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# Book selection

Edited by JM Wilson



**Decision Theory and Decision Analysis: Trends and Challenges**

S Rios (ed)

*Kluwer Academic Publishers, London, 1996. xv + 294 pp. £66.75. ISBN 0 7923 9466 6*

Decision analysis and decision theory have expanded substantially over recent years from the chapter on decision making and decision trees in operational research and management science texts to a well developed body of literature (and software) covering both the quantitative and behavioral aspects. This text is a valuable contribution to this body of literature. It is the published outcome of the conference *Decision Making: Towards the 21st Century* held in June 1993 at the Real Academia de Ciencias de Madrid

The text covers nearly 300 pages, produces the work of 36 experts in the area in twenty chapters, and is divided into three sections, Overviews (four chapters), Theory and foundations (seven chapters), and Applications (nine chapters). This is a sound balance because ultimately decision making is about making decisions in the business and organizational world.

The four chapters in the overview section are extremely readable, covering the prescriptive orientation of decision making, namely a synthesis of decision analysis, behavioral decision making, and game theory; recent development in utility theory; decision influence diagrams and their uses; and a structured model for approaches in decision making (a pyramid of decision approaches). I felt this part would be of great value to practitioners and to final year undergraduates and MBA students.

Part II, Theory and Foundations, containing a set of very strong theoretical papers, will repay very careful study for it is from here that applications will emerge in the future. The areas addressed embrace direct decision making where there is no prior information concerning underlying distributions; the Ellsberg phenomenon; robust decision making, rational comparisons and numerical representations; topological characterizations of posets; and inference in multidimensional Gaussian processes.

The final part of the text covers a wide range of applications, including such areas as lotteries, auctions, MCDM in relation to economic analysis, NP-complete job-shop scheduling, multiple choice in an oligopolistic market, and soil pollutants. Other chapters were of a more general nature and covered stochastic dominance for elliptical distributions involving applications in Bayesian inference; optimal hypothesis testing with a vague prior-involving a consideration of the decision maker's attitude towards ambiguity as well as risk; and experiments in robust decision making involving a consideration of the adequacy of expected utility theory and the factors which may influence inconsistencies in decision making.

As becomes a set of academic and conference papers, the referencing is particularly valuable for those who wish to follow back the trail to articles, papers and books cited. I would conclude this review by noting that this is an excellent book and will give extra insight and depth to those whose interests lie in the area of decision theory and analysis. However, except for specialist master's students

with good mathematical background, I do not feel that I could say that this is a text that could be generally recommended for student use without tutor guidance. The pricing of this hard cover edition would, I believe, restrict its purchase to organizational or university libraries.

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## Managing Business Processes BPR and Beyond

C Armistead and P Rowland

*John Wiley and Sons, Chichester, 1996. xiv + 362 pp. £24.95. ISBN 0 471 95490 X*

The book is divided into five parts. The first part is called 'Setting the Scene'. It consists of an introduction and two additional examples. One is from the private sector and the other from the public sector. Both articles set the stage for the balance of the book. The rest of the parts of the book follow this format with an introduction followed by examples or topics concerned with the subject matter of the part.

The second part is entitled 'Business Processes', which consists of three chapters all written by Armistead and Rowland. They are concerned with the concept of business processes and how they might be managed to the advantage of a corporation or public instituation. Part 3 is entitled 'Perspectives From the Operating Disiplines'. In this part the authors allowed some ideas other than their own to enter into the discussion. There are several articles, including one called Strategic Management and Business Process Reengineering (BPR) which I found to be very informative, that were not written by Armistead and Rowland. Part 4 is entitled 'Perspectives From the Enabling Disciplines'. This section caught my attention mainly because I am interested in building models to be used in an informational management enviroment. If one wished to plan ahead, one must be able to model the present in such a way that changes can be introduced creating a new model. It is then possible to determine which model offers the best advantages. In this way one might avoid the pitfalls of steaming full speed ahead into the uncharted waters of change. Knowing what might enable you to conduct BPR is critical to developing a model that will reflect reality. With this as my motivation, I found Part 4 especially interesting.

The last part 'Case Studies', provides some very interesting contexts or scenarios. The chapter 'Reengineering Customer Support in Hewlett-Packard'gives an excellent example of what was referred to as modelling in the previous paragraph. Figures 21.1 and 21.2 provide an example of how shifting and reconnecting the processes in an organization can provide new insights into how to improve the management of business processes, the theme of the book.

In summary, in my opinion, this book provides a number of useful insights to the OR analyst. It covers the topics in one book that are covered in a whole host of books. It is the condensed nature of this book which makes it practical to own. I recommend the book for one's personal library.

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## Power, Ideology and Control

JC Oliga

*Plenum Press, New York, 1996. xxi + 321 pp. $59.50. ISBN 0 306 45160 3*

I found this book difficult to read and very difficult to review. On the one hand, I have a great deal of sympathy with and admiration for anyone who wishes to grapple with the ideological premises of systems thinking and management science; on the other hand, this book is not a good advertisement for such endeavours.

