more (in the space of this short review) than enumerating the titles of the contributions with their authors.

Part I: *Statistical modeling and analysis of repairable systems*, by Bo Henry Lindquist; CPIT *goodness–of–fit tests for reliability growth models*, by Olivier Gaudoin; *On the use of minimally informative copulae in competing risk problems*, by Tim Bedford; *Model building in accelerated experiments*, by V. Bogdanovičius & M.S. Nikulin; *On semiparametric estimation of reliability from accelerated life data,* by V. Bogdanovičius & M.S. Nikulin; *Analysis of reliability characteristics estimators in accelerated life testing*, by L. Gerville–Reache & V. Nicoulina; *Chi–squared goodness of fit test for doubly censored data with applications in survival analysis and reliability*, by M.S. Nikulin & V.N. Solev; *Estimation of kernel, availability and reliability of semi-Markov systems*, by B. Ouhbi & N. Limnios. Part II: *Stochastical models of systems in reliability problems*, by V.S. Korolyuk; *Markovian repairman problems – Classification and approximation*, by V.S. Korolyuk, N. A. Derzko & V.V. Korolyuk; *On limit reliability functions of large systems*, I, by K. Kołoworcki; *On limit reliability functions of large systems*, II, by A. Cichocki, D. Kurowicka & B. Milczek; *Error bounds for a stiff Markov chain approximation technique and an application*, by O. Pourret, J. Collet & Jean–Louis Bon; *On the failure rate of components subjected to a diffuse stress environment*, by A. Le Breton & J.-L. Soler; *Modelling the reliability of a complex system under stress environment,* by Christina Zahalca & Mohamed Chardi; *On the failure rate*, by Gh. Oprişan; *Asymptotic results for the failure time of consecutive k-out-of-m systems*, by Brahim Ksir. Part III: *Two–state start–up demonstration technique*, by N. Balakrishnan & P.S. Chan; *Optimal prophylaxis policy for systems with partly observable parameters*, by B.P. Harlamov; *Exact methods to compute network reliability*, by Corinne Lucet & J.-F. Manouvrier; *On matroid base families and the reliability computation of totally amenable systems*, by A. Behr & L. Camarinopoulos; *The computer–assisted analysis of the semi–Markovian stochastic Petri nets and an application*, by A.P. Ulmeanu & D.C. Ionescu; *Incremental ap-*

proach for building stochastic Petri nets for dependability modelling, by N. Fota, M. Kaaniche & K. Karoun; *Lifetime of high temperature working pipes,* by A. Alămoreanu, R. Iatan, R. Chiriţă & R. Ceauşu.

The volume is opened by a *Foreword* due to Prof. M. Iosifescu of Bucharest, followed by a rich *Preface* which gives some general views and also guidance through the subject areas covered by the twenty–four contributions; it was written by the two editors: Dumitru Cezar Ionescu of Bucharest and Nicolaos Limnios of Compiègne. A list of *Contributors*, a *List of tables*, a *List of figures* and a *Glossary of terms* are also useful appendices, as well as the *Index* that closes the volume. The printing conditions are very good, the figures are clear and suggestive.

To conclude, this book that brings together twenty–four contributions to the 1^{st} International Conference on Mathematical Methods in Reliability (held in Bucharest, September 1997) is a very interesting and useful reference for everybody involved in reliability analysis and modeling.

Alexandru Cărăuşu

SUNDER, V.S. – *Functional Analysis Spectral Theory,* Birkhäuser Advanced Texts, Birkhäuser Verlag, Basel, Boston, Berlin, 1998, 241+13p.

This book consists in five chapters and a rather voluminous Appendix and grew out of a course of lectures on functional analysis given by the author at the Institute of Mathematical Sciences, Madras, during the winter semester of 1996.

The first couple of chapters are devoted to what may be usually seen in a first course on functional analysis: normed vector spaces and Hilbert spaces.

The third chapter is concerning to the spectral theorem as a statement about the representations of C^*–algebras both commutative and non–commutative. In particular, the final section of this chapter is devoted to the classification of separable representations of C^*–algebras in the sense of Hahn–Hellinger.

The fourth chapter is devoted to more standard "operator theory" in Hilbert spaces (the traditional theorem for normal operator obtained from Chapter 3 and the spectral analysis of compact operators).

The final chapter is a brief introduction to unbounded operators on Hilbert spaces.

The intended objective of the Appendix was to fill in the possible gaps in the background of the prospective Master's level reader (the course was

initially intended for somewhat mature students in the Ph.D. programme).

