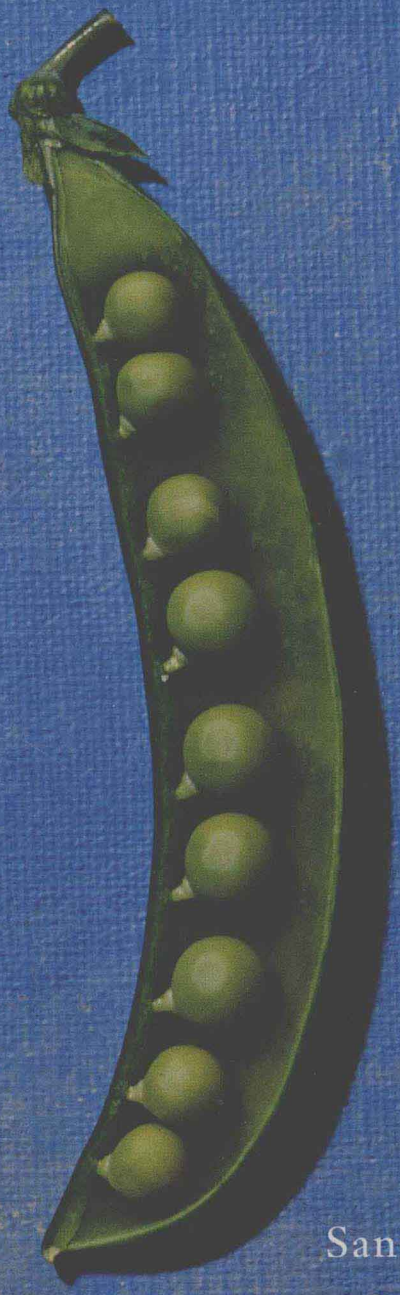
Elementary Algebra



Sandra Pryor Clarkson
Barbara J. Barone

ELEMENTARY ALGEBRA

Sandra Pryor Clarkson
Hunter College

Barbara J. Barone
Hunter College

with **Mary Margaret Shoaf** *Baylor University*

HOUGHTON MIFFLIN COMPANY **Boston New York**

We dedicate this book
to our fathers for their complete faith in us,
to Shepherd G. Pryor III, and
in loving memory of Walter J. Primosch (1917–1995)
—S.P.C. and B.J.B.

Sponsoring Editor: Maureen O'Connor
Development Editor: Dawn Nuttall
Project Editor: Cindy Harvey
Editorial Assistant: Michelle Francois
Production/Design Coordinator: Carol Merrigan
Senior Manufacturing Coordinator: Marie Barnes
Marketing Manager: Sara Whittern

Cover Design: Deborah Azerrad Savona
Cover Photo: Takashi Shima/Photonica
Interior Design: George McLean

Photo Credits: Chapter 1: David Witbeck/The Picture Cube; pages 2, 57, © Camerique/Picture Cube; page 3, Roy Morsch/The Stock Mkt; page 17, David Young-Wolff/Photo Edit; Chapter 2: © G.S.O. Images MCMXCIII/The Image Bank; Chapter 3: Dean Abramson/Stock Boston: Chapter 4: ITTC Productions/The Image Bank; Chapter 5: David M. Phillips/Science Source/Photo Researchers, Inc.; Chapter 6: Michael Melford/The Image Bank; Chapter 7: David Young-Wolff/PhotoEdit; Chapter 8: John Madere; page 467: The Chicago Historical Society; Chapter 9: Susan Van Etten/Photo Edit; Chapter 10: Glyn Kirk/Tony Stone Images.

Printed in the U.S.A.

Library of Congress Number: 97-72453

ISBNs:
Text: 0-395-74424-5
Instructor's Annotated Edition: 0-395-87940-X

123456789-VH-01 00 99 98 97

PREFACE

Elementary Algebra serves as a bridge between the traditional and the reform text. It is a text that encourages students to explore mathematical ideas, formulate questions, and communicate mathematics using writing and graphing. This text embraces the best elements of the American Mathematical Association of Two-Year Colleges (AMATYC) standards and reform: motivating *applications* that drive the mathematics, including an abundance of *real-source data* graphs and tables; *technology* integrated where appropriate; *writing about mathematics*—in the exercises, as a new margin note feature, and as interactive chapter summaries; *group projects*, the majority of which involve real data; *variety in presentation* and illustration of mathematical concepts; and a *problem-solving approach* introduced early and integrated throughout.

Approach

Mastery Many courses require students to demonstrate mastery of specific aspects of the material. Additionally, in this text, concepts and skills are integrated into a smoothly flowing text and not simply presented as isolated objectives. Section goals are identified, and the tests monitor achievement of those goals. Our exams give three questions for each objective. A student who answers two of the three questions correctly really knows the material.

