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LANGE, K. **Applied Probability.** Springer, 2003. xii + 300 pp. US$ 79.95, ISBN 0-387-00425-4.

This book titled "Applied Probability" authored by Kenneth Lange contains 13 chapters that run to 300 pages including references and index. The author of the book is from the Department of Biomathematics of UCLA School of Medicine, Los Angeles, U.S.A. The teaching experience of the author has generated inputs to this book tremendously in the form of examples and suggested problems as exercises.

Probability concepts are central to statistics and perhaps are the one that distinguish it from other mathematical sciences. Applications of probability are growing in every scientific field including biological sciences. Whether it is theory or applications, the discussion of probability is always through the medium of mathematics. Sometimes, extensive use of mathematics becomes necessary if attempts are made to present proofs of theoretical relations. In this book such attempts were not extensively done and the usage of rigorous mathematics is kept to a medium level.

The book starts with a brief review of probability theory and ideas of expectations followed by a chapter on convex functions, its optimization and inequalities. Applications of permutations and combinations, combinatorics, are discussed in the next chapter. Specifically, inclusion–exclusion methods, Stirling numbers, and Pigeonhole principle are covered in this chapter. Applications of probability in creating algorithms to solve discrete optimization questions are discussed in the chapter on combinatorial optimization. The sections in this chapter that are very useful for computer applications include Quick Sort, Data Compression, and Graph Coloring. Poisson processes and discrete-time Markov chains, continuous-time Markov chains, and branching processes are separate chapters. Chapter 10 is on Martingales, certain applications of conditional expectations. An introduction to diffusion processes is given in Chapter 11, where examples that are applicable to areas on population biology, neurophysiology, and population genetics are presented. Chapter 12 is on Poisson approximation and a discussion on Chen-Stein method is central. The book ends with Chapter 13 on number theory. A proof of the prime number theorem is the last section of the book.

All 13 chapters contain subsections. The subject matter is discussed with examples and every chapter ends with a list of problems to work out. The book ends with a list of 155 references and an index.

The purpose of this book is to bring applied probability into limelight at a graduate level.

The book assumes a certain level of prior mathematics knowledge. To be more explicit, the reader should have knowledge of multivariate calculus, linear algebra, and ordinary differential equations.

This graduate level textbook is intended to students in applied mathematics in general and specifically to those who are interested in biostatistics, computational biology, computer science, physics, and the like.

The title of the book is Applied Probability. This is not to mean direct applications of probability to statistical computing. The applications intended here require a certain level of mathematics knowledge but this is what the author aimed as well. To those who are inclined to mathematical statistics, this is an excellent graduate level textbook. To researchers and academicians who are interested in applied statistics but with minor interest in mathematics, this can be a reference book.

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TABLEMAN, M. and KIM, J. S. **Survival Analysis Using S. Analysis of Time-to-Event Data.** Chapman and Hall/CRC, 2004. xv + 260 pp. US$69.95, ISBN 1-58488-408-8.

This book is not meant for reading it through, it is meant for *working it through.* Much more than traditional textbooks it addresses the "how to..." focusing on the implementation and interpretation of methods and their outcomes rather than on their theoretical properties. Basically, you should sit at your computer and work through the example data sets and exercises with the given S/R commands in order to fully appreciate and enjoy the book, and to avoid getting bored with the rather long (in places) computer outputs.

The book is clearly aimed at people who want to learn how to carry out *practical* survival analysis. Theoretical details are mentioned only when they affect the interpretation or choice of methods but ample references are given for further reading. As far as survival analysis is concerned, the book is suitable for absolute beginners. The basic concepts of survival analysis are explained very clearly, in much detail and are nicely illustrated. There are plenty of real life examples; in fact, almost everything is explained with an example. Each chapter usually consists of a motivation and gentle introduction to the topic but when it comes to more advanced material, less details and explanation are given permitting one to keep track of the main ideas. Further, each chapter contains a list of learning objectives at the beginning and many practical as well as a few theoretical exercises at the end, facilitating self-learning and monitoring. No model solutions are given, which I as a teacher welcome very much.

However, an absolute beginner in S or R will have difficulties. A good or at least basic prior knowledge of the software is advisable as not much general explanation apart from the commands and outputs with short and not very consistent comments is given. Neither the basics of S/R nor the specific functions for survival analysis are introduced or explained, which I found quite tough in places if one really wants to understand the commands. It could have been mentioned that functions and their required arguments can and should be looked up in the help system of S/R. Also, slight deviations from the syntax can be an issue depending on the S/R version being used. This is not mentioned and can lead to some difficulties. Data examples as well as some additional S/R functions written by the authors of this book are available for download from the publishers web page, which I welcome in general, but again no instructions of how to install and use them are given. It took me a while to figure out that the downloaded files contained not just function definitions but included examples of code. I therefore do not agree with the claim in the preface that "no background in S or R is required."

The topics covered in the book comprise of the standard survival analysis methodology, i.e., nonparametric and parametric methods, regression models, and model checking. I found it unfortunate that the Cox proportional hazards model is scattered over three chapters, one that deals with regression models in general, one called "Cox proportional hazards model" (but is hardly more than a very detailed example), and one on model checking. Chapter 7 is devoted to further topics, which are the extended Cox Model for time-varying covariates, competing risks, and left-truncated or right-censored data. Chapter 8 is an interesting and well-written contribution by S. Portnoy dealing with censored regression quantiles. This last chapter presents a refreshing innovation as compared to the usual textbooks and might be interesting even for someone with more advanced knowledge in survival analysis.

