



# Book Selection

Edited by Uwe Aickelin

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## A Natural Introduction to Probability Theory

R Meester

*Birkhauser, 2003. 204 pp. £18.00*

*ISBN: 3764321881*

As the title suggests, this book is an introductory course in probability theory (PT). The book provides a rigorous treatment of PT basics without the use of measure theory (MT). In the case of continuous variables, probabilities are defined using probability density functions.

This approach allows one to teach rigorously PT to first or second year students in mathematics or related disciplines. It also provides an excellent motivation to study MT later on. When I was an undergraduate student (in the 1970s in the USSR), I was taught PT in year 2 using an approach similar to the one in this book. MT was taught only in year 4. My experience allows me to certify the validity and successfulness of the book's approach.

Despite relative compactness, in my view, the book may be considered as the main source of a semester course in PT. The book contains basic theory and many exercises. Certainly, more exercises might be required especially for more able students. Discrete PT is provided in the first four chapters. They include the arc-sine law for random walks and a simple version of the central limit theorem. A part called 'Intermezzo' is a bridge between discrete PT and continuous PT.

Chapters 5–8 are devoted to continuous PT. The material includes results on the Poisson process and the full version of the central limit theorem. Chapter 9 shows the limitations of the book's approach and indicates a more general approach based on sigma-algebras. The author's views on the practical use of PT are given in Appendix A; Appendixes B and C

provide advice on further reading and answers to selected exercises.

To my mind, the most serious disadvantage of the book is absence of solutions to the exercises. This limits the use of the book (for example, as a source for self-study). Nevertheless, the book can be recommended to undergraduates in mathematics or related disciplines and even to some more advanced readers, who wish to refresh quickly their basic knowledge of PT.

*Royal Holloway College, University of London* G Gutin

## Scientific Computing: An Introductory Survey

M Heath

*McGraw-Hill, 2003. 563 pp. £40.00*

*ISBN: 007112229x*

Scientific computing, traditionally called numerical analysis, deals with the design and analysis of algorithms for solving mathematical problems in science and engineering numerically. It is distinguished from other subjects of computer science in that, it is concerned with quantities that are continuous in nature, as opposed to discrete. The second factor that distinguishes scientific computing is its focus on the effects of approximations.

This book presents a broad overview of numerical methods for solving all the major problems in scientific computing, including linear and nonlinear equations, least squares, eigenvalues, optimization, interpolation, integration and differentiation, ordinary and partial differential equations, fast Fourier transforms, and random number generators. It has done well in proposing the fundamental

approach of scientific computing thoroughly by describing how to utilize the two distinguishing features stated above in each of the problems. This book also emphasizes the specific motivation and ideas for each individual problem. To give an example that is familiar to the OR audience, in Chapter 6 'Optimization,' the book describes many algorithms designed for a variety of optimization problems and discusses their advantages and disadvantages in terms of robustness, efficiency, accuracy, and implementability. In fact, these criteria are discussed throughout the book. This chapter focuses on the algorithms originally designed for nonlinear continuous optimization problems with a short section on linear programming. Considering that this is a review book, the risk of losing favour among discrete optimization people, I think, is minimized.

In the book, general concepts and issues are introduced in the first chapter and discussed in detail in subsequent chapters for specific types of problems. Some materials presented in early chapters serve as building blocks to design sophisticated algorithms for more complex problems, such as matrix factorization, interpolation with basic functions, and finite difference approximation. Another feature of this book is that each chapter has a section listing available software and a section introducing historical notes. The book also contains more than 160 examples illustrating most of the algorithms, and 500 review questions, 240 exercises, and 200 computer problems.

As written in the preface, the book could be used as the text for a comprehensive, one-semester course on numerical methods for senior undergraduates as well as graduate students depending on the purpose it serves.

I highly recommend this book to upper-class undergraduates and graduate students, mainly computer science, mathematics, and engineering majors. Its comprehensiveness and modern perspective, as well as the software pointers provided, also make it a highly useful reference for practicing professionals in the OR society who need to solve computational problems. As a textbook, its price is reasonable.

*University of Pittsburgh*

N Kong

**Operations Research/Management Science at Work (International Series in Operations Research and Management Science)**

E Kozan and A Ohuchi (eds)

*Kluwer Academic, 2003. 440 pp. £93.00*

*ISBN: 0792375882*

In 'Operations Research/Management Science at Work', editors Erhan Kozan and Azuma Ohuchi have compiled 27 articles that investigate current applications of operations research (OR) and management science (MS). Although it

may not be clear from the title, the articles are academic research papers, rather than case studies of OR/MS methods being applied in industry.

