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Book Reviews

Books for review are to be sent to the Book Review Editor Gösta Forsman, Department of Mathematics, University of Linköping, S-581 83 Linköping, Sweden.

Castillo, E., Extreme Value Theory in Engineering. Academic Press, Inc., Boston, 1988. ISBN 0-12-163475-2. xv + 389 pp., $ 59.95.

This book is the latest addition to the rapidly growing literature on extreme value theory. It differs from most of the others by being aimed not at mathematicians but at engineers. As the author explains in his introduction, there are many areas of engineering where the distribution of extremes is of practical importance, such as structural engineering, oceanography, hydraulics, pollution, meteorology, and both static strength and fatigue properties of materials. There would, therefore, appear to be a clear need for a book covering the theory at a level that a statistically trained engineer would understand.

The author's approach to the subject is a traditional one, centred on the extreme value distributions. The first two chapters are mainly introductory – Chapter 1 is entitled "Introduction and Motivation" while Chapter 2 is a general discussion of order statistics, presumably included to set the stage for the more specialised discussion of extremes which is to follow. I felt this to be too long-winded, with many repetitious examples. It is a good idea to include a section on simulation of order statistics, but the author fails to give any background on simulation in general, which seems inappropriate for a book at this level. For instance, no guidance whatsoever is given on random number generators, and on page 63 I spotted a reference to the rejection method with no explanation of what that is.

Chapters 3–6 represent the core of the book, dealing respectively with the extreme value limit distributions, shortcut procedures for estimation (such as probability plots), detailed estimation methods for the three main limit distributions, and the problem of selecting which limit distribution to use. I felt that these chapters could have been much improved had the author given more emphasis to the many recent developments of these topics. In particular, the use of the three-parameter generalised extreme value distribution renders obsolete much of the detailed discussion of Chapters 5 and 6 –

maximum likelihood algorithms for this are now readily available (Prescott and Walden 1983; Hosking 1985; Macleod 1989), and there is also a lively discussion of alternatives to maximum likelihood (e.g., Hosking, Wallis, and Wood 1985). Chapter 6 on choice of extreme value models could well have been replaced by Hosking's (1984) very well balanced review of the problem of testing for zero shape parameter in the generalised extreme value distribution. The two problems are equivalent because, when Hosking's null hypothesis is rejected, the direction of rejection automatically indicates which of the two alternative families is the more appropriate. Curiously, the last two Hosking references are both in the book's bibliography, yet they are not mentioned at the relevant points of the text.

The remaining four chapters are concerned with more advanced topics – limit distributions of kth order statistics, limit distributions for dependent processes, regression models related to extremes, and multivariate extremes. It would be unreasonable, in a book at this level, to expect the author to do justice to the great many modern developments in these areas, but I still felt that the presentation was rather stilted, often consisting of quoting mathematical results (mostly from Galambos 1978) rather than making a serious effort to explain the motivation behind those results.

The book contains no systematic discussion of methods based on exceedances over high thresholds. Although this is still a subject of current research (Davison and Smith 1990), the ideas behind these methods go back a long way, and indeed many of the early papers appeared in such journals as Water Resources Research. I therefore feel that this is a serious omission from the book.

The mathematics in the book is, I believe, accurate, but at various places the author's statistical judgement is suspect. For instance, Chapter 9 on regression models develops in detail the theoretical properties of particular families of models, but there is nothing on practical issues of model selection and verification. I have a greater objection to an issue mentioned several times in Chapters 4–6. The author emphasises that extreme value theory applies only to the upper tail of a distribution, and recommends censoring to ensure that only the upper tail is considered. This is a fair enough idea as it stands, but the author fails to make the distinction between complete samples from some distribution and samples which already consist, for example, of annual maxima and he proposes the curious guideline of using only the upper $2\sqrt{n}$ order statistics where n is the sample size. This cannot be theoretically justified – indeed, I have examined the same question theoretically (Smith 1987) with results which are extremely complicated, and which certainly do not support such a simple rule of thumb as Castillo's.

My other criticism of the book is that the author's style of writing is often unhelpful. For instance, the chapter on probability plots takes 33 pages to get to the issue of plotting positions, and then only says "the optimum plotting formula depends on the purpose of the graphic technique and on the kind of [plotting] paper to be used" (page 164). This is of course true, but it is also totally unhelpful. A reference such as Cunnane (1978) would do a much better job of coming up with clear-cut recommendations. This sort of indecisiveness is evident at many other points, for instance the discussion of numerical optimisation techniques on page 189.

