The Quarterly of Applied Mathematics

The Quarterly prints original papers in applied mathematics which have an intimate connection with applications. It is expected that each paper will be of a high scientific standard; that the presentation will be of such character that the paper can be easily read by those to whom it would be of interest; and that the mathematical argument, judged by the standard of the field of application, will be of an advanced character.

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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, etc. 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 exponents with lengthy or complicated exponents the symbol exp should be used, particularly if such exponents 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 solidsus.

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 which 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 der 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.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. D'ACUNTO</td>
<td>The moving load on a string as free boundary problem</td>
<td>201</td>
</tr>
<tr>
<td>S. C. GUPTA</td>
<td>Temperature and moving boundary in two-phase freezing due to an axisymmetric cold spot</td>
<td>205</td>
</tr>
<tr>
<td>RONALD K. PEARSON AND TIMOTHY L. JOHNSON</td>
<td>Energy equipartition and fluctuation-dissipation theorems for damped flexible structures</td>
<td>223</td>
</tr>
<tr>
<td>A. VISINTIN</td>
<td>Supercooling and superheating effects in heterogeneous systems</td>
<td>239</td>
</tr>
<tr>
<td>GILBERTO SCHLEINIGER</td>
<td>Quasi-transonic flow past delta wings</td>
<td>265</td>
</tr>
<tr>
<td>KENNETH B. HOWELL</td>
<td>Asymptotic behavior of periodic, periodic biharmonic and periodic harmonic functions</td>
<td>279</td>
</tr>
<tr>
<td>M. C. JORGE</td>
<td>Local existence of the solution to a nonlinear inverse problem in gravitation</td>
<td>287</td>
</tr>
<tr>
<td>THOMAS J. PENCE</td>
<td>Formulation and analysis of a functional equation describing a moving one-dimensional elastic phase boundary</td>
<td>293</td>
</tr>
<tr>
<td>A. M. J. DAVIS AND K. B. RANGER</td>
<td>A Stokes flow model for the drag on a blood cell</td>
<td>305</td>
</tr>
<tr>
<td>C. M. DAFERMOS</td>
<td>Trend to steady state in a conservation law with spatial inhomogeneity</td>
<td>313</td>
</tr>
<tr>
<td>A. MORRO AND M. FABRIZIO</td>
<td>On uniqueness in linear viscoelasticity: a family of counterexamples</td>
<td>321</td>
</tr>
<tr>
<td>S. CHIRIȚĂ</td>
<td>On the asymptotic partition of energy in linear thermoelasticity</td>
<td>327</td>
</tr>
<tr>
<td>DAVID DURBAN</td>
<td>Plastic stresses induced by a rigid ring embedded in a thin anisotropic plate under uniform tension</td>
<td>341</td>
</tr>
<tr>
<td>W. A. DAY</td>
<td>Adiabatic invariants for strings and membranes subjected to slowly-varying tension</td>
<td>349</td>
</tr>
<tr>
<td>JEAN-CLAUDE RAMIREZ</td>
<td>The three-dimensional stress intensity factor due to the motion of a load on the faces of a crack</td>
<td>361</td>
</tr>
<tr>
<td>JIONGMIN YONG</td>
<td>Stabilization of linear systems by time-delay feedback controls</td>
<td>377</td>
</tr>
<tr>
<td>W. A. DAY</td>
<td>Adiabatic invariants for strings, membranes, and beams of slowly-varying dimensions</td>
<td>389</td>
</tr>
</tbody>
</table>

**NEW BOOKS**  264, 278, 312, 320, 326, 348, 376, 399

This is volume 24 of Encyclopedia of Mathematics and its Applications, edited by Gian-Carlo Rota. The Paradox asserts that a solid ball may be taken apart into finitely many pieces that can be rearranged using rigid motions to form a ball twice as large as the original. This book begins with an elementary exposition of the Banach–Tarski Paradox that only requires familiarity with undergraduate mathematics. It goes on to explore the consequences of the Paradox for measure theory and its connections with group theory, geometry, and logic. It unifies the results of contemporary research on the Paradox and presents several new results including some unusual paradoxes in hyperbolic space. The 13 chapters are divided into 2 parts: 1. Paradoxical decompositions, or the nonexistence of finitely additive measures; and 2. Finitely additive measures, or the nonexistence of paradoxical decompositions.


