or multidimensional integration, this is a book for you.

References

1 Weerhandi S. *Exact statistical methods for data analysis*. New York: Springer, 1995.
2 Lehmann EL. *Testing statistical hypotheses*. New York: Wiley, 1986.

Reviewed by Eugene Demidenko, Section of Biostatistics and Epidemiology, Dartmouth Medical School, New Hampshire, USA.

Woodworth GG 2004: *Biostatistics: a Bayesian introduction*. New York: Wiley. xvi + 360 pp. $89.95 (HB). ISBN 0 471 46842 8.

This is a very interesting, well written and, I must say, very enjoyable and easy to read book on a Bayesian Introduction to Biostatistics. It is written in such a way that students, mainly in the biological sciences, can easily understand complex concepts in different areas of application related to their future professional interests. In my view, the way the author includes simple examples that illustrate every new concept or situation is remarkable and innovative. In addition, he also provides some programming details as to how the results presented in the illustrations can be obtained in SAS or WinBUGS. I believe this book can be used as a reference guide for practitioners and, at the same time, as a great introductory book for students in Biostatistics who show some proficiency in basic algebraic manipulation and who have, of course, plenty of computer experience. The book presents the foundations of Biostatistics from a Bayesian perspective, connecting statistical science with scientific reasoning in an interesting way. It presents the axiomatic basis of statistical reasoning via 'Dutch book' thought experiments, which help derive subjective probability from a simple principle of rationality. The author shows how to compute, interpret and report Bayesian statistical analyses in practice and, in addition, illustrates how to reinterpret traditional statistical reporting, such as confidence intervals, margins of error, and, in particular, *p*-values, in Bayesian terms. In this sense, I feel that the approach taken by the author in this book is unique and very appealing for both practitioners and students.

The book contains 13 chapters and three appendices with tables and a basic introduction to SAS and WinBUGS. Chapter 1 provides an introduction to statistical science, indicating that its purpose is to help people change their beliefs in a rational way when confronted with new information. The author emphasizes the need to quantify belief in terms of probability and the need to learn how to use the laws of probability (e.g., Bayes' theorem) to use data to revise beliefs. Chapter 2 introduces the idea of probability in this context (i.e., a person's belief about what is likely to be true) and also describes ideas about conditional probability and laws of probability covering fair bets, fair prices, odds and expected values. Chapter 3 deals with the idea of subjective probability and introduces the concept of a Dutch book thought experiment to expose the inconsistency of any given idea. While in general there is a clear presentation of the laws of probability via Dutch book arguments, I have my doubts about its clarity for students.

Chapter 4 introduces distributions, quantiles and moments as a way of describing and summarizing observed data, probability or, in summary, degrees of belief. Chapter 5 introduces the basic ideas of statistical inference, introducing models, the use of Bayes' rule to update beliefs, and its importance in the analysis of rates, introducing the ideas of credible sets and Bernoulli processes. Chapter 6 concentrates on the study of continuous probability distributions and, more specifically, on the normal and beta density functions and their use in the computation of posterior distributions for rates and credible intervals. Chapters 7 and 8 introduce methods to compare two rates and methods of inference on means, and provide some ideas about conventional statistical practice and how to see them in Bayesian terms. In addition, the ideas about relative risk, odds ratios, transformations, analysing designed experiments and the *t* family of distributions are also presented here.

Chapters 9 to 12 deal with linear models and statistical adjustment, logistic regression, hierarchical models and time to event analysis. The main idea is to introduce methods for computing, interpreting and reporting Bayesian statistical analyses in practice. All of these topics are presented in a very practical way, with not many technical details. Rather, their emphasis is on the interpretation of the results obtained using different specific software. Examples are very well presented and their selection is, in my view, outstanding. Students and practitioners will surely value this aspect in the book. Finally, Chapter 13 deals with the ideas of decision analysis, concluding that the main purpose of this book has been to show how to use the

posterior distribution to quantify what has been learned from observations.

Every chapter is illustrated with many very well selected and motivated real examples and exercises. In addition, there are other helpful materials mentioned in the book that include programs in SAS and WinBUGS, datasets, Excel spreadsheets, errata, and additional exercises. Everything can be downloaded from the website for the textbook (http://www.stat.uiowa.edu/~gwoodwor/BBIText/Index.html). There are a number of minor typos and recommendations that have already been sent to the author of the book.

In summary, this book is very well presented and it has been written in a lucid style that is concise and self-contained, making it really easy and pleasant to read. In conclusion, I highly recommend *Biostatistics: A Bayesian Introduction* as a good introductory textbook for practitioners and students in Biostatistics.

Reviewed by Vicente Núñez-Antón, Department of Econometrics and Statistics, University of the Basque Country, Bilbao, Spain.

Agresti A 2002: *Categorical data analysis*, 2nd edition. New York: Wiley. 719 pp. $105.00 (HB). ISBN 0 471 36093 7.

This is a fully revised edition of Agresti's 1990 text (first edition) on categorical data analysis (CDA). 'Categorical' here refers to the response variable. The methodology generally allows explanatory variables to be either quantitative or qualitative, so the approaches discussed are not limited to Chi-square analysis and so forth. I have used the first edition for some years as my main reference for CDA, and many others will be familiar with its content, so I shall concentrate in this review on the changes in the organization and content.

The introductory three chapters, covering the basics of contingency tables, simple probability models and some tests, have been updated and extended. The next chapter, originally covering binary response models, has been expanded to three chapters. The first introduces generalized linear modelling in some depth, followed by two substantial chapters on logistic regression. In this edition, generalized linear modelling provides the linking theme for many of the models presented within the book, including logistic regression, and this allows a more coherent organization of the treatment of the various models as they appear.

The four first edition chapters on log-linear modelling have been condensed into two, taking the view that log-linear models have diminished in importance. Material from the original chapter on logit models for multinomial responses has been re-worked and in places expanded. The updated chapter on matched pairs models covers many methods routinely used by applied statisticians: McNemar-type tests, agreement studies, and so forth. This chapter remains highly informative and usable. I do notice that the first edition example on presidential approval from a random sample of 1600 Americans has turned into an example on prime ministerial approval from a random sample of 1600 Brits, with exactly the same responses. Where the United States leads, Britain follows! This example remains described as 'presidential approval' in the examples index. There follows a chapter on repeated categorical responses, containing new material that outlines generalized estimating equation (GEE) approaches. Two new chapters deal with clustered categorical data and generalized linear mixed models, and with other mixture models for categorical data, for example, models that assume the existence of a latent categorical variable. The first edition concluded with chapters on asymptotic and estimation theory for parametric models. These are largely retained in the second edition, but with some re-organization of material. The second edition concludes with a short accessible history of the subject.

As in the first edition, there are many illustrative examples, with some new to the second edition. Often, the examples are analysed in rather more depth than in the first edition, and so they are more straightforward to read and interpret. In particular, many of the examples have been re-analysed (sometimes with slight alterations to the model) and full output presented in tables. This is especially helpful when it comes to checking the results provided by other packages. Notes at the ends of chapters point to relevant references and provide brief discussion of more esoteric material: many refer to work that has appeared since the first edition. There are many exercises supplied at the end of each chapter. The general layout of the book, the quality of the indices, and the comprehensiveness of the bibliography are all excellent.

A website is associated with the book. It contains sections on software, datasets, further exercises, some solutions, corrections, and a survey of Bayesian inference for CDA, co-written with David Hitchcock, which extends the material in Chapter 15. The lack of depth of coverage of Bayesian approaches is regrettable: the author