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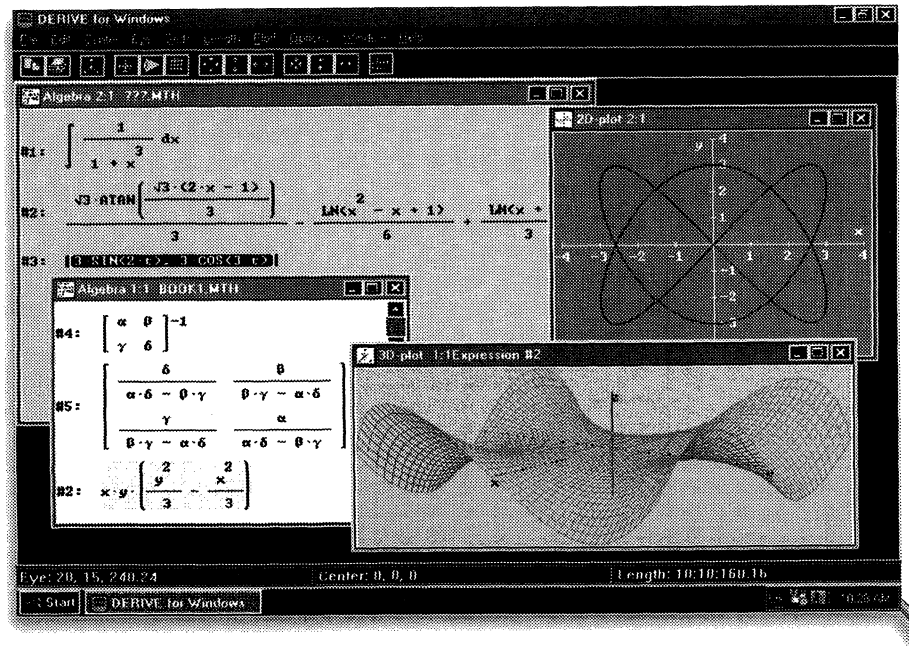

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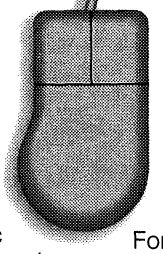

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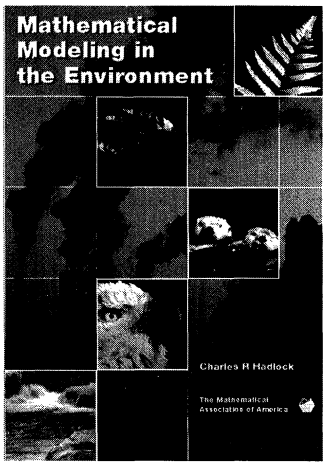

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Mathematical Modeling in the Environment

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- **a general education mathematics elective**
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This book has a dual objective: first, to introduce the reader to some of the most important and widespread environmental issues of the day; and second, to illustrate the vital role played by mathematical models in investigating these issues. The environmental issues addressed include: ground-water contamination, air pollution, and hazardous material emergencies. These issues are presented in their full real-world context, not as scientific or mathematical abstractions; and for background, readers are invited to investigate their status in their own communities.

The first part of the book leads the reader through relatively elementary modeling of these phenomena, including simple algebraic equations for ground water, slightly more complex algebraic equations (preferably implemented on a spreadsheet or other computerized framework) for air pollution, and a fully computerized modeling package for hazardous materials incident analysis. The interplay between physical intuition and mathematical analysis is emphasized.

For more advanced readers, the second part of the book returns to the same three subjects but with a higher level of mathematical sophistication (adjustable to the preparation of the reader by selection of subsections.) Many important classical mathematical themes are developed through this context, examples coming from single and multivariable calculus, differential equations, numerical analysis, linear algebra and probability. The material is presented in such a way as to minimize the required background and to encourage the subsequent study of some of these fields.

An elementary course for a general audience could be based entirely on Part I, and a higher level mathematics, science, or engineering course could move quickly to Part 2.

A PC compatible diskette packaged with the text contains a spreadsheet program that facilitates the numerical experimentation with the Gaussian plume equation introduced in Chapter 3, as well as public domain DOS program (ARCHIE) for evaluating the consequences from various hazardous materials scenarios (e.g., the physical extent of flammable and toxic vapor clouds). Text is not tied to the use of this software, but it is included as an aid to meet the pedagogical objectives of the text.