My last point refers to the style in which the book is written (with the exception of the last chapter by Portnoy). Even had the authors not mentioned it in the preface, it is very clear that the book has evolved from lecture notes of some course. It is based on catch phrases, notes, remarks, and comments that are sometimes just listed instead of being integrated into a coherent and fluent text, which I would have found more elegant and more enjoyable to read. There are also a considerable number of mistakes and typos, some of them already listed in the errata that can be downloaded from the publisher's web site. However, these matters of style should not belittle the practical use of this book for students and applied statisticians who want to get started on survival analysis as well as for teachers of this subject.

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GOOS, P. **The Optimal Design of Blocked and Split-Plot Experiments.** Springer, 2002. xiii + 244 pp. US$ 59.95, ISBN 0-387-95515-1.

Many books and papers discussing the blocking of experimental designs have been published since the appearance of the pioneer work of Ronald Fisher nearly a century ago. Unlike most of them, the author of the book approaches this topic as an application of the theory of optimum design. This is achieved without presenting too complex mathematical derivations of results, while those provided are clearly presented and easy to follow.

The focus of the book is on the blocking of a large class of response surface designs and the effect of orthogonality on the optimality of the designs. The case when the experimental design is divided into blocks with fixed effects is shown to be a particular case of blocking when the block effects are random. This helps the understanding of the interpretation of the two types of blocking. The author also presents some of his own theoretical results that are related to the design of experiments when the blocks are random.

Several chapters of the book are devoted to cases of problems where the observations are dependent. Particularly useful, because of the wide range of possible applications, are the chapters on split-plot designs and on design of studies where some factors are difficult to change.

The book clearly and convincingly illustrates the usefulness of the algorithmic approach for constructing tailor-made experimental designs when blocking is required. FORTRAN77 computer codes of useful algorithms for construction of blocked experimental designs when the block effects are random and when a split-plot block structure is required have been made available at http://www.econ.kuleuven.ac.be/public/NDBAC47/springer.htm on the Internet. While indeed FORTRAN is no longer a fashionable programming tool, it is nevertheless very powerful and allows the user to perform the search for optimum designs effectively. For those not familiar with FORTRAN, executable code has also been given. The book provides detailed descriptions of the algorithms and they can be used by an experienced programmer to implement them using other algorithmic languages. At the same site the reader can also find some useful additional files related to the use of the algorithms, as well as a useful erratum page for the book, where reassuringly there are not many reported corrections.

An interesting and competent review of the most recent publications in the area is given. For example, this includes the literature on minimum aberration factorial designs. However, some standard results, such as the role of the randomization and those of the blocking of factorial designs and the efficiency of blocking, have been only briefly described. Therefore, in my view a reader who is already familiar with standard texts on experimental design is likely to benefit most from this book.

The readers of Biometrics will not find many examples that are concerned with design of experiments in biology in the book. This is because the target audience of the book includes a wide range of applied statisticians and academics. In my view the examples could have been provided with broader discussions of the statistical benefits of using the recommended experimental designs. Despite this shortcoming, I found most of the examples useful and stimulating.

The book is well organized and clearly set out, except perhaps for a lack paragraph indenting. However, this does not diminish the appeal of this valuable addition to the literature on Design of Experiments.

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NEWMAN, S. C. **Biostatistical Methods in Epidemiology.** John Wiley & Sons Inc., New York, 2001. xii + 382 pp. £63.50, ISBN 0-471-36914-4.

Since the late 1970s statistics appears to play an increasing role in modern epidemiology. This is not only due to statisticians making contributions to the development of epidemiological methods and concepts, but also due to the easy accessibility of statistical program packages enabling the non-statistician to apply sophisticated biostatistical techniques. As a consequence, one could expect from the title an account of the latest biostatistical or methodological advancements. However, in his book Stephen Newman takes us back to the roots and provides an in-depth description of classical biostatistical methods commonly applied in chronic disease epidemiology.

The book is well structured and the organization follows the author's intention of a classroom text for students in an epidemiology or biostatistics program and as a reference for established researchers. Each of the book's 15 chapters opens with a brief introduction to the topic and references for further readings are provided.

Chapter 1 briefly reviews probability methods and (frequentist) statistical theory. Chapter 2 is on measurement issues in epidemiology and includes a good discussion of confounding including both the collapsibility and counterfactual approach. Chapters 3–7 describe statistical methods for the analysis of data from closed cohorts with focus on binary outcomes (risk difference, risk ratio, and odds-ratio) while other outcome types are only very briefly described. As a somewhat unconventional approach, odds-ratio methods are mainly covered here, rather than in the context of case-control studies. Chapters 8–10 proceed to the study of open cohorts and survival analysis with Chapter 9 giving a comprehensive discussion of Poisson methods for censored survival data. Chapter 11 presents odds-ratio methods for case-control designs. Since these were already covered in the chapter on closed cohorts, this chapter focuses on the justification of the odds-ratio approach and the description of methods for 1:1 and 1:M matched design. The next chapter deals with rate standardization methods and also includes a brief account of age-period-cohort analysis. Chapter 13 on life tables is followed by a chapter on asymptotic sample size formulae and power calculations. The text closes with Chapter 15 briefly touching logistic and Cox regression models. The book also includes eight—sometimes rather lengthy—appendices that cover a selection of more technical or theoretical topics such as ML-theory, hypergeometric/conditional Poisson distributions.

As with any book one can identify topics that would have deserved more attention and I expect that the title of the book may mislead some readers—not in the depth but rather the breadth of its coverage.

Also, by excluding regression techniques the book misses the opportunity to describe the relationship of some of the classical methods to the popular regression modeling.

Nevertheless, the topics covered by the book are well organized and presented. The clear notations and definitions of technical terms together with the many worked examples make the text worthwhile and pleasant to read. The books statements of the assumptions underlying the various analytic techniques and up-to-date references (including other epidemiological textbooks) are useful to researchers already applying these techniques.