The book is punctuated with a lot of exercices having in as purpose not only to learn functional analysis but to do it. We consider the book valuable not only to Ph.D. programme but also to Master's level programme.

Şt. Frunză

BERNDT, R., SCHMIDT, R. – *Elements of the representation theory of the Jacobi group*, Progress in Mathematics 163, Birkhäuser Verlag AG, Basel, Berlin, 1998, 232p, ISBN 3-7643-5922-6.

The Jacobi group is a semidirect product of a symplectic group with a Heisenberg group. It is an important example for a non–reductive group and sets the frame within which to treat theta functions as well as elliptic functions – in particular, the universal elliptic curve.

This text gathers for the first time mateerial from the representation theory of this group in b oth local (archimedean and non–archimedean) cases and in the global number field case. Via a bridge to Waldspurger's theory for the metaplectic group, complete classification theorems for irreducible representations are obtained. Further topics include differential operators, Whittaker models, hecke operators, spherical representations and theta functions. The global theory is aimed at the correspondence between authomorphic representations and Jacobi forms. This volume is thus a complement to the seminal book on Jacobi forms by M. Eichler and D. Zagier.

Incorporating results of the authors' original research, this exposition is meant for researchers and graduate students interested in algebraic groups and number theory, in particular, modular and automorphic forms.

RESNICK, S. – *A probability path*, Birkhäuser Verlag AG, Basel, Berlin, 1998, 472p, ISBN 3-7643-4055-x.

Many probability books are written by mathematicians and have the built in bias that the reader is assumed to be a mathematician coming to the material for its beauty. This textbook is geared towards beginning graduate students from a variety of disciplines whose primary focus is not necessarily mathematics for its own sake. Instead, "A probability path" is designed for those requiring a deep understanding of advanced probability for their research in statistics, applied probability, biology, operations research, mathematical finance, and engineering.

An one–semester course is laid out in an efficient and readable manner covering the core material. The first three chapters provide a functioning knowledge of measure theory. Chapter 4 discusses independence, with expectation and integration covered in Chapter 5, followed by topics on different modes of convergence, laws or large numbers with applications to statistics (quantile and distribution function estimation) and applied probability. Two subsequent chapters offer a careful treatment of convergence in distribution and the central limit theorem. The final chapter treats conditional expectation and martingales, closing with a discussion of two fundamental theorems of mathematical finance.

PATERSON, A., *Groupoids, inverse semigroups and their operator algebras*, Progress in Mathematics 170, Birkhäuser Verlag AG, Basel, Berlin, 1998, 296p, ISBN 3-7643-4051-7.

In recent years, it has become increasingly clear that there are important mathematical connections relating the three mathematical concepts – groupoids, inverse semigroups, and operator algebras. There has been a great deal of progress in this area over the last two decades, and this book gives a careful, up-to-date and reasonably extensive account of the subject matter. The book should appeal to professional matehamticians and graduate students in fields such as operator algebras, analysis on groupoids, semigroup theory, and noncommutative geometry. It will also be of interest to mathematicians interested in tilling and to theoretical physicists whose focus is modeling quasicrystals with tillings. An effort has been made to make the book lucid and 'user-friendly'; thus it should be accessible to any reader with a basic background in measure theory and functional analysis.

MÜLLER, M.W., BUHMANN, M.D., MACHE, D.H., FELTEN, M. – *New developments in approximation theory, 2nd International Dortmund Meeting (ODoMAT) '98, February 23–27, 1998*, International Series of Numerical Mathematics 132, Birkhäuser Verlag AG, Basel, Berlin, 1999, 344p, ISBN 3-7643-6143-3.

This book contains refereed papers presented at the 2nd IDoMAT conference in February 1998. They cover new developments in univariate and multivariate approximation theory. This research area has applications in computer aided geometrical design, a tool in engineering and medical technology (e.g. computerized tomography). This book contains refereed papers which were presented at the 2nd International Dortmund Meeting on

Approximation Theory (IDoMAT '98) at haus Bommerholz, the conference center of Dortmund University, during the week of February 23–27, 1998. At this conference 50 researchers and specialists from Bulgaria, China, France, Great Britain, Hungary, Israel, Italy, Romania, South Africa and Germany paticipated and described new developments in the fields of univariate and multivariate approximation theory. The papers cover topics such as radial basis functions, bivariate spline interpolation, subdivision algorithms, multilevel interpolation, multivariate triangular Bernstein bases, Padé approximation, comonotone polynomial approximation, weighted and unweighted polynomial approximation, adaptive approximation, approximation operators of binomial type, quasi–interpolants, generalized convexity and Peano kernel techniques. This research has applications in areas such as computer–aided geometric design, as applied in engineering and medical technology (e.g. computerized tomography).