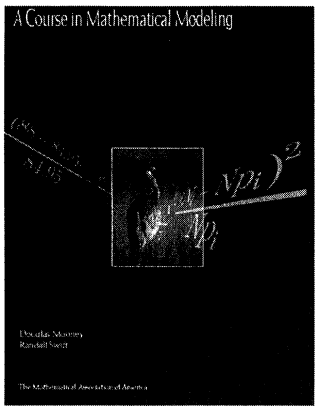
Catalog Code: ENV/SA
312 pp., Paperbound, 1998, ISBN 0-88385-709-X
List: $55.00 MAA Member: $43.95

Instructor's and Solutions Manual for *Mathematical Modeling in the Environment*

Charles Hadlock

Contains the complete solutions and further discussion of nearly every exercise presented in the textbook. This includes both the mathematical/computational exercises as well as the research questions and investigations. Readers will benefit greatly from perusing solutions to the problems whether they have worked them out themselves or not. Students using this volume will still need to work out solutions of research questions using their own sources and adapting them to their own geographic locations, or using their own computational schemes, so this volume could well be useful for students in many course contexts. Enrichment material is included on the topics of some of the exercises. Advice for teachers who lack previous environmental experience, but who want to teach this material is also provided and makes it practical for such persons to offer a course based on these volumes.

Catalog Code: EVS/SA
150 pp., Paperbound, 1998, ISBN 0-88385-713-8
List: $18.95 MAA Member: $14.95



A Course in Mathematical Modeling

Series: Classroom Resource Materials

Douglas Mooney and Randall Swift

Textbook

This book is intended as a text for a modeling course accessible to students who have mastered a one year course in calculus. It balances a variety of opposing modeling methodologies including theoretical models versus empirical models, analytical models versus simulation, deterministic models versus stochastic models, and discrete models versus continuous models. Most of the examples are drawn from real-world data or from models that have been used in various applied fields. The use of computers in both simulation and in mathematical analysis is an integral part of the presentation.

The authors emphasize the teaching of the modeling process as opposed to merely presenting models. They begin their book with the simple discrete exponential growth model, and successively refine it to include variable growth rates, multiple variables, growth rates fitted to data, and the effects of random factors. The last part of the book moves into continuous-time models. Issues of model validity and purpose are emphasized throughout.

Students taking a course based on this book should have some mathematical maturity, but will need little advanced knowledge. The book presents more advanced topics on an as-needed basis and serves to show how the different topics of undergraduate mathematics can be used together to solve problems. This perspective is valuable as either a road map for beginning students or as a capstone for more advanced students. The course presents elements of discrete dynamical systems, basic probability theory, differential equations, matrix algebra, stochastic processes, curve fitting, statistical testing, and regression analysis. Computer analysis is extensively used in conjunction with these topics.

You can also use this book if you are seeking applications to supplement a course in linear algebra, differential equations, difference equations, probability theory, or statistics.

Catalog Code: MML/JR
400 pp., Paperbound, 1999
ISBN 0-88385-712-X
List: $41.95 MAA Member: $32.95

Visit <www.wku.edu/~swiftrj/Modeling/ modeling.html> where you can visit the authors' website and download data sets, *Mathematica* files, and other modeling resources that execute the models described in the text.

CRYPTOLOGY

Albrecht Beutelspacher

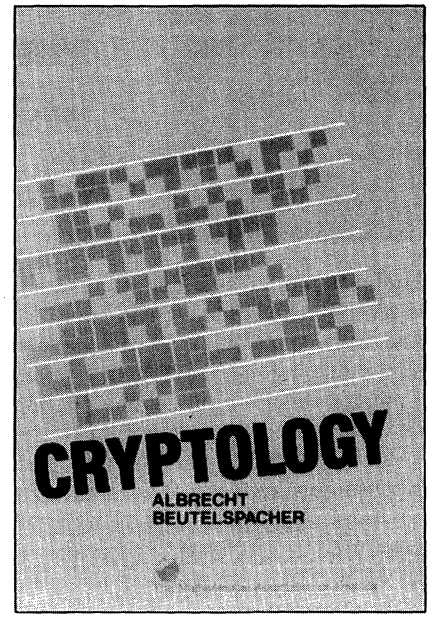
This fascinating little book is eminently readable, and it is a great deal of fun to peruse... the book is a real treat. We need more books like this, crafted by expert hands yet crafted so that the general reader can enjoy them.
—Bulletin of The Institute of Combinatorics and Its Applications

