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In accordance with their general policy, the Editors welcome particularly contributions which will be of interest both to mathematicians and to scientists or engineers. Authors will receive galley proof only. The author's institution will be requested to pay a publication charge of $30 per page which, if honored, entitles the author to 100 free reprints. Detailed instructions will be sent with galley proofs.

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ANNUAL INDEX

SUGGESTIONS CONCERNING THE PREPARATION OF MANUSCRIPTS FOR THE QUARTERLY OF APPLIED MATHEMATICS

The editors will appreciate the authors' cooperation in taking note of the following directions for the preparation of manuscripts. These directions have been drawn up with a view toward eliminating unnecessary correspondence, avoiding the return of papers for changes, and reducing the charges made for "author's corrections."

Manuscripts: Manuscripts should be typewritten double-spaced on one side only. Marginal instructions to the typesetter should be written in pencil to distinguish them clearly from the body of the text. The author should keep a complete copy.

The papers should be submitted in final form. Only typographical errors should be corrected in proof; composition charges for any major deviations from the manuscript will be passed on to the author.

Titles: The title should be brief but express adequately the subject of the paper. The name and initials of the author should be written as he/she prefers; all titles and degrees or honors will be omitted. The name of the organization with which the author is associated should be given in a separate line following his/her name.

Mathematical Work: As far as possible, formulas should be typewritten; Greek letters and other symbols not available on the average typewriter should be inserted using either instant lettering or by careful insertion in ink. Manuscripts containing pencilled material other than marginal instructions to the typesetter will not be accepted.

The difference between capital and lower-case letters should be clearly shown; care should be taken to avoid confusion between zero (0) and the letter O, between the numeral one (1), the letter l and the prime ($'$), between alpha and a, kappa and k, mu and u, nu and v, eta and n.

The level of subscripts, exponents, subscripts to subscripts, and exponents to exponents should be clearly indicated.

Single embellishments over individual letters are allowed; the only embellishment allowed above groups of letters is the overbar.

Double embellishments are not allowed. These may be replaced by superscripts following the symbols.

Complicated exponents and subscripts should be avoided. Any complicated expression that recurs frequently should be represented by a special symbol.

For exponentials with lengthy or complicated exponents the symbol exp should be used, particularly if such exponentials appear in the body of the text. Thus,

$$\exp[(a^2+b^2)^{1/2}] \text{ is preferable to } e^{[a^2+b^2]^{1/2}}.$$

Fractions in the body of the text and fractions occurring in the numerators or denominators of fractions should be written with the solidus. Thus,

$$\frac{\cos(x/2b)}{\cos(a/2b)} \text{ is preferable to } \frac{\cos\frac{x}{2b}}{\cos\frac{a}{2b}}.$$

In many instances the use of negative exponents permits saving of space. Thus,

$$\int u^{-1}\sin u\,du \text{ is preferable to } \int \frac{\sin u}{u}\,du.$$

Whereas the intended grouping of symbols in handwritten formulas can be made clear by slight variations in spacing, this procedure is not acceptable in typeset formulas. To avoid misunderstanding, the order of symbols should therefore be carefully considered. Thus,

$$(a+bx)\cos t \text{ is preferable to } \cos t(a+bx).$$

Figures: Figures should be drawn in black ink with clean, unbroken lines; do not use ball point pen. The paper should be of a nonabsorbant quality so that the ink does not spread and produce fuzzy lines. If the figures are intended for reduction, they should be drawn with heavy enough lines so that they do not become flimsy at the desired reduction. The notation should be of professional quality and in proportion for the expected reduction size. Figures that are unsuitable for reproduction will be returned to the author for redrawing. Legends accompanying figures should be written on a separate sheet.

Bibliography: References should be grouped together in a Bibliography at the end of the manuscript. References in text to the Bibliography should be made by numerals between square brackets.

The following examples show the desired arrangements: (*for books*—S. Timoshenko, *Strength of Materials*, vol. 2, Macmillan and Co., London, 1931, p. 237; *for periodicals*—Lord Rayleigh, *On the flow of viscous liquids, especially in three dimensions*, Phil. Mag. (5) 36, 354–372 (1893)). Note that the number of the series is not separated by commas from the name of the periodical or the number of the volume.

