# Book Reviews

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# BOOK REVIEWS

Krempaský J. et al.: SYNERGETICS (Slovak). Veda, Bratislava 1988, 261 pages.

The book contains an exposition of methods of various phenomena investigated in physics, chemistry, biology, medicine, astrophysics, cosmology, economy and sociology. These models are used in the book as samples illustrating an analogy of the way in which new qualitative properties of objects investigated in different scientific disciplines are acquired, owing to the influence of parameaters acting on these objects. The idea of unifying all methods and theoretical results concerning the arising of new qualitative properties of real objects in a unique discipline belongs to the theoretical physicist Herman Haken. H. Haken has characterized it as a new theory of the creation of new structures in systems with nonlinear dynamics and he calls it synergetics.

The authors of this book determine the field of research of synergetics by showing exaples of qualitative changes of properties of systems which are studied in different scientific disciplines and they point out the fact that all these changes have the same essence. The task of mathematics is reduced there to a passive auxiliary tool only. There is not sufficiently expressed its active share in the development of nonlinear theories which are parts of various scientific disciplines. However, mathematics, mainly the singularity theory, Thom's catastrophe theory and the bifurcation theory of dynamical systems considerably contribute to the fact that at present a new view of many natural and social phenomena studied within the framework of individual scientific disciplines, is forming. The authors have forgotten that facat. They mention the mathematical bifurcation theory established by H. Poincaré in the last century and the mathematical catastrophe theory in such a sense only that they are parts of synergetics (see page 32). There is no mention of the contemporary generic bifurcation theory and the singularity theory of mappings which form the mathematical foundations of Thom's catastrophe theory and the modern bifurcation theory.

The choice of mathematical literature quoted in the book is not very representative. Text-books containing the foundations of linear algebra, mathematical analysis and the theory of differential equations are quoted. This material is also contained in the first chapter of the book. The authors write in the introduction of the first chapter: "In the next chapters we will see that the synergetics deals with such expressive situations in systems, in which their quality is changing. The description of these situations requires an appropriate mathematical equipment, which is fortunately simple in many cases". It seems to us that these statements are not in accord with such an understanding of synergetics that it contains the mathematical catastrophe theory and the mathematical bifurcation theory (see page 32). Namely, in these theories several mathematical disciplines like the functional analysis, differential and algebraic geometry, differential and algebraic topology, etc. are used. There is not one book in the list of quotations of the book, representing at least partly, the contemporary state of the mathematical bifurcation theory.

The authors assert in the book (see page 26) that up to the present time there do not exist exacatly formulated conditions under which a motion following a limit cycle may occur in a given system. As a unique theorem giving instrucations for calculations of limit cycles the Poincaré-Bendixon theorem is mentioned. What purpose has the well-known theorem of the Hopf bifurcation? For the determination of conditions for the arising of the limit cycles functional methods based on the so-called Ljapunov-Schmidt reduction method and topological methods based on the degree theory of mappings have been developed and for the determination of the number of limit cycles of plane dynamical systems the theory of Abelian integrals is used. A partial survey of methods used in the study of limit cycles and also much other information concerning the theory of nonlinear dynamical systems and their bifurcations can be found e. g., in the books of V. I. Arnold: Geometric Methods in the Theory of Ordinary Differential Equations, Springer-Verlag, New York 1983, 1988 (Original Russian edition, Nauka, Moscow 1978) and S. N. Chow, J. K. Hale: Methods of Bifurcation Theory, Springer-Verlag, New York 1982.

In spite of the above mentioned shortcomings of the book it is valuable especially because it contains many models studied in different scientific disciplines, which illustrate the way of qualitative changes of the properties of systems of a various charactear. The book is written in an interesting style and can be understood by many readers. It gives a certain picture of the possibilities of creating real models and the study of their qualitative properties.

