Journal of Official Statistics
Vol. 3, No. 1, 1987, pp. 103–104

Special Notes

The Council of Professional Associations on Federal Statistics

The Council of Professional Associations on Federal Statistics (COPAFS) was established in 1980 by twelve national organizations in the United States. These associations were concerned with broadening and strengthening the participation of their members in decisions that affect the integrity, quality, utility, and accessibility of federal statistical programs and products. COPAFS was established in response to recommendations presented in 1978 by the Joint Ad Hoc Committee on Government Statistics. The council is intended to provide "a common effort by concerned associations to monitor developments in the federal statistical system that are of interest to the associations, to keep members of the associations advised, and to facilitate response to these developments."

The council works with both statisticians and legislators to identify emerging issues and areas for future involvement. COPAFS' general objectives are to:

- increase the level and scope of knowledge available to professional associations and their members about developments affecting federal statistics;
- encourage discussion within professional associations and elsewhere of statistical issues important to the professions and to the public;
- strengthen the capability of professional associations to respond to important issues in federal statistics; and
- ensure that the views of the professions have an influence on decisions affecting federal statistical programs.

Since COPAFS was established, many fundamental changes have occurred. In particular, government cuts in domestic spending affected the funding of statistical agencies. Concerned by these events, COPAFS concentrated on evaluating the effects of the budget cuts, and on communicating the concerns of statistics users to the government.

By 1985, restoration of funding for some key statistical programs had been achieved. Continuing efforts are needed, however, to ensure that important programs are maintained at the highest possible quality, especially in cases where budget problems persist for the agencies. COPAFS also devotes effort to strengthening the availability and usefulness of federal statistics.

COPAFS undertakes many activities to promote the interests of its member associations. For instance, the council establishes and maintains links with federal agency personnel, congressional committees, and others involved in the formulation and administration of federal statistical policy and programs. COPAFS disseminates information and encourage discussion and action on developments in federal statistics. In many cases, the Council serves as a liaison between the Administration and Congress and specialists who can review federal statistical programs.

Originally, the council was funded by pledges from the twelve founding associations, grants from four foundations, and contributions from individual donors.[1] As issues

[1] The Council's founding member organizations included: the American Agricultural Economics Association, the American Association for Public Opinion Research, the American Economic Association, the American Political Science Association, the American Public Health Association, the American Sociological Association, the American Statistical Association, the Association of Public Data Users, the Federal Statistics Users' Conference, the National Association of Business Economists, the Population Association of America, and the Society of Actuaries. During the past three years, the American Marketing Association, the American Psychological Association, the Association for Vital Records and Health Statistics, the Association for University Business and Economic Research, the Gerontological Society of America, the Industrial Relations Research Association, and the American College of Epidemiology have joined COPAFS; a number of other professional associations currently are considering membership in the Council.

central to the quality, utility, and accessibility of federal statistics evolve, the number of organizations and individuals interested in COPAFS' activities also increases. COPAFS cannot function effectively without the cooperation and support of its own members, government agencies, and legislators. The officers and staff of COPAFS appreciate comments on the council's work and ideas for improving its effectiveness.

Katherine K. Wallman
Executive Director
COPAFS
806 15th Street NW
Washington, DC, 20005
U.S.A.

European Population Conference: Issues and Prospects

Jyväskylä, Finland, 11–16 June 1986

The International Union for the Scientific Study of Population (IUSSP), the European Association for Population Studies (EAPS) and FINNCO, a Finnish consortium comprising the Finnish Demographic Society, the Finnish Population and Family Welfare Federation and the Central Statistical Office of Finland, are organizing a European Population Conference: Issues and Prospects which will take place at the University of Jyväskylä, Finland, from 11 to 16 June 1987. About 500 participants, demographers, economists, sociologists, statisticians, physicians, policy-makers, etc., coming from all parts of Europe are expected.

The scientific programme includes 7 plenaries and 25 sessions covering a large range of topics peculiar to the demography of Europe:

Plenaries: Population prospects; Fertility: diversity or convergence?; The future of the family; Inequalities in the face of death; Population movements and planning; Demographic change, economic growth and social welfare; Policy response and effects.