The volume is an example of the work that has arisen from the systems theorists who have gathered around Robert Flood and Michael Jackson, and in particular the journal Systems Practice. Readers of JORS will be familiar with the debates between, amongst others, John Mingers, Paul Keys and Peter Checkland. To summarise crudely, Checkland (along with others such as Churchman and Ackoff) have presented critiques and 'softer' alternatives to the hard, 'scientific' model of systems thinking which is the dominant ethos of most of the papers published by JORS and other operational research journals. These ideas have been picked up, and challenged, by others who have sought to incorporate ideas from social theorists and philosophers, notably Habermas and Foucault, and to develop the idea of a systems thinking which has emancipatory intent. In other words, people who think about systems (such as operational researchers) should eschew philosophical and political naivety and understand that the very way people think about the world and construct problems reflects particular economic and social interests. Systems thinking is not a neutral, objective science whose application can be divorced from issues of social control and ideology.

Despite its importance, all this is old news. The depressing thing about Oliga's book is that after an exhausting and convoluted tour of these ideas, there is little which advances the debate and nothing whatsoever to assist those engaged in practice or research. The author covers the ground, but in a way which will do little to inform those who are not already informed: if you are not sure of the meanings of Weltanshauung or Verstehen, or you are unfamiliar with the work of Burrell and Morgan,[1] this is not the book for you.

The discussion proceeds with almost no use of examples, until the introduction of two tokenistic case studies in Chapter Twelve, which warrant three pages each, and barely any sensible discussion. Both cases use secondary data with no discussion of the ideological commitment of the material used, which rather undermines the rather lame point being made (that the powerful can put a spin on the interpretation and constitution of 'events').

Towards the end of the book the author attempts to précis Habermas's Theory of Communicative Action, a heroic effort hindered by the use of largely incomprehensible and under-explained diagrams drawn from Oliga's earlier papers. The closing section of this chapter fails to draw any coherent conclusions from the material presented, but introduces a new idea which is not obviously connected to anything previously mentioned: ironically, this is that coherence should be a criterion of truth (p. 268). Maybe this is a joke.

The penultimate chapter leaps, with no warning and little explanation, to an unspecific discussion of the general problems of developing countries. The reader is given a momentary glimpse of how some ideological ideas about development might be deconstructed, but the argument seems to be rather shallow compared to, say, what might be found in any copy of New Internationalist magazine. Indeed, the final recommendation is that 'developing countries consider adding to their externalist emancipatory tasks the idea of social movements grounded in universal ethical principles (p. 288)'. The unblinking use of the last three words in that sentence makes one wonder if the author was the same person who had written the preceding 80 000-odd.

Overall, then, the book is a disappointment. There are lots of references to the literature, at one point (p. 87) 43 are concatenated within one pair of brackets, but there are some odd omissions; the discussion of ideology makes no reference to Terry Eagleton's helpful and influential book,[2] and the critical accounting literature is barely touched. The reader's sympathy with the author's declared intentions is stretched by the inclusion of pointless and pretentious subtitles to the sections ('Towards self-clarity and self-will: must we remain helpless and ignorant of ourselves?', 'Can we not shape our own destinies').

The physicist Alan Sokal[3] recently perpetrated an entertaining prank on the readers of the cultural studies journal Social Text. He wrote an article deliberately devoid of logic or evidence, but full of jargon and cheap references to modish philosophy. The piece was accepted and published, allowing the author to point out to the world what he had done. Sokal's justification was that his action might help improve the quality of writing and thinking in that field. Perhaps someone might try a similar wheeze in the field of systems theory; or perhaps someone already has.

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## References

1 Burrell G and Morgan G (1979). *Sociological Paradigms and Organisational Analysis*. Heinemann: London.
2 Eagleton T (1991). *Ideology: An Introduction*. Verso: London.
3 Sokal A D (1996). Transgressing the boundaries: towards a transformative hermeneutics of quantum gravity. *Social Text* **46/47**; 217–252.

## Probability Models and Statistics. AJ Mehdi Festschrift

AC Borthakur and H Choudhury (eds)

*New Age International, New Delhi, 1996. xviii + 263 pp. $45.00. ISBN 81 224 0879 6*

This book represents a collection of 18 papers in honour of the Indian statistician J Medhi on the occasion of his 70th birthday. J Medhi is perhaps most widely known for his book 'Stochastic Processes'[1] which is now in its second edition. The processes that Medhi has been particularly involved in are those of queueing, inventory, reliability and time series and it is these areas that the papers in this collection broadly address.

The editors have done a good job in ordering the papers sensibly, although it must be pointed out that a reasonably large number of typographical errors have slipped through. The papers start with a look at some theoretical aspects of statistical processes including convexity, submodularity and Hadamard differentiability. In particular, a paper by Yao applies some of these aspects to Markov processes and in turn to three 'good' OR problems: the joint setup problem, production with trial runs and the sequential quality control problem. This paper is a good example of a balance between theory and application.