Authors' initials should precede their names rather than follow them.

In quoted titles of books or papers, capital letters should be used only where the language requires this. Thus, *On the flow of viscous fluids* is preferable to *On the Flow of Viscous Fluids*, but the corresponding German title would have to be rendered as *Über die Stromung zaher Flüssigkeiten.*

Titles of books or papers should be quoted in the original language (with an English translation added in parentheses, if this seems desirable), but only English abbreviations should be used for bibliographical details such as ed., vol., no., chap., p.

Footnotes: As far as possible, footnotes should be avoided. Footnotes containing mathematical formulas are not acceptable.

Abbreviations: Much space can be saved by the use of standard abbreviations such as Eq., Eqs., Fig., Sec., Art., etc. These should be used, however, only if they are followed by a reference number. Thus, "Eq. (25)" is acceptable but not "the preceding Eq." Moreover, if any one of these terms occurs as the first word of a sentence, it should be spelled out.

Special abbreviations should be avoided. Thus "boundary conditions" should always be spelled out and not be abbreviated as "b.c." even if this special abbreviation is defined somewhere in the text.

CONTENTS

Vol. LVII, No. 4 **December 1999**

Linear Statistical Models. By James H. Stapleton, John Wiley and Sons, 1995, ix+449 pp., $59.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. The author studies multiple regression and analysis of variance models from the point of view of the geometry of vector spaces, emphasizing intuitive understanding of the theory by their means. Pictures of these spaces have been added for this purpose. Students should have had a one-year course in probability and statistics at the post-calculus level, plus one course in linear algebra. Material on inner products and orthogonal projections is introduced in Chapter 1. Chapter 2 introduces the multivariate normal, chi-square, t and F distributions, central and non-central. Chapter 3 discusses the linear statistical model, including confidence intervals, the Gauss-Markov Theorem, power, and multiple and partial correlation coefficients. It concludes with a study of the SAS multiple regression printout. Chapter 4 is devoted to a more detailed study of multiple regression methods, including sections on transformations, analysis of residuals, and on asymptotic theory. The last two sections are devoted to robust methods and to the bootstrap. Chapter 5 discusses simultaneous confidence intervals and Chapter 6 two- and three-way analysis of variance, emphasizing the geometric point of view. Chapter 7 considers topics such as random component models, nested designs, and partially unbalanced block designs. Chapter 8, the longest, discusses the analysis of frequency data. Computations illustrating the theory were done in APL*Plus, S-Plus, and SAS.

Bayesian Analysis in Statistics and Econometrics—Essays in Honor of Arnold Zellner. Edited by Donald A. Berry, Kathryn M. Chaloner, and John K. Geweke, John Wiley and Sons, 1996, xxii+577 pp., $79.95

This is a volume in the Wiley Series in Probability and Statistics. The volume of papers has been collected in celebration of the 25th anniversary of the Seminar in Bayesian Inference in Econometrics, and its founder and leader, Arnold Zellner. There are 48 papers, divided into eight parts: I. Forecasting and probability assessment (4 papers), II. Inference, estimation, and prediction (12 papers), III. Regression, linear models, and multivariate analysis (11 papers), IV. Model selection (3 papers), V. Computation (4 papers), VI. Applications (4 papers), VII. Reliability and clinical trials (4 papers), VIII. Foundations and philosophical issues (6 papers).

Adaptive Sampling. By Steven K. Thompson and George A. Seber, John Wiley and Sons, 1996, xi+265 pp., $54.95

This is a volume in the Wiley Series in Probability and Statistics. It explores the theory and methods of adaptive sampling, which refers to designs in which the procedure for selecting units to include in the sample may depend on values of the variable of interest observed during the survey. It is intended for researchers in the methods and theory of sampling and for researchers faced with inherently difficult sampling situations, such as rare, clustered, unpredictable, elusive, spatially and temporarily uneven, and hard-to-detect populations. The book is organized into 10 chapters: 1. Introduction and preliminaries, 2. Fixed-population sampling theory, 3. Stochastic population sampling theory, 4. Adaptive cluster sampling, 5. Efficiency and sample size issues, 6. Adaptive cluster sampling based on order statistics, 7. Adaptive allocation in stratified sampling, 8. Multivariate aspects of adaptive sampling, 9. Detectability in adaptive sampling, 10. Optimal sampling strategies.