Sessions: Societal values and population policies; The demography of minorities; The changing marriage systems' effects on fertility and children; Social and geographical contrasts in major chronic diseases; Population forecasting and planning; Changing patterns of household structure; Family policy and population change; The correlates of the regional fertility transition; Fertility fluctuations in conception and births; Utilization of data sources for new analytical demands; The demographic implications of highly effective birth control methods; Pre-natal and infant mortality; Economic activity and fertility; Social and economic consequences of ageing populations; Internal migration and regional development; Urban historical demography; 1990 round of censuses; The dynamics of labour force participation; The family support of the elderly; Migration of the elderly; International labour migration; Long-term fluctuations in fertility; Early contributions to demography; Population and technology; Economic-demographic models.

Detailed information on the Conference can be obtained from one of the following addresses:

Dr. Altti Majava
Chairman of the Organizing Committee
c/o FINNCO-Travel Experts
P.O. Box 722
SF–00101 Helsinki
Finland

Mr. Bruno Remiche
Executive Secretary
IUSSP
34 rue des Augustins
4000 Liège
Belgium

Mr. Nico van Nimwegen
Executive Secretary
EAPS
P.O. Box 11676
2502 AR The Hague
The Netherlands

Journal of Official Statistics
Vol. 3, No. 1, 1987, pp. 105–113

Book Reviews

Books for review are to be sent to the Book Review Editor Jan Wretman, Statistical Research Unit, Statistics Sweden, S–115 81 Stockholm, Sweden.

Atkinson, A.C. and Fienberg, S.E., A Celebration of Statistics. The ISI Centenary Volume. Springer-Verlag, Berlin, 1985, ISBN 3-540-96111-9, xv + 606 pp., DM 138.00.

The centenary of the International Statistical Institute (ISI) was appropriately commemorated not only through celebrations during its biennial meetings, but also through a collection of essays written by major authors in statistics called "A Celebration of Statistics." The editors, Anthony Atkinson and Stephen Fienberg, have put together a diverse range of statistical essays covering the many facets of contemporary statistics.

This volume is worth reading if only to gain an appreciation of how important statistics has become over the last few years in widely diverse areas. The subjects covered in the volume vary from archeology and astronomy to psychiatry and agriculture. Statistical aspects vary from defining robustness and advances in experimental design to a review of nonsampling error. There is a mix of general interest essays, philosophical essays, technical essays covering specific areas of statistics, and mathematical aspects of statistics. This provides an interesting mixture for any reader.

There is also a very nice mixture of historical articles, state-of-the-art essays, and discussions on future directions. This is just what a volume like this should do in celebration of the ISI's one-hundredth anniversary.

It is not always clear, however, why the chapters are sequenced the way they are, and there does not seem to be any sectioning of the essays to give the reader a more precise idea of the different characteristics of the statistical specializations. It must also be said that the quality of the writing varies somewhat, although the internal organization of each of the chapters is very good. One should also note that the authors come from a cross-section of the countries that the ISI represents. Unfortunately, a volume such as this can only be representative of the penetration of statistics in social, economic, cultural, and mathematical areas of science and cannot really cover any of the areas in detail. One of the things the editors did to remedy this was to make sure that each author provided a detailed bibliography. This goes a long way towards helping the reader find additional information in unfamiliar fields.

My review then is favorable. I personally found a great deal of pleasure in reading the various articles, even those far outside my field or understanding, but which I was able to read for intellectual content in an easy manner.

I found some of the chapters to be of particular interest historically in that they covered certain significant periods in various countries or areas that advanced the development of statistics and statistical theory.

First of all and with special mention, one has to look at Durbin's chapter on the evolutionary origins of statisticians and statistics. He proposes that the ability to think in symbols and use logic leads to survival according to Darwinian law. Anyone who is interested in the historical/philosophical origins of statistics will find this article of immense interest. Fienberg's article on statistical developments in World War II is also of particular interest because of the advancements made during that period of time in the Western world, especially in the United Kingdom and the United States. One hopes that wars are not necessary for substantial advancements to be made, but it cannot be ignored that significant progress took place during World War II. The third article of historical interest is by Barnard and Plackett entitled "Statistics in the United Kingdom, 1939–1945." This essay also describes the period *between* the two World Wars, the number of people trained and the foundations of statistical theory being laid. By the end of the war, the outlook of statistics in the United Kingdom had changed vastly.