BRAMSON, M., DURRETT, R.T. – *Perplexing problems in probability, Festschrift in Honor of harry Kesten*, Progress in Probability 44, Birkhäuser Verlag AG, Basel, Berlin, 1999, 408p, ISBN 3-7643-4093-2.

For almost four decades Harry Kesten has been known throughout the world as a prodigious problem solver. In the 60s, he proved many refined results on random walks and continuous time processes with stationary independent increments. This research continued in the 70s with impressive contributions to renewal theory and branching processes, but soon Kesten's work moved toward topics inspired by physics: random walks in a random environment, diffusions with random coefficients and self–similar processes. The 80s began with his proof that 'the critical probability of percolation on the square lattice equals 1/2', followed by an explosion of results on percolation and first passage percolation. In the late 80s and into the 90s, he obtained deep results on the behavior of percolation near the critical value, used percolation methods to study the Ising model, and proved remarkable results about diffusion limited aggregation and the sub–diffusive fluctuation in first passage percolation. To this day he continues to work on hard open problems, a number of which come from physics. To honor Kesten's achievements, and to highlight important directions for future research, a number of prominent probabilits have written survey articles on a wide variety of active areas of contemporary probability, many of which are closely related to Kesten's work. This festschrift volume is an expression of appreciation and a demonstration of the depth and breadth of his ideas.

LE GALL, J.-F. – *Spatial branching processes, random snakes and partial differential equations*, Lecture in Mathematics, Birkhäuser Verlag AG, Basel, Berlin, 1999, 176p, ISBN 3-7643-6126-3.

This book is intended for postgraduate students and researchers in probability, mathematical physics and partial differential equations who want to learn about some recent developments regarding new probabilistic objects combining spatial motion with a continuous branching phenomenon. No prerequisites are assumed except for some familiarity with Brownian motion and the basic facts of the theory of stochastic processes. Although the text includes no new results, simplified versions of existing proofs are provided in several instances.

Several new important probabilistic objects which combine random spatial motion with a continuous branching phenomenon have been studied extensively in recent years. The purpose of this book is to give a detailed and self–contained account of some of these developments.

The text includes a presentation of the measure–valued branching processes also called superprocesses and of their basic properties. In the important quadratic branching case, the path–valued process known as the Brownian snake is used to give a concrete and powerful representation of superprocesses. This representation is applied to several connections with a class of semilinear partial differential equations. On the other hand, these connections give insight into properties of superprocesses. On the other hand, the probabilistic point of view sometimes leads to new analytic results, concerning for instance the trace classification of positive solutions in a smooth domain.

An important tool is the analysis of random trees coded by linear Brownian motion. This includes the so–called continuum random tree and leads to the fractal random measure known as ISE, which has appeared recently in several limit theorems for models of statistical mechanics.

AUBIN, J.-P. – *Mutational and morphological analysis, Tools for shape evolution and morphogenesis*, Systems & Control: Foundations and Applications, Birkhäuser Verlag AG, Basel, Berlin, 1998, 472p, ISBN 3-7643-3935-7.

The analysis, processing, evolution, optimization, regulation and control of shapes and images appear naturally in engineering (shape optimization, image processing, visual control), numerical analysis (interval analysis), physics (front propagation), biological morphogenesis, population dynamics (migrations), and dynamic economic theory.

These problems are currently studied with tools forged out of differential geometry and functional analysis, thus requiring shapes and images to be smooth. However, shapes and images are basically sets, most often not smooth. J.-P. Aubin thus constructs another vision, where shapes and images are a compact set. Hence their evolution requiring of differential calculus must be studied in the metric space of compact subsets. Despite the loss of linearity, one can transfer most of the basic results of differential calculus and differential equations in vector spaces to mutational calculus and mutational equations in any mutational space, including naturally the space of nonempty compact subsets.

DIJKSMA, A., GOHBERG, I., KAASHOEK, M.A., MENNICKEN, R. – *Contributions to operator theory in spaces with an indefinite metric, The Heinz Langer anniversary volume*, Operator Theory: Advances and applications, 106 (Dijksma, A. et al. (Ed.), Birkhäuser Verlag AG, Basel, Berlin, 1998, 417p, ISBN 3-7643-6003-8.