This is a volume in the Prentice/Hall International Series in Computer Science. It introduces the subject of computer programming as a rigorous, mathematical discipline. Its level of exposition makes it suitable for an advanced undergraduate university course, or introductory graduate course. As much as possible, it is self-contained, relying on mathematical ability but not on specific mathematical knowledge past the secondary school level. The programming language used is Pro; no previous knowledge of it is assumed. Chapter headings: 0. Logic. 1. Types and bunches. 2. Names and definitions. 3. Sequences and grammars. 4. Pro language. 5. Semantics. 6. Programming. 7. Parameters. 8. Iteration. 9. Models, programs, communication. 10. Data structures. 11. Sequential execution. 12. Concurrent execution.


This is a volume in the series Oxford Mathematical Monographs. It is the first volume of a two-volume work: the forthcoming one will be on nonlinear theory and applications. The emphasis is on motivation, heuristics, and applications. The author hopes that this work will be of use to graduate students and professionals in science and engineering as well as mathematics. All the main results are well known, but several of the proofs are new. An effort is made to solve some nontrivial initial-value problems for parabolic and hyperbolic differential equations without doing the hard work associated with elliptic theory. The reason is pedagogical; the author wishes to get across some main ideas involved in Cauchy problems for partial differential equations as an easy consequence of semigroup theory. Besides partial differential equations, other areas of application include mathematical physics (Feynman integrals, scattering theory, etc.), approximation theory, ergodic theory, potential theory, classical inequalities, fluid motion, and so on. There is a substantial bibliography (50 pages), but the author also refers to his (more or less) complete bibliography of semigroups of operators through 1984 (covering more than 300 single-spaced typed pages) and, presumably, available from him. The material is divided into two chapters: 1. Semigroups of linear operators, and 2. Linear Cauchy problems.

Continued on page 278

This monograph constitutes a self-contained exposition, but differs from the usual introduction in that it emphasizes the underlying notions of general relativity and the difficulties and perplexities associated with them. The author poses and attempts to answer numerous questions about the nature of the theory. The book presupposes only a general background in physics.


This is a volume in the series Contemporary Soviet Mathematics and constitutes the proceedings of the Petrovskii Seminar No. 5. There are eleven papers, mainly on aspects of partial differential equations.


This is a volume in the series Mathematics Research Symposium. It is the proceedings of a conference held by the Mathematics Research Center, Madison, Wisconsin, October 11–13, 1983. It contains the invited talks, whose topics include general theories of phase transitions, equilibrium shapes of surfaces, morphological instabilities and dendrite formation, shock-induced phase transitions, and related results on the calculus of variation.


This Dover edition is an enlarged and corrected republication of the work first published by Holt, Rinehart and Winston, Inc., New York, in 1973. A supplement, originally prepared for the German edition, entitled “Twentieth Century Mathematics”, an index to the supplement, and solutions to the exercises at the end of each chapter have been added to the Dover edition. The twelve chapters are divided into three parts of four chapters each: 1. Mathematics in antiquity. 2. The adolescence of computation. 3. The rise of geometrical analysis.


This Dover edition is an unabridged republication of the work first published by Addison-Wesley Publishing Company, Inc., in 1967 under the title Mathematics for the Liberal Arts. The Instructor’s Manual published with the original edition, containing additional answers and solutions to the problems in the text, has been added to this edition.


These are the proceedings of the conference on classical (non-quantum) general relativity, held at City University, London, 21–22 December 1983. There are five review talks: J. D. Barrow on chaotic behaviour and the Einstein equations; J. N. Islam on exact solutions for rotating charged dust and on asymptotically flat rotating solutions; M. A. H. MacCallum on algebraic computing in general relativity; B. F. Schutz on gravitational radiation; and J. M. Stewart on numerical relativity. The volume also contains the texts of twelve contributed papers, and an introduction by Sir Hermann Bondi.