For someone like myself, whose statistical work is restricted to the area of censuses and surveys, some of the articles were of particular interest. There is an article by Barndorff-Nielsen, Blaesild, Jensen, and Sørensen on "The Fascination of Sand." I find this of particular interest not only because of the statistical applications, but more so because of the importance for sub-Saharan Africa to expand our knowledge of how sand moves. It may be that the statistical foundations that are being laid, as described in this chapter, will have an immense impact on the regeneration of sub-Saharan Africa. DeGroot and Mezzich describe psychiatric statistics as a new offshoot of statistics which is very different from health statistics and epidemiological statistics. This article is of more than passing interest to many who are working on the periphery of this area. The article by Field on the concepts of robustness, while somewhat technical, should be of great interest to many statisticians. The chapter "On the Statistical Analysis of Floods" by Pericchi and Rodrĩguez-Iturbe, is of interest to all kinds of statisticians, as an example of the breadth of statistics and statistical applications.

The article on statistical computing by Eddy and Gentle gives an idea of what is happening in both the developing and the developed world. I would have hoped, however, for a little more speculation of what the future may bring and a better description of what has been the computing situation in the past. The Hansen, Dalenius, and Tepping essay on the development of sample surveys for finite populations again describes some of the theory and achievements in that area. I also think there is some special interest in the essays on experimental design and the Russian experience. They describe the developments in experimental design and some of the future directions that experimental design is taking. The article on large-scale social experimentation serves to show some new directions in the area of evaluation and monitoring of programs and projects.

The Bjerve article on international trends in official statistics is a wonderful overview of what is happening in that dynamic field – again not only in the developed, but also in the developing world. This is an extremely complex topic and author Bjerve does a very nice job surveying the field.

The reflections on the World Fertility Survey by Macura and Cleland are not as critical as they should have been. It is obvious that the World Fertility Survey is one of the most significant international and ISI undertakings ever done and perhaps such a project may never be replicated on that scale. But I think a discussion of some of the controversy surrounding the early WFS work, as well as some of the controversy now appearing about the lack of development of local capability through the WFS, would have been pertinent here.

Malinvaud's "Economic and Social Statistics for Comparative Assessments" gives a very practical idea of the difficulties, both technical and sociological (if not political), in doing comparative economic assessments. Again, in conjunction with the experimental

design chapter and the chapter on social experimentation, it outlines some of the requirements that must be addressed for good program assessment and evaluation. It is an important overview.

I do not think that I can afford to pass over the article by Pearce entitled "Agricultural Experimentation in a Developing Country." Pearce has a very honest and critical eye in reviewing those programs and some of the problems faced by international agencies, as well as elucidating some of the difficulties that the developing countries themselves have in undertaking agricultural experimentation. Some of his ideas are very pertinent to the work being done in agricultural experiments also in the developed world. More importantly, some of his thoughts on how this work is to be accomplished, who is to accomplish it, and the ways that it should be accomplished, are "must" reading for anyone in this field in the developing world.

All in all, this volume celebrating the one-hundredth anniversary of the ISI is an excellent volume for almost any statistician. There is something for everyone. There is much for those of us who are interested in understanding the breadth of statistics and understanding the penetration of statistics into many new areas. This volume helps us understand the history and philosophy of the past and the directions of the future.

Karl K. Kindel
U.S. Bureau of the Census
Washington, DC
U.S.A.

Atkinson, A.C., Plots, Transformations, and Regression. Clarendon Press, Oxford, 1985, ISBN 0-19-853359-4, xiv + 282 pp., £25.00.

The analysis of linear models is supported by elegant mathematical theory. The validity of the analysis depends on two critical assumptions: (1) the assumed model is correct for the system being studied, and (2) good data are available for the analysis. Correctness of the model implies that all relevant explanatory variables are observed and that these variables, and the response, are in the correct functional form, and further that the proper assumptions are made about the error distribution. The assumption of good data implies that the data are free from gross errors and that they are representative of the region of interest. The advent of cheap, high-speed computing has prompted an explosion of research on methods for verifying these assumptions and for recommending appropriate action when they are violated.