The book concludes with some example data sets, and listings of BASIC programmes for the two-parameter Gumbel, Weibull, and Fréchet families, incorporating the author's censoring ideas. I have not tried to use the programmes myself, but I did check some of the maximum likelihood computations in Tables 5.2, 5.3, 5.9, and 5.10 using programmes of my own, with good agreement. On the basis of this very limited study, I believe the author's programmes to be accurate.

In conclusion, the presence of a book at this level on extreme value theory is something badly needed. Castillo's book is accurate in its mathematical and computational aspects, but a lot of the material is either not up to date or not presented in the most helpful way, and for these reasons it does not fulfil this role as well as might have been hoped.

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Farnum, N.R. and Stanton, L.W., Quantitative Forecasting Methods. The Duxbury Series in Statistics and Decision Sciences, PWS-KENT Publishing Company, Boston, 1989. ISBN 0-534-91686-4. xvi + 573 pp., £ 18.95.

This book was designed to serve both as a reference source and as an introductory college-level text to be used in business schools, etc. It requires previous knowledge of only algebra and basic statistics. It deals with time series forecasting and has been organized around the classical time series model $y = T + C + S + I$. The pedagogical idea is to introduce the components one by one, starting with adaptive level forecasting (y = level + I) in Chapter 2, proceeding with deterministic and stochastic trend models ($y = T + I$) in Chapter 3, discussing seasonal models in Chapter 5 ($y = T + S + I$) and the complete model in Chapter 6. There are also chapters dealing with regression analysis and Box–Jenkins procedures.

The idea to introduce the components one by one gives the book a nice and clear structure. From a technical point of view, it is a high quality text – the forecasting techniques are clearly explained and the book contains much important material. From a pedagogical point of view, however, the book has some drawbacks. The aim to write a reference text leads to the inclusion of many techniques that solve the same problem. For instance, Chapter 2 contains ten different tests for stationarity and randomness. This is justified in a reference text, but it is not pedagogical in a text-book. Students become confused and lose sight of the main issues. The authors also have the goal of explaining matters in small steps. This is good, but it also leads to many techniques for a given problem. For example, in Chapter 3 a deterministic trend line is estimated in four ways – free-hand method, method of selected points, method of semiaverages, and finally the least squares method. One should drop two of these and recommend one of the two remaining as the preferred method. The

forecasting techniques are clearly explained, but when many techniques are explained in detail, the text will contain many pages of formulas and computations, which gives students the impression that statistics is rather tedious. An experienced teacher can, of course, still use the book, skip some portions, and stress the main issues.

The book discusses in detail how to extrapolate a time series model but lacks practical applications. What happens if your sales forecast is $384,000 instead of $427,000? How can you combine an extrapolation with judgement and get a forecast? Can you survive as a forecaster if you use deterministic models? How do executives misunderstand and misuse statistics and forecasts? How can a business corporation earn money on clever time series analysis and forecasting? It is much more important to teach students that statistics is thrilling than to teach all possible formulas.

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Gonin, R. and Money, A.H., Nonlinear L_p-Norm Estimation. Marcel Dekker, Inc., New York, 1989. ISBN 0-8247-8125-2. viii + 300 pp., $ 99.75 (U.S. and Canada), $ 119.50 (All other countries).

This is an excellent textbook for an advanced course in computational statistics. Its approach and level are appropriate for graduate students and research workers with good knowledge of mathematical programming and statistics. It contains six chapters grouped for the purpose of this review in four parts:

1. Introduction to linear L_p-estimation (Chapter 1)
2. Numerical solution procedures to nonlinear L_p-estimation (Chapters 2, 3, and 4)
3. Statistical analysis (Chapter 5)
4. Numerical applications (Chapter 6)

The introductory chapter is designed to convince readers of the value and necessity of L_p-norm estimation. Its strength is that in the space of 42 pages, the authors provide a history of curve fitting (from Galilei 1629 to the first international conference on the L_1-norm and related methods in Neuchâtel 1987), the formulation of the L_p-norm estimation problems, the algorithms for $p = 1$, 2, and ∞, the statistical properties of the linear L_p-norm estimators, and a remarkable set of bibliographical notes. The chapter in itself is a book and practically all who have made a contribution in the field of L_p-norm estimation have been acknowledged. To illustrate the application of linear L_p-estimation, a careful example has been worked out in the chapter.