Continued on page 312
Continued from page 278


This is a volume to celebrate the founding of the International Statistical Institute in 1885. As part of its centennial celebration planning, the institute decided to publish a volume of papers representing the wide range of interests encompassed by statistics in its international context, viewed both from a historical and from a contemporary standpoint. There are 25 papers, covering theoretical, applied and historical matters, by an international galaxy of authors.


These are the proceedings of the first Robotics Europe Conference, held in Brussels, June 27–28, 1984. There are eighteen chapters.


The author's purpose in writing this book is to make available to the undergraduate students a presentation of the development and application of mathematical methods and analysis techniques that make it possible to structure and solve important decision problems of business, industry, and government. The 26 chapters are divided into the following parts: 1. A framework for decision making. 2. The linear-programming model: Applications. 3. Solving linear-programming models: The model and its algorithm. 4. Network and related combinatorial problems. 5. Games, trees, and decisions.


The symposium was held in Boulder, Colorado, on October 15–16, 1982. These proceedings contain the texts of 23 papers presented.


This volume in Cambridge Monographs on Mechanics and Applied Mathematics is a paperback edition first published in 1980. It collects together the fundamental results of linearized elastodynamics primarily from the point of view of the propagation of transient pulses in an isotropic material which may be regarded as unbounded.


This is a volume in the Springer Series in Statistics. It is addressed to statisticians who face the problem of variance estimation for large complex sample surveys, being a central reference text offering practical advice on the various variance estimating methodologies, emphasizing both their theory and their applications. Each technique is presented in a separate chapter, and each chapter is divided into several sections dealing with theory and motivation for the method, and numerical examples where the technique was applied to a real survey. Chapter headings: 1. Introduction. 2. The method of random groups. 3. Variance estimation based on balanced half-samples. 4. The jackknife method. 5. Generalized variance functions. 6. Taylor series methods. 7. Variance estimation for systematic sampling. 8. Summary of methods for complex surveys.

Continued on page 320
Continued from page 312


This is volume 93 in the series Pure and Applied Mathematics. It only assumes an elementary course in calculus and differential equations, and motivates the subject with examples from various fields. Chapter headings: 1. Integral equations, their origin and classification. 2. Modeling of problems as integral equations. 3. Volterra integral equations. 4. The Green’s function. 5. Fredholm integral equations. 6. Existence of equations: Basic fixed-point theorems.


This book is based on the lectures given by the authors at the Physics Department at Moskow University.


This book is designed as a problem book for L. Elsgolt’s Differential Equations and the Calculus of Variations, from the same publisher.


This book presents an abstract theory of measurement in the sense that it is concerned with highly general axiomatization of empirical and qualitative settings and how these can be represented quantitatively. It represents a generalization and extension of the first volume of “Foundations of Measurement” by Krantz, Luce, Suppes, and Tversky, published in 1971. One of the new directions introduced in this book is the extension of measurement to non-Archimedean situations through the use of the nonstandard analysis.


This Dover edition is an unabridged and unaltered republication of the second 1957 edition of the work first published by G. Bell & Sons, Ltd. in 1954. Chapter headings: 1. The mathematician and his task. 2. The tools of the trade. 3. Ballistics, or Newtonian dynamics in war. 4. An essay on waves. 5. The mathematics of flight. 6. Statistics, or the weighing of evidence. 7. Mathematics and the weather.


This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is the aim of the book to make the methods of asymptotic analysis of queueing processes as general as possible and to present effective means of investigation of fairly complex systems. Three directions of research are pursued in this monograph: 1. Asymptotic analysis of explicit equations which describe the distribution of some characteristic of the system; 2. The study of the limit behavior of the random processes which define the system; 3. Stability theorems: conditions under which service systems will be close to a given concrete system. The book consists of four chapters: 1. On the convergence of random processes; 2. Limit theorems for systems with intensive input stream and a large number of service channels; 3. The description of service systems by diffusion processes; 4. Stability theorems.