This book represents an attempt to condense and summarize many recent developments, focusing on the essential issues and providing numerous illustrations. It is not a general textbook on regression or the analysis of variance, and it will be most appreciated by readers who have already studied these areas and, in particular, have experience with such models.

The primary concerns of the book are (1) diagnostic methods for checking data and model adequacy and (2) transformations of response and explanatory variables.

The first five chapters constitute a very readable summary of the essential ideas for diagnosing problems with the data using the concept of deletion diagnostics. The concepts of outliers, leverage, and influential data are reviewed in Chapter 1, and the algebra of deletion is developed in Chapter 2. In Chapter 3, the author focuses on two diagnostic measures, the deletion (studentized) residual and Cook's distance (or the author's modification). Many other diagnostics have appeared in the literature but these two capture the essential ideas. I was pleased to see a detailed and consistent analysis using these measures as opposed to being overwhelmed by the usual vast array of diagnostics.

Chapter 4 contains ideas for presenting and assessing results. The use of plots is stressed. The envelopes associated with half-normal plots are quite informative. In Chapter 5, the author discusses added variable plots and the closely related partial regression leverage plots for adding carriers and deleting observations. The ideas are illustrated by examples which are carried throughout the book to reveal alternative analyses. Including the list of examples after the table of contents for ease of reference back to the first introduction of the example was very helpful. However, I would have added the reference for all subsequent discussions of each example.

The reader interested in a well-written, nicely developed, and liberally illustrated discussion of deletion diagnostics and associated ideas will enjoy these first five chapters. Some ideas on multiple deletion and the effects on subsets of parameters are given in Chapter 10 along with extensions to nonlinear and generalized linear models. This material can be read immediately after Chapter 5.

In Chapters 6–9, the author develops ideas on transformations of both the response and explanatory variables. The Box-Cox transformation is nicely described in Chapter 6 including the constructed variable approximation. The author makes extensive use of the score test throughout these chapters. There is a nice discussion of this test in Chapter 6 contrasting it with the likelihood ratio and Wald tests. The author emphasizes the relation between the concepts of outlier rejection, variable transformation, and model elaboration. The ideas are illustrated with several examples where the influence of observations on the choice of transformation is noted. While the material in Chapter 6 is more difficult than that in the earlier chapters, it is presented in a readable form and should be easily understood.

The material in Chapters 7–9 is fairly advanced and somewhat more specialized. I suspect that only those readers who are seriously interested in the study of transformations will enjoy these chapters. I found them to be somewhat tedious. Chapter 11 is concerned with the generalized linear model, and familiarity with that concept is required. The last chapter summarizes work on related topics and concludes with some of the author's insights.

My reaction to the book was very favorable. As noted, it is not a book on the general theory of linear models. It might be used for a special course in diagnostics and transformations, although I think it is not intended as a textbook but rather as a reference book. There are no exercises included but the examples illustrate the ideas well. I would most likely use the book as a supplement to a regression course and as a valuable reference.

Ronald R. Hocking,
Texas A & M University
College Station, TX
U.S.A.

Breiman, L., Friedman, J.H., Olshen, R.A., and Stone, C.J., Classification and Regression Trees. Wadsworth International Group, Belmont, California, 1984, ISBN 0-534-98053-8, x + 358 pp., $21.95.

In the early 1960s, Morgan and Sonquist developed the AID (Automatic Interaction Detection) program at the Institute for Social Research of the University of Michigan. The AID method introduced the use of trees in regression analysis and soon became popular among many social scientists. During the 1970s, Morgan and Messenger developed a sequential tree classification program called THAID for the analysis of nominal scale dependent variables. The present book describes research and developments that are aimed at strengthening and extending the original AID and THAID methods.

The book grew out of independent work by Breiman and Friedman that began in 1973. They used tree methods in nonparametric classification and were joined by Stone who contributed to the methodological development. Olshen also contributed to the theoretical development and was an early user of tree methods in medical applications. A computer program called CART (Classification And Regression Trees) has been developed, and readers are encouraged to contact Olshen regarding the availability of CART software.

The authors describe the contents of the book as consisting of eight expository data analysis chapters and four theoretical chapters. The practical use of trees as a data analytic tool is illustrated by interesting and illuminating examples taken from medical diagnosis and prognosis. The organization of the book is not very clear, though. Discussions of formal, conceptual, and theoretical issues are not confined to the last four chapters. Readers will have difficulties in locating and distinguishing general theoretical results from the more expository discussions. There are many repetitions and a lot of overlap among the chapters.