Other areas of Markov processes are explored in further papers. Athreya gives some interesting results about population models where there is growth and geographical migration, Mazumdar *et al* use a Markov model to find the mean and variance of the production costs of electricity production in the United States and Tipper and Dawson make good use of control theory (in particular, Lyaponov stability) to find bounds on the settling time for finite Markov processes (useful quantities in justifying the use of steady state solutions).

There is only one paper in the collection looking at the area of time series, and in it Rao introduces the idea of cumulant generating functions to lead to the bispectral density function for a time series. This function allows the identification of nonlinearity and the study of chaos in the series. A broader area covered in the papers is that of queueing theory. Of relevance to the telecommunications business (a growing area in the current information age) are papers on queues where customers arriving to find there are no free channels are lost to the system. Both Tijms and Hogenkamp and Chaudhry and Gupta present well-written

papers on this area. Medhi's son, D Medhi, also contributes a paper in this field, giving call blocking formulas when the arrival rate is given by a variety of different distributions.

Other areas addressed in the papers include inventory systems, repair rates and failure rates. Cho *et al* look at ways of judging and optimising repair and purchasing decisions in systems where repairs may or may not be carried out on returned items. On failure rates, Mukherjee gives a good review of current ways of estimating the failure rate function based on a sample of lifetimes. Finally, two papers are given that look at new types of distribution. The first, by Sen and Jain, looks at the cluster generalised negative binomial distributions that may be useful where traditional binomial distributions fail. The second, by Basu, presents a bivariate geometric distribution useful for failure rates in discrete bivariate systems.

This collection of papers presents a wide ranging look at the current state-of-the art in stochastic processes. The papers provide a survey of some areas (and most of the papers have a good list of references) and current research in others. Either way the results involve a large degree of theory and make use of many mathematical and statistical techniques. There is also a host of interesting applications, making the collection of interest to the OR practitioner. However, papers are not for the uninitiated and are probably best suited for those with undergraduate statistics knowledge who wish to find good introductions to new areas in statistics and probability.

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## Reference

1 Medhi J (1994). *Stochastic Processes*, 2nd edn. Published simultaneously by Wiley Eastern Ltd., New Delhi and John Wiley and Sons, Inc: New York

## Stochastic Programming Problems with Probability and Quantile Functions

AI Kibzun and YS Kan

*John Wiley and Sons, Chichester, 1996. xiii + 301 pp. £35.00. ISBN 0 471 95815 8*

This book deals with stochastic optimization, but from a point of view which is different from that of most published books on this subject. The authors devote this monograph to the analysis of optimization problems in which the objective is in the form of a probability function or a quantile function, opposed to the usual choice of optimizing the expected value of a random variable. The authors give in the first chapter some illuminating examples to convince the reader of the usefulness of this approach. Indeed, in some cases, optimizing the expected value of a criterion (a loss function) might lead to paradoxical situations. It should be clear to most people that, particularly when dealing with risky situations (for example those arising in many environmental problems) minimizing the expected risk might turn out not to be a good strategy, whereas maximizing the probability of keeping the loss below some pre-specified threshold might be more sensible.

This book contains an in-depth analysis of the theoretical aspects of probability function optimization. While the probability function might easily be seen as the expected value of a suitable random variable, its non-smoothness makes the analysis of the resulting optimization problem sufficiently special and hard to deserve an independent treatment. The authors deal also with objective functions in the form of quantile functions. This latter model becomes useful in those problems in which it is not clear, a priori, how to fix a sensible threshold for the loss function. In these cases it might prove more reasonable to fix the risk, that is to fix in advance a confidence level, and to optimize in order to find such a threshold. In this case one is looking for the minimal threshold which limits the loss with a pre-specified probability.

In the first chapter the authors introduce the main definitions and describe in some detail applications in the fields of finance, aircraft landing platforms, wind forecasting, air ticket reservation systems, hospital budgeting, water supply systems, satellite orbit correction, and even soft landing on the moon. All of these examples are indeed interesting and presented in a good didactical style. Most of the examples are accompanied by explicit computations and/or simulations for small dimensional practical examples.

The following chapters contain the theoretical and algorithmic details. In the second chapter basic notions on convexity and its relationship with stochastic programming are recalled; several estimation procedures are introduced in Chapter Three, while Chapter Four is devoted to the presentation of algorithms for the approximate solution of stochastic programming problems.

The book is not for the casual reader. Although it is well written and all the relevant mathematical results are proven, I think it can be profitably used only at a postgraduate level. One of the merits of the book is the fact that it brings together much material which was scattered around in different journals and reports, most of which were not easily accessible or never published in English.

I have just a single minor criticism to make: after the first interesting chapter on such diverse applications, the reader is very willing to know all of the theoretical and algorithmic details and to know how they can be applied to real-world problems. However, no mention is made of actual applications in the book. The examples, which derive indeed from actual applications, are solved as 'toy' problems, mostly with didactical purposes. I would have liked to see a fifth chapter in which the solution to some of

those problems, with real data, is approached by means of the tools presented in the book.

