Book Reviews

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This book is the first of two volumes, and it is intended to be a resource book for reliability engineers and product-assurance engineers. It is also intended for use as a textbook in a two-semester course in reliability engineering. Volume 1 is organized into 21 chapters and includes an appendix giving tables of the normal distribution function and density function, percent point values for the Kolmogorov–Smirnov goodness-of-fit test. Each chapter presents several problems but does not include the solutions. References are given at the end of each chapter. I would expect a more up-to-date and comprehensive list of references from a "Handbook" in reliability, however. For instance, Section 13.6 dealing with confidence intervals on the Weibull parameters gives only six references. With the exception of Kececioglu (1991), all references are from 1974 or earlier. The book is a sequel to Kececioglu (1991). Several of the topics, such as functions in reliability (Chap. 3), exponential distribution (Chap. 6), and the normal, log-normal, and Weibull distributions (Chaps. 9, 11, and 12) are also covered in Volume 1 of Kececioglu (1991). The main additional topics covered in this first volume of Reliability Life Testing Handbook are confidence intervals and goodness-of-fit tests.

Chapter 1 discusses the objectives of reliability and the management of reliability. Chapter 2 deals with data acquisition and processing and provides some forms that may be used. Chapter 3 deals with common functions used in reliability—the probability density function, the failure-rate function, the reliability function, the conditional reliability function, and the mean life function. Chapter 4 discusses the types of failure characteristics and the early, useful, and wearout life. Chapter 5 presents the t distribution, the chi-squared distribution, and the F distribution. Chapter 6 covers the exponential distribution in a manner similar to Kececioglu (1991, chap. 5).

Confidence limits on the MTBF are discussed in Chapter 7. The author introduces the concept of confidence intervals by discussing two samples from the same population (equipment) and comparing the two estimates of \( m \), the MTBF of the equipment. It may not be clear to the reader how this describes a confidence interval: "If it is claimed that the first estimate is the \( m \) of this equipment and we were asked to conduct another such test, we would be much embarrassed if it yields an \( m \) which turns out to be lower than that of the first estimate. To minimize the probability of being embarrassed we utilize the concept of confidence level, such that the probability of our being proven wrong, or the risk \( \alpha \), that the second \( m \) turns out to be lower than the first, in a long run, is kept at a prechosen low level" (p.173).

In Section 7.4 the author describes what is apparent from the formulas—namely, that the degrees of freedom for the lower confidence limits are 

\[ 2r + 2 \]

for the time-terminated case and 

\[ 2r \]

for the failure-terminated case. The reader may be more interested in knowing the statistical foundation for this difference.

Chapter 10 covers confidence intervals on the mean and reliability of the normal distribution. Chapter 13 deals with confidence limits for the Weibull distribution parameters. The author first shows how to obtain confidence intervals from probability plots. In the introduction to Section 13.6 the author then states that this section describes "more sophisticated methods for determining the confidence interval on \( \beta \) and \( \eta \)" (p.476) but produces only tables based on Monte Carlo simulations after mentioning the shortcomings of tables by Billman, Antele, and Bain (1972). I would prefer a more comprehensive discussion of confidence intervals. For example, large-sample confidence intervals are not discussed at all. For a more comprehensive discussion of confidence intervals, the reader may refer to, for instance, Nelson (1987).

Chapter 14 discusses ranks; Chapter 15 presents tests of comparison for the Weibull distribution; Chapters 16 and 17 deal with the gamma and beta distribution, respectively. Chapter 18, which seems somewhat out of sequence, deals with parameter estimation. Chapters 19–21 discuss goodness-of-fit tests. Most statisticians may object to the treatment of statistical testing. A null and alternative hypothesis is never stated. Instead, the author discusses the chi-squared goodness-of-fit test as a type of fitting when he states that "several theoretical distributions are fitted to the experimental data and the chi-squared goodness-of-fit test is used to determine which distribution fits the data best" (p.681). The author then continues to write that "if the calculated chi-squared value is less than the value obtained from the chi-square table, the fit is considered to be good at the desired confidence level, \( 1 - \alpha \)" (p.681).

Some readers may be irritated by the number of grammatical errors and sentence fragments, which could have been eliminated if someone had proofread the text before publication. Commas and semicolons are generally misused. Awkward statements such as "if data points exist which are substantially out of line with the rest of the data, called outliers, they may be suspected as bad data" (p.392) are plentiful throughout the text. Other examples of a lack of proofreading include a missing parenthesis on page 5, Equation (3.2), which may lead to a wrong estimation of the standard deviation; and on one page (p.74), four references to equations that contain two question marks instead of the proper reference numbers.

The index is inadequate. Several important topics such as failure and time censoring are not mentioned. In summary, I consider this book valuable because it covers several important topics. I would prefer, however, a more comprehensive coverage of the mentioned topics. In addition, the book suffers from poor style and includes numerous grammatical errors. The back cover of the book is symptomatic for this lack of proofreading. Here Weibull is spelled as "Wiebull" and it is promised that, in addition, "Volume I" "offers unique testing techniques such as Sequential Testing, Accelerated Testing" and other topics. None of these items are covered in Volume I, however. I suspect that they will be treated in Volume II.

Those desiring a more complete and readable coverage of life testing might prefer to consult Nelson (1982).

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REFERENCES


The use of counting processes to model time-to-event data has become a standard tool for most researchers in survival analysis. By using results on continuous time Martingales and stochastic
introduction, it is possible, in a unified framework, to solve many problems typically encountered in analyzing such data. Censoring and truncation of the main event of interest are handled quite easily using this general framework. This book presents the general theory of event-history analysis using these tools, as well as their application to a variety of problems commonly encountered in practice. It serves both as source for the mathematical development of the methodology and a set of detailed examples of the applications of these methods to many interesting and nonstandard examples.

The book contains 10 chapters. The first chapter consists primarily of a presentation of practical examples that will be used throughout the book. The majority of these examples are drawn from biological experiments. Nonstandard examples include left-truncated data on survival of diabetics in Fyn, left-censored data on the time of descent from tree of baboon troops, and data on software reliability. Several examples of illness-death models in which a nonhomogeneous Markov process is a reasonable model are given as well.

Chapter 2 provides the mathematical background for the remainder of the book. This chapter is a good survey of Martingale theory as applied to counting processes, limit theorems, product integration, likelihood construction, and the functional delta method. This chapter is not for the mathematically unsophisticated, but, as noted by the authors, “the whole chapter is intended to form a compendium of results for later use, and the reader should not feel obliged to study it all in detail before proceeding with the rest of the book” (p. 45). A good companion to this chapter for someone with an interest in the mathematical theory is the recent book by Fleming and Harrington (1991), which presents these results in more detail for right-censored data.

Chapter 3 provides a series of examples of models for life-history data that can be analyzed by the techniques of the book. Attention here is on models for the intensity process of the counting process and construction of the likelihood function under a variety of censoring and truncation schemes.

Chapter 4 deals with univariate nonparametric estimation of the survival function and the cumulative hazard rate. Each section includes a discussion of the derivation of the estimator and its large-sample properties and a series of examples. Estimators presented include the Nelson–Aalen estimator of the cumulative intensity, the Product-Limit estimator of the survival function, and kernel-smoothed estimators of the hazard rate. Each section includes improved confidence intervals and confidence bands based on a transformation of the basic estimator. A section on estimation of the transition matrix for the nonhomogeneous Markov model is also included.

Chapter 5 deals with nonparametric hypothesis testing. Included are one-sample and k-sample tests. Primary attention is on tests based on stochastic integrals of the weighted differences between Nelson–Aalen estimators. Other tests include tests based on the ratio of the intensity processes, stratified tests, tests for trend, and censored-data versions of the Kolmogorov–Smirnov or von Mises test.

Chapter 6 deals with parametric models. Included are sections on maximum likelihood and the M estimator. A section on model checking, which includes a variety of graphical checks as well as goodness-of-fit tests, is also included.

Chapter 8 discusses regression for event-history data. The primary discussion here is of semiparametric regression techniques. Two main classes of models are considered, the multiplicative-intensity model that yields the well-known Cox regression model and an additive-hazard model. For the multiplicative-hazards model, topics discussed include likelihood construction, large-sample properties, estimation of baseline survival, and regression diagnostics. For the additive model, nonparametric techniques for estimation of the risk functions are presented. This section is full of applications of these techniques to both standard survival experiments and to informative nonstandard examples, as is all of the book.

Chapter 8 provides a brief discussion of LeCam’s theory of asymptotic normality and contiguity. It provides a framework for discussing the efficiency of the nonparametric procedures discussed in Chapters 4–7. This section is primarily for the mathematical statistician.

Chapter 9 provides a brief introduction to the incorporation of random effects or frailties into the analysis of survival data. Chapter 10 gives a brief survey of multivariate survival analysis. Topics here include the choice of time scales, nonparametric estimation of the multivariate survival function, and sequential analysis of survival data.