I particularly liked the excellent chapters on confounding and poisson methods for censored survival data. I can clearly recommend this book to students both as an introductory text as well as a book for later references. Also, epidemiologists and health professionals familiar with some algebraic notation and interested in the statistical background of classical non-regression-type methods in epidemiology will find this a very useful resource. A trained biometrician entering the field of epidemiology may prefer a book that offers a broader perspective on epidemiological methods and concepts such as causality, study design options, bias mechanisms, attributable risks, and misclassification biases.

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PUGESEK, B. H., TOMER, A., and VON EYE, A. (eds.). **Structural Equation Modeling: Applications in Ecological and Evolutionary Biology.** Cambridge University Press, Cambridge, 2003. xiii + 409 pp. £50.00/US$75.00, ISBN 0-521-78133-7.

Structural equation modeling (SEM) is a set of techniques for modeling relations among observed and latent variables; regression, path analysis, and factor analysis are special cases. Most historical accounts of the development of SEM trace its origins to the early 1920s and the development of path analysis by Sewall Wright, an evolutionary biologist. Despite its historical roots in evolutionary biology, and in contrast to its widespread use in the social sciences, SEM is rarely used in biological research, leading one methodologist to express concern that SEM could meet the same fate as path analysis, which was "stillborn in biology and largely ignored" (Shipley, 2000, p. 638). This edited volume should convince readers that SEM is alive and well suited for modeling processes typical of ecological and evolutionary biology.

The book comprises 14 chapters arrayed in three sections. The treatment of SEM is largely nontechnical and application oriented. The first section of the book, which includes five chapters, covers material that will most interest prospective users. After a brief introduction to SEM, Chapter 1 presents the "nuts and bolts" of the technique. Chapter 2 focuses on the strengths of SEM, especially the capacity to model latent variables. Chapter 3 illustrates the use of SEM for tests of complex theoretical models using biological data. Chapter 4 traces the emergence and development of SEM techniques through the 1980s, integrating developments in biometrics, econometrics, sociometrics, and psychometrics. The section concludes with a brief chapter that offers guidance for using SEM and reporting the results of SEM analyses.

The heart of the book is the second section, which includes eight chapters illustrating applications of SEM in biological research. Although prospective and novice users could glean useful knowledge about the possibilities SEM affords, material in this section will most interest veteran users. Chapter 6 describes and illustrates the use of factor analysis for studying intraindividual change processes in development. Chapter 7 compares OLS regression, principle components analysis, and SEM as approaches to examine the prediction of a set of variables on a set of outcomes, focusing on the capacity to include latent variables in prediction equations as a strength of SEM. Chapter 8 discusses causal inference in SEM with a focus on equivalent models and the importance of strong research design. Chapters 9–13 describe and illustrate specialized uses of SEM, including applications to dynamic systems (Chapter 9), multilevel designs (Chapter 10), comparisons of models across groups (Chapters 11 and 12), and models of change over time (Chapter 13). Chapters in this section vary widely in the depth of coverage they provide. For instance, Chapters 10 and 13 exceed 40 pages in length, whereas Chapters 11 and 12 (which could have been combined) span only 18 and 15 pages, respectively. Taken as a whole, however, the section confronts biological researchers with a broad array of potential applications with intriguing possibilities for addressing important research questions.

The third "section" of the book includes a single chapter in which three stand-alone pieces of software for implementing SEM are reviewed. Owing to the frequency of new developments in SEM, such software is updated often. As such, reviews such as this are likely to be dated by the time they appear in print. For instance, Version 3.6 of Amos is reviewed, but Amos 5.0 is now in release. Version 6.1 of EQS, which includes a new interface and many new features, is ready for release and will replace release 5.7 reviewed by the authors. The most accurate review is of LISREL Version 8.2, currently in release 8.54. A more worrisome feature of this chapter is the omission of MPlus, which is less widely distributed but more comprehensive than any of the packages reviewed. Mplus Version 3 will be available by the time this review appears in print. The authors provide web addresses for accessing current information about Amos, EQS, and LISREL; information about Mplus can be found at http://www.statmodel.com/index2.html.

A strength of the volume is the provision of companion materials—electronic copies of data, program, and output files for analyses presented in the book—on the web. Although I was unable to find the materials using the entry point provided in the preface to the book, Google took me right to the page listing the companion materials available for each chapter. At http://www.nrmsc.usgs.gov/products/Pugesek_SEM.htm readers will find downloadable covariance matrices and program files for the example applications described in the book.

Although I would not hesitate to recommend this volume to biological researchers interested in learning more about SEM, two features of the volume temper an otherwise favorable opinion. Although the book carries a 2003 copyright date, with two exceptions the latest citations are for works published in 2000 or earlier. Hence, many application-oriented books and papers published since the chapters were written are not referenced (e.g., Bollen, 2002; McDonald and Ringo Ho, 2002). The volume could have been more tightly edited. Notation, diagramming, and use of terminology vary from one chapter to the next. The material is "chunked" in such a way that some chapters are much longer than others and some material that might have been included in a single chapter is spread over two or more chapters. These features of the volume could have been acknowledged and defended, and readers given a useful context for working through the chapters, had the editors provided an overview chapter. Despite these shortcomings, *Structural Equation Modeling: Applications in Ecological and Evolutionary Biology* amply fills a void in the biometrics literature. The contents will inspire biological researchers who have never used SEM, help novice users raise the sophistication of their applications, and give veteran users new ideas.

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JOLLIFFE, I. T. and STEPHENSON, D. B. (eds.). **Forecast Verification: A Practitioner's Guide in Atmospheric Science.** Wiley, Chichester, U.K., 2003. xiii + 240 pp. US$95.00/£50.00, ISBN 0-471-49759-2.