This excellent and entertaining book is suitable for a first course in cryptology for mathematical enthusiasts. An abundance of exercises and an excellent list of related references are included.
—The Mathematics Teacher

In spite of the light-hearted style in which the book is written throughout, it is a serious—-and successful—-attempt to explain the basis of coding and decoding messages...I can strongly recommend this book to anyone who wants a brief but comprehensive, eminently readable, and up-to-date introduction to this increasingly popular topic.
— The Mathematical Gazette

All of cryptology is covered in this work...Occupying a niche in the halls of the ivory tower of pure mathematics for nearly two millennia, number theory now forms a pillar of modern society. This book is the best explanation available today of how that pillar was constructed.
— Charles Aschbacher

A model to follow in order to make mathematics better known and understood. Accessible to a broad audience. Have fun reading this book, while you are getting a better understanding of cryptology.
— Bulletin of the Belgian Mathematics Society



How can messages be transmitted secretly? How can one guarantee that the message arrives safely in the right hands exactly as it was transmitted? Cryptology—the art and science of "secret writing"—provides ideal methods to solve these problems of data security.

The book is fun to read, and the author presents the material clearly and simply. Many exercises and references accompany each chapter.

176 pp., Paperbound, 1994
ISBN 0-88385-504-6
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MAA Member: $26.95
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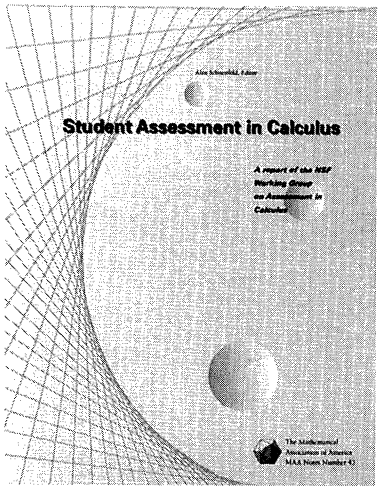


Student Assessment in Calculus

A Report of the NSF Working Group on Assessment in Calculus

ALAN SCHOENFELD, EDITOR

Series: MAA Notes

If you teach calculus, you should read this book. If you want to know what mathematics your students understand, or if you want to know how to find out what they understand, this book contains essential information for you.

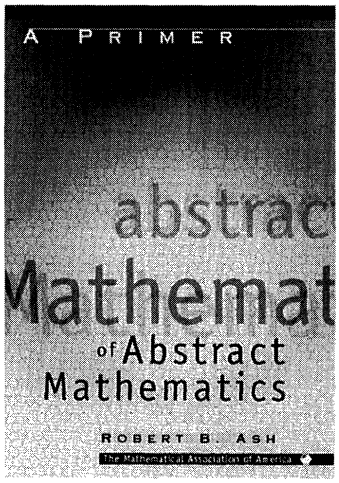
It doesn't matter whether you teach a reform or traditional course, whether you have large or small sections, or whether you use lectures or laboratories. The bottom line is the same: When all is said and done, what counts is what our students understand. And that's what *Student Assessment in Calculus* is about.

Over the last ten years calculus instruction has changed in numerous ways. Whether they were trying on new ideas or following the more traditional routes towards conceptual understanding, both individual faculty and departments needed to know if their instruction was effective. To help deal with that issue, the National Science Foundation brought together a Working Group of experts in students' mathematical thinking, in assessment, and in calculus reform. The goals of their work were to:

- develop a framework to tailor calculus instruction to the students' needs;
- establish an agenda for further research on student understanding;
- describe how to make use of a range of techniques to test what students know, such as multiple-choice tests or short essay questions, student portfolios and "clinical" interviews;
- summarize major goals of the reform movement and describe the challenges faced by those who are taking a closer look at how students learn;
- illustrate the ways in which calculus projects attempt (via exams, papers, projects, etc.) to find out what their students have learned.

This book is the result of those efforts. If you teach calculus, if you want to see examples of useful assessment techniques, or if you are interested in issues of how to measure student learning in mathematics, then there is a lot for you here.