This volume is dedicated to Heinz Langer, a leading expert in spectral analysis and its applications, in particular to operators in spaces with an indefinite metric, on the occasion of his 60th birthday.

The book begins with his biography and list of publications. It contains a selection of research papers, most of which are devoted to spectral analysis of operators or operator pencils with applications to ordinary and partial differential equations. Other papers deal with time–varying systems, interpolation and factorization problems, and topics from mathematical physics. About half of th epapers contain further developments in the theory of operators in spaces with an indefinite metric and treat new applications. The book is of interest to a wide audience of pure and applied mathematicians.

NADKARNI, M.G. – *Basic ergodic theory*, Birkhäuser Advanced Texts, Birkhäuser Verlag AG, Basel, Berlin, 1998, 149p, ISBN 3-7643-5816-5.

This is an introductory book on ergodic theory. The presentation has a slow pace and the book can be read by anyone with a background in basic measure theory and metric topology. In particular, the first two chapters, the elements of ergodic theory, can form a course of four to six lectures at the advanced undergraduate or the beginning graduate level. A new feature of the book is that the basic topics of ergodic theory such as the Poincaré recurrence lemma, induced automorphisms and Kakutani

towers, compressibility and E. Hopf's theorem, the theorem of Ambrose on representation of flows are treated at the descriptive set–theoretical level before their measure–theoretical or topological versions are presented. In addition, topics centering around the Glimm–Effros theorem are discussed, topics which have so far not found a place in texts on ergodic theory. In this second edition, a section on rank one automorphisms and a brief discussion of the ergodic theorem due to Wiener and Wintner have been added.

This relatively short book is, for anyone new to ergodic theory, admirably broad in scope. The exposition is clear, and the brevity of the book has not been achieved by giving terse proofs. The examples have been chosen with great care. Historical facts and many references serve to help connect the reader with literature that goes beyond the content of the book as well as explaining how the subject developed. It is easy to recommend this book for students as well as anyone who would like to learn about the descriptive approach to ergodic theory.

NISHIYAMA, Y. – *Entropy methods for martingals*, CWI Tract, vol. 128, Centrum voor Wiskunde en Informatica, Amsterdam, 2000, 139p. ISBN 90-6196-490-3.

Conţinutul volumului constituie o versiune revizuită a tezei de doctorat a autorului susţinută, la Universitatea Utrecht, în anul 1998. Metodele entropiei în studiul legii numerelor mari şi problemei limită centrale, pentru procese empirice indexate prin clase de mulţimi sau clase de funcţii, apar după publicarea rezultatelor remarcabile obţinute de R.M. Dudley (1978) privind teoreme limită centrală pentru măsuri empirice. Iniţial, metodele entropiei au fost introduse pentru procese empirice de date independente şi identic repartizate. Cadrul abordării studiului este cel al teoriei martingalelor. Principalele aplicaţii în inferenţa statistică a proceselor stochastice se referă la estimatorii integrali şi de verosimilitate maximă. Volumul se încheie cu trei subiecte independente privind estimarea funcţiei nucleu, logaritmul raportului de verosimilităţi şi un model neliniar de serie cronologică.

Elena Nenciu

BELISTER, E.N. – *Minimax estimation in regression and random censorship models*, CWI Tract, vol. 127, Centrum voor Wiskunde en Informatica, Amsterdam, 2000, 130p. ISBN 90-6196-488-1.

Volumului este destinat studierii problemei estimării minimax a curbei neparametrice, unde prin curbă se înţelege fie o funcţie de regresie, fie o densitate. Sunt considerate următoarele modele: modelul zgomotului alb gaussian, modelul de regresie şi modelul cenzurat aleator. Principala problemă, în cadrul fiecărui model, este determinarea unui estimator asimptotic minimax. Conţinutul volumului este divizat în patru capitole. Capitolul 1 reprezintă o introducere elementară în problema estimării curbei neparametrice, în cadrul modelului zgomotului alb gaussian. In capitolul 2, pentru un model de zgomot "colorat" gaussian se studiază comportarea asimptotică a riscului minimax, pe un elipsoid. Modelul aditiv de regresie, cu puncte echidistante, este studiat în Capitolul 3. Capitolul 4 conţine problema estimării densităţii, în modelul cenzurat aleator. Volumul se încheie cu un apendix conţinând o lemă, o inegalitate şi o teoremă, folosite în capitolele volumului.

Elena Nenciu