Continued on page 326

This volume is the second in a three volume series of applied mathematics for science and engineering students. This volume is suitable for final year undergraduates and first year graduate students.


This is a volume in the Ellis Horwood Series in Mathematics and its Applications. The aim of this book is to present formulas and methods that may be applied to the problem of finding the range of a function in one or several variables over an interval, yielding the range or the intervals including the range. This is the equivalent of saying that the formulas or methods yield the global minimum (or maximum) of $f$ or lower (upper) bounds for the global minimum (maximum). The reason for choosing outer (and not inner) estimations for the range is that the logic of methods for solving for zeros of equations, etc., requires outer estimations. A theory is treated in this book whose applications will guarantee safe bounds for the range (or global minimum, etc.) for each function considered. The theory and the contents of the book do not depend on a computer but the theoretical or historical background of some parts of the theory needs some theoretical facts of interval arithmetic. Chapter headings: 1. Interval arithmetic. 2. The standard centered form. 3. General definition of centered forms. 4. More about quadratic convergence. 5. Optimality of standard centered forms. 6. Other inclusions for the range of a function.


The intent of this book is to present a variety of design, to look at the advantages, disadvantages, and uses of each type of design, to outline the procedure for constructing the designs, and to consider the analysis and interpretation of data from each type. The purpose of this book is two-fold: to provide a textbook in modern experimental design for students both in statistics and in fields of applied science, and to serve as a reference book for research scientists faced with the necessity of obtaining and interpreting data in an efficient way. It is assumed that the reader has had an introduction to statistical inference including estimation, significance tests, some analysis of variance, and an exposure to simple and multiple regression. Chapter headings: 1. Introduction. 2. Completely randomized designs. 3. Randomized block designs. 4. More restrictive designs. 5. Separation of means. 6. Factorial experiments. 7. Data interpretation. 8. Multifactor experiments. 9. Confounding. 10. Split-plot design: variations. 11. Response surfaces. 12. Change-over trials. 13. Incomplete block designs.


This is a volume in the Translations Series in Mathematics and Engineering. It is a translation from the Russian, edited by J. Stoer, which describes both the theoretical foundations and the range of applications of many important methods for solving nonlinear problems, emphasizing their use for the solution of optimal control problems for ordinary differential equations. It is the principal aim of the author to point out the necessity of using many techniques in combination, and interactively on computer, to solve more difficult problems. Chapter headings: 1. An introduction to optimization theory. 2. Convergence theorems and their application to the investigation of numerical methods. 3. The penalty-function method. 4. Numerical methods for solving nonlinear programming problems using modified Lagrangians. 5. Relaxation methods for solving nonlinear programming problems. 6. Numerical methods for solving optimal control problems. 7. Search for global solutions.

This is volume 271 of Grundlehren der mathematischen Wissenschaften, A Series of Comprehensive Studies in Mathematics. The book has two main topics: large deviations and equilibrium statistical mechanics. The author hopes to convince the reader that these topics have many points of contact, with entropy, in its various guises, being their common core. There are two parts to the book, Part 1 consisting of chapters 1–5. Chapter 1 introduces large deviations by means of elementary examples involving combinatorics and Stirling's formula. Chapter II presents the Donsker-Varadhan theory as well as the author's large deviation results. Chapter III gives a large deviation analysis of a discrete gas model. Chapters IV–V discuss the Ising model of ferromagnetism and related spin systems. The emphasis in these two chapters is upon properties of Gibbs states. While large deviation theory provides a terminology and a set of results that are useful for treating Gibbs states, the book also develops other tools that are needed. These include convexity and moment inequalities. Part II consists of Chapters VI–IX. Chapter VI is a summary of the theory of convex functions on $\mathbb{R}^d$. Chapters VII–IX prove the large deviation results stated in Chapter II without proof. The prerequisite for these chapters is a good working knowledge of probability and measure theory. The essential definitions and theorems in probability are listed in an appendix. The book can be used as a text. It contains over 100 problems, many of which have hints. Chapter I and II and VI–IX are self-contained treatments of large deviations and convex functions. Readers primarily interested in spin systems can concentrate on Chapters IV and V and refer to the statements and proofs of large deviation results as needed. Those portions of Chapters IV and V which do not rely on large deviations are self-contained. Chapters IV and V can be completely understood without reading Chapter III.