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## The Simulation Metamodel

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*Kluwer Academic Publishers, Norwell, Mass, 1996. xvii + 202 pp. £62.95. ISBN 0 792 396480*

In the context of simulation, a metamodel is a simpler analytic model, typically but not exclusively taking the form of a multiple regression model, which seeks to relate the key input parameters of a particular simulation model to its key output measures. It is thus an *external* model, treating the simulation as a 'black box', where the simulation itself is more an *internal* model, seeking to represent relevant features of the behavior of the real world system.

I commonly have mixed feelings when I approach an article or text on metamodels in simulation. It is not that I question the potential or theoretical benefits of metamodels. They may be an aid to finding the best control parameter combination; or they may be a tool for identifying relationships between parameters and behavior that are otherwise obscured by the complex simulation or by the real system (both points being clearly argued in this monograph). My concerns are practicalities, in particular:

(a) To fit a metamodel to a simulation requires the output from a very large number of simulation model runs. Who in industry has that amount of time available, or, if given that time, would not secure the solution or insight with fewer runs than that necessary to create the metamodel?
(b) If a multiple regression model is such an adequate predictor of reality, is the intermediate stage of simulation necessary? (The logical answer to this would be that the real-world data cannot be collected–which may beg other questions.)
(c) Advocates of metamodels appear to have a tendency, once a metamodel has been created, to disregard the simulation and give the metamodel an authority of its own. Yet the simulation had constraints regarding the real world domain within which it was an adequate predictor, and the metamodel can only add to those constraints.

As an academic monograph on metamodels, this text does not address (a) or (b) and does show signs, at times, of (c).

However, the book does make its case for the use of metamodels in the understanding or interpretation of more detailed and complex simulation models. It discusses the creation and validation of metamodels, a corresponding methodology, and a brief overview of some current research. The text majors on linear additive and multiplicative multivariant regression models, first and second order, citing Barton[1] for other formulations but neglecting Neural Networks as metamodels, for example Hurrion[2]. The book has extensive references, although omitting work by Gardenier, for example Gardenier[3].

Overall, this is a book for University libraries wishing to provide a full literature base for simulation research and teaching.

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### References

1 Barton RR (1994). Metamodeling: A State of the Art Preview, *Proceedings of the Winter Simulation Conference*, 237–244.
2 Hurrion RD (1992). Using a neural network of a simulation model, *J Opl Res Soc* **43**: 333–341.
3 Gardenier TK (1990). PREPRIM as a pre-processor to simulations—a cohesive unit, *Simulation* 65–70.

## Global Optimization (3rd edition)

R Horst and H Tuy

*Springer, Berlin, 1996*. xviii + 727 pp. DM 248.00. ISBN 3 540 61038 3

I accepted this book for presentation with the ulterior motive to test the impact of theory once touched upon but not quite learned at a postgraduate OR course, almost thirty years ago and never used since. Well the news is that theory can still be meaningful, although it makes frustrating and occasionally traumatic reading. Following the authors' suggestion it was of course necessary to be re-immersed into sources of elementary real analysis, linear algebra and convexity theory but comprehension would have been an impossible task if the book lacked clarity.

This is an elegant state-of-the-art book aggregating concepts and methodological developments of a relatively closed group of researchers, and even occasionally proposing alternative algorithms. The task of the authors is the confrontation, if not solution, of multi-extremal (namely with many local extreme points) global optimisation problems (namely eventually yielding a globally optimum solution). It is obvious from the sources encountered that there is a thriving Vietnamese (ex-North) global optimisation community linked with the West possibly via some post-socialist researchers.

The book is in three parts. Part A (Chapters I to IV) is a dense overview presenting the global optimisation problem in its entirety even if telegraphically. Part B (Chapters V to IX) is a detailed account of approaches to concave minimisation. Part C (Chapters X and XI) addresses more general non-linear problems, dc programming and Lipschitz.

Chapter I introduces the formulation of the *standard global optimisation problem, the concave minimisation problem* (with a very interesting enumeration of special cases like integer and bilinear programming), *dc programming* (dc standing for 'difference of two convex functions'), and *Lipschitzian optimisation*. Throughout these expositions there is an effort at clear definitions of concepts (including elusive ones such as that of *robustness*, of a *Lipschitzian* function and of *dc functions*). Furthermore there is an explicit attempt at close correlation between mathematical formulations and real life problems, although the latter are mentioned only casually. Lastly, there is a dense bibliography marking latest developments.

Chapters II to IV present the basic methods developed over thirty years ago for tackling global optimisation problems. Chapter II introduces the group of *outer approximation* (constraint dropping or *relaxation*) methods in their generality, whereby the objective function is optimised (minimised) by relaxing initially the feasible set to an obviously larger and simpler set (containing the feasible set) and then applying a process of re-approaching the feasible set by checking and cutting (namely, introducing a suitable additional constraint, a generic method called '*cutting plane*').

This process of approximating from without, by re-applying moderate degrees of complexity, evidently should not lead to a surrogate problem with the complexity at its initial level. It is fascinating how different in performance are some of the algorithms devised. With some pride, understandably, the authors show that the algorithm with which they were closest associated (via a co-authorship) was for one problem 40 times faster than another (8 mins of CPU time on an IBM-PC/AT as opposed to 303 min).