In 1884 Sergeant Finley of the U.S. Army Signal Corps published a paper evaluating an experimental program to predict the occurrence of tornados (the book cover shows a two-way contingency table of these forecasts and the corresponding observations superimposed upon a photograph of a tornado). Although Finley characterized these forecasts as being correct on an overwhelming majority of occasions, simply never predicting a tornado, as pointed out subsequently by another researcher, would have resulted in correct forecasts even more often. Thus the field now known as "forecast verification" was initiated.

Despite this long history, *Forecast Verification* is the first book length treatment to appear. Edited jointly by a statistician and a physicist, the book is oriented toward atmospheric scientists. It aims to provide a broad coverage, with technical issues being omitted other than providing references. Nevertheless, statisticians (in particular, biostatisticians) will find much of the content to be of interest as well. Forecast verification is inherently statistical, with some of the relevant literature having even appeared in *Biometrics* (e.g., on receiver operating characteristic curves in medical diagnosis).

The editors have done a commendable job, with the book reading for the most part as if it were a single-authored text. Modern statistical terminology and notation are used, making its reading less formidable for statisticians than is much of the literature. Also helpful is a glossary on forecast verification, as many terms (e.g., "accuracy," "skill") have more precise meanings than in common use. The level of statistics is relatively elementary. Yet, while the treatment in the atmospheric sciences literature is too often only descriptive, prescriptions are provided in the book for how to draw statistical inferences about whether a forecasting system has any skill or whether one forecasting system is more skillful than another. Resampling techniques are advocated, relaxing distributional assumptions as well as possibly taking into account temporal and spatial dependence.

In my view, the current practice of forecast verification reflects the influence of the late Allan Murphy more than any other individual and his contribution is evident throughout the book. Somewhat surprising to statisticians will be the book's emphasis on deterministic prediction in which no uncertainty is attached to the forecast. Despite Murphy being an ardent proponent of forecasts being communicated to the public in probabilistic form, only one chapter focuses on this topic. For decades, both "subjective" and "objective" (i.e., based on empirical/statistical modeling) probability forecasts have been issued operationally. The ability of weather forecasters to produce probabilities that are reasonably well calibrated long ago caught the attention of researchers in other fields, particularly in psychology and statistics. But the book considers only probability forecasts derived from ensemble forecasting, an approach still in its infancy. Ensembles are generated by repeatedly running one or more deterministic numerical models under different initial conditions. Because not all sources of uncertainty are necessarily fully taken into account, ensemble-based probability forecasts tend to be far from well calibrated.

Another chapter is devoted to the verification of spatial fields, a natural topic given the essential role played by maps in depicting weather patterns. Methods for spatial verification are not at all well developed, with data reduction techniques such as principal component analysis being employed, not making explicit use of the geographic location. Given recent advances in spatio-temporal statistical modeling and its application to the environmental sciences (Mateu, Montes, and Fuentes, 2003), the verification of forecast fields is a fertile area for statisticians.

An entire chapter deals with the decision-theoretic concept of the economic value of imperfect information such as weather forecasts. Examples in which economic value can be negative are included, counterintuitive results that beg for more explanation. "Sufficiency," a concept developed primarily within statistics, provides a link, albeit tenuous, between forecast skill and forecast value. But it was felt that this concept is too technical to be treated in any detail in the book.

In closing, pedagogy is one more reason to consider making use of this book. Any student can readily identify with the weather events being forecast, and forecasts and observations can be tracked on a virtually real-time (e.g., daily) basis. So, if you are searching for more compelling applications to use in your next statistics or biostatistics course, this book might be the place to start.

Reference

Mateu, J., Montes, F., and Fuentes, M. (2003). Recent advances in space-time statistics with applications to environmental data: An overview. *Journal of Geophysical Research* **108,** 8774.

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BAUSELL, R. B. and LI, Y.-F. **Power Analysis for Experimental Research: A Practical Guide for the Biological, Medical and Social Sciences.** Cambridge University Press, Cambridge, 2002. xi + 363 pp. US$65.00/£47.50, ISBN 0-521-80916-9.

The back cover of the book states *"This comprehensive, yet accessible, book provides practicing researchers with step-by-step instructions for conducting power/sample size analyses, assuming only basic prior knowledge of summary statistics and the normal distribution."* and the introduction adds *"... we have studiously avoided the use of technical terms and formulas until the appendix to make it as accessible (and hopefully interesting) to individuals without advanced statistical training as possible."*

In spite of the rather general title the content of the book is restricted to experiments with *continuous* outcome data and covers only *t*- and *F-tests* for *balanced* designs (having equal number of subjects per group). *Nonparametric* rank tests as well as tests for *proportions* are not dealt with. This is no criticism of the book's content but of its misleading title.

The computation of power/sample size is based on the concept of the *effect size* among two groups, i.e., their standardized mean difference. The first three chapters provide a well-written introduction to the subject and give an overview over the remaining chapters. The Chapters 4–9 are arranged according to the following pattern. First, the design leading to the respective test is explained in detail, giving explicit advice when to use or not to use the test. Then for typical examples the power (given the sample size) or sample size (given the effect size) is computed using the detailed templates and tables found at the end of each chapter. The tables cover the common values: $\alpha = 1\%$, 5%, 10% and power = 80%, 90%.

Chapter 4 deals with the two-sample *t*-test and Chapter 5 with the paired *t*-test. In the latter (and in Chapters 7–9) separate tables are given for "typical" values of the correlation (0.4 and 0.6) rather than providing a single table using the *adjusted* effect size.