The general set-up of the presentation is a set of n cases with measurements $x_1,\ldots,x_n$ in some measurement space, and a finite set of J possible categories of cases. The categories $y_1,\ldots,y_n$ of the n cases are to be predicted by a classifier, that is, by a function $y = d(x)$ from measurements to categories. The classifier can also be specified by a partition of measure-

ment space into J subsets or decision regions corresponding to the different categories.

The n cases are said to constitute a learning sample if both their measurements and their categories are known. If d is constructed from a learning sample, the error rate of d is given by the proportion $R(d)$ of incorrect classifications in the learning sample. This resubstitution estimate of the risk of error usually gives a falsely favorable picture of the success of d. In fact, d can easily be constructed so that $R(d) = 0$. To achieve more realistic classifiers and better estimators of their risks of error, a probability model is introduced by which the measurement and category of a case are viewed as the outcome of a pair of random variables (X, Y). Different cases are supposed to correspond to independent random variables. According to the probability model, the risk of error of a classifier d is given by the probability $P(Y \neq d(X)) = R^*(d)$. To estimate $R^*(d)$, the learning sample can be split into two parts, one for constructing and one for evaluating d. This procedure will yield a test sample estimator $R^{ts}(d)$ of $R^*(d)$. If the learning sample has size $n = v\,m$ and is split into v parts of equal size m, v classifiers $d_1,\ldots,d_v$ can be constructed from these parts according to a common procedure, and each one of them can be evaluated by using data from the remaining v–1 parts. This yields v test sample estimators $R^{ts}(d_1),\ldots,R^{ts}(d_v)$. Their mean value is called a v-fold cross-validation estimator $R^{cv}(d)$ of a classifier d constructed in the same way as $d_1,\ldots,d_v$ from any learning sample of size m. The book discusses and compares resubstitution estimators, test sample estimators, cross-validation estimators, and various bootstrap estimators of $R^*(d)$.

Tree classifiers are constructed by hierarchical partitioning of the measurement space into decision regions. The choice of a tree classifier involves the selection of good criteria for successive splits of the parts in a current partition of measurement space. It also involves stopping rules and rules for weighting the complexity against the accuracy of a tree classifier. Split criteria are formulated in terms of an impurity measure of the conditional probability distribution of categories in different parts of measurement space. High impurity means that further splits are needed, and low impurity means that the category is likely to be correctly predicted. Impurity can, for instance, be defined as entropy or as Gini's index of diversity.

The tree methods are often easy to explain and illustrate in applied work. They have an intuitive appeal that may make them preferable to other methods, even if, according to some criteria, they are not strictly better. This makes tree methods important practical data analytic tools, and the present book should inspire further use of tree methodology and further development of the theory.

Ove Frank
University of Stockholm
Sweden

Chaghaghi, F., Time Series Package (TSPACK). Lecture Notes in Computer Science, Vol. 187. Springer-Verlag, Berlin, 1985, ISBN 3-540-15202-4, iii + 305 pp., DM 41.00.

This book consists of about 75 computer procedures, mainly for analysis of univariate and bivariate time series. The procedures are written as machine independent FORTRAN 77 functions. They include estimation and filtering in the time domain, spectral analysis, curve-fitting, data generation and transformation, some numerical matrix routines, and procedures for reading, writing, and plotting data.

The main purpose of the book is

> "to provide ready-made Time Series procedures to a large amount of researchers of various horizons, such as Economists, Social Scientists, Psychologists, Biologists, who are involved with the analysis of chronological data, thus relieving them of the programming's burden."

The user must write a main program from which he calls the procedures. He can also easily insert his own FORTRAN 77 functions into TSPACK. There is no code for an interactive use of the program package.