The classes of cuts are more closely specified in Chapter III, with the introduction of the concept of a *valid cut* and the special cases such as *stronger (deeper) valid cuts, valid convexity cuts, valid concavity cuts* (introduced by one of the authors in 1964) and cuts using positive or negative extensions of the edges (of the polyhedron). Lastly, Chapter IV introduces another approximation/relaxation generic technique, that of *branch and bound* where elementary bounds for Lipschitzian and dc functions are investigated.

Part B continues and deepens the investigation of methods for global optimisation problems by focusing on concave minimisation over a convex set. These techniques are chiefly repetitions of the generic methods already presented (cutting, successive approximation, successive partition).

Chapter V deals with cutting methods of the basic concave programming problem (BCP), called *concavity cuts*, as an extension of Chapter III. *Facial cut algorithms* and *cut and split algorithms* are introduced as well as *the concave quadratic programming problem (CQP)*, a special case of the original problem BCP. There is extensive analysis of the merits of the various algorithms as well as close links with state-of-the-art bibliography.

Chapter VI goes deeply into *successive approximation* methods refining Chapter II from *outer approximation* into *inner approximation, convex underestimation, concave (polyhedral) underestimation* and henceforth *polyhedral annexation* with *rank k* (special case *two*) *quasiconcave minimisation* problems. Polyhedral annexation leads at times onto *concave polyhedral underestimation*. While the subcategories of methods might appear complicated, it should be borne in mind that the objective is invariably to find a global optimal solution with the least number of iterations, and to achieve that goal some methods are more efficient than others.

Similarly, Chapter VII investigates in detail *successive partition* methods (the readers may be reminded that these are branch and bound operations) presenting in detail *conical* algorithms, introduced as early as 1964 by Tuy (a critical date in South East Asia; heavens knows why his second oldest reference in the book is lagged by 17 years), *simplified* algorithms and *rectangular* algorithms with a god-sent example.

Chapter VIII addresses the same simplification goal in problems of large size and complexity from another angle, that of *decomposition* into simpler equivalent problems, usually linear programming problems. Methods developed in the previous chapters are tried (branch and bound procedures developed in Chapter VII above, as well as polyhedral underestimation and outer approximation methods of Chapter VI). An interesting special case of decomposition is presented more analytically, that of concave minimisation that relates to networks (the *minimum concave cost flow problem* and its variants, the *uncapacitated minimum concave cost flow problem* and the *single source uncapacitated minimum concave cost flow problem*).

Lastly of Part B, Chapter IX presents special problems of a non-convex nature which can be reduced to concave optimisation (presumably to exploit the ready developed algorithms for concave minimisation). Such cases are the *bilinear programming problem* already discussed under *deep cuts* in Chapter V, and *complementarity problems* (*concave complementarity* or the simpler, *linear complementarity*).

Part C is much smaller than Part B, consisting of only two chapters where the authors attempt a generalisation of the non-linear problems (dc programming and Lipschitz) presenting some of the more recent research findings on algorithms developed by their affined group (to adopt one of the current neologisms).

The book is in its third edition despite its highly specialised, technical (mathematical and computational) subject matter. Surely it will draw its inelastic readership which is bound to disregard its high price, as the previous editions did. For the simply curious non-initiated, it will certainly convey the research trends and the neologisms, an

impressive number no doubt, but it will make quite hard reading. The book is not inviting for just an overview. While the authors evidently strived for a synthesis and their concepts are clearly developed, they chose the gradual introduction as their educational method. This results in significant repetition of concepts and procedures between parts, often not keeping a uniform notation, something that is clearly a disadvantage. Perhaps a readership algorithm with iterations, would have assisted the table of contents.

As previously noted, potential practical applications are mentioned, but only in passing. There are few case studies and examples of actual functions that are optimised. Curiosity grows about how these algorithms, some of them extremely efficient, have been applied. Have they solved difficult problems otherwise insolvable or have they just economised on computer time?

Another query is about the comparison of performance of these wonderful algorithms with heuristics and simulation? There is an analogy of this comparison with numerical methods and abstract algebra. Take, for instance, the diamond cutting problem, a special case of the design centring problem which occupies a prominent position, after all diamonds are worth even the mathematician's time, in Part C under dc programming. The problem is to cut the largest possible diamond of a prescribed form out of a rough polyhedron. Surely this problem has taxed the minds of diamond cutters, whether with a mathematical mind or not, from the inception of diamond cutting and efficient heuristic solutions definitely exist (now with computer-aided design they should even have higher efficiency). Can there be a strong proof that an algorithm is more cost-beneficial than a simple graphical method on the computer? In many instances it has been proven that the intuitive/heuristic strategy is only seemingly irrational.

The above doubts should not be construed as anti-mathematical Philistinism, on the contrary: Knowledge and mathematical elegance cannot be straightjacketted to applications, but they why not leave the methods at their mathematical Olympus (and their supportive journals) instead of trying our best to identify practical problems even remotely befitting the algorithmic solutions of initially theoretical investigations?