This book is a comprehensive survey of methods in analyzing event history data by four of the leading researchers in the area. The number of papers cited that have been published in the last five years makes this book a valuable reference work for anyone doing research in this area or for anyone who needs to analyze time-to-event data. The notation may be a bit troublesome for the applied statistician, but there are numerous detailed examples that make the techniques understandable. A major strength of the book is that it handles a wide variety of censoring and truncation schemes, as opposed to the excellent monograph by Fleming and Harrington (1991), which deals exclusively with right-censored data. I strongly recommend this book to anyone doing research in this area and to anyone who routinely analyzes these types of data. I believe that this book will soon become the standard reference for statistical methods for survival data.

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REFERENCE


Advances in statistical computing are changing the face of statistics. Data analysis is becoming more interactive and exploratory in nature. Graphical displays, which were once primarily a means for data presentation, are indispensable tools in analyzing data. Dynamic graphics, such as three-dimensional rotating scatterplots, open our eyes to views of data not before possible. Computer-intensive techniques, such as bootstrapping and simulation, are changing the course of statistical theory as well as practice. Many of these advances are now available in statistical computer packages, but the new attitude toward statistical data analysis is only just beginning to emerge in introductory statistics books.

Regression With Graphics is an excellent introduction to regression that takes a graphical, exploratory view of data analysis. In addition to traditional regression topics, the author presents many new developments at an introductory level that is suitable even for the nonstatistics major who has had one or two semesters of statistical methods. Graphical displays are emphasized at all stages of the analysis, including model selection, model fitting, model criticism, and data criticism. The presentation is up-to-date and includes current topics in statistical computing, such as robust regression and bootstrapping. Regression With Graphics is roughly comparable to the applied regression books by Montgomery and Peck (1992) and Neter, Wasserman, and Whitmore (1989). The technical level of Regression With Graphics is about the same or slightly lower than that of these books.
The book begins with numerical and graphical summaries for univariate data in Chapter 1, including boxplots, quantile plots, and normal probability plots. Chapter 2 presents the basics of bivariate regression analysis and includes some discussion of residual analysis and power transformations for straightening the relationship between two variables. The basics of multiple regression are presented in Chapter 3.

Chapter 4 is a more detailed account of residual analysis for checking model assumptions and identifying outliers. This chapter also discusses the problems of influential data and multicollinearity. In Chapter 5, polynomial regression, variable transformations, and nonlinear regression are considered.

The remaining three chapters in Regression With Graphics contain introductions to advanced topics in linear models. Chapter 6 is a well-written survey of robust regression. Few applied regression textbooks discuss this topic that will eventually become an integral part of regression courses. Chapter 7 provides an introduction to logistic regression. This topic is often left out of applied regression courses but is a useful application tool for graduate students in business and the social sciences. Chapter 8 discusses principal components and factor analysis. All three chapters provide references for those readers interested in pursuing these topics further.

At the end of the book are four appendices, the first two of which are especially well written and should be required reading. Appendix 1 describes the concept of sampling distributions. Appendix 2 is an excellent discussion of computer-intensive methods and their role in statistical theory and applications. The last two appendices provide a review of matrix algebra and a collection of statistical tables for regression analysis.

Regression With Graphics could be used in a follow-up course to a good one- or two-semester introduction to statistical methods. (One might consider Modern Data Analysis: A First Course in Applied Statistics by the same author [Hamilton 1990a] for the earlier course.) This book may be more suitable in an applied regression course for graduate students in business, engineering, and other application areas, however. It could also be used for independent study by someone with basic knowledge of statistical methodology. Even professionals who frequently use regression analysis will find some new ideas for graphical displays to add to their data-analysis toolbox. The author has made the book easier to read by boxing the more technical material that can be skipped without loss of understanding or continuity. The notes given at the ends of chapters point out supplemental readings to the interested reader. Most of the exercises at the ends of chapters are based on real data from environmental applications.


REFERENCES


The title is appropriate. This is a practical introduction to statistical signal analysis. The format of the presentation, as stated in the preface, is "to define a theoretical concept, to show areas of engineering in which these concepts are useful, to define the algorithms and the assumptions needed to implement them, and then to present detailed examples that have been implemented on a computer." The author clearly has succeeded in producing a readable account of the current practices in the area of introductory statistical signal analysis. The bulk of the book treats one-dimensional single-channel signal analysis with only the last chapter devoted to such topics as cross-correlation, cross-spectral estimation, and coherence. The author provides little theoretical background, if any, in the main body of the text. Instead, he relegated it to the appendix. The book is addressed to the senior or the beginning graduate student with an undergraduate-level exposure to advanced engineering mathematics including probability, statistics, and computer programming.

As expected in a volume of this nature, there is a lack of mathematical rigor. In some cases, the author does not clearly state the assumptions. For example, in Chapter 5, in assessing the stationarity of a signal, the presentation of the $F$ and $T$ tests is misleading because of the implicit assumption of independence of blocks of data. This will be true only if the data blocks are separated by a long enough interval (Bendat and Piersol 1986, p. 343). There are other problems. Even though I enjoyed the informal style of presentation in the text, frequent absence of explicit definitions of symbols and terms is annoying at best. Take, for example, the use of the "free" notation to denote the transformation $h(t)$ to $H(f)$ (p. 72) or the use of the notation $U(x)$ (p. 170). The list goes on. Convolution is introduced on page 81 without a formal definition. It reappears in the guise of convolution sum later on page 236.

The table of contents listed here can be described as a modest subset of those found in current books on signal processing (Bendat and Piersol 1986; Marple 1987; Papoulis 1977) and reflects the choice of a basic core needed for the development of the applications. Specialized topics such as Prony's method (Trivett and Robinson 1981), eigenanalysis-based spectral estimation (Owensby 1985), or multichannel spectral estimation (Robinson 1983) have not been considered. The table of contents is as follows:

- Preface
- Chapter 1: Introduction and Terminology
- Chapter 2: Empirical Modeling and Approximation
- Chapter 3: Fourier Analysis
- Chapter 4: Concepts of Probability and Estimation
- Chapter 5: Introduction to Random Processes and Time Domain Description
- Chapter 6: Random Signals, Linear Systems, and Power Spectra
- Chapter 7: Spectral Analysis for Random Signals—Classical Estimation

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Chapter 8: Random Signal Modeling and Modern Spectral Estimation

Chapter 9: Theory and Application of Cross Correlation and Coherence Index

Each chapter includes a collection of exercises divided into two groups. One contains theoretical problems of a simple nature, sometimes extending the material presented in the chapter, and the other contains computation-intensive numerical problems. Unlike many of the current textbooks in this area, the book does not come with a floppy disk containing software codes for the algorithms described in it. The plus side of that, of course, is that the publishers have been able to keep the price of the book modest by not including the software. The author does, however, indicate the sources of available software. The book abounds in a rich variety of examples from different areas of signal-processing applications, the biomedical ones being a major source. There are also examples from speech processing, acoustics, and geophysics.

The algorithms are clearly stated, emphasizing the assumptions needed.

The references at the end of each chapter are adequate for students who are theoretically inclined, as well as those interested in more applications. In summary, the book is a good introduction to students interested in applications of signal processing.

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REFERENCES


Many applied statistics books are a collection of methods but give little, if any, perspective on when a particular technique is appropriate. This book provides real insight. Chapters 2 and 3 discuss types of data and more than the usual nominal, ordinal, interval, ratio classification. Topics include hard and soft data, time series and cross-sectional data, and primary versus secondary data. Chapters 4 and 5 discuss techniques to describe and summarize geographical data. These include boxplots, time series plots, distributions, and scatterplots. In addition, various numerical summary techniques are presented. What sets this book apart from many others is the insight provided concerning the use of techniques. A specific example under Section 4.5, “Summarizing Scatter” (p. 74), illustrates this point. The subheadings (4.5.1 through 4.5.6) are, respectively, the range, the inter-quartile range, percentile ranges, the mean absolute deviation, the variance and standard deviation, and the coefficient of variation. Two or three paragraphs are used to describe the statistic and present its advantages and limitations. In the discussion of the mean absolute deviation (p. 76), the author notes that, “The three measures described so far provide useful information about how scattered the data are...” Without a magic number like $R^2$ to guide them.

I groaned when the editor sent me this book. Not another “Statistics in blank,” which all too often are poorly written versions of good or bad introductory statistical textbooks (there are a few good ones around, Moore and McCabe [1993] is at the top of my list) with examples from blank field. Thus I engaged in a reviewer’s prerogative to procrastinate but finally felt guilty enough to read it.

To say I was pleasantly surprised is an understatement. This is a well-written book by an author who knows statistics and geography. His references are current and appropriate. It is different from the usual raft of “Statistics in blank” books in that it takes an innovative approach to presenting statistics to geographers and other earth scientists with no prior background in statistics, and I hope it works. I shall expand on this latter comment.

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credit, it is not a cookbook. It is in some sense a "how-to book" because of the insights provided. Even though the writing is very clear, I am unsure about how the more difficult material in Chapter 6 and beyond will be received by those with minimal background in statistics. I think it is excellent reading for a student or practitioner with some knowledge of statistics. I would, however, strongly encourage anyone teaching a course in statistics for earth scientists to take a serious look at this book. It does not contain problems but has computer examples. Indeed, I would encourage anyone looking for a way to present complex topics in a clear manner to read this book.