Fundamentals of Atmospheric Modeling. By Mark Z. Jacobson, Cambridge University Press, 1999, xvi+656 pp., $110.00 (Hardback), $49.95 (Paperback)

This text describes the atmospheric processes, numerical methods, and computational techniques required to study air pollution and meteorology. It presents the fundamental equations that describe physical, chemical, and dynamical processes in the atmosphere, and it provides numerical methods to solve these equations. It has been developed from the author's graduate courses and research at Stanford University and contains homework and computer programming assignments. Chapter headings: 1. Introduction, 2. Atmospheric structure, composition, and thermodynamics, 3. The continuity and thermodynamic energy equations, 4. The momentum equation in Cartesian and spherical coordinates, 5. Vertical coordinate conversion, 6. Numerical solutions to partial differential equations, 7. Finite-differencing the equations of atmospheric dynamics, 8. Boundary-layer processes, 9. Cloud thermodynamics and dynamics, 10. Radiative energy transfer, 11. Gas-phase species, chemical reactions, and reaction rates, 12. Urban, free-tropospheric, and stratospheric chemistry, 13. Methods of solving chemical ordinary differential equations, 14. Particle components, size distributions, and size structures, 15. Aerosol emissions and nucleation, 16. Coagulation, 17. Condensation, evaporation, deposition, and sublimation, 18. Chemical equilibrium and dissolution processes, 19. Aqueous chemistry, 20. Sedimentation and dry deposition, 21. Model design, application, and testing. Appendix A, Conversions, constants, and symbols. Appendix B, Tables.

Elements of Applied Bifurcation Theory, Second Edition. By Yuri A. Kuznetsov, Springer, 1998, xix+591 pp., $69.95

This is volume 112 in the series Applied Mathematical Sciences, and the second edition of the text first published in 1995. It preserves the structure of the first edition while updating the context to incorporate recent theoretical developments, such as new and improved numerical methods for bifurcation analysis. The book is designed for advanced undergraduate or graduate students in mathematics who plan to engage in applied mathematical research, as well as for researchers in physics, biology, engineering, and economics who use dynamical systems as modeling tools in their studies. Therefore, only a moderate mathematical background in geometry, linear algebra, analysis, and differential equations is required. Chapter headings: 1. Introduction to Dynamical Systems, 2. Topological equivalence, bifurcations, and structural stability of dynamical systems, 3. One-parameter classification of generic equilibria, and one-parameter bifurcations of equilibria in continuous-time dynamical systems, 4. One-parameter bifurcations of fixed points in discrete-time dynamical systems, 5. Bifurcations of equilibria and periodic orbits in n-dimensional dynamical systems, 6. Bifurcations of orbits homoclinic and heteroclinic to hyperbolic equilibria, 7. Other one-parameter bifurcations in continuous-time dynamical systems, 8. Two-parameter bifurcations of equilibria in continuous-time dynamical systems, 9. Two-parameter bifurcations of fixed points in discrete-time dynamical systems, 10. Numerical analysis of bifurcations.

Surveys in Applied Mathematics, Volume 2, Plenum Press, New York, 1995, xi+287 pp., $75.00

This volume contains the following articles: 1. Wave Front Propagation for KPP-Type Equations, by Mark Freidlin; 2. Particle and Wave Transmission in One-Dimensional Disordered Systems, by Sergey Gredeskul, Andrew Marchenko, and Leonid Pastur; 3. Asymptotic Equations for Nonlinear Hyperbolic Waves, by John K. Hunter.