F-tests and multiple comparisons in a one-way ANOVA with up to five groups are treated in Chapter 6. The power of the *F*-test (which depends on the allocation of the group means) is given for three "typical" patterns of the means associated with low, medium, and high power (no formula is provided for an *arbitrary* pattern). A normal power approximation due to Laubscher is offered for situations not covered by the tables. In the corresponding formula 6.1 the factor $(2df_{\text{num}} - 1)$ should read $(2df_{\text{den}} - 1)$. And the weight W for high-dispersion pattern in formula 6.2 (which should contain K^2 instead of $K2$) only applies for *uneven* K (for *even* K the weight is $W = 0.5$). Among the variety of multiple comparisons for any two group means the authors present tables for two procedures based on the Studentized range statistic: The "relatively liberal" Newman–Keuls' test and Tukey's "relatively conservative" honestly significant difference procedure.

Chapter 7 contains an extension to a one-way ANCOVA with one continuous covariate. The one-way ANOVA with *repeated* measures (i.e., the groups represent different measures either on the same or matched subjects) is treated in Chapter 8. Chapter 9 deals with *F*-tests for *interactions* in a two-way factorial ANOVA. Only 2×2 interaction is discussed in detail and for more complex designs the authors recommend collapsing to obtain a 2×2 interaction (the appendix gives details for general two factor interactions). Extensions to a corresponding ANCOVA resp. ANOVA with repeated measures are also treated. In Chapter 10 more complex designs are discussed, but less explicit than in previous chapters (with no additional power or sample size tables). The final Chapter 11 gives a very useful overview on books, selected articles, software, and web resources dealing with various aspects of power and sample sizes. The appendix provides some technical details and extensions.

The authors chose to present extensive tables for "typical" situations instead of general formulas, which would enable the reader to do the computations himself using his favorite software (capable of computing the noncentral *t*- and *F*-distribution or normal approximations thereof given in the book). For input values not covered by the given tables a computer program is obtainable ("free of charge for readers") by e-mail from one author. However, the software is not part of the book itself and therefore not reviewed here.

To summarize the book primarily addresses practicing researchers who are looking for an informal introduction and prefer tables (covering nearly half of the book) to formulas. For these readers the book will—within its scope (*t*- and *F*-tests for balanced designs)—provide a helpful companion.

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WALKER, G. A. **Common Statistical Method for Clinical Research with SAS Examples.** SAS Institute, 2002. xiv + 464 pp. US$62.95, ISBN 1-59047-040-0.

This well-written book is a very useful guide to understand various statistical methods and to learn how to apply them using SAS. It is clearly arranged and, even if the title suggests to target clinical researchers, it is also very helpful for all people who have to carry out the most common statistical tests in SAS. However, interested readers should be aware that SAS is not the primary focus of this book and some elementary knowledge concerning SAS DATA step and basic procedures is required.

After a short introduction into the basics of statistics, common descriptive statistics as well as the most essential elements of hypothesis testing are described. Elementary SAS procedures (PROC MEANS, PROC UNIVARIATE, PROC FREQ, PROC CHART) are introduced to explain summary statistics or to present rough histograms for several variables from an example data set. Subsequently, the most common statistical methods and tests that occur in the everyday life of clinical researchers (e.g., *t*-test, chi-square test, nonparametric tests, ANOVA, logistic regression, log-rank test) are presented in separate chapters. Starting with a brief description of the application area in clinical data analysis each test and statistical method is explained in a very comprehensible way, resulting in a summary including the null hypothesis, the test statistic and the decision rule. Statistical hypothesis testing is the main focus of the book. For those, who are not very familiar with the principles of statistical testing and the required arithmetic operations behind the formulas, very detailed manual calculations are shown to illuminate the use of test statistics and the conclusions which can be drawn. This is worth mentioning particularly from the didactical point of view, since the results from these manual calculations are subsequently derived and affirmed using the adequate SAS procedure. In this context, the complete SAS code as well as the resulting output are shown and explained. Finally, each chapter concludes with some additional details and notes which are very helpful for understanding complemental model-options, when applying the presented test to slightly different problems or in the case of violated assumptions (e.g., small data, skewed distribution). Derivations of test procedures are omitted.

As compared to the first edition, this second edition includes some new methods sections (e.g., crossover designs), more detailed and expanded chapters (e.g., linear regression, ANOVA, logistic regression) as well as a new chapter with exercises. These exercises provide an excellent opportunity to apply most of the methods established in the preceding chapters, by means of a small data set. Finally, the results of the analyses are briefly discussed and the corresponding SAS codes are given. However, perhaps some minor revisions are possible, e.g., it seems not very obvious to introduce the layout for the chi-square test and Fisher's exact test combining the groups as rows and the events as columns whereas in Example 17.1 it is exactly the other way round.

In total, this book is a great reference for all people using the SAS system to perform a wide variety of different statistical methods. The reader is provided with the necessary SAS statements to run programs for most of the commonly used statistical methods and tests, especially in clinical research. Even those readers who are not very familiar with statistics will get a basic intuition of what they are doing.

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McCulloch, C. E. and Searle, S. R. **Generalized, Linear, and Mixed Models.** Wiley, 2001. xxi + 325 pp. US$99.95, 0-471-19364-X.

The book contains a preface, 11 chapters, and two appendices. All chapters have a strong hierarchical structure, with sections and subsections, which make the book easy to use as a reference guide. In some occasions, this is at the price of continuity in the flow of the book, but as indicated in the preface, this was a personal decision of the authors.

In the preface, the general context is described and the structure of the book is justified. The target audience consists of graduate students and practicing statisticians, and it is indicated how the book could be used in a variety of courses on statistical modeling, at different levels.