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REFERENCES


Factor Analysis in Chemistry was originally published in 1980 (with Darryl G. Howery as a coauthor) at a time when the field of chemometrics was just beginning to come into its own. The first edition pulled together considerable information available in the chemical literature at that time, and has been well received and frequently cited. The second edition reflects Malinowski's efforts to update the progress that occurred in the ensuing decade. I counted nearly 80 references to material published between 1980 and 1990, including 7 by the author himself. The references cited certainly cover the gamut of the chemical literature, especially in the chapters on specific applications. The applied nature of the book is evident in the predominance of citations from Journal of Chemometrics and Chemometrics and Intelligent Laboratory Systems among the statistical references. References from other statistical sources are more sparse. (I counted only two from Technometrics.)

The chapter titles in the book are:

1. Introduction
2. Main Steps
3. Mathematical Formulation of Target Factor Analysis
4. Effects of Experimental Error on Target Factor Analysis
5. Numerical Examples of Target Factor Analysis
6. Special Methods of Factor Analysis
7. Component Analysis
8. Nuclear Magnetic Resonance
9. Chromatography
10. Additional Applications

The major differences from the first edition occur in Chapters 3, 4, and 6, where new or updated topics are discussed (e.g., methods of matrix decomposition, rank determination, target testing, communality, partial least squares, and evolutionary, rank annihilation, and multimode factor analysis).

As stated in the preface to the first edition, the book was designed to cover the theory, practice, and application of factor analysis. The mathematical and statistical theory behind factor analysis is generally well presented, but it is in the practice and application areas that the book does best. Numerous real data examples are used throughout the book to motivate and illustrate mathematical concepts. The importance of careful data selection and pretreatment is properly stressed. Chapter 5 does a very neat job of stepping through an example of a complete analysis, with helpful cross-references to the mathematics derived in previous chapters. Several graphical illustrations of the geometry of factor spaces are also very helpful, particularly in the area of factor rotation.

Statistical programs (written for FORTRAN by the author) for implementing target factor analysis are described (but not included) in an appendix. (The programs are presumably available through the author, but, curiously, no mention of a source is given.) Another appendix gives sample programs for factor analysis written in the matrix language MATLAB (for which a source is given) Programs for factor analysis in computer packages such as SAS and SPSS are mentioned only briefly.

Although the book offers much in the way of advice for applying factor analysis, a word of warning is in order. The book is not an easy read, and this hampers the main objective "to explain factor analysis and thereby to facilitate greater use of this technique in chemical research" (p. vii). It requires a good deal of mathematical understanding to get through. Even the general overviews intended to motivate the methods require a fair knowledge of matrix-algebra terminology. For example, the "qualitative" introduction to factor analysis in Chapter 2 very quickly gets into discussions of eigenvector analysis and singular value decomposition with little in the way of background given. The book is not suitable for chemists seeking a quick general understanding of the topic or a cookbook approach to incorporating factor analysis into their work.

I had some minor quibbles with the book. First, although the social-science origins of factor analysis are discussed in motivating the theory, little mention is made of current views on the limitations of factor analysis among some of the statistical community. Neither is there much discussion of competing methodologies. Although the author revised notation and terminology in the second edition to conform more closely to current practice, some anomalies remain (e.g., the definition of a pseudo-inverse and the use of the term "factor size" to refer to the number of factors). Moreover, terms and notation are sometimes used prior to their definitions. Finally, it seems odd that the first motivating example in a book for chemists does not involve chemical data (rather it deals with grades on laboratory reports).

Although the book attempts to cover the broad range of material that exists on factor analysis, the emphasis is clearly on target factor analysis. Given the nearly impossible task of doing justice to the entire subject of factor analysis in 350 pages, a more specific presentation of target factor analysis and its use might have been a better goal for the second edition of this book. It is the detailed discussion about target factor analysis that reveals why chemometricians are so enthralled with factor analysis although many statisticians take a much dimmer general view of its usefulness (e.g., Seber 1984, p. 235). Still the book serves as a useful reference on the general theory of factor analysis and a specific guidebook for application of target factor analysis by mathematically sophisticated chemists.

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REFERENCE


TECHNOMETRICS, FEBRUARY 1994, VOL. 36, NO. 1
I am always hopeful when I have a "Statistics for..." or "Data Analysis for..." book targeted toward one of the populations pertinent for Amoco that I will find the perfect book to help these people make better use of the statistical tools appropriate for their work processes. A large petrochemical company like Amoco has many hundreds of people involved in chemical analysis and even more who do chemistry, so this book certainly is pertinent. The book is more specifically aimed strictly at the person doing chemical analyses—that is, analytical chemists. In its entirety this book is, as usual for this type of book, not the perfect book on statistics or data analysis for analytical chemistry. There are a few exceptionally good chapters, however, that were very worthwhile to read.

More specifically, there are four really excellent chapters on aspects of chemistry that require the effective use of statistics. These are joined by a great deal of very ordinary and unexciting chapters of standard statistical fodder for this type of book that would have appeared in similar books perhaps 20 years ago. One has to go through eight chapters of this stuff, a basic statistics primer in 150 pages, to reach the first really interesting chapter. The book’s first chapter actually does a nice overview of statistics in chemistry. It discusses lab issues, such as references and interferences, and statistical concepts in the lab, such as accuracy, precision, and detection limits. Topics for the other seven introductory statistics chapters are probability, exploratory data analysis, characterization of data, distributions, fitting distributions, estimation and testing, and comparisons. These chapters are distinguishable only by being presented strictly in the classical manner—probability through combinatorics, emphasis on distribution theory, use of integral calculus. There is little reference to any books or papers published in the past 20 years.

After this statistical antiquity, suddenly one reaches a rather oddly placed Chapter 9, "Transformation of Instrument Data." This does not mean taking logarithms but the smoothing of instrumental data. The chapter begins with an overview of the need for smoothing, then proceeds to discuss several methods—boxcars, moving-window averages, recursive filters, convolutions, and least squares polynomials. There are a couple of nice examples, and there are a few more recent references. Modern statistical computational tools, such as splines, are not presented, however.

There follows a four-chapter intermediate-statistics interlude that moves into the next level of statistical tools. Here another 75 pages is allocated among chapters with the following topics: design of experiments, analysis of variance, review of matrix mathematics, and linear models. The penultimate in that group rather reflects the tenor of the presentations. Everything remains very classical—designs like Youden and Latin squares, emphasis on matrices, antiquated references.

Somewhat more logically placed comes the next chapter pertinent to chemistry, Chapter 14, "Quantitation of Analytes." As one might expect following linear models, this chapter covers the use of calibration curves. Many other quantitation methods are presented too—comparison to a single standard sample, use of an internal standard, basic standard addition, and a more generalized standard addition that adjusts for interferences from analytes other than the one of interest in the analysis. Illustrations are adequate, and the discussions are excellent.

Another good chemistry chapter, with a somewhat misleading title, "Measures of Performance of Analytical Methods," follows. Primarily this chapter is about the determination of detection limits, a topic of great concern right now in environmental applications. Several methods are presented—comparison to the signal for the background, comparison versus a multiple of the standard deviation from repeated blank samples, and use of a calibration curve. No distinction is made, however, between a quantitation limit and a detection limit; for example, see Maddalone, Rice, Edmondson, Nott, and Scott (1993).

The last of the four chemistry chapters is next. It is concerned with quality assurance in the laboratory. Following a discussion of general procedures, the author presents control charts strictly in the Shewhart averages-and-ranges-for-subgroups mode. This perspective on control charts, contrary to almost any chemical laboratory situation that I have known in which one periodically runs a standard sample, strongly diminishes the value of this chapter.

The final three chapters cover advanced topics in statistics—nonparametric tests, multiple linear regression (MLR), and multivariate analysis. Nonparametric tests are the Wilcoxon rank sum test, the Kruskal-Wallis test, and the Friedman test. The MLR chapter proves a matrix explanation of parameter determination for polynomial and multiple-variable equations. The only multivariate methods that are mentioned are cluster analysis and principal components, the latter more as explanation for doing computations than motivation for use in applications.

Anyone who tallied chapters will find that I have described 19, the text for the book. Surprisingly, this encompasses only 347 out of the 536 pages. There follow here more than 180 pages of appendices; 150 of these are devoted to tables, including a 125-page F table, the largest I have ever seen in any book. More useful is an extensive listing of software packages, including capabilities (in a few words), addresses, and phone numbers for service by the author to statistical computing, which otherwise does not have a role in this book.

Probably at the risk of repeating what I have said in other reports or reviews, I will suggest again that chemists writing about statistics should not plan simply to write what they know about statistics, which statisticians can do better as countless books appropriate for use in teaching statistics have demonstrated. Four chapters here are reasonably well done but not worth the cost and the simultaneous acquisition of much rather arcane and mundane material supplemented with a nearly equal measure of fairly useless tables.