Advances in Biometry. Edited by Peter Armitage and Herbert A. David, John Wiley and Sons, 1996, xiv+473 pp., $59.95

This is a volume in the Wiley Series in Probability and Statistics, and is designed to mark 50 years of the International Biometric Society. It contains 21 contributions by Lynne Billard; Alan T. James and Chester Bliss; Ralph A. Bradley and Richard L. Anderson; Pierre Dagnelie; Shayle R. Searle and Charles E. McCulloch; Peter B. Imrey, Gary G. Koch, and John S. Preisser; C. Radhakrishna Rao; Bradley Efron and Robert Tibshirani; J. C. Gower; Per Kragh Andersen and Niels Keiding; John A. Nelder; G. P. Patil; G. H. Freeman and Janet Riley; E. A. Thompson; Norman E. Breslow; Klaus Dietz; James H. Ware and Kung-Yee Liang; Peter J. Diggle; C. A. Glasbey and M. Berman; Stuart J. Pocock; Daniel Krewski, Brian G. Leroux and Yiliang Zhu.

Response Surface Methodology. By Raymond H. Myers and Douglas C. Montgomery, John Wiley and Sons, 1995, xiv+700 pp., $59.95

This is a volume in the Wiley Series in Probability and Statistics. Response surface methodology (RSM) integrates the three topics of statistical experimental design, regression modeling techniques, and elementary optimization methods into a coherent framework. The book assumes no more than some previous exposure to statistical methods and matrix algebra. Chapter 1 is an introduction to the general field of RSM and describes typical applications; chapter 2 is a summary of regression methods; chapters 3 and 4 describe two-level factorial and fractional factorial designs; chapter 5 presents the method of steepest ascent, an optimization procedure that moves the process from a region of poor performance to one of greater potential; chapter 6 introduces the analysis and optimization of a second-order response surface; chapter 7, 8 and 9 present detailed information on the choice of designs for fitting both first-order and second-order response surfaces. Chapter 10 describes a robust design methodology, and chapters 11 and 12 describe techniques for designing and analyzing experiments with mixtures. Chapter 13 is an introduction to evolutionary operations, a methodology for carrying out experimental design methods on-line. An extensive set of exercises is provided, along with a reference section.

Introduction to Statistical Time Series. By Wayne A. Fuller, John Wiley and Sons, 1996, xxii+698 pp., $69.95

This volume in the Wiley Series in Probability and Statistics is the second edition of a book first published in 1976. It takes account of the considerable developments in statistical time series during the past twenty years, such as nonstationary models, nonlinear estimation, multivariate models, state space representations, and empirical model identification. There are new sections on the Wold decomposition, partial autocorrelation, long memory processes, and the Kalman filter in chapters one through four. Chapter 5 has been enlarged, with additional material on central limit theorems for martingale differences, an expanded treatment of nonlinear estimation, a section on estimated generalized least squares, and a section on roots of polynomials. Chapters 6 and 8 have been revised using the asymptotic theory of chapter 5. The material on nonstationary autoregressive models is now in a separate chapter, chapter 10. The chapter headings are: 1. Introduction; 2. Moving averages and autoregressive processes; 3. Introduction to Fourier Analysis; 4. Spectral analysis and filtering; 5. Some large sample theory; 6. Estimation of the mean and autocorrelation; 7. The periodogram, estimated spectrum; 8. Parameter estimation; 9. Regression, trend and seasonality; 10. Unit root and explosive time series.

Mathematical Physiology. By James Keener and James Sneyd, Springer-Verlag, New York, 1998, xix+766 pp.

This is volume 8 in the series Interdisciplinary Applied Mathematics. It describes work that lies on the border between mathematics and physiology; it describes ways in which mathematics may be used to give insight into physiological questions, and how physiological questions may, in turn, lead to new mathematical problems. It is divided into two parts, the first dealing with the fundamental principles of cell physiology, and the second with the physiology of systems. After an introduction to basic biochemistry and enzyme reactions, the book moves on to a discussion of various aspects of cell physiology, including the problem of volume control, the membrane potential, ionic flow through channels, and excitability. Chapter 5 is devoted to calcium dynamics, emphasizing the two important ways that calcium is released from stores, while cells that exhibit electrical bursting are the subject of chapter 6. Spatial aspects, such as synaptic transmission, gap junctions, the linear cable equation, nonlinear wave propagation in neurons, and calcium waves, are the subjects of the next few chapters. There is a discussion of the biochemistry of RNA and DNA and the biochemical regulation of cell function.