Chapters 2, 3, and 4 discuss in detail the L_p-norm estimation in nonlinear statistical problems. They provide extensive numerical estimation procedures for $p = 1$, $p = \infty$, and for any finite $p > 1$. These procedures make up an excellent collection of algorithms. Numerical examples have been provided to clarify some of the more complicated algorithms. In order to separate the theoretical parts from the main discussion, the mathematical developments and many FORTRAN programs are presented at the end of each of the three chapters.

The statistical analysis of the nonlinear L_p-norm estimation is discussed in Chapter 5. While the chapter is generally well written and clear, a warning should be made regarding pages 213 and 216, in which Gonin and Money refer to their conjecture on the asymptotic distribution of the nonlinear L_p-estimator. The conjecture is subsequently used to derive the confidence intervals, tests of hypotheses, and other related statistical inference for the nonlinear L_p-estimator. Care should be made in using the results as the conjecture has not been validated in any part of the book and may prove incorrect at least under certain conditions.

The application of nonlinear L_p-norm estimation to practical problems are discussed in Chapter 6. These problems are chosen very carefully to convey ideas and stimulate interest.

This is a pioneer book in the field of

L_p-norm estimation and the authors should be congratulated for their effort. I have already consulted my copy of the book several times for my current research and recommend it to graduate students and research workers who wish to discover a new world of L_p-norm estimation problems.

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Netherlands Central Bureau of Statistics, Automation in Survey Processing. Netherlands Central Bureau of Statistics, Voorburg, 1987. ISBN 903570915 2. 144 pp., Dfl. 40.00.

In the art of rope skipping, "double Dutch" means jumping with two ropes instead of one. In the Netherlands, the Central Bureau of Statistics (CBS) is moving forward very quickly in converting from paper and pencil techniques to fully automated (computerized) operations and has been doing it in double Dutch format – very quickly and on all fronts.

This book is a compilation of the first experiences describing the problems, solutions, and future directions the CBS has had in moving toward fully automating operations and yet incorporating current techniques. While it is a very particularized account, it has broad implications for other agencies attempting to move into a fully automated state of data collection. It also has a foresightful compilation including all major areas and considerations of data collection. The variety includes (1) research leading to the basic decisions on how the CBS wanted to approach automation and details how the decision went to an integrated approach, (2) the advent of laptop computers and the early experiments in their use, (3) the integration of data editing and coding into the overall schema of automation, (4) research on disclosure policy given the easy and fast access to microdata, (5) the integration of paper, laptop, telephone, and other techniques in the overall system and the originating design of BLAISE to handle and operate this integrated system, and (6) some very interesting and innovative research into the data, interviewers, and respondents under automated conditions.

Of particular interest to agencies in the early stages of automation are Chapters 1 and 2 which describe the CBS's experience in going from 3 to 300 laptop computers and how they decided on an integrated system. Certainly not meant to be a blueprint for others, it clearly explains why this system is right for the Netherlands. It may be right for many other countries, but even if it is not it provides clear insights on why this particular avenue was chosen and is indicative of the careful planning necessary to effect change to automated survey processing.

The chapter on the BLAISE system is a summary and not comprehensive of the system in use. The CBS will provide demonstration materials to other agencies upon request. The documentation is probably the most useful and again, although tailored to the CBS's uses, a good, general map of what is currently possible in a fully integrated environment.

Chapter 7 is probably the most depressing since the research reported shows how easy it may be to disclose (unintentionally) data on individuals or establishments. The conditions may not be identical everywhere, but the clear signal from this research is that governmental agencies charged with protecting individual data had better beware – it is easy to fall into the pit. The solution offered is viable but it is unclear if it is reasonable or acceptable. This research should be of interest to every statistician or anyone interested in nondisclosure.

The closing chapters concentrate on some of the very interesting research done on automation – from the routing structures of questionnaires as related to design and

response variance, and the implications for automated questionnaires, to interviewer variance and response research in computer assisted telephone interviewing. These chapters describe some important new considerations for those moving into the computerized systems.

The CBS has been an early and productive leader in research and development of automated survey processing techniques and they continue to skip "double Dutch" in the field.

This publication is easy reading (and in English) and a valuable guidepost in the development of automated survey techniques.

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Skinner, C.J., Holt, D., and Smith, T.M.F. (eds.), Analysis of Complex Surveys. John Wiley & Sons, Chichester, 1989. ISBN 0-471-92377-X. xv + 309 pp., £ 38.50.