The papers' authors are primarily from Australia and Japan, with only two papers originating elsewhere. The industries covered in the book represent a diverse range of situations, from agriculture to manufacturing to electricity distribution. However, this diversity is not necessarily apparent from a glance at the table of contents, which would have benefited if the articles had been organized into sections based on the industry being studied.

The authors have certainly attempted to choose the highest-quality papers available for this project, but the book would have been even better if they had been able to include more articles directly related to specific industrial problems. There are a number of papers in the book that discuss developments in OR methods without applying them to a specific situation.

Although it can be difficult in a project such as this, it would have been very interesting to provide some articles that included a co-author from an industrial facility or similar setting. One of the complaints that is often levelled at the field of OR is that much of the research is only academic, without consideration of how the results can be applied in a practical situation. Perhaps a future project could explicitly target how industries are applying OR methods to achieve real benefits.

The articles in the book that are most interesting are those that describe how solutions to a specific industrial problem were developed and compare the effectiveness of different strategies in developing solutions. For example, Lake, Ferreira, and Kozan studied maintenance scheduling on railway track using three different heuristic methods. They were then able to test the methods using data from Queensland Rail in Australia.

The book contains several additional examples of applied work, such as the study of mate selection in dairy cattle by Abbass, Towsey, Kozan, and Van der Werf and the study of locating and routing of programs in a video-on-demand system by Ouveysi, Sesana, and Wirth.

One feature that was lacking in many articles was illustrations of the problem being addressed and the solution procedures used. The number of equations required for some of the methods can be overwhelming to everyone except the most experienced OR analysts and illustrations can be useful in clarifying or simplifying the mathematics of a situation.

A pleasant exception to this was the paper of Saito, Ohuchi, and Maeda on the use of concept maps for collaborative learning.

Figures throughout the article illustrated the structure and usage of the concept maps so that they are clear to the reader.

This book is relatively specialized and seems to be more suitable for the academic OR/MS researcher rather than the

practitioner seeking developed solutions to problems that they may be facing. Owing to the diversity of applications and solution methods that are included, this book would be most effective when purchased for a library, where people with a variety of interests can access it.

University of Ohio

D Masel

**Optimization and Industry: New Frontiers (Applied Optimization)**

PM Pardalos and V Korotkikh (eds)

*Kluwer Academic, 2003. 352 pp £116.00*  
*ISBN: 1402011873*

The book emphasizes the increasing scope of the optimization discipline by showing its suitability and applicability to technological, financial, and industrial innovations. The book gives researchers and managers the possibility to understand the ongoing changes in optimization by presenting some of its accomplishments and future developments in specific fields.

The book is a collection of papers presented at the International Conference on Optimization and Industry held in Australia and jointly organized by the Center of Applied Optimization, University of Florida and the Faculty of Informatics and Communication, Central Queensland University. The 15 articles included in the book cover some of the latest advances in optimization problems related to telecommunications, power industry, supply chain management, aerospace engineering, air traffic management, to name a few. However, this diversity of the papers does not really allow for an in-depth treatment of those fields.

In the next paragraphs, I focus on some of the most promising articles. The second article is related to the construction of a replenishment plan for a multi-stage supply chain characterized by fixed-charge costs. The associated problem is an NP-hard network flow problem. The authors develop two heuristics-based optimization procedures for solving the network flow problem, and evaluate the results for different scenarios.

The fifth article presents a new ground holding model in air traffic management. Considering different weather and airport capacity scenarios applicable to Sidney airport, the results obtained with the model presented in this article and that of Navazio and Romanin-Jacur are compared. The new model is shown to be better in case of harsh weather conditions, and in the presence of reduced airport capacity.

The book fulfills the authors' objectives and is written at a level suitable for graduate students, researchers and practitioners in decision science, computer science, information technology, management science and business. The book can be used as supplementary reading material for a graduate course. The references could have been expanded, and an

index should have been included. The price of the textbook can be prohibitive for students.

Rutgers University

M Lejeune

**Introduction to the Theory of Cooperative Games (Theory and Decision Library C)**

B Peleg and P Sudholter

*Kluwer Academic, 2003. 388 pp. £84.00*  
*ISBN: 1402074107*

Whereas competitive game theory is normally concerned with a number of independent players, each of whom is interested in maximizing his profit or minimizing his losses, cooperative game theory deals with the situation in which players can work together in groups to their mutual advantage. Cooperative games appear to be less well known than their competitive counterparts, but they have many practical applications in industry, commerce, defence, government and so on. It is therefore not surprising that there exists a large body of literature on the subject. This new book by Peleg and Sudholter is the latest addition.