The second part of the book gives an overview of organ physiology, mostly from the human body, beginning with an introduction to electrocardiology, followed by the physiology of the circulatory system, blood, muscle, hormones, and the kidneys. Finally, the authors examine the digestive system, the visual system, ending with the inner ear.

Geostatistics: Modeling Spatial Uncertainty. By Jean-Paul Chilès and Pierre Delfiner, John Wiley and Sons, 1999, xi+695 pp., $125.00

This is a volume in the Wiley Series in Probability and Statistics, Applied Probability and Statistics Section. The term Geostatistics was originally defined by Georges Matheron in 1962 to designate his own methodology of ore reserve evaluation. It aims at providing quantitative descriptions of natural variables distributed in space and time. The applications of geostatistics thus extend to many fields in the earth sciences, including not only the subsurface but also the land, the atmosphere, and the oceans. The authors pay tribute to the late Geoffrey S. Watson who showed an early interest in geostatistics and introduced it to the statistical community.

The book gathers in a single place a number of results that were either scattered, not easily accessible, or unpublished. The emphasis is on methodology. Chapter headings: 1. Preliminaries, 2. Structural analysis (e.g., variogram models and applications, including fitting them); 3. Kriging (named after D. G. Krige), the spatial analogy of the prediction problem in time series analysis; 4. Intrinsic models of order k (which, in a sense, generalize ARIMA models of time series analysis); 5. Multivariate methods; 6. Nonlinear methods; 7. Conditional simulations; 8. Scale effects and inverse problems. There is a bibliography with over 700 items.

Surveys in Applied Mathematics, Volume 1. Edited by Joseph B. Keller, David W. McLaughlin, and George C. Papanicolaou, Plenum Press, New York, 1995, 264 pp., $75.00

This volume contains the following review articles: 1. Asymptotic methods for partial differential equations: the reduced wave equation and Maxwell's equations, by Joseph B. Keller and Robert M. Lewis; 2. Whiskered tori for integrable pde's: chaotic behavior in near integrable pde's, by David W. McLaughlin and Edward Overman II; 3. Diffusion in random media, by George C. Papanicolaou.

The Jungles of Randomness—A Mathematical Safari. By Ivars Peterson, John Wiley and Sons, 1997, xiii+239 pp., $24.95

The author aims for this book to "offer a random trek through the mélange of order and disorder that characterizes everyday experience". His intention is, along the way, to reveal a little of the immense, though often overlooked, impact of mathematics on our lives. Chapter headings: 1. The die is cast; 2. Sea of life; 3. Shell game; 4. Call of the firefly; 5. Different drums; 6. Noise police; 7. Complete chaos; 8. Trails of a wanderer; 9. Gambling with numbers; 10. Lifetimes of chance.

Survival Analysis: Techniques for Censored and Truncated Data. By John P. Klein and Melvin L. Moeschberger, Springer-Verlag, New York, 1997, xiv+502 pp., $59.95

This is a volume in the series Statistics for Biology and Health. It is designed to be a reference book for investigators and a textbook for a one-semester graduate course, the prerequisites being only a traditional course in statistical methodology. Chapter headings: 1. Examples of survival data; 2. Basic quantities and models; 3. Censoring and truncation; 4. Nonparametric estimation of basic quantities for right-censored and left-truncated data; 5. Estimation of basic quantities for other sampling schemes; 6. Topics in univariate estimation; 7. Hypothesis testing; 8. Semiparametric proportional hazards regression with fixed covariates; 9. Refinements of the semiparametric proportional hazards model; 10. Additive hazards regression models; 11. Regression diagnostics; 12. Inference for parametric regression models; 13. Multivariate survival analysis.

Bootstrap Methods and their Application. By A. C. Davison and D. V. Hinkley, Cambridge University Press, 1997, x+582 pp.