Catalog Code: NTE-43/JR97
122 pp., Paperbound, 1997
ISBN 0-88385-152-0
List: $34.95 MAA Member: $29.00



A Primer of Abstract Mathematics

Robert Ash

Series: Classroom Resource Materials

A Primer of Abstract Mathematics prepares the reader to cope with abstract mathematics, specifically abstract algebra. It can serve as a text for prospective mathematics majors, as well as for those students taking or preparing to take a first course in abstract algebra, or those in applied fields who need experience in dealing with abstract mathematical ideas.

Learning any area of abstract mathematics involves writing formal proofs, but it is equally important to think intuitively about the subject and to express ideas clearly and cogently. The author aids intuition by keeping proofs short and as informal as possible, using concrete examples which illustrate all the features of the general case, and by giving heuristic arguments when a formal development would take too long. The text can serve as a model on how to write mathematics for an audience with limited experience in formalism and abstraction.

Ash introduces several expository innovations in *A Primer of Abstract Mathematics*. He presents an entirely informal development of set theory that gives students the basic results that they will need in algebra. The chapter which presents the theory of linear operators introduces the Jordan Canonical Form right at the beginning, with a proof of existence at the end of the chapter.

Contents:

Logic and Foundations: Truth Tables, Quantifiers, Proofs, Sets, Functions, Relations.

Counting: Fundamentals, The Binomial and Multinomial Theorems, The Principle of Inclusion and Exclusion, Counting Infinite Sets.

Elementary Number Theory: The Euclidean Algorithm, Unique Factorization, Algebraic Structures, Further Properties of Congruence Modulo m, Linear Diophantine Equations and Simultaneous Congruences, Theorems of Euler and Fermat, The Möbius Inversion Formula.

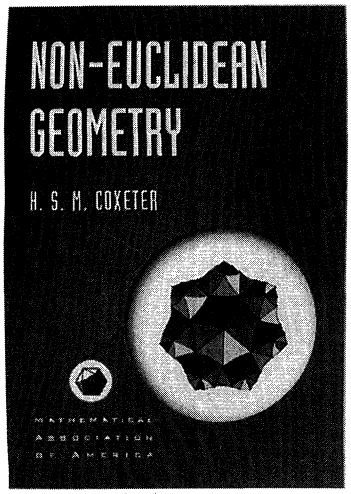
Some Highly Informal Set Theory: Well-Orderings, Zorn's Lemma and the Axiom of Choice, Cardinal Numbers, Addition and Multiplication of Cardinals.

Linear Algebra: Matrices, Determinants and Inverses, The Vector Space F^n, Linear Independence and Bases, Subspaces, Linear Transformations, Inner Product Spaces, Eigenvalues and Eigenvectors.

Theory of Linear Operators: Jordan Canonical Form, The Minimal and Characteristic Polynomials, The Adjoint of a Linear Operator, Normal Operators, The Existence of the Jordan Canonical Form.

Appendix: An Application of Linear Algebra.

Catalog Code: BMA/JR
188 pp., Paperbound, 1998
ISBN 0-88385-709-X
List: $27.95 MAA Member: $21.95



Non-Euclidean Geometry

Sixth Edition

H. S. M. COXETER

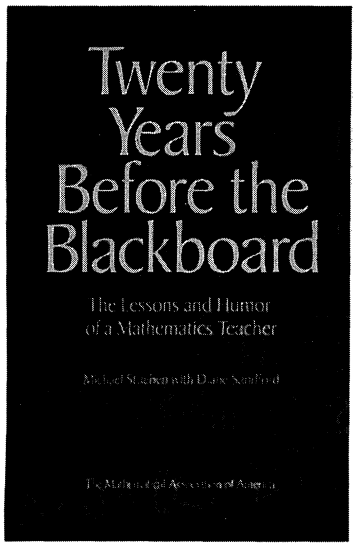
Series: Spectrum

H. S. M. Coxeter's classic book on non-Euclidean geometry was first published in 1942, and enjoyed eight reprintings before it went out of print in 1968. The MAA is delighted to be the publisher of the sixth edition of this wonderful book, updated with a new section 15.9 on the author's useful concept of inversive distance.

Throughout most of this book, non-Euclidean geometries in spaces of two or three dimensions are treated as specializations of real projective geometry in terms of a simple set of axioms concerning points, lines, planes, incidence, order and continuity, with no mention of the measurement of distances or angles. This synthetic development is followed by the introduction of homogeneous coordinates, beginning with Von Staudt's idea of regarding points as entities that can be added or multiplied. Transformations that preserve incidence are called collineations. They lead in a natural way to elliptic isometries or "congruent transformations". Following a recommendation by Bertrand Russell, continuity is described in terms of order. Elliptic and hyperbolic geometries are derived from real projective geometry by specializing an elliptic or hyperbolic polarity which transforms points into lines (in two dimensions) or planes (in three dimensions) and vice versa.