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REFERENCE


As stated in the introduction by the series editor of Advanced Quantitative Techniques in the Social Sciences, hierarchical data structures are quite common in the social sciences. They are quite common in many other disciplines as well. The term hierarchical, however appropriate, is not universally used to indicate the type of data discussed in this book. People familiar with the sampling literature refer to these types of data structures under the title of multistage cluster sampling. Sociologists would be more comfortable with the phrase "growth-curve models." In yet other areas, it is referred to as nested data. In any case, Hierarchical
Linear Models is concerned with the analysis of models for data collected or organized in a hierarchical fashion. This organization naturally leads to models in which observations joined at some level in the hierarchy are considered to be more related (correlated) than those that are not joined at that level. Using an example related to the book, one might be interested in studying student success on a standardized exam. The data collection involved a selection of $s$ schools and $n$ students within each school. Clearly, students in the same school might be considered to respond more similarly than students from different schools. Models can be built to study the scores that contain variables at both the student level (e.g., sex, age, SES) and the school level (e.g., school size, funding level). It is the aim of this book to provide readers with an understanding of the development of such models and their analysis when confronted with the fact that the hierarchical data collection produces sets of observations that are not independent.

The book is organized into 10 chapters and, for the most part, concentrates on two-level hierarchical models. Chapter 1 is a brief introduction and comments on the various terms used for this area. Chapter 2 motivates the use of hierarchical linear models through examples and develops the notation. Chapter 3 contains the limited estimation and inference theory provided in the text. It discusses both frequentist and empirical Bayes perspectives. Chapter 4 discusses the application of the material to one-way models. Chapters 5–7 are devoted to specific applications. In each chapter, a brief introduction is provided, and then detailed examples of the use of these models are given. In each case the models are applied to topics in education. The areas of application in the three chapters are organizational research, studies in individual change, and meta-analysis, respectively. Chapter 8 extends the results to three-level hierarchical models and, again, presents most of the material through examples. Chapter 9 deals with assessing model adequacy and discusses the validity of assumptions, inference, and the model-building process. The last chapter is a technical appendix. There are no problems or exercises at the end of any chapter.

I found the book easy to read. The authors progress through each chapter in a logical fashion. It is also nice to encounter a book in which the examples are not elementary in nature and demonstrate more complicated implementation of the proposed theory. Most of the examples contain several covariates and are not simply cases of two- or three-factor nested mixed linear models. I do not know of another book that provides as many examples of the use of these models.

In reading the book, however, I was struck by the lack of references to many of the sources to which most statisticians would look for more detail on this subject. Authors such as Graybill, Harville, Hocking, Rao, and Searle are noticeably absent from the discussion and references (e.g., Harville [1977] as a reference for REML estimation). The examples are exclusively from the social sciences, which I do not consider a drawback. Unless you are interested in these areas, however, it may be difficult to relate the information in these examples to other areas. The theoretical development in the book is limited. Most of the information is imparted through examples, and if the reader is interested in more technical results, the reference list does not include many of the sources that one would expect.

In conclusion, I would characterize this as an advanced reference monograph. It is a useful book for people interested in hierarchical linear models. It provides several examples of their use in realistic situations so that the reader can appreciate the full complexity and generality of their application. The examples, however, are not the most natural ones for readers with a natural-science or engineering background. This is a minor limitation. A more serious drawback is the lack of references to more technical development of the related theory. If the reader is already aware of the literature, this is not a problem, but if this is a first exposure, one will be left without the most commonly referenced sources to which to turn for further information.

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REFERENCE


This book pulls together many topics in the analysis of quantal (dose-response) data, providing a summary of recent research. The emphasis throughout is primarily on describing analysis methods, with many detailed mathematical derivations (e.g., a comparison of the method of scoring versus weighted regression for estimation of logistic models). Use of these methods is discussed briefly in the context of real or simulated data sets taken from the original statistical journal articles. The writing style is clear and concise, and the material is well organized. Many references are provided for each topic. The author also gives some guidance as to which statistical software packages may be useful for various types of analyses.

Chapter 1 introduces quantal response data through a series of brief discussions of data sets, requiring different techniques of analysis. Chapter 2 discusses maximum likelihood fitting for the simple logistic (dose-response) model. A discussion of goodness-of-fit measures, estimation of dose for given mortality, and confidence intervals is also included. Extensions and alternatives to the two-parameter logistic model are presented in Chapters 3 and 4, including mixture models (e.g., natural response vs. response to a drug), trichotomous and multivariate response, errors in dose measurement, and more complex three- or four-parameter models resulting from various link functions. These latter models are compared with variations of the logistic model such as Box–Cox transformations of dose. The author points out the usefulness of extended models, particularly in the context of low-dose extrapolation.

Chapter 5 deals with modeling of time to response and considers topics such as simple descriptive methods, mechanistic models, nonmonotonic response, mixture models (e.g., long-term survivors), and parametric survival analysis. Semiparametric survival analysis is not discussed here because the focus is on estimation of quantities such as dose for a given mortality. Overdispersion is introduced in Chapter 6, with a comparison of beta-binomial, correlated-binomial models, finite mixtures of binomials (in the context of outlying values), and models with transformed dose, regarding appropriateness in different situations, goodness of fit, and ease of computation. Issues such as tests for group comparisons, quasi-likelihood, and modeling the effect of litter size are also discussed. Chapter 7 summarizes nonparametric and robust procedures, including trimmed estimators, for estimation of quantities such as dose for a given mortality. Robustness and efficiency of different estimators is discussed in detail. A description of design and sequential methods is given in Chapter 8. For nonsequential studies, various optimality criteria are discussed, as well as efficiency and use of prior information. Several sequential methods are summarized and their performance com-
pared. The appendices provide brief summaries of topics such as the delta method, link functions, and asymptotically equivalent tests, as well as a list of relevant available statistical software packages and routines.

Regarding use as a textbook, this book would be most useful for a statistical methods course on quantal response data for advanced graduate students. Each chapter has numerous related exercises, many with suggestions for solutions given in an appendix. A large number of these are open-ended and thought-provoking, providing possible discussion topics for lectures or class projects. Use as a textbook in a more applied course would be difficult, requiring supplemental material and much more effort on the part of the instructor. As noted previously, the focus of the book is mainly on description of the statistical techniques themselves rather than on direct applications and involves a fairly high level of knowledge of mathematical statistics. Data-analysis examples are given to illustrate the techniques but are not described in detail, and most of the exercises provided do not involve direct analysis of data sets. Lower-level students also would probably find the book hard going.

Although discussion is fairly thorough for the most part, additional explanation or motivation would be helpful in several places, such as in the introduction of the logistic model; the discussion involves the fitting of a model but little description of why such a model is often useful. It would be helpful to see an example of a data set in which the logistic model provides a good fit in addition to the example given, in which the logistic model does not fit well. A nice discussion of logistic model diagnostics, presented in Chapter 3, might be more relevant in Chapter 2. In Chapter 6, there is little discussion as to what data patterns indicate overdispersion. Descriptions of alternative procedures—for example, beta-binomial, dose transformations, and various link functions—are thorough but somewhat scattered; a comparison of several methods (more than two) for a single data set would be illuminating. A similar example could be given for comparing modeling approaches described in Chapters 3 and 4. Chapter 7 could provide somewhat more guidance, again perhaps in the context of an example, as to when standard parametric methods fail and nonparametric or robust procedures are needed.

In summary, this book provides a thorough and readable reference (and an ample bibliography) for researchers and practitioners, particularly those with some familiarity of the area, summarizing recent research in dose-response modeling issues. The book also can be used as a textbook for a theoretical course for advanced graduate students.

Sybil L. CRAWFORD
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This book is a second edition. The first was by Johnson and Kotz (1969) only and dealt with both univariate and multivariate discrete distributions. “Dr. Adrienne W. Kemp, with her wide experience and expertise in the field of discrete distributions, was invited to serve as coauthor of a completely revised second edition” (p. xvi). As opposed to the first edition, “This volume deals only with univariate discrete distributions—material in the previous Chapter 11 will be transferred to a projected volume on multivariate distributions (discrete and continuous)” (p. xvi).

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the frame of reference. More emphasis is put on the understanding of topics versus making sure the student can do the analysis.

The author covered the basic topics for an introductory statistics class. The following comments summarize the parts that might distinguish this book from many of the other introductory statistics books. Chapters 2–5 show how to use graphs to summarize and evaluate data. No analysis is done on the data. Students are asked to plot the data appropriately and come to conclusions based on the graphs. Chapters 6–8 deal with probability. The end of Chapter 6 contains a very interesting discussion on risk and uncertainty. The discussion points out the importance of how the question of interest is phrased. Chapter 9 introduces the concepts and definitions of inference and tests of hypotheses. The concept of power is illustrated with varying sample sizes. The author places tests of hypotheses into the context of designed experiments and talks about double blind and extraneous variables. This chapter sets the tone for the remainder of the book, which contains all of the usual tests and inference-type issues and appropriate calculations. The author introduces each nonparametric analysis with the corresponding parametric analysis. Relative power of each test is discussed. Included is a nonparametric test for variance. Multiple comparisons are introduced in Chapter 12 with the Bonferroni method.

The following are general comments that can be pluses or minuses depending on your intentions for this book:

Positive Side
- Amazing number of real examples in the text as well as the exercise sets
- Many great medical/scientific real examples
- Important definitions are blocked off for ease of use
- Extensive instructions on how to use Minitab™ to work the problems

Negative Side
- Seemed wordy at times
- Not many examples from industry
- Blocked-off definitions are redundant, repeating what was stated in the preceding paragraph
- Other packages are used more in nonacademic settings

I do have a couple of concerns that relate to possible misunderstandings about data analysis done by the author in examples. The first concern is on page 454: The author uses an example that discusses taking subsamples and then calls the subsamples replicates. In the context of this example, however, the treatment is not applied until after the subsampling is done. So, in fact, the three slices of bread are replicates. No mention is made that in general subsamples are not replicates. (See Milliken and Johnson 1989.)