The time domain methods can be divided into the following main groups:

- estimation of mean, variance, correlation, partial correlation, and cross correlation functions;

- estimation of an AR model from the covariance function (using Durbin's formulae); estimation of an ARMA model from the covariance function, see Box-Jenkins (1976), pp. 201–203;
- prewhitening; estimation of impulse functions; calculation of a transfer function from the impulse function, see Box-Jenkins (1976), pp. 377–380;
- complex demodulation, that is, estimation of the local amplitude R_t and the local phase φ_t in the model

$$y_t = R_t\cos(\lambda t+\varphi_t) + \text{noise},$$

where R_t and φ_t are slowly varying, and λ is known, see Bloomfield (1976), pp. 118 ff; to this function also belong MA filtering, and filtering with a least-squares low pass filter;
- a method for adaptive forecasting; and
- triple exponential smoothing.

The spectral analysis covers autospectrum estimation from the covariance function (where one can use several different windows), fast Fourier transform (both Cooley-Tukey and Sande-Tukey) with tapering, and various versions of cross spectra.

The curve-fitting methods (to relate two vectors x and y) contain spline functions, polynomial least squares, and non-linear least squares (using Marquardt's algorithm).

Among the data generation and transformation routines, we find a random number generator, which can generate both uniformly and Gaussian distributed random numbers, three sorting algorithms (both in-core and out-of-core), binary search, and a routine to find a fractile in a vector.

The package contains a program for scatter diagram plots, a program for time-wise plotting of one to five vectors (alphanumerical plots only), a number of read and write routines, as well as some text handling procedures. There is also a program for error messages, and some functions for storing matrices in a specially designed compact form.

I have tried some of the programs on a Vax 11/780 and they seem to work fine. As a whole, the package covers the basic techniques of time series analysis well. There are, however, some important exceptions.

The methods for estimating the parameters in ARMA and transfer function models are inefficient and should only be used to obtain preliminary estimates. A better and more general alternative would be to use a Maximum Likelihood procedure on the transfer function model

$$y_t = \sum_{j=1}^{k} \delta_j^{-1}(B)\omega_j(B)\, x_t^{(j)} + \phi^{-1}(B)\theta(B)a_t$$

(where $x_t^{(1)},\ldots,x_t^{(k)}$ are k input processes). Alternatively, one could use the simpler model

$$\delta(B)y_t = \sum_{j=1}^{k} \omega_j(B)x_t^{(j)} + \theta(B)a_t$$

(the notation is from Box and Jenkins).

I also would have liked to have a routine to estimate the general multiplicative seasonal model (p, d, q) x $(P, D, Q)_S$. A special case of this model is the much used "airline model" $(0,1,1)$ x $(0,1,1)_S$, that is,

$$\nabla\nabla_S y_t = (1-\theta B)(1-\Theta B^S)a_t$$

That TSPACK does not contain the above routines is a major drawback, since efficient estimation of standard models is central in time series analysis. It is also tedious to write programs for such procedures.

The package lacks some diagnostic checks of the estimated models, such as a test whether a series is white noise. It is, however, easy for the user to write such a program himself.

Unfortunately, the book is not very self-contained. It gives the user too little guidance about the methods. Those readers who are not experts in time series analysis, will have to seek through up to 30 references to get a proper idea of the package. The programs are introduced in alphabetic order only, and there is no index with page references. Thus, it is difficult to get a good survey of the routines.

Twenty or thirty more pages in which to present the algorithms and explain what a method does and what possible limitations it has, would have substantially improved the readability of the book.

With the above reservations, the book can mainly be useful to researchers without access to any of the major statistical packages. But also the user of such a package, who wants to create his or her own library of special time series routines, will be helped by the book.

References

Bloomfield, P. (1976): Fourier Analysis of Time Series: An Introduction. John Wiley & Sons, New York.

Box, G. and Jenkins, G. (1976): Time Series Analysis: Forecasting and Control, 2nd ed. Holden-Day, San Francisco.

Lennart Olbjer
University of Lund
Lund
Sweden

Cleveland, W.S., The Elements of Graphing Data. Wadsworth Advanced Books & Software, Monterey, 1985, ISBN 0-534-03729-1 (cloth), 0-534-03730-5 (paperback), xii + 323 pp., $27.95 (cloth), $18.95 (paperback).

Tufte's The Visual Display of Quantitative Information (reviewed in JOS Vol. 1, 1985 pp. 92–94) has become more or less The Book for graphing quantitative information inasmuch as it gives overall hints and directions. Cleveland's book puts this knowledge into practice.