An unusual feature of the book is its use of the general linear transformation of coordinates to derive the formulas of elliptic and hyperbolic trigonometry. The area of a triangle is related to the sum of its angles by means of an ingenious idea of Gauss. This treatment can be enjoyed by anyone who is familiar with algebra up to the elements of group theory.

Catalog Code: NEC/JR
320 pp., Paperbound, 1988
ISBN 0-88385- 522-4
List: $30.95 MAA Member: $24.50



Twenty Years Before the Blackboard

The Lessons and Humor of a Mathematics Teacher

Michael Stueben with Diane Sandford

Series: Spectrum

A perfect gift for the new teacher. . . or for anyone interested in the teaching of mathematics.

This book is the legacy of twenty years of mathematics teaching. During this time, the author searched for motivation techniques, mnemonics, insightful proofs, and serious applications of humor to aid his teaching. The result is this book: part philosophy, part humor, and part biography. Readers will be amused and enlightened on every page.

Mr. Stueben shows how he has used humor and wordplay to motivate his students. The book is filled with wonderful problems and proofs, as well as the author's insights about how to approach teaching problem solving to high school students. Sections of the book also treat the use of calculators and computers in the classroom. A section on mnemonics shows how teachers can use memory aids to help their students learn and retain material.

All in all, *Twenty Years Before the Blackboard* provides a goldmine of ideas for the classroom teacher. Although Mr. Stueben taught at the high school level, his book is an excellent "methods" book for mathematics teachers at all levels.

Read what Martin Gardner has to say about this fascinating book:

It's been decades since I read so entertaining a book about mathematics. The book is a treasure-trove of mathematical jokes, rhymes, anecdotes, word play, mnemonics, and beautiful proofs. For teachers there is an abundance of wise advice based on the author's twenty years in high school teaching. Mathematicians at all levels, from amateurs to college professors will not only chuckle over its gems, but learn much they did not know before. ——Martin Gardner

Catalog Code: TYB/JR98
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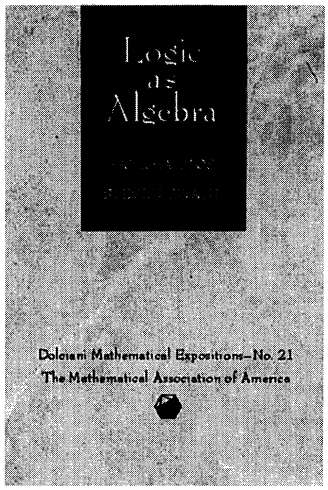


Logic as Algebra

Paul Halmos and Steven Givant

Series: Dolciani Mathematical Expositions

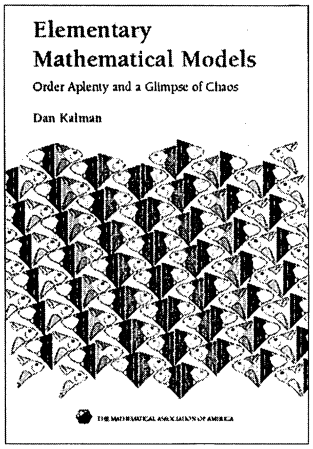
This book is based on the notes of a course in logic given by Paul Halmos. This book retains the spirit and purpose of those notes, which was to show that logic can (and perhaps should) be viewed from an algebraic perspective. When so viewed, many of its principal notions are seen to be old friends, familiar algebraic notions that were "disguised" in logical clothing. Moreover, the connection between the principal theorems of the subject and well-known theorems in algebra becomes clearer. Even the proofs often gain in simplicity.

Propositional logic and monadic predicate calculus—predicate logic with a single quantifier— are the principal topics treated. The connections between logic and algebra are carefully explained. The key notions and the fundamental theorems are elucidated from both a logical and algebraic perspective. The final section gives a unique and illuminating algebraic treatment of the theory of syllogisms—perhaps the oldest branch of logic, and a subject that is neglected in most modern logic texts.

