and 3/4 page. Series are subsumed into polynomial approximation, which consists of a brief introduction to Legendre and Chebyshev polynomials. Whilst this is interesting material, it has little relation to the subject at hand, since no algorithms are presented for such approximations to any of the elementary functions, and there is nothing on the efficient evaluation of either Chebyshev or Legendre series. This efficient evaluation is arguably the principal reason that Chebyshev expansions are genuine *practical* approximation tools.

Overall, I found this book something of a curate's egg.

I cannot envisage using it as a teaching text for its lack of exercises, nor will it form an important reference book in my library, since the treatment too often left me with more questions. What it covers in detail, the basic arithmetic algorithms, are dealt with very well and the style is certainly easy. I just wish it had been twice as long so that the reader is left with more answers and fewer questions. Maybe this implies its likely role—as an introduction for a research student which will prompt him/her to ask some of the questions and perhaps find some of the answers.

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16[62-07, 62A10].—MURRAY AITKEN, DOROTHY ANDERSON, BRIAN FRANCIS & JOHN HINDE, *Statistical Modelling in GLIM*, Oxford Statistical Science Series, Vol. 4, Clarendon Press, Oxford, 1989, xi+374 pp., $23\frac{1}{2}$ cm. Price \$75.00 hardcover, \$35.00 paperback.

This text provides a statistically capable reader with an opportunity to view the interplay between the theory of maximum likelihood estimation using analysis of deviance principles and data analytic techniques available with the GLIM3, Generalized Linear Interactive Modelling, statistical package. For each of a variety of useful exponential family models, the authors present a concise summary of the likelihood approach to model fitting and parameter estimation. An analysis of a specific data set typically follows. Included in this analysis are suitable GLIM commands to implement the chosen model, examples of GLIM output, especially analysis of deviance tables and likelihood ratio tests based on the differences between deviances, discussions about model selection, simplification and adequacy, and graphical tools, available as GLIM macros, that greatly facilitate the entire modelling procedure.

For a data analyst, the strength of the text is in the examples, especially when the authors discuss choices between competing models, where the principle of *parsimony* (see Section 2.1) is applied when formal statistical methods can no longer distinguish between alternative models. The reader may not always agree with the authors' final model selection, but will benefit from observing the data analytic approach taken and the GLIM tools used to reach the decision. This is particularly important when the competing models involve different error distributions and link functions (see Sections 2.4 and 2.5) and the models themselves become more complex (see Chapter 6).

The text will benefit an audience with a mixed statistical background, especially those data analysts who require a more extensive theoretical framework than that provided by classical regression theory. However, the reader should be familiar with standard normal model regression theory and have some knowledge of maximum likelihood model fitting, along with an understanding of the log likelihood function and likelihood ratio test. The theoretically weak reader should follow the discussion in Appendix 1 on maximum likelihood fitting of exponential family regression models, especially the sections devoted to the *profile likelihood* which is used extensively throughout the text. The reader wanting further theoretical detail should consult the recommended text *Generalized Linear Models* by McCullagh and Nelder.

With its obvious dependence on GLIM modelling capabilities, the reader should have access to some version of GLIM. The examples provided do allow the text to be used in a teaching environment without access to the appropriate software, although at a considerable reduction in the text's value. Chapter 1 of the text is devoted to an overview of GLIM command syntax and output features. By itself, this chapter and the appendices on GLIM directives and structures are sufficient for a new user to cope with the examples and macros presented within the text. However, it is certain that any user should have the GLIM manual available for reference, so as to maximize the practical, not just statistical, advantages of the text. This is especially true if the user intends to embark on macro writing, or even to fully understand the details of the macros supplied within the text.

Chapter 2 introduces modelling and inference using maximum likelihood techniques in exponential families. The definition of the generalized linear model through its three primary elements: the probability distribution of the dependent variable; the linear regression function involving the explanatory variables; and the *link* function between the linear predictor and the mean of the dependent variable, is given in Section 2.4. The likelihood function and maximum likelihood estimation of the parameters is developed in Section 2.5, while in Section 2.6 there is a discussion of the nature and potential weaknesses of standard errors of regression parameters based on the estimated expected information matrix that GLIM provides. The likelihood ratio test for choosing among models (Section 2.7), model simplification methods (Section 2.8) and model adequacy and diagnostic checking (Section 2.10) are especially valuable parts of the text. The reader is also referred to Section 2.14, where the authors mention the minor difference between the GLIM definition of *deviance* and the definition used throughout the text.