The first chapter starts by giving a general introduction to the types of models that will be handled in the book. The distinction is made between linear and generalized linear models, as well as between mixed and nonmixed models. Afterward, an example-based discussion is given on the differences between fixed-effects models and random-effects models, and on their implications. Many examples clearly illustrate all the issues in deciding whether or not a factor should be handled as random or fixed. Here, the authors completely restrict attention to the linear models, typically relying on normality assumptions. It would have been nice to also include some examples from the generalized linear models context. Further, some general principles are given about inference, including maximum and restricted maximum likelihood-based inference, quasi-likelihood methods, estimating equations, likelihood ratio, and Wald-type tests. For the less experienced readers, some of these concepts are probably not explained in sufficient detail in order to grasp the general idea behind them. Finally, the authors explicitly mention that, only occasionally, information will be given on software available for fitting the models discussed in the book. This decision is based on the fact that the available software continuously changes with sometimes severe differences with respect to implementation as well as with respect to generated output. However, especially for applied statisticians, it would be nice to get at least some guidance with respect to available software, or to be referred to a web site where more information can be obtained and which could contain data sets, programs, case studies, etc.

In the second chapter, one-way classification models (models with one single factor as explanatory variable) are discussed, according to a 2×2 setup. First, linear models are considered, afterward models for binary outcomes are handled. In both situations, the cases of fixed as well as random effects are receiving attention. For linear models with random effects, both maximum likelihood as well as restricted maximum likelihood are worked out, hereby further distinguishing between balanced and unbalanced data sets. For binary mixed models, the beta-binomial, the logit-normal, and the probit-normal model are considered, although not all in the same depth. This chapter already clearly illustrates the general policy of the authors to start from simple settings, and to gradually generalize to more general models or more general data structures. This sometimes left me with an unsatisfied feeling due to the lack of justification in combination with the need for many references to later chapters where the topic of discussion will be treated in full detail (and in full generality). An example of this is the vague intuitive justification given for restricted maximum likelihood (REML) estimation, only possible for balanced data, while readers have to wait three more chapters for a more formal introduction and justification of REML.

Chapter 3 has a very similar structure as the previous one. Only, the single factor is replaced by a single covariate, i.e., focus is on regression-type models. All random-effects models have been restricted to models with random intercepts only. For models for normally distributed data with fixed effects only, an extension toward nonlinear models is made. For the normal mixed models, there is again a completely separate discussion for balanced and unbalanced data sets, even though the unbalanced case could have been handled at once, provided a slightly more general notation had been used. For binary mixed models, conditional inference (conditional on sufficient statistics for the random intercepts) is discussed as well.

The Chapters 4, 5, 6, and 8 are devoted to the four general classes of models (linear/generalized linear; fixed/random effects), introduced before. Many aspects, encountered in the introductory chapters, are now shown to follow from a much more general theory. General models are formulated, various estimation methods are discussed and compared, and inferential procedures are derived. In contrast to the earlier chapters, where estimation and inference (testing and construction of confidence intervals) were treated separately, this is no longer the case in some of these more general chapters. This lack of similarity in structure between the introductory chapters and the chapters containing the general theory may be confusing for some readers.

The intermediate Chapter 7 is on longitudinal data, probably the context where mixed models are applied the most. Only normally distributed outcomes are considered, and most of the attention is on balanced data since, as justified by the authors, "unbalanced data are much more difficult to deal with than balanced data." Of course this is only when interest is in deriving analytic solutions for the parameter estimates. Indeed, for a series of relatively simple covariance structures, analytic expressions are derived. In some cases this requires a lot of matrix algebra, which has been put in a separate appendix at the end of the chapter. Given that the derived results yield little additional insight, I doubt that this kind of calculations will be useful for many readers, except for statisticians doing research in this particular area. There is no discrete counterpart of this chapter. The final section of Chapter 8 is a case study, but not of the longitudinal type. So maybe, it would have been better to move Chapter 7 after Chapter 8 and to extend it with longitudinal examples.

Although prediction of random effects has been mentioned in earlier chapters, Chapter 9 is completely devoted to this topic, giving a very nice overview, starting from "Best Prediction (BP)," over "Best Linear Prediction (BLP)," to "Best Linear Unbiased Prediction (BLUP)" for the linear model. This chapter contains numerous references to "Variance Components," the book by Searle, Casella, and McCulloch (1992). At moments, that gave me the impression that this chapter is just a brief summary, and that interested readers should skip it and read the full version elsewhere.

Chapter 10 is an overview of numerical algorithms often used in practice in situations where estimates are obtained from optimizing objective functions, such as for maximum or restricted maximum likelihood estimation. This is done for linear and generalized linear mixed models separately. This includes the Expectation–Maximization (EM) algorithm, the Newton–Raphson method, typically used for fitting linear mixed models, but also information on numerical quadrature and penalized quasi-likelihood methods, frequently used for the fitting of generalized linear mixed models.

Chapter 11 is a five-page chapter containing two examples of nonlinear models, as well as references to other literature where on this topic. This chapter really feels like a stand-alone chapter, with little of no connection to the rest of the book, and therefore could have been omitted. Finally, there are two appendices, containing useful matrix results and statistical properties, respectively.

No doubt this book gives a good overview about linear and generalized linear models, with and without random effects. When interest is primarily in a single one of those topics, then other books are available which give far more details. Sometimes, there seems to be some imbalance in how much attention is given to some topics. For example, when generalized linear (mixed) models are discussed, most examples and derivations are in the context of binary outcomes with logistic- or probit-type models. Very little is said about the analysis of counts with Poisson-type models. In my opinion, the readership will primarily consist of students (graduate level) and researchers looking for some theoretical background behind these models. This book is perfect for somebody starting research in the area of mixed models or longitudinal data analysis as it trains the skills needed to do analytical derivations of parameter estimates and associated statistical properties. I am not convinced that the book will be particularly useful for more applied statisticians, i.e., those who need sufficient background in order to correctly apply these models in a daily consulting situation, without having the need to be able to derive all results themselves. Such practioners will not find any practical guidelines on model building, model selection, model checking, etc. This theoretical flavor is also reflected in the fact that several important issues are treated from a purely mathematical point of view, without any further practical consequences or examples. For example, a purely theoretical approach is given to the problem of negative estimates for variance components. Nothing is said about the practical relevance nor about what this indicates about the marginal covariance structure of the assumed model.