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**Mathematical Classification and Clustering**

B Mirkin

*Kluwer Academic Publishers, London*, 1996. xv + 428 pp. £140.00. ISBN 0 7923 4159 7

Classification and clustering is the pivotal methodology for our understanding of data. It is studied in a wide variety of subject areas from taxonomy and experimental data analysis in the sciences through the social sciences to widespread use in commerce and industry. In many modern businesses, quality classification and clustering is vital to commercial success. As a simple example, we might consider the insurance business where we are all familiar with insurance prices being dependent upon the class of car we drive, the type of area we live in, etc. The clustering of cars, postcodes, etc. into classes with similar characteristics is typical of the type of problem this book addresses.

This is an impressive and scholarly book which, according to the author, has three main goals. First, it purports to be a reference book for the vast amount of theory and algorithmic techniques developed in this field. Second, it is claimed to be a text book and, third, it is a presentation of the author's and of his Russian colleagues' results, put in the perspective of current developments. We will consider these goals individually.

Firstly, let us consider the book as a reference book. The first observation that has to be made is that the book does contain a wealth of valuable material which has not been gathered together in such a methodical way heretofore. The bibliography citing 352 references in the area is useful but the index is disappointing and strangely structured. There are also some notable gaps in the survey. Coverage of complexity theory is scant and there is only a passing mention of the use of techniques such as genetic algorithms, simulated annealing or tabu search, all of which can be particularly useful in clustering. These, however, are relatively minor gripes since overall the book does explain a large number of ideas and techniques in a very clear and readable fashion. The quality of writing is high, type setting clear and diagrams suitably illustrative.

As a text book, it is probably most suitable for post-graduate use, perhaps on a Master's course. There is clearly an overabundance of material and a teacher would be wise to limit study to particular topics. Chapter One, which includes a discussion of classification forms and functions, is essential. It is there that basic data formats are discussed and the scope and goals of clustering are defined. Chapter Two on data geometry would then follow naturally. The prerequisites for all the remaining chapters have then been covered. A suitable course would probably include Chapter Three which gives a review of clustering algorithms. This should then be enlarged by the inclusion of in-depth studies of a range of algorithms selected from the remaining chapters. Usefully, the text includes a dozen illustrative, though small, real-world data sets with corresponding clustering problems and solutions; these would prove particularly useful as class examples. Although each chapter begins with a clear description of its purpose and ends with a discussion session, there are unfortunately no suggested exercises suitable for student use. The major problem though is the price of this tome—very few students in the UK will be able to afford it!

Mirkin's work in this field has been largely in *approximation clustering* an area which has been developing since the early seventies. Using this approach, major clustering

techniques have been reformulated as locally optimal approximation algorithms. This gives a much firmer mathematical foundation to the subject and, within this framework, a range of methods have been further developed. These are all well covered in the book. There is also some completely new material, for example the cluster-by-cluster versions of the K-means method described in Chapter Four. The book therefore achieves the author's third goal relatively successfully.

In conclusion, this is an important, well written text. It will be of interest to a wide range of readers and is vital to any OR specialist interested in the fields of data analysis and clustering, in whatever particular application area he or she might be working. It is primarily a reference book but might be useful as a text for a postgraduate course with a large KDD component.

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**Nonparametric Methods for Quantitative Analysis (3rd edition)**

J Dickinson Gibbons

*American Sciences Press, Columbus, Ohio*, 1997. xvi + 537 pp. $70.95. ISBN 0 935950 37 0

As you might expect, most of this book consists of explanations of a large number of statistical tests with accompanying statistical tables. This edition has several additions to what was already a thick book and so the coverage is very wide. After about 40 pages of preliminaries, we begin with 60 pages on goodness of fit for one sample against a given distribution. Two hundred pages later we come to 100 pages on correlations and associations; but we still have two short chapters to go. Included on the way are tests on location and scale, randomness, and comparison of the distributions of two parent distributions. And it is not in large type either!

Each chapter has plentiful exercises, with answers given to even numbers. One of the strengths of the book is the large number of examples which use real data with references given to the original case study.

The book is quite even in style and quality. Descriptions of tests normally begin with a numerical example which is solved before giving a general description and rationale for the test. Often the numerical example is then taken up again or extended. There is no calculus and any proofs are incidental to a background explanation of the tests themselves.

One innovation is that the book includes many examples of printouts from various statistical packages. However, I could not see why. In no sense was the book a manual on how to use the named package, nor were there any insights into what were usually self-explanatory and very brief computer reports.

The author has chosen to order her subject according to the type of problem being dealt with, for example correlation, goodness of fit, etc., rather than a more mechanical indexing system based on number of samples, type of measurement etc. This is a better than average solution to a very difficult problem. However, it does raise the question of why the book has separated out nonparametric tests for discussion.

Jean Gibbons is unapologetic about writing what she calls a cookbook of methods, rather than teaching her readers to become statisticians. When I was at school, we had a textbook, 'Introduction to Calculus' in 350 pages. We pupils were curious as to what calculus itself would be like once we had got past the introductory stage. In the same vein, we might have supposed that after 500 pages of text, we would have picked up some statistics. Perhaps the answer is that no-one would read the book from beginning to end. The literary style is a little too even and there is a continual passing from one topic to the next. To use a metaphor, if Jean Gibbons had been describing a railway journey we would have got a timetable and map with descriptions of the stations but not a travel guide. There was little sense that the author found the procedures remarkable for their economy or power and that we should stop and gaze. But anyone using this book because they are faced with a problem will need to read and understand most of the appropriate chapter and not just one part of it.