The book, consisting of four main chapters, Introduction, Principles of Graph Construction, Graphical Methods, and Graphical Perception, is mainly about graphing data in science and technology. The material is intended for both analysis of data and communication with data. The intention of the book is (p. 9) "that infusing the new knowledge about graphical data display into science and technology will lead to a deeper understanding of the data that arise in scientific studies."

The Introduction (Chapter 1) gives a short review. This is mainly done with illustrative examples. The author also discusses the power of graphical display. The second chapter is about the elements of graph construction such as terminology, clarity in vision and understanding, and scales. In the terminology section, rules are given for writing names of the axes, the title, legend, and other labels in a graph. In the sections discussing clarity, a lot of figures from scientific journals are used to illustrate how data can be maltreated. Rules are given on how one should succeed in letting data stand out and the maltreated graphs are regraphed according to these rules. The scale section discusses constructing scale lines, comparing scales, including zero, taking logarithms, and breaking scales. It might seem a straightforward task to construct scales, but it is a difficult one. The hints and directions for making good scales are easily put into practice. The last section gives a list of the principles of graph construction. This should be used as a check-list.

The third chapter discusses various types of graphs and ways of encoding quantitative information on graphs. Seven subsections are devoted to various graphical methods: (1) logarithms and residuals, (2) graphing one or more categories of one quantitative variable, (3) dot charts, (4) relationship between two quantitative variables, (5) relationship between two or more categories of two quantitative variables, (6) measurements of three or more variables, and (7) statistical variation. The discussion is not only on how to graph the data but also on interpreting data. As an example, the first section discusses the use of various log bases and rules of thumb on how to quickly read off changes.

The last chapter is about graphical perception, that is, about visual decoding of graphed and encoded information. The author uses theory and experimental results from the field of visual perception to set out rules and the ordering of the most to the least accurate graphical-perception tasks. The important principle of data display is that one should encode data on a graph so that the visual decoding involves tasks as high in the ordering as possible. The two highest tasks are (i) Position along a common scale and (ii) Position along identical, nonaligned scales. The results are applied to both new and old graphs. For example, Playfair's well-known chart of exports and imports to and from the East Indies is regraphed according to the rules obtained.

Cleveland's book is highly recommended to publishers of scientific journals, scientists writing papers and books, teachers, and students working with quantitative information.

Arne Sandström
The Service Company of
the Insurance Corporations (FSAB)
Stockholm
Sweden

Dodge, Y., Analysis of Experiments with Missing Data. Wiley, New York, 1985, ISBN 0-471-88736-6, xvii + 499 pp., $39.95.

In an experiment designed to study differences between treatments applied to individuals or units, it may happen that measurements of responses for some units cannot be made or are missing. For example, crops are destroyed on some plots, an experimenter fails to record some data, gross errors occur in recording, a patient withdraws from a program, or one or more animals die during an experiment. Missing data of these kinds occur quite frequently. In such cases, various methods have been proposed to make adjustments for missing values in the analysis of data. There is an implicit assumption in some of these methods that missing data do not affect the estimability of the relevant parametric functions. Of course, an exact least squares theory can be developed for this purpose using the incidence matrix for the observed data, but the computations would be rather complicated. The purpose of the book under review is to provide systematic computational procedures to deal with missing data in a variety of situations. The author has done an admirable job in this respect by producing a valuable guide book for both theoretical and applied statisticians.

The first four chapters discuss the background material on the principles of design and analysis of data in varietal and factorial experiments. Relevant theories of linear estimation and tests of hypotheses are outlined and original sources are referred to for details.

Chapter 5 provides a comprehensive treatment of the analysis of two-way classified data with missing observations. Detailed computational steps are given for examining estimability of parametric functions, determining ranks of matrices that are needed to specify the degrees of freedom of the F statistic used in testing linear hypotheses, obtaining the sums of squares in the analysis of variance tables, and providing the covariance matrix of estimates. The methods discussed are new and useful for practical applications.

The results of Chapter 5 are carried over to Chapters 6 and 7 for a discussion of 3-way and n-way classified data. Chapter 8 is devoted to the theory and computation of g-inverses of matrices which play a key role in the analysis of experiments with missing data. It is of some interest to note that exact g-inverses could be computed in most of the cases. Minimally connected designs are discussed in Chapter 9 and computer programs are developed for generating such designs.