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SINGER, J. D. and WILLET, J. B. **Applied Longitudinal Data Analysis. Modeling Change and Event Occurrence.** Oxford University Press, 2003. xx + 643 pp. US$65.00/£39.50, ISBN 0-10-515296-4.

Time-related data occur very often in the scientific literature and statistical methods to analyze such data have been in existence for a number of decades and are widely available in many statistical packages. Nevertheless, the statistical analyses used in actual applications and the published scientific literature are often inefficient or even misleading. This is mainly due to the fact that standard statistical tools do not always translate easily in to longitudinal procedures.

With this book, the authors try to narrow this gap by presenting up-to-date methods in an intuitive way based on many actual data sets, all of which come from the broad area of social sciences. The book is presented as a tutorial for professional readers who want to fully exploit longitudinal approaches. It presents thus all aspects, starting from the data organisation on the computer, to the strategy of data analysis and the presentation of results from the computer output. It always spells out the implicit hypotheses underlying each statistical model, it tells whether and how these hypotheses can be checked given the data and provides guidelines as how to extend the model if the hypotheses are not fulfilled. The scientific aim of each study is, as it should always be, central to each modeling strategy so that each statistical modeling is adapted to the scientific aim. In other words, in this book the examples motivate rather than illustrate the statistical methods. A large part of this book is devoted to the actual presentation of the results with an emphasis on predicted graphical trajectories for selected subjects.

The book is divided in two almost equal parts: The first considers what the authors call the study of change which is the usually called the modeling of quantitative longitudinal data. The second part is devoted to survival analysis.

The first part is divided into eight chapters from a chapter on descriptive methods to an interesting and quite unusual (at least for biostatisticians) chapter on latent growth modeling. It is entirely focussed on modeling a quantitative normally distributed endpoint. The basic model on which the presentation is based, is a linear growth random-effect model which is expanded in several directions. An interesting section discusses reciprocal causation with time-varying covariates, (i.e., does the hypothesized endpoint cause the change in covariate?) and conditions where this can be excluded. The fact that the covariance structure induced by the random-effect linear growth model is not completely general is only mentioned in Chapter 7 in which some alternatives are presented but the importance of modeling the covariance is downplayed. "Refining the error covariance structure . . . is akin to rearranging the deck chairs on the *Titanic*." However, qualitative endpoints and GEEs are not even mentioned.

The second part comes in two parts: The first is dedicated to discrete-time modeling of hazards considered as conditional probabilities, the second part considers continuous-time mainly using Cox regressions and extensions. A strong point is again a useful practical presentation of standard methods especially a quite comprehensive guidance through the testing of proportional hazards. I have however some reservations. The distinction between time-origin and date of entering the follow-up is not really made clear and correspondingly staggered entries, here called late entrants, are only considered as rare special cases. I doubt also that a professional reader would be able to do a correct person-time allocation with different time-varying variables based singly on this book. I was further surprised that the standard way of modeling discrete-time event data in biostatistics by a log-linear (Poisson) modeling of rates was not even mentioned. The standard way proposed by the book is a modeling of the hazards themselves through a logistic and complementary log–log link, which I have never seen used in practice. I suspect this is a difference of tradition between social and life sciences.

Overall this book might prove useful to the intended readership but in its aim to be close to the nonstatistical readers it is excessive. In many instances a simple formula is replaced by half a page of text, which makes it hard reading for mathematically trained people. In other instances the mathematical symbol is just replaced by a word. Is it really clearer to use "cumulation between t_0 and t_j" in place of the integral symbol? I also found the consistent use of the star-notation ($^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.005$) irritating.

In summary this is a book on good statistical practices in data analysis of longitudinal and survival data. For details on the presented methods one has to look elsewhere. I doubt therefore that this book will prove useful to the average *Biometrics* readership.[1]

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BRIEF REPORTS BY THE EDITOR

CHATFIELD, C. **The Analysis of Time Series, 6th edition.** Chapman & Hall, Boca Raton, Florida, 2004. xiii + 333 pp. US$49.95/£29.99, ISBN 1-58488-317-0.

If you are interested in a readable, introductory survey to modern time-series analysis this book can be highly recommended. The author gives a comprehensive and more intuitive discussion of models for time-series analysis instead of going unnecessarily deep into technical details. Although its focus is not on biometrical applications, the presented approaches can be easily transferred to practical problems in biometry. The book can be used as a textbook for undergraduate as well as postgraduate courses in this topic but also for self-tuition by researchers. First published in 1975, this concisely updated sixth edition now contains 14 chapters covering descriptive techniques, probability models for time series, approaches for fitting these models, forecasting procedures, time and frequency domain approaches, methods for analyzing two time series, linear systems, state-space models, the Kalman filter, nonlinear, multivariate and long-memory models, just to give an impression of the contents. In each of these chapters some exercises can be found. The answers to the exercises are sum-

[1] In the introduction, it is stated that every example is available on a web site whose address is not given. Searching the web I found it relatively easily at http://www.ats.ucla.edu/stat/examples/alda.htm.

marized at the end of this book. Practical examples are given throughout the book where Chapter 2.9 reveals some general aspects to be taken into account in data analyses. Worked examples and computational advice are given in Chapter 14, which help to tackle real data problems. Readers being interested in more advanced techniques may consult the numerous references provided to further reading and especially Chapter 13, which addresses several new topics.