The second concern I have is the use of correlation of averages in two places. On page 542, the author calculates the correlation between the averages of two variables. On page 542, the author calculates the correlation of the total pine trees per acre and average diameter of the trees. In Exercise 15-3, the author asks the student to calculate the correlation between the averages of two variables. No mention is made of the dangers that can arise from calculating correlations from averages. (See Freedman, Pisani, and Purves [1978] on ecological fallacies.)

The listed concerns seem minor if you are interested in a book that emphasizes statistical thinking. The effects of the general comments will all depend on how you want to use it. Overall it is a well-written book, but it is up to you to weigh the pros and cons for your application.

Roger M. Sauter
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REFERENCES


Statistics is the book I recommend to anyone who wants to know what statistics is all about and why it is important. Statistics is not only a solid introduction to the field, it is fun to read.

The book's greatest strength is that it uses real examples (no "Acme widgets" here) to answer the question "Why is statistics relevant to me?" Instead of giving examples in which unnamed investigators perform a t test to explore the pressing question of whether an unnamed characteristic of a manufactured product is significantly higher using manufacturing process A rather than manufacturing process B, the authors discuss the field trials of the Salk polio vaccine, the Gallup polls, the Current Population Survey, the chances of winning at roulette, probability models and genetics, and more.

The unusual order of topics informs readers of the uses and misuses of statistics before introducing probability theory and significance tests. Part I, "Design of Experiments," describes the virtues and limitations of controlled experiments and observational studies. This is the ideal subject to start with because many of the misuses of statistics encountered in the newspaper involve using observational studies to answer questions for which they are unfit. Persons completing the book and understanding it will not be statisticians, but they will be on their way to becoming educated and skeptical consumers of statistics. Since the most important part of being a consumer is knowing when a study is being used appropriately, the first chapter provides a good start.

Part II, "Descriptive Statistics," introduces histograms, averages and standard deviations, the normal distribution, measurement errors, and scatterplots. Part III introduces correlation and simple linear regression and contains an enlightening discussion of regression to the mean. Probability is not discussed until Parts IV and V, a refreshing postponement because by that time the reader can see why probability is needed.

Part VI, "Sampling," discusses sample surveys and confidence intervals. Many introductory statistics books discuss only simple random samples, and students leave the book with the impression that the "usual" confidence intervals are valid for any data set. The authors of Statistics emphasize repeatedly that complex surveys and other complicated data structures require a more complicated analysis, and they devote a chapter to the Current Population Survey to illustrate a complex survey. Part VII, "Chance Models," reiterates that the simple random sampling formula for standard error only applies when those assumptions are met and illustrates how probability models apply to genetics.

Significance tests are not mentioned until the final section of the book, after the reader has some idea of what statistics can do and is less likely to be confused by the concepts of null and alternative hypotheses. The authors wisely avoid the accept/reject language used in many other books, instead using p values along with some guidance on how to interpret them. The book ends with a critical discussion of significance tests, encouraging the budding statistical consumer to be skeptical. It warns against data snooping, distinguishes between "statistically significant" and "important," and emphasizes once more that significance tests do not give truth but only answer one specific question.

The order of topics is roughly the same as in the first edition. Some new examples are added, and some old examples are up-

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dated. For example, the newer chapter on the Current Population Survey uses results from June 1989. Graphs are much cleaner and easier to read in the second edition, and a substantial number of new exercises are added.

The exercises throughout encourage thinking rather than plugging into formulas. A student must understand the concepts to do the exercises—reading the problem and then paging back to find the appropriate formula simply will not work. In the section introducing the standard deviation, for example, none of the exercises require any calculations: They emphasize an intuitive understanding of the nature of the standard deviation.

Kline (1977, chap. 10) argued that a good textbook allows students to participate in the struggles of the development of the discipline instead of being presented with a historyless version of the subject: “Authors do not recognize the psychological damage of a bare logical presentation” (p. 219). The authors of Statistics meet Kline’s challenge: They present hypothetical conversations between Pascal and Fermat and other historical figures, showing the development of probability in its historical context. They also discuss many recent studies in the text and the exercises in which statistics have been misused. They introduce no topic baldly—they first show why a statistical or probabilistic idea is needed before introducing it. They avoid jargon whenever possible—in fact, there are almost no formulas in the book because the authors explain concepts in words. Some readers with a technical background may find the authors’ avoidance of formulas annoying at first and may want to supplement Statistics with another book that does involve more mathematics (and many students may find the lack of formulas frustrating when trying to do homework), but I found it refreshing to read a book that emphasized the ideas instead. The authors succeed at their stated purpose, which is to be “a sympathetic friend who will explain the ideas and draw the pictures behind the equations.”

The book may be a slightly better friend to men than to women, however. Even though the authors have clearly made a conscientious effort to include some health studies of women in examples and to avoid gender-biased language in the chapter text, some of the insidious cultural biases against women remain. I am not just referring to the use of such vestigial words as “weatherman”: I am more concerned about unexplained statements such as “On the math SAT, men have a distinct edge” (p. 87)—the implication is that men score higher merely because they are men. All pictures of historical figures are of men. In the otherwise entertaining cartoons, the active figures and persons in authority are men; in all cartoons except two, the female characters stand or sit passively in the background or weigh themselves. Many readers of this book will be women, who may be subtly reinforced in the notion that women are passive human beings and cannot do math.

Sharon LOHR
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REFERENCE


This is a very readable book on statistical process control. There are many examples and also problems given at the end of each chapter. Readers would surely enjoy discussions on management in countries of Central and Eastern Europe. The chapters are as follows:

1. Statistical Process Control: A Brief Overview
2. Acceptance-Rejection SPC
3. The Development of Mean and Standard Deviation Control Charts
4. Sequential Approaches
5. Exploratory Techniques for Preliminary Analysis
6. Optimization Approaches
7. Multivariate Approaches

Appendix A. A Brief Introduction to Linear Algebra
Appendix B. A Brief Introduction to Stochastics
Appendix C. Statistical Tables

The book is organized so that the earlier part can be used by people interested in applications only and the later part by more advanced readers. The book is appropriate for advanced undergraduate and graduate students at the universities.

In conclusion, this is an excellent reference book.

Subir GHOSH
University of California, Riverside


This book will provide the statistician a good overview of the quality function and primary techniques used in the discipline. For the student of management, it provides an adequate understanding of the techniques, as they fit into the overall operation of the company, to make informed decisions. As the authors state in the preface, it is aimed at giving a broad picture of the quality function while at the same time providing adequate technical detail to aid in decision making and implementation. This it achieves very well. Spread judiciously through the text are excellent examples, which give a strong connection between the material and the reality of industrial operations. The authors also address both military and commercial standards, with excerpts included at appropriate points in the text.

Chapter 2: Quality-Definitions, Concepts, Connotations, and Warranties. One of my pet peeves has always been inadequate attention paid to defining terms or, worse yet, giving definitions lip service. The authors here do a good job of defining the terminology starting from my favorite source, the dictionary, and including an exploration of the ambiguity inherent in any field. Another indicator of the strong practical bent of the text is a comment about the “considerable hyperbole” contained in the Crosby “quality is free” pitch, stressing the more realistic “higher quality costs less” quote from J.J. Juran.

Chapter 3: Statistical Techniques and Concepts Used in Quality Control. This is an excellent introduction to the statistics of processes. It has the appropriate emphasis on processes and sources of variation, with a good introduction to probability and statistics in this context. Although no statistical background is assumed, it is clearly not intended as a first course in statistics. It does, however, make a good brief application-oriented introduction or a good application-specific refresher for those with at least one course in statistics under their belts. Additional work will be needed for anyone with a weak statistical background.

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Chapter 4: Process Capability Studies. I would have liked to see more discussion here of gauge capability studies. One major mistake often made by new practitioners is not properly studying the capability of their measuring instruments and processes. The material here is, however, general enough for anyone recognizing the measurement as a process in itself to apply the techniques.

Chapters 5–7: Statistical Control Charts. You will find all of the basics here for both variable and attribute data, but no more. Chapter 5 gives the reader a good theoretical background, and 6 and 7 go into specifics of variable and attribute data-control charts. A few words about short-run methods and better discussion of the impact of sources of variation could be used.

Chapters 8–10: Acceptance Sampling. The authors here start out showing you the basics of acceptance sampling, and then get down to reality, such as how to select the appropriate plan from standardized military and commercial standards. Considerable effort is put into how to deal with standardized plans, and the material will definitely be helpful for the reader who finds the need to deal with the pages of tables, which are the core of these standards. If you find that you are not bound by the standards and they do not readily fit, the theoretical background appears to be adequate to get you started in the right direction.

Chapter 11: Reliability and Statistical Quality Control. As the authors state, reliability is directly related to quality control. In my experience, its monitoring is also sometimes a part of the quality organization. Thus the quality manager or practitioner needs to be cognizant of the area. This chapter provides only a very basic introduction, but it is sufficient for the intended audience.