This is not just another book on design of experiments. It deals with an important aspect of data analysis for which adequate and systematic procedures are not available elsewhere. Computer programs written in standard FORTRAN are given at the end of each chapter and their use is illustrated with examples. Bibliographic notes with complete references are given at the end of each chapter, which will be useful to researchers as well as applied workers.

The methods developed by the author are applicable only when the missing data can be considered a random subset of the whole data. But in practice, this may not hold and the missing data usually have special characteristics. The author has not discussed such issues or ways of treating them. However, the book is a valuable addition to the literature on analysis of experimental data with missing observations. It could be used as essential additional material for courses on linear models and analysis of variance.

C. Radhakrishna Rao
University of Pittsburgh
Pittsburgh, PA
U.S.A.

Jolliffe, F.R., Survey Design and Analysis. Ellis Horwood Limited, Chichester, 1986, ISBN 0-85312-599-6, 178 pp., £28.50.

Here is a finely crafted synthesis of a wide variety of survey analysis methods. The tone is confident and one feels comfortable that almost any issue can be resolved. A reader insisting on full comprehension should have a fairly extensive grounding in basic statistical methods as well as in basic statistical theory. This book can give even those with little statistical background a proper attitude towards survey data. The book is concisely written, and there are good references.

The topics covered include: kinds of surveys, kinds of populations and samples, sampling frames, levels of measurement, data collection instruments, sample designs such as

simple random, stratified, systematic, clustered and multi-stage, non-random sampling methods, case non-response, item non-response, measurement errors, enumerator and coder effects, design effect, confidence intervals, bias in estimation, sample size, estimating variances, inference in surveys, processing data from editing through entry into computer with imputing to tabulations, contingency tables with measures of association, log-linear models, multiple regression, dummy variables, principal components, cluster analysis, and factor analysis. As might be expected, some topics are discussed only briefly, but there are always good references. What is missing are actual data. There is a fair number of realistic illustrations but there are more formulas than numerical examples.

Here are five areas that I believe can be improved: (1) After a good discussion of post-stratification, there comes a short section on unknown strata sizes (p. 47) wherein confusion arises between being able to draw a stratified sample from a listing of individuals and knowing stratum totals. Advice is then given on estimating stratum weights from the sample, perhaps without realizing that this brings one back to the sample unweighted mean. (2) A sentence on page 62 begins "If n_1 members ..." and should read "If $n - n_1$ members ... ." (3) On page 84 the intra-cluster correlation coefficient is called "rate of homogeneity" and is claimed to be more "portable" than design effect, deff. However, both of these coefficients depend on cluster size, unlike a portable measure that does not depend on cluster size, see Brewer et al. (1977). (4) While giving advice on increasing sample size to overcome case non-response is widespread in the survey literature, it should be resisted. Even though it may not be the author's intention, users can be led to believe that by setting sample size at $n' = n/p'$, where n would be required and p' is expected response rate, they can overcome effects of case non-response (see p. 95). I think it would be better not to mention this dodge. (5) After some good advice on ignoring the sampling variability in X-values (p. 151), a rather lame proviso is offered: "... provided the dependent variable $\mathbf{Y}$ is distributed independently of $\mathbf{X}_1, \mathbf{X}_2, \ldots, \mathbf{X}_p$." I don't know what is intended but surely $E(\mathbf{Y})$ will depend on the X's even when resampling of the X's can be ignored.

This book may best be used as a guide to current topics in survey data analysis. Although many computationally viable formulas are to be found here, their use has not been illustrated by actual data. The reader who is himself doing a survey analysis, rather than reading a report on one, will need to study the examples in the references. The book reads easily enough to be welcomed by students as a textbook, and along with examples of actual data supplied by the instructor, could make a nice course on survey analysis methods.

Reference

Brewer, K.R.W., Foreman, E.K., Mellor, R.W., and Trewin, D. J. (1977): Use of Experimental Design and Population Modelling in Survey Sampling. Bulletin of the International Statistical Institute, 47, No. 3, pp. 173–190.

Charles H. Proctor
North Carolina State University
Raleigh, NC
U.S.A.

Printed in June 1987.