KLEINBAUM, D. G. and WHYTE, D. **ActivEpi.** Springer, New York, 2002. CD-ROM US$69.95, ISBN 0-387-14257-6.

ActivEpi is an interactive self-learning software on epidemiology consisting of three major parts: objects and methods of epidemiological research; validity of epidemiological research; epidemiological analysis; and an appendix containing a reference guide to the statistical analysis program included in the CD, called Data Desk. ActivEpi provides a very valuable introduction into basic epidemiological concepts. The program features many helpful details (e.g., a glossary, bookmarks) and practical examples. The contents are realized with high didactic standard, and working with the program is simply fun. The only drawback is Data Desk that is not very concise. Nevertheless, ActivEpi can be warmly recommended as an introductory epidemiological course or even for refreshing of details for more experienced scientists.

SENN, S. **Dicing with Death.** Cambridge University Press, Cambridge, 2003. xii + 251 pp. US$28.00/£14.99 (Paperback) US$75.00/£45.00 (Hardback), ISBN 0-521-54023-2 (Paperback) ISBN 0-521-83259-4 (Hardback).

Have you ever been really entertained reading a book on statistics? No? Then, you should try this book by Stephen Senn. He entertains you with puzzling examples and paradoxes in statistics taken from various situations in the broad field of medicine. Of course, I may be accused of being biased since I am a statistician but I can only subscribe what Stephen Senn says in his preface: "Statistics is a wonderful discipline. It has it all: mathematics and philosophy, analysis and empiricism, as well as applicability, relevance and the fascination of data." And Stephen Senn manages the challenging task to prove this in 11 chapters dealing with the role of statistics in decisions about medical care, in allocating resources for health, in determining which drugs to be approved, and in the investigation of relationships between causes and diseases. He covers a broad range of relevant topics as for instance clinical trials, life tables, Simpson's paradox, regression to the mean, and even the power of prayer. I enjoyed each chapter starting with a quotation especially because of Stephen Senn's type of writing. Summarizing, this book does not only provide an enjoyable intuitive introduction to the world of medical statistics but also a valuable reference for statisticians who wondered how to explain to friends and colleagues that "reasoning with probability is essential to making rational decisions in medicine, and how and when it can guide us when faced with choices that impact on our health and even life."

GELMAN, A., CARLIN, J. B., STERN, H. S., and RUBIN, D. B. **Bayesian Data Analysis, 2nd edition.** Chapman & Hall, Boca Raton, Florida, 2004. xxv + 668 pp. US$59.95/£38.99, ISBN 1-58488-388-X.

The second edition of this book is a completely updated and extended revision of the first edition published in 1995, which has been favorably reviewed in *Biometrics*, **52,** pp. 1160–1161. The book is still divided four major parts where Part I consisting of four chapters deals with the fundamentals of Bayesian inference which is an excellent starting point for readers being not familiar with Bayesian ideas; Part II (now five chapters) is devoted to the fundamentals of Bayesian data analysis where Chapters 6 and 7 on model checking and data collection have been reorganized and expanded; the revised Part III (now four chapters) is on advanced computation and Part IV (now nine chapters) treats regression models, where among others chapters on nonlinear models and decision analysis have been added. Nearly each chapter contains a bibliographic note and several exercises. Three appendices complete this book, where the overview of standard probability distributions and their properties given in Appendix A is extremely helpful; Appendix B stresses on proofs of asymptotic properties; the new Appendix C which illustrates computation based on R and Bugs. The huge number of worked examples of the first edition has still to be expanded by several valuable new practical problems, which show throughout the book the three steps of the Bayesian approach in analyzing data. The first step concerns setting up a full probability model, the second step is to form a posterior inference conditioning on observed data, and the third step deals with the evaluation of the fitted model. The book is well structured giving for instance a list of models and of examples in advance, which is helpful in preparing a lecture. I also liked very much the detailed preface which among others gives hints how to build up a one-semester or one-quarter course on Bayesian statistics. Thus, the book can be highly recommended as an introductory text on Bayesian inference, a graduate text to Bayesian modeling covering new approaches, and as a reference text for researchers in this area.

AGRESTI, A. **Categorical Data Analysis, 2nd edition.** John Wiley & Sons, Hoboken, New Jersey, 2002. xv + 710 pp. US$89.95, ISBN 0-471-36093-7.

In 1990 the first edition of this book was published (*Biometrics*, **47,** pp. 346–347) and since then it has become the standard reference for researchers in this field. The last 14 years have, however, seen an increasing need for new methods to analyze categorical data mainly due to numerous applications in daily practice. Thus, this new edition has been carefully revised taking account of the new developments in this field, especially of methods for repeated measurements and clustered categorical data. In addition, the focus has somewhat shifted from log-linear models to logistic regressions because of the minor importance of the former where also extensions for multicategory responses and clustered data are given. Furthermore, all models are presented throughout the text as special cases of generalized linear models. This unified approach helps to clarify the various underlying ideas. The book now consists of in total 16 chapters with a new first chapter, three additional chapters on methods for clustered, correlated data, and a new chapter describing the historical developments of methods for analyzing categorical data. Numerous examples are given throughout the text where Appendix A shows how SAS can be used for the analyses presented in this book. The examples are supplemented by a large number of theoretical as well as practical exercises at the end of each chapter. There you can also find additional references to further topics of interest. A web site is provided by the author to give more information on the use of other software, further data sets, short answers to selected exercises, corrections of errors, and even more exercises. The book can be recommended for students but also for researches in social, behavioral and biomedical sciences, public health, genetics, ecology, marketing and of course all other research fields where categorical data play a role.