Chapter 12: Quality Control in Service Industries and Service Functions. Too often quality-control techniques have been limited to production. With the increasing magnitude of the service industries, application of quality control to nontraditional areas is becoming more important. In addition, quality-control techniques can be applied to service aspects of manufacturing operations. The authors here provide the reader with the necessary tools for recognizing the opportunity for application of quality techniques to service activities.

A List of Available Software for QA/QC. I suppose the provided list is better than nothing, but it has the potential for becoming a recommendation for the small percentage of available programs that are listed here. A reference to a more thorough review of available software including cost, required hardware, support available, and performance reviews would be much more appropriate. My experience with some of the software from a few of the companies listed indicates that the software listed here ranges from very bad and overpriced to some of the best available. The reader needs more help here than just a list of contacts.

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The book is primarily addressed to engineers working in an industrial environment and does not require any background in statistics. The author's objective is to supply engineers with a set of tools from design of experiments to guide them in conducting experiments to improve product quality in manufacturing processes. The tools provided in this book are restricted to those propagated by Taguchi.

The book is divided into four main parts, which are all represented in the acronym PDCA: Planning the experiment, Designing the experiment, Conducting the experiment, and Analyzing the experiment.

The first part, on planning the experiment, formed by Chapters 2–6, is an extensive discussion on considerations that need to be made at the planning stage of an experiment to make the actual experiment a success. Although presented at an elementary level, these are very interesting and useful chapters, not only for those sold on the methods used by Taguchi. These chapters also benefit from Peace's personal experience. Among the topics included in these chapters are setting up an experimentation team; how to get people interested in the team and how to get management's support; defining the quality characteristic of interest and how to measure it; identifying factors that may affect the quality characteristic, levels for those factors, and possible interactions; control factors versus noise factors; and what type of experiment is most appropriate.

The second part of the book consists of Chapters 7–11. Among the topics in these chapters are an introduction to orthogonal arrays, the concept of degrees of freedom, a discussion of linear graphs, Taguchi's use of outer arrays for the noise factors, and a discussion, with practical considerations, on randomization and replication. The author's style in these chapters remains very accessible and pleasant, and the many examples should help those with no previous exposure to this material. The choice of topics covered in these chapters, the manner in which the topics are covered, and the terminology used in some of these chapters do, however, suggest deficiencies in Peace's command of the statistical issues presented here.

The three appendices in the book are all related to material in these chapters on designing the experiment. Appendix A provides tables of some orthogonal arrays, Appendix B provides linear graphs corresponding to these orthogonal arrays, and Appendix C provides tables for some of these orthogonal arrays that present, for each two-factor interaction, the main effect with which it is confounded.

Chapters 12–14 cover the third component of the PDCA cycle—namely, conducting the experiment. These chapters deal with practical issues for data collection and with documentation of the experiment. They provide useful considerations for anyone involved in experimentation.

The main chapters that deal with analyzing the experiment are Chapters 15–20. Analyses are presented for measurement data and categorical data when no noise factors are included in the experiment and for measurement data when noise factors are part of the experiment. The latter is entirely based on signal-to-noise ratios. Although Peace's style of presentation remains very pleasant in each of these chapters, the overlap in some of the chapters, especially Chapters 17, 18, and 19, could easily have been avoided.

The last three chapters in the book are a brief discussion of some additional issues. These include dealing with more complicated structures for the factors of interest (e.g., not all factors have the same number of levels; nesting of factors), dealing with multiple response problems, and dealing with missing data.

Peace is very successful in meeting his goals, and that is the major strength of the book. The book is organized very logically, the presentation of the topics is very clear, the basic issues associated with Taguchi's philosophy are covered, and no knowledge of statistics is assumed or required. A nice feature is that each
chapter, except Chapter 19, starts with a brief introduction, typically less than one page, to outline the contents and objective of the chapter. Another nice feature is that the book is rich in examples; virtually every new idea or concept, even the very simple ones, is clearly illustrated by one or more examples or by comparing the idea or concept metaphorically to an analogue that readers may more easily relate to. Peace's personal experience is especially noted in the chapters on planning and conducting the experiment. The number of typographical errors is almost negligible; the only one of some consequence that I noted is on page 277, where the line that should contain the computation of the signal-to-noise ratio for $A_1$ is completely blank.

If one is only interested in an elementary presentation of Taguchi's philosophy and a clear display of the methods he has propagated, this book deserves high recommendation. If one hopes to gain some understanding of concepts in design of experiments, including those used by Taguchi, the value of this book is very limited. Although Peace dismisses the notion that this book is in a cookbook format, with regard to the statistical issues it is, in my opinion, just that.

Peace's choice to limit coverage to the methods propagated by Taguchi is questionable. He chooses to ignore the many contributions during the last years—for example, in Technometrics—that aim at combining the useful ideas in Taguchi's philosophy with sound principles of design and analysis of experiments.

Peace's coverage of the statistical issues is also at times questionable. Coverage of topics such as interpretation of interaction graphs, comparison of fractional factorial designs with orthogonal arrays, dealing with interactions (and confounding of main effects and interactions), and rules for analyzing data (analysis of variance is labeled as a "more sophisticated technique" and is not used or covered at all) are wrong or overly simplistic and do not convey a strong command of these topics by the author himself.

In summary, chapters on the more practical aspects of experimental design in an industrial environment are certainly worth reading. Statistical methods used by Taguchi are also covered in an elementary way and are easily accessible—though discussions of the concepts are not always entirely correct. A sound understanding of statistical concepts in design of experiments should, however, not be expected from this book.

John Stufken
Iowa State University


This book presents engineering and statistical techniques behind Motorola's improvements in the quality of its products. As suggested by the title, two of these techniques are productivity analysis and process characterization. Productibility is defined as essentially the ease of manufacturing a high-quality product. Process characterization, on the other hand, is seen as the description of a process via product characteristics. This book does not assume any background in statistics and appears to be aimed at the practitioner.

Part I of the book (Secs. 2–3) contains a discussion of productivity analysis. Here, first-time yield is proposed as the productivity metric. Although first-time yield affects productivity, it is just one of the many factors affecting productivity (assuming the preceding definition). Inefficiencies and unnecessary costs may be due to a poor process and not only to rework. Therefore, first-time yield, as a metric for productivity, does not capture all important aspects of productivity and so is flawed. Continuing, the book recommends analysis of a process for both its short-term and long-term operation. The short-term operation assumes the process to be centered at the target value with deviations due to chance (i.e., deviations are due to common causes). The long-term operation of a process includes variations due to assignable causes. For productivity analysis, a formula is given for computing the first-time yield of a system or a set of variables (this is called the rolled-throughput) from the first-time yields of the components. This formula is an application of the multiplicative law of probability. An attempt is also made to express the first-time yield of the individual components making up a system (called the normalized first-time yield) in terms of the first-time yield of the system. The stated reason for this is to give a productivity metric that does not include the effect of the complexity of the process. This appears counterproductive. Normalized first-time yield appears best justified when, given some target for system rolled-throughput, it is used as an initial target for the first-time yield of the individual system components.

Part II of the book (Secs. 4–6) discusses process-characterization studies. These studies, among other things, provide data from which first-time yields can be calculated. First, a four-phase model for process characterization (product parameter definition, product parameter analysis, process parameter optimization, and process parameter control) and a tool for planning such studies are given. Next, the standard process capability indexes, $C_p$ and $C_{pk}$, are presented as process performance metrics that the second process characterization phase produces. $C_p$ and $C_{pk}$ are also called the short-term and mid-term capability indexes, respectively. To handle the long-term case in which the effects of assignable causes of variation are included, the book introduces the capability index $C_p^*$. An attempt is then made to equate $C_p^*$ to $C_p(1 - k)$, where $k$ is related to the offset of the process mean from the target value. In other words, an attempt is made to relate $C_p^*$ to $C_p$ in the same way that $C_{pk}$ is related to $C_{pk}$. This device leads to problems when one attempts to compute the corresponding yield when there are upper and lower specification limits. The book gets the correct answer by incorrectly adding the probabilities of nonconformance corresponding to different values of the mean. Part II also includes discussions of capability indexes for attribute data.

Examples on computing capability indexes and a case study on process characterization and optimization are given in Part III. The remainder of the book consists of appendixes, containing, among other things, a table showing the effect a varying mean has on the standard deviation and statistical tables.

To conclude, this book tries to convey the worthwhile message that projected product yields based on actual process performance should be calculated at the design stage. It also gives some tools for these calculations and for getting the information on which these calculations are based. Presentation of the material, however, is marred by loose and incorrect use of statistical terms, and incorrect statistical formulas. The wordiness of the book also makes reading unnecessarily difficult.
Information Age. Because of the user needs, it is necessary to ensure a very high quality of data. The dynamic nature of data, however, makes striving for this quality more complex than in a manufacturing process. One key problem with the quality of data is that no one takes responsibility for it. The author proposes assigning substantial responsibility, in the nature of ownership authority, for the data process to a "process owner." This individual can then take steps to ensure data quality. The author illustrates how quality-management techniques developed for manufacturing can be adapted to ensure quality in such data-intensive processes.