I think it is best to begin by stating what the book is not, rather than what it is. It is *not* an introduction to game theory in general. The reader will find no mention of payoff matrices, zero-sum games, the prisoners' dilemma, Nash equilibria, or any of the other concepts that are central to competitive game theory. The focus is exclusively on cooperative games, which in my view is justifiable because they are less well known. It is also not a book for the complete novice: the authors dive into theoretical discussions of coalitions, utility, payoff vectors and so on right from the start, with very few examples for the reader.

It is also fair to say that the book does not give a completely objective and unbiased overview of the field: the authors quite clearly state that they follow the *axiomatic* approach throughout. In this approach, various properties are defined which could be expected to be held by fair solutions to any cooperative game. These properties are called axioms. Then, various existing solutions (the nucleolus, the core, the modiclus and so on) are examined to see which of these axioms they satisfy. I personally find the axiomatic approach quite natural, so I was happy with the general approach, but it may not appeal to everybody.

Having made the above disclaimers, I will now outline the structure of the book. In an initial introductory chapter, the authors define various key concepts: cooperative games, coalitions, utility, axioms and so on. The remainder of the book is divided into two main sections. The first section, consisting of nine chapters, deals with games with transferable utility. Chapter 2 introduces these games and explains that they can be monotonic, superadditive, convex, balanced, and so on. It also gives brief definitions of some of the solutions which have been proposed in the literature for

such games. The following six chapters examine each solution in turn: the core in Chapter 3, the bargaining set in Chapter 4, the prekernel, kernel and nucleolus in Chapter 5, the prenucleolus in Chapter 6, the epsilon-core in Chapter 7, and the Shapley value in Chapter 8. In each of these six chapters, a detailed examination is made of the axioms that each solution satisfies. Chapters 9 and 10 then go on to examine continuity issues and dynamic bargaining, respectively. The second section, concerned with games with non-transferable utility, consists of only four chapters. Chapter 11 gives various formulations of non-TU games. Chapter 12 is concerned with properties of the core. Chapter 13 examines variants of the Shapley value in the non-TU case and, finally, Chapter 14 discusses bargaining sets.

I found the book fairly easy to read, although one would not want to read it all in one sitting as it is very mathematical. The presentation is clear and precise and I did not spot any major errors or typos. I only have two complaints. First, I would have liked to see more examples to illustrate the points made. For example, when I read the definitions of convexity, (weak) superadditivity, monotonicity and so on in Chapter 2, it took me a long time to understand how a game could be weakly superadditive without being superadditive, or superadditive without being monotonic, and so on. Eventually I was able to construct my own examples in order to understand the distinctions, but the authors could easily have given a couple of examples so that the reader could avoid having to make the effort. My second complaint is more personal: my background is in combinatorial optimization and I would have liked to see more mention made of combinatorial games such as the spanning tree game, the travelling salesman game, the vehicle routing game, and so on. There is a brief mention of the spanning tree game on pp. 19 and 20, but that's about it.

To sum up, the book gives an excellent introduction to cooperative games, although with a clear bias towards the axiomatic approach. I think that the book would be useful for graduate and doctoral students who are about to embark on research in this field. It would also make an excellent reference text for more experienced researchers who already have some familiarity with cooperative games. The book is a little expensive, although this is true of most academic books. According to the Kluwer web site, a paperback edition is due out in 2004, at the more reasonable price of EUR 45.00/USD 50.00.

*Lancaster Management School*

A Letchford

**Delivering Excellence in Health and Social Care: Quality, Excellence and Performance Measurement**

D Fillingham (Foreword) and M Moullin

*McGraw-Hill, 2003. 248 pp. £20.00*

*ISBN: 0335208886*

Best value, TQM, quality protects, benchmarking, clinical governance, etc students and practitioners in health and social care will recognize these terms as staples in the steady stream of 'guidance' and exhortation emanating from the supposedly slimmed down and hands off regime at the Department of Health etc. Are these terms mere sound bites of spin? Or, do they represent valuable concepts, for which useful tools exist that can be marshalled in the challenging task of delivering high-quality responsive health and social care services to an increasingly informed public with rising expectations? This book provides a useful guide through this marshy swampland.