While Chapter 3 presents topics involving the well-known normal regression model and analysis of variance, the great strength of this chapter is its presentation of the Box-Cox transformation family and model selection using the BOXCOX macro for construction and plotting of the *profile log likelihood*. Theory is given in Section 3.1, then GLIM modelling directives and model comparison in the next section. The authors make the excellent point that the transformations apply to the skewed distribution of the response variable and are to be distinguished from the link function. Examples of the latter appear in Section 3.3. Regression models for prediction, the mean squared error criterion for model selection, cross-validation techniques and the PRESS statistic are discussed in Sections 3.4–3.6. The analyses of designed factorial experiments and cross-classified observational data are discussed in Sections 3.11 and 3.12. Techniques given for handling unequally replicated cross-classified data are especially useful, in particular the modification to a two-parameter Box-Cox family of transformations and corresponding profile log likelihood function, or the addition of small positive constants to empty cells.

Chapter 4 looks at binomial response data, beginning with the well-known logit, probit and complementary log-log transformations, the idea of the log-odds ratio, and model evaluation methods for such data (Sections 4.1–4.3). The remaining sections of this chapter discuss more complex contingency tables for binary data, with detailed examples of modelling with GLIM, especially with the large example in Section 4.8. The reader's attention is also drawn to Section 4.9, where the problem of overdispersion due to omitted variables is briefly discussed.

The natural extension of the binary response model to a multicategory response appears in Chapter 5. Section 5.4 summarizes the theory and GLIM fitting of the multinomial logit model. However, since GLIM lacks a specific multinomial error distribution, the fitting is achieved by exploiting the known relationship between the multinomial and Poisson distributions, and using GLIM's available Poisson error distribution. Sections 5.5 and 5.6 provide the necessary details, while direct fitting of a Poisson model and overdispersion problems with such fits are discussed in the early sections of this chapter. The topic of ordered response categories is addressed in Section 5.7.

In Chapter 6, the emphasis switches to continuous responses and role of the exponential distribution, and many related and derived distributions, in survival analysis. The hazard function is introduced in Section 6.2. GLIM fitting of the exponential distribution is performed in Sections 6.3 and 6.4, and a comparison made with the normal family and Box-Cox transformations in Section 6.5. Censoring in survival analysis is discussed throughout Sections 6.6–6.8. Most of Sections 6.9–6.19 are devoted to short introductions to a variety of competing survival distributions, including gamma, Weibull, extreme and reversed extreme value, piecewise exponential, logistic, log-logistic and lognormal distributions. The Cox proportional hazards model is briefly discussed in Section 6.15. The reader will benefit from Section 6.20, where GLIM procedures are used to help decide among different survival distributions. A number of published papers listed in the references will provide the more advanced reader with GLIM modelling methods for a greater variety and complexity of survival models.

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17[76-06, 76T05].—JOSÉ FRANCISCO RODRIGUES (Editor), *Mathematical Models for Phase Change Problems*, Internat. Ser. Numer. Math., Vol. 88, Birkhäuser, Basel, 1989, x+410 pp., 24 cm. Price $76.00.

These are the proceedings of a workshop held at Óbidos, Portugal, October 1–3, 1988. There are 20 contributions, organized in three chapters entitled: Generalized Phase Changes, Stefan Problems, and Miscellaneous Problems. While the emphasis is on mathematical modeling, several contributors also address computational issues.

W. G.

18[65-06, 65Dxx].—TOM LYCHE & LARRY L. SCHUMAKER (Editors), *Mathematical Methods in Computer Aided Geometric Design*, Academic Press, Boston, 1989, xv+611 pp., 23 $\frac{1}{2}$ cm. Price $49.95.

This volume grew out of an international conference on the topic of the title, held at the University of Oslo, Norway, June 16–22, 1988. Its content is accurately described on the back cover of the book: "The volume contains survey papers as well as full-length research papers. The mathematical objects discussed include univariate and multivariate splines, algebraic curves, rational curves and surfaces, Bézier curves and surfaces, and finite elements. The topics treated include scattered data interpolation, geometry processing, convexity and shape preservation, subdivision, knot insertion and removal, knot selection for parametric curves, geometric continuity, and cardinal interpolation."

W. G.

19[68U30, 68N05].—DAVID V. CHUDNOVSKY & RICHARD D. JENKS (Editors), *Computer Algebra*, Lecture Notes in Pure and Applied Mathematics, Vol. 113, Marcel Dekker, New York and Basel, 1989, ix+240 pp., 25 $\frac{1}{2}$ cm. Price: Softcover $99.75.

The book consists of a collection of articles related to the Conference on *Computer Algebra as a Tool for Research in Mathematics and Physics*, held at New York University in April 1984. This conference was the first of the *Computers & Mathematics* series, the latest of which was held at Massachusetts Institute of Technology in July 1989. The papers cover a diverse range of subjects with the emphasis on either computer use to carry out mathematical