The book is obviously solid value: the fact that it is in its third edition suggests that this book has proved itself in the market place. It will be usable by anyone who has grasped the ideas of a statistical test, and is prepared to put in a little careful and attentive reading. To a large extent you get what you see—for 71 US dollars you will get 500 pages of description of statistical tests.

*Time and Tide Ltd* K Evans

**OR at WORK: Practical experiences of operational research**

L Fortuin, P van Beek and L van Wassenhove (Eds)

*Taylor and Francis, London*, 1996. xiv + 359 pp. £24.95. ISBN 0 7484 0456 2

For a decade the editors of this volume have felt that operational research workers, and especially those in training to become OR analysts, should have a widely realistic view of the variety of activities, relationships, and outcomes that practice entails. In other words, there should be a comprehensive theory of practice that is well founded in experience and clearly set forth in the OR literature, where it will be readily available to practitioners, students, and those who undertake to train OR workers. This last category of people is especially important, as

those in it often lack the experience of practice on which to base instruction, and most of the case literature available to them offers a somewhat idealised view of practice.

To develop a theory, the right way to start is to observe the relevant phenomena. Before they began the project leading to this book the editors had immediately available their own consulting experience and a rich and varied literature describing cases. But their experience—complemented by some systematic research and discussions with other analysts with mature records of practice—told them that the case literature nearly always suppresses much of the detailed experience of consultation that is essential to a well rounded and comprehensive understanding of practice, and therefore much of importance of what such a theory should represent.

Thus, in this book, the capstone of their ten-year concern, the authors have taken an important step toward the goal of a theory of practice by assembling evidence: a series of 15 case discussions that probe the details of practice more deeply than is usual. Their instructions to the contributors asked that the project accounts emphasise process rather than technique, with more extended discussions than usual of the environment for the work, how the problem evolved, the approach used by the analysts, implementation, the practical results that accrued, and the culminating state of affairs.

They divided the 15 cases into five categories:

*Clean-room OR*. In work of this sort the context is a world with highly skilled functional experts, little cross-functional integration, and modest people or process content; the problem is related to operational decision making in a fairly routine, repetitive setting; there is a relatively stable environment that does not depend on last-minute interactions because of dynamic events; there is a well-defined goal (often to develop an algorithm to solve a particular operational problem); and usually the relevant data set is fairly small.

There are three cases in this category: Designing a fast step-and-scan wafer stepper, a device for processing integrated circuits by photolithography; developing economical configurations for telephone exchanges; and exercising appropriate stock control in a pharmaceutical company.

*Commodity OR*. In cases of this sort the problems emerge from a single function, although inputs are required from other functions and solutions must be integrated with them; the goal is to improve tactics; the environment is relatively stable, although input data in the solution must be updated continually; the objective is fairly straightforward, although there may be multiple conflicting concerns; and the data set can be large, but is manageable.

There are two cases here: Cutting problems in a production planning environment; and supporting decision making about scheduling maintenance.

*Computer-interactive OR*. The cases in this category usually concern a single organisational component or a connected set of subsystems; the environment is one where operations and tactics are difficult to separate; although the environment may be stable, there are many small decisions to be made from among a very large number of options; goals are fairly well defined, although there may be multiple concerns that have to be balanced; and the data set may be small or large, but is volatile, needing constant updating.

There are four cases of this type: Shop-floor planning and control for small-batch parts manufacturing; production planning in the fodder industry; computer-aided planning for public transport operations; and planning the size and organization of aircraft maintenance personnel for an airline.

*Facilitator OR*. In these cases there is a complex system consisting of highly connected subsystems; decision models deal with strategic issues, although they also inform tactical decisions; the environment is usually dynamic; objectives are difficult to express simply because they arise from longer-term strategic concerns; and the data set must be comprehensive, but may be large or small depending on the context.

There are four cases in this category: Strategic and tactical planning for joint-product industries; designing a production system for liquid-crystal displays; supporting decisions in asset liability management for pension funds; and the supply chain for distributing potted plants.

*Capstone OR*. In work of this type the systems are complex and delicately balanced; there is a focus on longer-term scenario analysis; the decision environment is highly dynamic; goals are fuzzy and the stakes can be enormous; huge databases from highly varied sources need to be filtered, merged, aggregated and interpreted.

There are two cases here: Reoperations on patients with possibly defective artificial heart valves; and applying OR to environmental problems.

The brief titles of the cases are enough to indicate that they come from the classical centre of OR practice: settings where there is a clear structure established by technological artifacts embedded in an institutional framework and where there are constraints of a variety of kinds, including some from nature. The cases do not come from settings dominated by people considerations, although, as the book brings out, the actors, both the OR analysts and persons in the setting, have a great deal to do with the outcomes.