The presentation is aimed at a broad audience—mathematics amateurs, students, teachers, philosophers, linguists, computer scientists, engineers, and professional mathematicians. Whether the reader's goal is a quick glimpse of modern logic or a more serious study of the subject, the book's fresh approach will bring novel and illuminating insights to beginners and professionals alike. All that is required of the reader is an acquaintance with some of the basic notions encountered in a first course in modern algebra. In particular, no prior knowledge of logic is assumed. The book could serve equally well as a fireside companion and as a course text.

Contents: **What is Logic?:** To count or to think; A small alphabet; A small grammar; A small logic; What is truth?; Motivation of the small language; All mathematics. **Propositional Calculus:** Propositional symbols; Propositional abbreviations; Polish notation; Language as an algebra; Concatenation; Theorem schemata; Formal proofs; Entailment; Logical equivalence; Conjunction; Algebraic identities. **Boolean Algebra:** Equivalence classes; Interpretations; Consistency and Boolean algebra; Duality and commutativity; Properties of Boolean algebras; Subtraction; Examples of Boolean algebras. **Boolean Universal Algebra:** Subalgebras; Homomorphisms; Examples of homomorphisms; Free algebras; Kernels and ideals; Maximal ideals; Homomorphism theorem; Consequences; The representation theorem. **Logic via Algebra:** Pre-Boolean algebras; Substitution rule; Boolean logics; Algebra of the propositional calculus; Algebra of proof and consequence. **Lattices and Infinite Operations:** Lattices; Non-distributive lattices; Infinite operations. **Monadic Predicate Calculus:** Propositional functions; Finite functions; Functional monadic algebras; Functional quantifiers; Properties of quantifiers; Monadic algebras; Free monadic algebras; Modal logics; Monadic logics; Syllogisms.

Catalog Code: DOL-21/JR98
152 pp., Paperbound, 1998, ISBN 0-88385-327-2
List: $27.00 MAA Member: $21.95



THE MATHEMATICAL ASSOCIATION OF AMERICA

Elementary Mathematical Models

Order Aplenty and a Glimpse of Chaos

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Dan Kalman

New in the Classroom Resource Materials Series...suitable as a text in college algebra, finite mathematics, precalculus, and liberal arts mathematics courses

Elementary Mathematical Models *(EMM)* claims a middle ground between college algebra and liberal arts mathematics. Like the college algebra course, *EMM* emphasizes the elementary functions of analysis: linear, quadratic, polynomial, and rational functions; square roots; exponentials and logarithms. These functions are the building blocks for the simple models that appear in first courses in the physical, life, and social sciences. And while *EMM* does not stress algebraic manipulation as an end in itself, it does recognize how important algebra is. Moreover, it provides students with the opportunity to see for themselves why algebra is needed, and what it contributes to formulating and analyzing models.

Like the liberal arts mathematics course, *EMM* makes a concerted effort to convey something of the scope, power, and fascination of mathematics, to students who may never study mathematics again. Each mathematical topic evolves naturally in formulating simple discrete models for inherently interesting contexts. For example, exponential functions emerge from the study of models exhibiting geometric growth—defined as growth that increases by equal proportions in equal periods of time. Throughout the course, a recurring theme is the evolution from simple recursive hypotheses (e.g., the population next year will be 10% greater than this year), to difference equations ($p_{n+1} = 1.1\,p_n$), to solutions ($p_n = p_0\,(1.1^n)$), to qualitative behavior of models. This theme appears repeatedly as the students encounter a series of increasingly sophisticated growth models, starting with arithmetic growth and ending with logistic growth. The course climaxes with an exploration of the chaotic behavior that can occur in logistic growth models.

The presentation is accessible even to students with a weak algebraic background. Throughout the book, numerical, graphical, and symbolic approaches are used systematically. There is a rich collection of examples and exercises. Reading comprehension exercises in each chapter provide a strong emphasis on reading and writing about mathematical concepts.

Contents: Overview; Sequences and Differences Equations; Arithmetic Growth; Linear Graphs, Functions and Equations; Quadratic Growth Models; Quadratic Graphs, Functions and Equations; Polynomials and Rational Functions; Fitting a Line to Data; Geometric Growth; Exponential Functions; More on Logarithms; Geometric Sums and Mixed Models: Logistic Growth; and Chaos in Logistic Models.

Catalog Code: EMM/JR
360 pp., 1997, Paperbound, ISBN 0-88385-707-3
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