This book contains an excellent and comprehensive account of the current state of the art in the analysis of survey data. Anyone unfamiliar with this topic will be surprised to see how survey statistics has evolved to the point where many of the concepts of classical statistical modelling are now being used by survey statisticians. In addition, the survey statisticians' perspective will have an influence on other statistical disciplines. This is why this book should be read, not only by theoretical and applied survey statisticians, but also by anyone analyzing economic, sociological, or biological populations. For example, biometricians doing longitudinal studies, or case-control studies will benefit from many of the ideas discussed in this book. Examples of the concepts which cross disciplines are robust variance estimation, and methods to incorporate knowledge of the population structure in the analysis either directly in the model or indirectly through the use of sampling or poststratification weights.

Various aspects of data analysis are described in separate chapters. Credit for each chapter is given to a particular author or co-authors. But, in contrast to most books with this format, the editors are hidden co-authors of every chapter. They have insisted on standardized notation, frequent cross-referencing to other relevant chapters, and have generally ensured that the book reads like a unified text rather than a number of individual contributions. The editors should be congratulated for their efforts.

The level of mathematics and statistics needed to read this book is that of a good undergraduate level course in regression analysis. Knowledge of logistic regression and loglinear models for categorical data would be helpful, but is not essential. Other aspects of multivariate analysis such as principal components analysis would also be useful. The reader should have a knowledge of the fundamentals of sampling theory. The book would be ideal as a supplementary text for a masters level course in sampling, or as part of a directed readings course.

The book has been divided into three major sections, with each section containing an introductory chapter. These introductions give the general objectives of the section and highlight the main results. Here is where most of the philosophy and recommendations for the practitioner appear. The three sections are:

Part A. Aggregated Analysis: Standard Errors and Significance Tests
Part B. Aggregated Analysis: Point Estimation and Bias
Part C. Disaggregated Analysis: Modelling Structured Populations

The difference between aggregated and disaggregated analysis is that in the latter, the complexities of the design are explicitly part of the model and are an integral part of the objectives of the study.

There is also a general introductory chapter at the very start of the book. Here there is a discussion of the various underlying philosophies which exist in the literature

regarding descriptive versus analytic uses of survey data and their effect on the methods of analysis.

In Part A, the concept of misspecification effect ("meff") is introduced and compared to Kish's concept of design effect. The misspecification effect can be used in either a model-based or design-based setting and it refers to the effect on the estimates of the variance of the sampling error when the sample design is ignored. It is suggested that this could also be called design effect, but I disagree, since the design effect already has an established meaning and the two concepts do not always coincide. There are good discussions in Part A on the distinction between model parameters under an assumed model and their meanings under various deviations from that model. This part contains problems associated with regression analysis and the estimation of covariance matrices, as well as an excellent summary of the recent work in the analysis of categorical data from complex designs. My main criticism of this part is that no real guidance is given to the practitioner on how to choose between the model-based and the design-based approaches.

Whereas Part A offers some convincing arguments on the robustness of methods which use the design weights in the estimation of the model parameters, Part B gives examples of where this can lead to misleading results. Some remedies, such as poststratification, and otherwise accounting for the selection biases are offered. It is emphasized that the objectives of the analysis are of paramount importance. The model-based and design-based frameworks can be incompatible in certain circumstances. The analyst must be aware of the assumptions being made and what is the appropriate randomization set. The concept of approximation error is introduced as the bias introduced by fitting the wrong model in a design-based framework. If this error is small for large samples, then the design-based approach may offer some protection to incorrect assumptions. Otherwise other adjustment methods are called for.

In Part C, it is assumed that the design information itself is an integral part of the population structure. Some comparisons of weighted and unweighted estimates are made. Included are nested models with both random and fixed effects. With such a model formulation, it is also possible to estimate the cluster effects and these may themselves be of intrinsic interest to the analyst. It is argued that if the model-based variation is smaller than the design-based variation, then this extra variation should be explained as part of the model. This is particularly true if the purpose of the analysis is to understand the underlying population structure.

The final chapter argues that p-weighting and variance adjustment is not in itself sufficient for performing analysis. The goal should be to refine the model to the point that unweighted analysis is satisfactory. Then an unweighted analysis should be performed, it is suggested. Here, I disagree. Although the analyst should strive to find the model which makes the weighted and unweighted analyses comparable, there is usually some protection in using the weights, which for large samples should not adversely affect the conclusions.

In summary, this book contains a comprehensive collection of the most recent views on the analysis of survey data. Some topics are lacking, mainly because they are not yet well understood. These include the effect of nonresponse and response errors, and diagnostics for model checking. I would highly recommend this book to any serious analyst of survey data, particularly those who are unfamiliar with recent developments on this topic. I hope too that statisticians in other disciplines will notice this book and gain an understanding of the conceptual difficulties which are described in it.

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