The sub-title, 'quality, excellence and performance measurement', defines the three parts that make up the book's structure. In the first part, on quality, we are first introduced to the reasons why quality is important and different approaches to its definition. The book then overviews different approaches to quality improvement, including the philosophies of three of the quality 'gurus' (Deming, Juran and Crosby), and reviews quality initiatives in health and social care, including also relevant national standards/schemes such as 'Investors in People' and 'Charter Mark'. The third and final chapter in this part then looks at quality standards and quality systems, dealing with the topics of setting and monitoring service standards, and quality systems, including ISO9000.

The second part of the book, five chapters in all, focuses on excellence. The first chapter in this part introduces the European Foundation for Quality Management's Excellence Model.<sup>1</sup> Moullin's view of the Excellence Model is that it provides a useful overall framework within which other approaches can be integrated, and he takes the reader through the steps involved in using the model for organizational self-assessment. Helpful diagrams and checklists are included, including especially on 'using the model if limited time is available'. The other four chapters in this second part then focus on areas that represent enablers within the model: first on leadership, policy and strategy; second on people development and involvement; third on partnerships and user involvement; and fourth on process improvement. It is these four chapters that I found less satisfactory than other parts of the book, since the fields they each cover are very large, and thus the treatment in each chapter is necessarily highly selective.

The third part of the book concentrates, in a single substantive chapter, on performance management. This presents a number of different approaches, including the performance prism, the balanced scorecard and the excellence model, as well as discussing performance indicators for quality and best value, and the measurement of user perceptions and expectations. The emphasis here, as elsewhere, is on how local health and social care organizations can use these approaches for themselves. Thus there is no detailed consideration of the methodology currently used by the Department of Health to assess star ratings for Trusts or

indeed of the work of the Commission for Health Improvement in its clinical governance reviews. This enables some highly controversial areas to do with the performance management of local organizations by the national level to be sidestepped; for just a glimpse into these, see the fascinating news coverage in the *Health Service Journal*,<sup>2</sup> published the very week I started to write this review.

The book succeeds in providing a nice balance between academia and practice. While it will fail to satisfy many academics in terms of a comprehensive coverage or detailed critique of the academic literature in many of the areas it overviews, it does provide a good series of signposts into this literature from the various approaches and tools discussed. It is thus aimed at the practitioner rather than the academic. Its presentation of a range of different approaches to quality and performance management and the provision of some simple comparisons between them, rather than the attempt to sell a single approach, is likely to be particularly welcome. One further advantage of the book is its use of a variety of well-chosen examples from across the health and social care field.

In conclusion therefore, this would be a welcome addition to the library and tool kit of anyone working in the health or social care field, and that includes OR practitioners. It is also a book that students will find useful, for its clear and accessible introductions to many of the different approaches to quality and performance measurement.

## References

- 1 European Foundation for Quality Management (1999). *The European Foundation for Quality Management Excellence Model: Public and Voluntary Sectors*. European Foundation for Quality Management: Brussels.
- 2 McLellan A (2003). Star ratings: the insider story. (*Health Service Journal* 113) (5886): 3–5.

South Bank University

A Taket

## Distributed Decision Making

C Schneeweiss

*Springer-Verlag, 2003. 528 pp. £67.00*  
*ISBN: 40402012*

This book is considerably extended with regard to its first edition of 1999, with the title 'Hierarchies in Distributed Decision Making'. The author has added chapters on supply chain management, service operations, and multi-agent systems, and extended existing chapters, which cover topics such as principal agent theory, production planning, coordination through communication and negotiations.

The structure of the book is well chosen: Part I provides the basic concepts of distributed decision-making (DDM), Part II describes general applications, and Part III focuses on leadership and coordination processes. The main

achievement is unification of several DDM problems, where typically decisions are made at different levels, often involving multiple decision makers. Early in Part I, a set of coupling equations is presented which describe the mathematical modelling and optimization suitable for general DDM problems. In later chapters, these general equations are specified in more detail to fit with specific DDM problems.

It is indeed valuable to see how many different DDM problems, which at first sight often appear not to share many features, share the same mathematical structures and fit the same general coupling equations. The different DDM problems addressed are presented with great clarity and detail, leading however to sometimes quite boring pages of optimization problem formulations with many constraints, requiring much mathematical notation to be introduced which frequently is not used further in the text. The book is almost encyclopaedic; it discusses many topics in great detail and one struggles to get excited when reading it. This latter aspect could have been better if more examples were used, with actual solutions of DDM problems instead of just mathematical formulations in terms of optimization problems. New to this edition are nine exercises, with solutions, which would perhaps have fitted better as examples in the text.