The contents of the book are as follows: Chapter I: 1. Mathematical minimum of synergetics, 2. Contents and the aim of synergetics, 3. Possibilities of applications of synergetics in nonphysical systems, 4. Synergetics and thermodynamics, 5. Dissipative structures, self-excited oscillations and deterministic chaos, 6. Stochastic methods, 7. Solitons, 8. Organization in systems. Chapter II: 1. Synergetics in astrophysics and cosmology, 2. Synergetics in chemistry, 3. Synergetics in biology, 4. Synergetics in ecology, 5. Central nerve system as a synergetic complex system, 6. Heart arythmia, 7. Synergetics in economy, 8. Synergetic modelling of some social systems, 9. Methodological problems of synergetic modelling of social dynamics.

*Milan Medveď, Bratislava*

Székely G.J.: PARADOXES IN PROBABILITY THEORY AND MATHEMATICAL STATISTICS. Akadémiai Kiadó, Budapest 1986, 250 pages.

The attractive title of the monograph is in a nice agreement with its contents. Everybody who is interested in probability theory and mathematical statistics will find in this book not only entertainment. More than fourty paradoxes supplemented by comments on their history and mathematicians connected with them are explained and elightened from several points of view.

The reading of this book is helpful not only for students but for teachers as well. It represents a suitable supplement of each textbook on probability theory and mathematical statistics. It helps to prevent a missunderstanding of basic concepts, theorems and solutions of well known problems.

The monograph is divided into five chapters. The first chapter "Classical paradoxes of probability theory" (1—69) is devoted to the following problems: the paradox of dice, Mére's paradox, the division paradox, the paradox of independence, the paradox of bridge and lottery, the paradox of giving presents, horse kickings, telephone calls, misprints, St. Petersburg paradox, etc. The chapter ends with problems for the reader, e.g. the paradox of conditional probability, Borel's paradox, absurdities and fallacies of Lewis Carrol.

The second chapter "Paradoxes in mathematical statistics" (70—136) deals with Bayes' paradox, estimators of expectation and variance, least squares, correlation and regression paradoxes, sufficiency, maximum-likelihood, interval estimations, testing a hypothesis, Rényi's paradox of information theory and Student's test. Sixteen problems for the reader are given at the end the chapter.

The third chapter "Paradoxes of random processes" (137—173) contains problems on branching processes, Markov chains, Brownian motions, waiting time (do buses run more frequently in the opposite direction ?), random walks and martingales. Quickies at the end of the chapter contain, e.g. Jacob and Laban's paradox from the biblical story, the Pinsker paradox of stationary processes and others (together 8 problems).

The fourth chapter "Paradoxes in the foundations of probability theory. Miscellaneous paradoxes" (174—223) deals with paradoxes of random natural numbers, the Banach-Tarski paradox, Monte-Carlo method, an incalculable probability, random graphs, paradox of expectation, the first digit, zero probability, infinitely divisible distributions, paradoxes of characterization, factorization, irreducible and prime distributions. Eight problems for the reader are at the end of this chapter.

The last chapter "Paradoxology" (224—225) can be considered as an epilogue of the book.

Notations, tables, name index and subject index (228—250) are a useful help for the reader.

*Lubomír Kubáček, Bratislava*

Reiman, J.: MATHEMATICAL STATISTICS WITH APPLICATION IN FLOOD HYDROLOGY, Akadémiai Kiadó, Budapest 1989, 330 pages.

The present book is an introduction into mathematical statistics and probability models related to flood problems. The book is intended for hydrologists and hydrology students interested in the flood protection activities, and it needs only an elementary knowledge of statistics.

The book is divided into three parts, eight chapters, appendix and literature.

The first part is devoted to the foundations of the probability theory. The author explains fundamental notions as, for examples, probability, random variables, distributions, examples of distributions, laws of large numbers, Markov processes, etc. The majority of the illustrated examples is related to the hydrological problems of the River Tisza in Hungary, since during floods the River Tisza and its tributaries are a menace to one fifth of the Hungarian territory, inhabited by one fourth of the population.