This is a volume in the Ellis Horwood series Mathematics and its Applications. It introduces the reader to a class of mathematical models that have proven to be useful in many areas of biology and medicine. Chapter headings. 1. Matrix representation of compartment models. 2. Solution by eigenvalue analysis. 3. Computer implementation. 4. The Leslie matrix model. 5. Generalizations for the Leslie matrix model. 6. Harvesting matrices and linear programming. 7. Driving functions and nonhomogeneous linear systems. 8. An introduction to tracer methods in physiology. 9. Parameter estimation in two-compartment models. 10. Approximations: linearization and numerical methods. 11. Applications to systems ecology. 12. Sensitivity analysis.


The author sets out in detail the story of the intricate inner workings of the process whereby the prizewinners were selected. A picture of the contemporary international scientific establishment emerges, one shedding light on how the developing Nobel institution became enmeshed in speciality and other networks, notably those of Arrhenius and Mittag-Leffler, the two Swedish scientists who were best known internationally at that time. While the general development of disciplines and the standing of scientists in international and national communities heavily influenced the selection process, the cases presented in this book show that the specific choices of specialities, discoveries, and people to be honored were determined by the Swedish participants in the process. The question of how, after some initial uncertainties, the Nobel Prizes became synonymous with the highest achievements in science and culture is also addressed. Chapter headings: 1. Precursors to the Nobel prizes in the sciences. 2. Developments in Swedish and international science having a bearing on the Nobel institution. 3. Implementing the will of Alfred Nobel, 1896–1900. 4. An overview of the nominating system and its influence on the prize decisions. 5. Networks at work in the prize selections: Arrhenius and Mittag-Leffler. 6. Committee decision making. 7. The prizes, the public, and the scientific community.
Continued from page 348


This is the second edition of a text first published in 1972. It has been very substantially modified since the seventies has been the decade of the leptons and the electron-weak unification, so two chapters have been added on this side of the subject. Also, the discovery of new quark flavours has been deepened and has extended our understanding of the quark-gluon structure of matter, and this material is treated in two new chapters. The chances for a grand unification is also allotted a new chapter. Table of contents: 1. Accelerators, beams and detectors. 2. Pions and muons. 3. Conservation laws. 4. Strong, weak and electromagnetic interactions. 5. Strange particles. 6. Spin and parity of the K-mesons and nonconservation of parity in weak interactions. 7. Weak interactions: basic ideas. 8. Invariance under the CP and T operations, properties of K0-mesons. 9. Strongly-decaying resonances. 10. SU(3) and the quark model: classification and dynamic probes. 11. Weak interactions and weak-electromagnetic unification. 12. New flavours. 13. Quark and gluon interactions. 14. Higher symmetries.


In the first chapter of this book, the author introduces the general idea of mathematical structure and representation, while in the second chapter he analyzes linear systems and the representation of transformations of linear systems by matrices. In the third chapter, topological ideas and continuity are introduced, and made use of in solving convex optimisation problems. In the last sections of the third and fourth chapters, the author introduces some of the standard tools of economic theory, namely the Kuhn Tucker Theorem, some elements of convex analysis and procedures using the Lagrangian, and provides examples of consumer and producer optimisation. The final section of chapter four also discusses the smooth or critical Pareto set and the idea of a regular economy. The fifth and final chapter is somewhat more advanced, and extends the differential calculus of a real-valued function to the analysis of a smooth function between “local” vector spaces, or manifolds. Modern singularity theory is the study and classification of all such smooth functions, and the purpose of the final chapter is to use this perspective to obtain a generic or typical picture of the Pareto set and the set of Walrasian equilibria of an exchange economy. Chapter headings: 1. Sets, relations, and preferences. 2. Linear systems. 3. Topology and convex optimisation. 4. Differential calculus and smooth optimisation. 5. Singularity theory and general equilibrim.