This is a volume in the Cambridge Series on Statistical and Probabilistic Mathematics. The authors start their preface by observing that the publication in 1997 of Bradley Efron's first article on bootstrap methods was a major event in Statistics, at once synthesizing some of the earlier resampling ideas and establishing a new framework for simulation-based statistical analysis. Their stated central goal in the book is to describe how the computer can be harnessed to obtain reliable standard errors, confidence intervals, and other measures of uncertainty for a wide range of problems, the key idea being to resample from the original data to create replicate datasets, from which the variability of the quantities of interest can be assessed without longwinded and error-prone analytical calculation. The volume is accompanied by a library of S-Plus functions, written by A. J. Canty, which implement the methods of the book. Chapter headings: 1. Introduction; 2. The basic bootstrap; 3. Further ideas; 4. Tests; 5. Confidence intervals; 6. Linear regression; 7. Further topics in regression; 8. Complex dependence; 9. Improved calculation; 10. Semiparametric likelihood inference; 11. Computer implementation.

Loss Models: From Data to Decisions. By Stuart A. Klugman, Harry H. Panjer, and Gordon E. Willmot, John Wiley and Sons, 1998, xiii+644 pp., $79.95

This is a volume in the Wiley Series in Probability and Statistics. It takes a model-based approach to its subject matter, i.e., it takes the view that much of actuarial science consists of the construction and analysis of mathematical models for the process by which funds flow in and out of an insurance system. This book deals with one aspect of the problem, namely the loss process, that is, the outflow of cash due to the payment of benefits. It first discusses the amount of a single claim, then the number of claims, then the total claims, then the use of additional information to modify the results obtained, and finally the progress of the process over multiple time periods. A solid background in mathematical statistics (to the level of, for instance, Hogg and Craig) is assumed, but none in insurance mathematics. Chapters 2, 3, and 5 cover loss distributions and credibility theory to the level of Casualty Actuarial Society examination 4B, and chapters 4 and 6 cover risk theory as required for Society of Actuaries examination 151. Questions from these examinations are included among the exercises (and so marked). Chapter headings: 1. Introduction: a model-based approach to actuarial science; 2. Loss distributions: models for the amount of a single payment; 3. Frequency distributions: models for the number of payments; 4. Aggregate loss models; 5. Credibility theory; 6. Long-term models. Appendices: A. An inventory of continuous distributions; B: An inventory of discrete distributions; C. The simplex method; D. Frequency and severity relationships; E. Limited expected value calculations; F. The recursive formula; G. Discretization of the severity distribution; H. Simulation; I. Answers to selected exercises.

Functional Data Analysis. By J. O. Ramsay and B. W. Silverman, Springer-Verlag, New York, 1997, xiv+310 pp., $49.95

This is a volume in the Springer Series in Statistics. Data in many fields come to the statistician through a process naturally described as functional. For instance, one might be given the mean monthly temperatures for a number of weather stations. For some, the smooth temperature function presumed to generate the observations might be sinusoidal; for others, it might be one with distinctive departures from sinusoidal variation. The book discusses aspects of smoothing methods (chapters 3 and 4); curve registration (chapter 5); functional principal components analysis (chapters 8–11); the functional analogue of canonical correlation (chapter 12); and specifically functional methods that exploit derivative information and the use of linear differential operators (chapters 13–15). The final chapter provides historical remarks and some pointers to possible future developments. Data arising in real applications are used throughout the book for both motivation and illustration. The data sets are drawn from growth analysis, meteorology, biomechanics, equine science, economics, and medicine.

The Basics of S and S-Plus. By Andreas Krause and Melvin Olson, Springer-Verlag, 1997, xi+242 pp., $29.95

This is a volume in the series Statistics and Computing. Although primarily intended for the S-Plus novice, the material covered in the book extends to more advanced topics and contains many hints useful even for more advanced users of the system. There are chapters on system design, graphics, exploring data, programming, input and output, useful hints and techniques, and special topics such as libraries and exchanging information with other users, as well as detailed exercises and solutions.