The book is divided into four parts—"Foundations," "Implementing Statistical Control and Process Management on Data-Intensive Processes," "The Overall Data Quality Program," and the "Summary." The "Foundations" section includes five chapters. In the first chapter, "Introduction," the definition of quality is given by the following statement: "A product, service, or datum X is of higher quality than product, service, or datum Y if X meets customers needs better than Y" (p. 5). This customer orientation becomes the foundation for quality improvement discussed throughout this book. In the second chapter, "Data and Information," the author examines the many existing definitions of data, including static and dynamic definitions. He then describes the data cycle in terms of acquisition activities and usage activities. Acquisition activities are described as (1) defining a view or "part of the world" to be captured in the data; (2) implementing the view, including how it will be measured and stored; (3) obtaining values; and (4) storing. This author advocates inserting quality check points, feedback loops, and data-destruction activities between acquisition steps 3 and 4 as a means of monitoring the quality of the data.

Diagrams in this chapter are informative. Concepts are well labeled. The reader has a difficult time in this chapter, however, sorting out key concepts from less important ones. In addition, the author devotes extensive effort to discussing alternative definitions of data and a definition of information in Chapter 2 that are not used in later chapters.

In the third chapter, "Dimensions of Data Quality," six quality dimensions of a conceptual view of data are first presented. They correspond somewhat to step (1) in the acquisition activity of the data cycle (discussed in Chap. 2 and listed previously). Next, the quality dimensions of data values are discussed, and these loosely relate to step (3) in the acquisition activity of the data cycle. Finally, the quality alineaments of data representation are discussed. These are loosely related to step (4) in the acquisition activity of the data cycle. The author identifies and discusses some 27 attributes of quality in this chapter.

Discussion in this chapter is poorly organized and does not carry forward the data definitions from Chapter 2. Some of the subsections do not indicate how they fit into the context of the chapter. Key quality attributes are not really emphasized more than the less important ones.

In the fourth chapter, "Statistical Quality Control (SQC)," the use of SQC is examined as a tool to identify and eliminate the special causes of process variation. Since SQC is used to achieve stability in a process and then make predictions, a traditional explanation of SQC concepts is discussed. In the fifth chapter, "Process Management," the key contribution of process management in linking the customer with the organization is discussed. An interesting approach of process management that focuses on the future performance of the process is also discussed. It is in this chapter that the "process owner" concept is defined. Many useful diagrams are employed to explain the concepts.

The second part of the book, "Implementing Statistical Control and Process Management on Data-Intensive Processes," has four chapters. In Chapter 6, "Process Representation and the Function of Information Processing Approach," the author discusses the importance of modeling the process as it transforms input data into output data. The author suggests several elements of the model that help translate the model into small executable steps. Simple pictorial diagrams are given to help illustrate the process. The example provided was very detailed and informative. Several enhancements to this model are briefly discussed. Moreover, measurement and improvement opportunities are discussed.

In Chapter 7, "Data Quality Requirements," general purpose tools are used to translate subjective user requirements into objective technical specifications. The four requirements are: (1) to develop a set of relevant, consistent user requirements; (2) to translate user requirements into technical language; (3) to map data quality requirements into individual performance requirements, and (4) to establish performance requirements for subprocesses. Data quality requirements are also given for the design stage. The author also presents some mathematical notation that was not necessary for explaining the concepts and was somewhat distracting.

In Chapter 8, "Measurement Systems and Data Tracking," the logic and means of developing and implementing a measurement system based on the data-tracking method is presented. Data tracking is the measurement tool that is used when the goals are to control and improve data accuracy, data consistency, and process cycle times. The measurement systems are concerned with the daily operational needs in managing the process. The use of sampling procedures in the measurement step is stressed.

Chapter 9, "Process Redesign Using Experimentation and Computer Simulation," concerns itself with using physical experimentation if possible or computer simulation if necessary to check on customer requirements, find improvement opportunities, pursue these opportunities, and implement them. The steps and illustrative diagrams for a physical experiment and a computer simulation are given. These two types of experimentation also are combined in one flowchart.

In the third part of the book, "The Overall Data Quality Program," two chapters are presented. In Chapter 10, "Managing Multiple Processes: The Data Keeper," the book describes several management functions that can minimize the conflicts between several data bases. Communication between users and creators is stressed. This task is assigned to a "data keeper." Several quality requirements are listed as duties of the data keeper. Data edits are discussed and the importance of using them as close to the time the measurement has been taken as possible. Data base cleanups are also discussed. The author describes how this is done in an enterprise-level operation many data keepers may be used. He highlights the importance of ensuring that each data keeper still communicates with the user.

Chapter 11, "Perspectives, Prospects, and Implications," talks about the dedication of the process owner to the higher quality improvements for data-intensive tasks. The author claims that, from his experience, the quality of data can be improved by one or more orders of magnitude by using the methods detailed in this book. The final chapter contains a "Summary" that wraps up the book in a very enlightening way. It talks about the quality of data and how it relates to the Information Age. The idea that data are dynamic is also stressed.

These last two chapters pull together very nicely what the book is trying to accomplish. It is, however, frustrating for the reader to get this insight at the end of the book. I found the perspective taken in this book to be enlightening. I can see that the techniques described in this book would be helpful in improving data quality, if the reader can only get past the organizational difficulties in Chapters 2 and 3.

Other features of the book include a good glossary and extensive use of meaningful diagrams in each chapter.

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If you are looking for an introductory book that describes the quality-improvement tools, this book is worth your time. Because the majority of the book describes the basic quality-improvement tools and spends a minimal amount of time on how these tools are used in process improvement, a better title would be Basic Quality-Improvement Tools.

The book briefly describes data collection, check sheets, Pareto charts (omitting the 20-80 rule), variation, histograms, normal and skewed distributions (including location and dispersion), cause-and-effect diagrams, control charts (variables and attribute charts), pre-control, process capabilities, and scatter diagrams. The book does not include brainstorming or flow charting, which are commonly included in other introductory books, however.

In addition to its appropriate content, the book is well structured, having a brief chapter summary, instructional objectives for each chapter, learning activities, and chapter review questions, as well as a summary of the notation and formulas in the appendix. The book's organization makes it easier for the novice to comprehend it and to use as a reference. Since the book is written for the beginner, however, it would have been helpful to include the answers to the questions.

Although the book does a good job of explaining the different tools, it is confusing in some areas, such as the discussion of samples versus population including the notation and the central limit theorem; defining a C, (capability of process) and C, (capability ratio), which are redundant; using percent defective when the formulas portray proportion defective for attribute control charts; and explaining process capability before control charts. The book fails to address the common situation of data falling on a cell boundary when constructing histograms, and it does not contain a bibliography or references of some of the tables and charts.

Overall the book does a very good job of discussing process-improvement tools and the need for process improvement, including a brief history, and it emphasizes the steps used for reliable data collection. Due to the wide range of topics covered, the book does adhere to the fundamental topics well and is written with the novice in mind. With so many books on statistical process control on the market (e.g., Grant and Leavenworth 1980; Ishikawa 1983), I would not hesitate to recommend its use in a beginning process-improvement course.

Lillian Le-Comte Rosemount, Inc.

REFERENCES


For the user of the MINITAB software package, this book is a gold mine. In a brisk, informal style, the author provides a brief review of statistical concepts, a tutorial on how to use MINITAB to compute the concepts, and a large set of macro commands. The macros are supplied on a 3.5-inch MS-DOS disk.

The book is intended as a supplement to a student's statistics textbook. It is organized like most basic textbooks starting with descriptive statistics, histograms, and line graphs and then advancing to probability, hypothesis testing, analysis of variance, and regression. On each topic, the basic equations are given with a short explanation of how the concept works. There are frequent reminders to the student to go to the text for better understanding. Each topic covers the standard MINITAB commands and offers one or more macro instructions to cover what MINITAB does not.

When designing any package, the software writers strive for an optimum compromise of ease of use, completeness, and cost. In general, MINITAB's choices were sound, but some of the things that were left out are pretty basic—things like permutations and combinations, the hypergeometric distribution, the use of summary statistics as input for hypothesis tests, tests of variances, and so forth. Author Zehna has macros to fix almost any of these statistical shortcomings. Unfortunately, he cannot do anything about literal data, and he does not get into quality-control applications.

In one sense, a book of macro instructions is an implied criticism of the package, but in a second sense, this book of macros illustrates the ease with which the package can be customized to suit the user. This book provides many improvements and many ideas for the statistician to use. It should be considered essential by the serious MINITAB user.

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Editor Reports on New Editions, Proceedings, Collections, and Other Books

This section reports on new editions of books, most previously reviewed in Technometrics. Descriptions are also given for conference proceedings, for collections of papers that should hold some interest for practitioners in the physical, chemical, and engineering sciences, and for statistics books and other books of more general interest.

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Here is the second edition of a book whose first edition was the eagerly awaited companion volume to the first statistics course for public and educational television, Against All Odds: Inside Statistics, which was developed by and featured the first author. The book was fully reviewed in this journal by Arnold (1990). He commented, "The book is well written and presents the concepts and limitations of statistical methodology in a much more precise and serious way than most competing texts" (p. 348). With the video available as a supplement, he aptly described the book as "a welcome addition to the new generation of introductory textbooks that are aimed at capturing the attention of students instead of turning them off" (p. 348).