I do not think that this book could serve as a text book for a course on DDM, although it does have great value for students who want to understand how many different problems are linked, from a mathematical perspective. Lecturers in operational research may also benefit from the detailed presentation of the individual topics: creating examples and exercises is relatively straightforward.

On the choice of topics, I was a bit disappointed that little attention has been paid to random aspects in decision-making, where for example one may wish to use Bayesian methods. There is great scope for DDM problem formulations from adaptive perspective, where decisions adapt to statistical information whenever this becomes available. Of course, the very nature of some of these DDM problems includes different levels of information, and information becoming available at different moments, but the randomness, and often necessary use of subjective beliefs about random quantities, are not discussed in detail.

To summarize, I think this book has great value as it shows how many different DDM problems share very similar mathematical structures. It is, however, not a book to read from cover to cover, and it is also not suitable as text book. It certainly deserves a place in academic libraries, and provides a lot of material that can be further developed by lecturers in operational research, or related management science topics, into interesting course materials.

University of Durham

F Coolen

**The Nonlinear Workbook: Chaos, Fractals, Cellular Automata, Neural Networks, Genetic Algorithms, Fuzzy Logic with C++, Java, SymbolicC++ and Reduce Programs**

W-H Steeb

*World Scientific, 2003. 600 pp. £24.00*  
*ISBN: 10240260*

The study of nonlinearity in dynamical systems has been of high interest for the past 2 decades. A nonlinear system does not have explicit formulas. There are plenty of journals in this field and departments are flourishing, particularly in Mathematics. Nonlinearity rules...in nature as well as in man-made systems. Chaos is directly linked with nonlinearity.

Chaos is stochastic behaviour occurring in a deterministic system. Another way of describing it is sensitive dependence on initial conditions as in the famous words of Edward Lorenz; 'Predictability: Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas?'

James Gleick's book 'Chaos' is an excellent introduction for the layman and is not full of formulae to put you off, so do read it.

In this uncertain world, nonlinearity obviously affects the economy with its complex financial markets and with supply and demand dependent on many factors, one being the climate. It is not all simple and linear.

The Nonlinear Workbook is an interesting book full of nonlinear programming in C, C++ and Java written by an author who is involved with the International School of Scientific Computing. The basic concepts are mapped out, with definitions, theorems and algorithms.

The book attempts to balance practical computation and underlying mathematical theory, which succeeds if you have good programming knowledge and degree level mathematical knowledge. There are more than 100 programs; however, if you want to learn about nonlinearity, it is best to consult a textbook: 'An Introduction to Dynamical Systems' by Arrowsmith and Place is highly recommended.

The Subject areas include nonlinear and chaotic maps, time series analysis, autonomous systems in the plane, nonlinear Hamilton systems, nonlinear dissipative systems,

nonlinear driven systems, controlling and synchronization of chaos, fractals, cellular automata, solving differential equations, neural networks, genetic algorithms, gene expression programming, discrete wavelets and fuzzy sets and fuzzy logic.

The book uses simple language, is well organized and programs are separated from the text to avoid confusion. The explanations are clear and diagrams are used for clarifications. With 612 pages, 'The Nonlinear Workbook' provides you with more than enough to explore, understand and implement whatever system you can program.

The topics of interest in the OR field may be

- Studies of chaotic time series, for quantitative characterization of deterministic chaos.
- The Hurst exponent, used in the study of financial markets.
- Fractals (scale-independence and self-similarity are included in the properties).
- Fuzzy logic in decision-making and controlling problems.

This book is ideal for anyone wishing to explore the world of such dynamical systems numerically. More than 100 written programs can let you create images, computations and carry out techniques. You can adapt the programs to suit your own requirements.

So if you are researching nonlinearity in an economic/financial field this is ideal, especially as there are explanations and the minimum mathematical background is provided.

The International School of Scientific Computing provides courses in these subjects if you wish to study further.

I recommend this book to anyone who has basic experience in programming, a mathematical foundation and wishes to explore this area further. Having 'met' Chaos 5 years ago, I still find it fascinating. This sensitive dependence on initial conditions affects us all, from the weather (very British, I know) to a chance meeting with a beautiful stranger.

*University of Surrey*

P Ali