This is a part of the Handbook of Applicable Mathematics, edited by Walter Ledermann. The handbook consists of six core columns (algebra, probability, numerical methods, analysis, geometry and combinatorics, statistics) and six guidebooks on applications, of which this is volume 2. Chapter headings: 1. Production and inventory control-basic models. 2. Production and inventory control-further models. 3. Marketing. 4. Distribution management. 5. Human resource management. 6. Accounting and finance.


This is volume 78 in the London Mathematical Society Lecture Notes Series. It was the objective of the author in writing these notes to provide a leisurely and elementary introduction to Riemann surfaces, and (to a lesser extent) to function theory on Riemann surfaces, making these available as early as possible and with the minimum of topology. Chapter headings: 1. Analysis in the plane. 2. Topology. 3. Riemann surfaces. 4. Analytic functions. 5. The disc, the plane, and the extended plane. 6. Compact surfaces. 7. Covering spaces. 8. Subharmonic functions. 9. The major results.

This is volume 29 of Lecture Notes in Statistics. Its genesis was a one-day meeting arranged under the auspices of the Mathematical Ecology Group, jointly of the British Region of the Biometric Society and the British Ecological Society, held in the Natural History Museum in London on the 4th of May, 1982. There is an introductory paper, by the editors, entitled The General Context of Statistics in Ornithology. There are six papers in the section entitled General: Colour, Feeding, Movement and Migration, seven under Analysis of Census Data, and twelve under Survival.


This is a volume in Pure and Applied Mathematics: A Wiley-Interscience Series of Texts, Monographs and Tracts. It is a translation from the German and the first of three volumes: volume 2 will be entitled Real Integration Theory and volume 3 Selected Topics. It is its aim to unify abstract integration theory (such as required by probabilists) and the theory, preferred by analysts, which combines integration and topology. As long as the underlying space is reasonably nice, the abstract theory and the topological theory yield the same results, but for more complicated spaces the topological theory gives stronger ones. The unification is achieved by using new definitions in the abstract theory: the integral is defined in such a way that it coincides in the case of random measures on Hausdorff spaces with the usual definition in the literature. In this volume, the chief goals are to define the integral, to provide a rationale for the definition, to establish its properties and to develop important tools.


This is a volume in the Wiley Series in Probability and Mathematical Statistics. Though largely self-contained, it continues the author's book Understanding Robust and Exploratory Data Analysis (Wiley, 1983), presenting a variety of more advanced techniques and extensions of basic exploratory tools and tracing their development from classical statistical theory. Table of contents: 1. Theories of data analysis: From magical thinking through classical statistics, by Persi Diaconis. 2. Fitting by organized comparisons: The square combining table, by Katherine Godfrey. 3. Resistant nonadditive fits for two-way tables, by John D. Emerson and George Y. Wong. 4. Three-way analysis, by Nancy Romanowicz Cook. 5. Identifying extreme cells in a sizable contingency table: Probabilistic and exploratory approaches, by Frederic Mosteller and Anita Parunak. 6. Fitting straight lines by eye, by Frederic Mosteller, Andrew F. Siegel, Edward Trapido, and Cleo Youtz. 7. Resistant multiple regression, one variable at a time, by John D. Emerson and David C. Hoaglin. 8. Robust regression, by Guoying Li. 9. Checking the shape of discrete distributions, by David C. Hoaglin and John W. Tukey. 10. Using quantities to study shape, by David C. Hoaglin. 11. Summarizing shape numerically: the g- and h-distributions, by David C. Hoaglin.