The review made many criticisms of details, and the authors have responded to some of these. They made modifications to the chapter on mobility, which he found "lacking in motivation" and redid the presentation on contingency tables, which he described as "incomplete." The most major change was the elimination of Chapter 2 from the first edition. This chapter, entitled "Looking
at Data: Change and Growth,” which concerned concepts of statistical control, growth curves, and time series, was absorbed into other chapters. The length of the book is basically unchanged.

The authors deliberately have avoided having statistical computing play a major role in their book. Without diminishing its importance, they chose, as the Preface states, “to focus on data and on statistical reasoning” with the aim of helping readers “to think about data and to use statistical methods with understanding.” The 850 pages that they have allocated to this effort and their failure to use software do not make the book very suitable for industrial short courses on introductory statistics. The goals of the authors, however, are beautifully met in this book. One can only envy the students who will get to experience the joy of learning statistics through this exciting presentation for the 1990s rather than those stuffy and tedious versions of the 1960s and 1970s through which I first encountered the subject.

REFERENCE


The original incarnation of this book was in 1972. The first author is deceased, and the second author, not an author of the original, has been widely and thoughtfully modernizing the book through three new editions. The fourth edition appeared as recently as 1989 and was subsequently given a full review in this journal by Robinson (1990). His review began, “This is a good book full of wonderful examples and exercises with real data.” He continued, “The exposition is outstanding—very clear and well honed” (p. 348). He cited as a “major strength” the “inclusion of many examples, problems, and data sets from real practice” (p. 349).

The effusive praise was accompanied by criticisms about the absence of probability plots and the lack of intuitive data analysis. So it is gratifying to find that the Preface notes that “graphical approaches to data analyses are emphasized even more than in the fourth edition.” In addition, complete case studies have been added for the two-sample comparison, simple linear regression, one-way analysis of variance, unreplicated two-level factorial experimentation, and replicated two-level factorial experimentation. Perhaps recalling reviews of several similar new editions that I have strongly criticized for their failure to deal with statistical computing, the author cites in the Preface “the use of high-speed computers by data analysts” as the aspect of statistical practice that most necessitated changes to the text. Already having added a chapter on statistical quality control, the author here has added new material on both Taguchi methods and on unreplicated factorial designs. To improve motivation for the reader, the Fifth Edition has the addition of a new preparatory first chapter, “Introduction to Statistics and Data Analysis.”

Robinson (1990) noted, “There are two ways to interpret this book, as a low-level theory book with lots of additional data and examples or as an applied-statistics book supplemented with enough theoretical development to motivate the mathematically inclined” (p. 349). He leaned to the first interpretation. The revisions certainly move the book more toward being described by the second. Certainly the mathematical level through multivariate integrals places the book beyond the content level that would be comfortable for most industrial scientists and engineers. One would certainly be pleased, though, if their education could have included a course from a book like this.

REFERENCE


Some of these editor reports on books not central to the topics for this journal appear because the effort of the authors in doing the book merits recognition. Such is the case here. These two fine volumes are a collection of 39 seminal papers in statistics that originated in statistics journals from 1900 through 1979. In deciding what to include, the editors sought and received input from 30 statisticians from around the globe. As they state in the Preface, the 39 papers, 19 in Volume I and 20 in Volume II, were “publications that have initiated fundamental changes in the development of statistical methodology.” These were “papers that have had lasting effects” in the minds of the editors.

Each of the 39 papers, which have been shortened in some cases “to reproduce only those parts of the papers that were relevant to the central theme of recording breakthroughs,” is preceded by an introductory paper. These comments average about 10 pages and include as authors mostly widely recognized names in statistics, such as T. W. Anderson, G. A. Barnard, H. A. David, N. R. Draper, I. J. Good, D. V. Lindley, G. E. Noether, and H. P. Wynn, to name some of them. The earliest papers in the two volumes, respectively, from statistics journals are Hotelling (1908) and Student (1922). The most recent papers are Fraser (1966) and Efron (1979). None of the papers come from Technometrics. Note that all of these papers have been typeset anew by the publisher, which has created a very high-quality presentation. As an illustration of content, most Technometrics readers probably are familiar in some way with at least a portion of the content of Box and Jenkins (1962), perhaps through using Box–Jenkins methods for time series analysis, which in part originates here. The paper appears in its entirety, but the discussions published with the original are excluded. In the six sections of his introductory paper, E. J. Wegman places the paper in historical context, comments on technical feedback, which he defines as the interaction of experimental information with technical knowledge, formulates the discrete time model for a control system, relates the Kalman filter model to the Box–Jenkins model, discusses linear and nonlinear time series modeling, as presented in the paper, and finally relates the work to high-resolution spectral analysis. This is also a brief biography of each author.

These are books for students of the history of statistics, because anyone who cares can certainly get copies of the papers. The high cost surely consigns these volumes to libraries with large acquisition budgets. Still, the authors and publisher deserve considerable credit for what they have done for the profession here.

REFERENCES


This book, with its cover picture of control charts, led me to expect another basic statistical process control book. There is some of that kind of material, with chapters on variability and normality, two control-chart chapters, and even a chapter on acceptance sampling. But there is also a good statistical content with chapters on hypothesis testing and on correlation and regression. In the “rather unusual” category, there are also four chapters on outlier testing, more than one-third of the book.

This may all sound very satisfactory, but there are several negative aspects to the book. This is a very classical approach to statistics with the beginning of the first chapter being devoted to probability and combinatorics. All of the other topics are similarly treated in a strictly traditional manner, as exemplified by the use of references mostly from the early 1970s or before. Examples are perfunctory until the penultimate chapter, “Statistical Quality Control for Asbestos Counting,” which shows how to use some of the tools for some real data in a practical situation.

Though it is advertised on the back cover for “medical, pathological, environmental, industrial hygiene, and forensics labs,” there is nothing particularly pertinent about the book for those applications. It is hard to believe that Shewhart averages and ranges charts should be the primary statistical monitoring tool in those kinds of labs. For the chemist, there is a five-page final chapter, “Non-routine Quality Control Procedures,” that discusses spikes, splits, blanks, blinds, and similar topics specific to chemical labs. There are other books, however, that do all of the things mentioned in this review better for the types of basic statistics applications that will occur in the laboratory.


There seems to be a never-ending succession of reasonably similar books like this one, differentiated by style, title, content, or approach, on aspects of total quality management (TQM). Two TQM components, involvement through teams and continuous improvement, star here along with a workbook format for team building through working together on action assignments. As for perspective, the book credits Deming, Juran, Crosby, and even Tom Peters as part of its foundation. There are a couple of chapters on a structure for improvement, several team chapters, and chapters on soft skills such as process management, communication, and self-management. There also are some statistical process control (SPC) topics—measurement, problem-solving, and SPC fundamentals.

Measurement does not have a statistical focus because here it concerns the effectiveness of teams. This chapter and the book in general do well in their focus on customers. Problem-solving tools include the usual list one would see in any basic SPC book, plus a half dozen others. The SPC chapter gives a nice motivation of SPC within process management and then covers statistical concepts and four kinds of charts (average-ranges, individuals, and two-attribute charts).

The authors make many lists, use many diagrams, and provide folksy illustrations, while still meeting the basic requirements for good textbook presentation, such as chapter introductions, motivating examples, and chapter summaries. There are numerous illustrations, and the unique workbook format provides all kinds of hands-on experiences for the teams. Anyone seeking this type of format will otherwise find the presentation content quite satisfactory.


This is the third of a four-part book series by the first author about total quality management (TQM), the other titles being Leadership for the Quality Transformation, Management Processes for Quality Operations, and Quality Training Practices. The authors include statistical process control (SPC) as part of the mechanics of TQM, so this book was chosen for reporting here. The first author writes from the perspective of an outside service contractor’s experience at a company where TQM and continuous improvement were not well known and obviously necessary for the competitive survival of the organization.

The author’s description in the Preface of their experiences, such as employees thinking TQM “would be dominated by statistical process control concepts which they didn’t feel a need for and were afraid they wouldn’t be able to grasp” gives the book a perspective worthy of consideration by any statistician. Mechanics, though, includes a lot more than SPC. The first six chapters, half the book, cover “how to” for process mechanics—holding meetings, conducting audits, setting quality goals, understanding processes, understanding productivity, and improving productivity. Intended to “stand alone,” they are basically essays, with extensive use of diagrams, lists, charts, and questions. They avoid categorization relative to Deming, Juran, or Crosby by avoiding much mention of any other TQM methodologies and philosophies.

The first of the SPC chapters deals approximately with graphics, advancing through distributions and correlations. Next comes another two essays, first one on the problem-solving process, then another on the decision-making process. The chapter on quality tools based on the plan–do–check–act cycle, introduces the usual problem-solving tools. There is an SPC chapter, which deals just with variation and finally a process control chapter, which deals with process consistency and the basics of monitoring by control charts.

It is probably unfair to evaluate this book solely as a stand-alone volume because it is only a quarter of the author’s TQM package. This volume is perhaps a little dry and could benefit from more illustration from the authors’ experiences with this organization on the success of implementing some of these programs.