Under the heading 'the process of OR' the book closes with three chapters: The first, reproduced from a paper previously published in *Operations Research*,[1] discusses the debate over the last four decades about the 'crisis' in OR; the second, entitled 'what the cases do not tell us,' summarises what was learned from detailed and lengthy interviews with seven successful OR analysts; and the third is an epilogue.

The editors have been successful in getting all concerned to offer structural outlines of the work while suppressing its technical details. Thus, the 37 contributors have success-

fully emphasized the aspects of OR work called for in the editors' instructions. The result is a rich smorgasbord of experiences, the differences emerging from the widely differing contexts and problems. There is too wide a variety of instructive points made about these experiences to summarise them in a brief review, but here are some that I found to resonate with my own experience and with the relevant literature that I know:

- Most significant OR engagements begin with a mutual effort by analysts and members of the client staff to assemble enough knowledge about the problem situation to define a useful problem and set realistic boundaries and constraints for it. As part of this effort, it is essential for the analysts to become thoroughly familiar with the client's operations and the factors that affect them.
- Data gathering usually demands a significant amount of work, and often calls for a major effort by the client staff as well as the analysts. The needed data may already exist, or procedures may have to be created to gather it.
- Models are an essential core of good OR work, and it often calls on technical developments in the academic literature. But these standard models virtually always have to undergo substantial modification in order to be of service in the new practical context.
- It is relatively rare when an analyst can frame a problem and then go away to work out a solution that can then be brought back to the client. Rather, it is almost always the case there the analysts have to establish a teamwork relation with the client and his staff, contributing the technical knowledge from OR while the client staff people contribute their special knowledge to the whole. Thus, there is often a form of interdisciplinarity dictated by the nature of the problem and the organizational structure in which it is embedded.
- Clients show great interest in the assumptions entering an analysis and the elements from their world that enter the analytic structure, but evince little interest in the technical details of the models that the OR workers introduce. These assumptions and structural elements offer the comparison that allows the client a prior judgment of the reality of the ongoing work and its prospective findings.
- Many situations involve so many variables that any model striving to incorporate all of its complexities would make calculations too cumbersome to allow prompt results to be derived. In such cases, less complex overview models may be possible and/or it may be desirable to create appropriate heuristic procedures that will yield helpful results promptly.
- The results of modern OR work are presented to clients in a variety of ways: Hard-copy reports, talks with charts, computer displays, computer programs adapted to client use, decision support systems, and so on. The important principle is that the form of the presentation be one that is the most meaningful and useful to the client organisation. Considerable effort is usually required to achieve this goal.
- Although optimisation often lies at the heart of the analysis, several cases illustrate the point that an optimum computed from the model cannot necessarily be claimed to be the optimum for the real situation from which the model is abstracted. Any model is an approximation to reality, invariably including some important factors but excluding others, and the march of time can be counted on to see the values of the variables change. Thus, the realistic claim for a study must, *à fortiori*, be that its results offer the client an opportunity to be guided by its results to an improvement. In fact, in some cases the way for an OR engagement to offer help to a client is to evolve a DSS that offers information enabling members of the client staff to make informed decisions as time moves on.
- Similarly, while decision analysis models may serve useful purposes, it is not realistic for the analysts to feel that they have taken over decision making. Rather, the most they should be expected to do is to offer valuable illumination to the client related to the decisions he/she may have to make involving the contexts included in the analysis.
- Much of the case literature suggests that an OR engagement is a prosperous voyage on a calm and sunlit sea, with a victory celebration after the slip anchors at its destination port and delivers its cargo. Some evidence here suggests rather that it is often more like a kayak trip down a rapid-strewn river: the analysts have to keep their heads above water as the shoals of changing values of key variables and new executives with new interests roll the water, and beyond a calm pool there may be a waterfall. Although accounts of failures do not dot the literature, good work may be wrecked on rocks in the channel and thus not achieve useful results.
- There is much evidence here that OR work helps clients with their problems, but in a variety of ways, depending on the context and the problem. But, of course, we know that this need not invariably be so, for a wide variety of reasons. And this last fact needs to be recognised as part of the experience of practice, although not emphasised in this book—or the literature.

These few general points that I have chosen to represent the contents of this important book fall far short of conveying the rich variety of its views of the practice of OR. To read it will amply repay students and consultants, and particularly academics with modest or no consulting experience. The editors and their contributors have set before us a feast of realistic experience as a contribution to a well-rounded view of what work involves in the central core of classical OR.

Further, with the five categories of OR work into which they divided their cases, they have suggested that it may be possible to categorise the forms of OR work in relation to

their problem settings—an interesting challenge suggesting further inquiry.

It is perhaps ungrateful to wish for more than they have given us, but I for one would have valued a structured synthesis at the end of the book that would set us all a little further on the road to an overt epistemiology of OR practice that the profession desperately needs at this stage of its history. In any case, I hope that the editors and others will see this step as a challenge for future inquiry. In any case, this valuable compilation sets the problem of meeting this need clearly, and offers much useful information as a partial foundation for how it should be developed.

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## Reference

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