The second part deals with statistical inference. Here are presented such notions as sample, empirical distribution functions, statistical estimation, testing of statistical hypotheses, Student t-test, F-test, $\chi^2$-test with applications, test of exponentiality, the Kolmogorov—Smirnov two-sample test, etc.

The notions in both chapters, as well as in the third, are illustrated by examples from hydrology. In particular, it is shown that the number of floods follows the Poisson law which is virified through a $\chi^2$-test.

The final, third part, deals with the methods of analysing stochastic relations between random variables. This is an important field of practical hydrology which uses correlation and regression analyses. Moreover, some new methods which were established recently are introduced here.

The appendix contains the elements of combinatorics, tables of normal, $\chi^2$, Student, Poisson distributions, respectively. The list of references contains 49 items.

*Anatolij Dvurečenskij, Bratislava*

Mišík, L.: FUNCTIONAL ANALYSIS (Slovak), ALFA, Bratislava 1989, 570 pages.

The book is intended to be a systematic exposition of the functional analysis to university students. It gives a modern survey which concerns the contents and methods of the linear parts of the functional analysis.

The theory is systematically treated in ten chapters. The first two have an introductory character. They contain the basic facts of the set theory and the theory of topological and metric spaces. The third chapter is devoted to the study of the structure of linear spaces from the algebraic point of view. In the fourth chapter the basic structures of functional analysis (linear normed space, Banach space, linear topological space, locally convex space) and continuous linear maps are introduced. The Hahn—Banach Theorem and the Krein—Milman Theorem are introduced in the fifth chapter. Chapter 6 is devoted to the geometry of the Hilbert spaces. The seventh chapter deals with applications of the Baire Category Theorem. It contains the Banach—Steinhaus Theorem, and, the Open Mapping and the Closed Graph Theorems. A systematic exposition of the theory of linear functionals and continuous linear operators is given in chapters 8 and 9. The last, tenth chapter is devoted to the Radon, the Bochner and the Pettis integrals.

Every section of the book is complemented by exercises. These "Exercises" (a total of 317) are devoted to further results and supplements, in particular to examples and counter-examples. Many of them with hints.

The whole book is written in a style easy to understand. It fulfils all claims to be a successful textbook much in demand.

*Pavel Kostyrko, Bratislava*

Medveď, M.: DYNAMICAL SYSTEMS (Slovak). Veda, Bratislava 1988, 253 pages.

The book under review is the first of that kind in Czechoslovak mathematical literature dealing with the dynamical systems theory. The book with such contents obviously cannot cover the whole subject of the contemporary dynamical systems theory. The author of the book, an outstanding specialist in this field, selected the material according to his scientific orientation. Therefore the essence of the book consists of the bifurcation theory, which is the contents of Chapter 5 and also of the main part of Chapter 6.

Chapter 5 is devoted to generic bifurcations of one-parameter families of differential equations in a neighbourhood of their singular points and periodic trajectories as well as to bifurcations of fixed and periodic points of one-parameter families of diffeomorphisms. A part of Chapter 6 is devoted to bifurcations of singular points of multiparameter systems and then to the Šiľnikov bifurcation and to the global Hopf bifurcation. The rest of the chapter is devoted to some global bifurcation problems of the dynamical systems theory.

The book is intended as a text book and therefore the author accumulated a necessary mathematical apparatus in the first two chapters from algebra, topology, analysis and mainly from differential geometry and topology.

The third chapter contains the essential notions, one can say today, of the classical dynamical systems theory on differentiable manifolds. The fourth chapter represents a transition between "the general" and "the special" part of the book, containing the theory of the invariant manifolds. The special attention is devoted to the theory of center manifolds having the importance in the bifurcation theory.

The book has in many places the features of a guide through the literature on dynamical systems and it enables the reader to gain easily and quickly a good survey of this theory. The author's aim was to enable the reader to be able to work actively in the dynamical systems theory after reading the book and I think he was successful. The book will be useful for all mathematicians dealing with the dynamical systems theory.

The book certainly deserves to have a much better editorial set-up mainly "the optical" arrangement of the pages.

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