Sensitivity to Learning Styles and Disabilities Students have many opportunities to "see" mathematics in multiple formats—graphically, numerically, symbolically—and to use all these formats in solving problems. Additionally, Study Hints and Instructor Notes are given to aid students, including those with learning or perceptual difficulties. A section in the Instructor's Resource Manual is devoted to working with students with learning disabilities.

Motivation We present problem situations from many areas of interest and concern that reflect the impact of mathematics in all aspects of modern life. Therefore, answers are not always artificially "nice" numbers but are often from real situations. This realism helps students develop genuine number sense.

Real-Life Applications

With respect to motivation and real data, newspapers, magazines, professional journals, and current and historical books are the source materials for the applications found in the following features.

Chapter and Section Applications Each chapter has a *Chapter Lead-In* and a *Chapter Look-Back* and each section has a *Section Lead-In* and a *Section Follow-Up* that extends knowledge of mathematics in a real-life situation or in a mathematical exploration. These Lead-Ins relate peripherally to the section and chapter and help to interest students in the material to come.

Exercises and Examples Examples and exercises involve data gathered from contemporary business, sports, current events, the sciences, and virtually all real-life situations. They cover a diverse selection of topics, including biology, physics, astronomy, real estate, architecture, engineering, and even elements of popular culture, such as movies. They appear early in the text and throughout all chapters. The wide variety and realism of the applications will appeal to students. The areas of application are identified.

Excursions Excursions are extended project exercises that follow each section's exercise set. These problems can be assigned to individuals or groups. These exercises contain a wealth of real data, and a written answer or justification is often required. Many are also open-ended and encourage creative thinking and problem solving.

- *Class Act* These problems are especially designed to stimulate discussion and cooperation as student groups formulate the best solution. These can be assigned to individuals but may require more time than for groups.
- *Data Analysis* These problems encourage graphical and/or statistical analysis. They are appropriate for both groups and individuals.
- *Posing Problems* Numerical information is given in table, graph, or paragraph format. Students are encouraged to pose their own problems and solve them and share with others. These activities often stimulate lively classroom discussion.
- *Exploring ...* These problems often require some informed trial-and-error procedures to find a solution. Students will explore problems involving patterns, numbers, calculators, problem solving, and geometry.

Technology

Calculator Corners All technology material has been specifically developed and written for this text. The Calculator Corners are integrated at appropriate places, providing detailed directions for how a graphing calculator can be useful—both in graphing and non-graphing topics. The Calculator Corners not only illustrate how a graphing calculator can make mathematical calculations easier, they also can take a mathematical idea one step further or present an alternate way to illustrate a mathematical concept. For classes not using calculators, the Calculator Corners are easy to identify and skip. Screen displays and directions are given for the Texas Instruments *TI 82/83* series, but the features discussed are found on all graphing calculator models.

The Calculator Corner examples and exercises were contributed by Dr. Mary Margaret Shoaf, who has given numerous workshops on the use of calculators in teaching mathematics. Additionally, her research and writing have focused on the use of calculators in enhancing student understanding. We are pleased to have her as a member of the writing team.

Writing/Group

Besides the Excursions and the section exercises identified with ✏, there are additional features that encourage student writing.

Margin Notes In other texts, often student margin notes contain information for students to read only. We offer two types of student margin notes that ask

students to give a written response, allowing students to interact immediately with the material.

- *Error Alert* These can be assigned individually or used as a catalyst for group discussion. A problem is presented along with an incorrect or incomplete solution. Students are asked to identify and correct the errors. Common student errors are presented in this feature. We ultimately want students to be able to identify and correct the errors they might make in their own work. No answers are given in the text in order to encourage students to rely on themselves for these answers.
- *Writer's Block* These questions require students to write about mathematics. Students explain, define, clarify, and interpret mathematical ideas, terms, and procedures.

Student Journal The student text comes with a separate Student Journal booklet. This journal contains interactive chapter summaries in which students must write their own summaries as prompted by questions. Each chapter summary covers all the definitions and rules in that chapter and asks students to provide definitions, complete statements and diagrams, fill in blanks, and write explanations in their own words. Students are encouraged to give an example of each definition and rule and to make notes to help them remember the material. Students are also encouraged to keep a homework journal, with pages numbered, in order to note the page numbers of problems that they have worked that best "model" the chapter's main ideas. Overall, the Student Journal is designed to help students make the most efficient use of their time while studying the material.

Chapter Pedagogy

Section Goals On the first page of each section, Section Goals list the terminal objectives for the section. These goals will be taught and practiced in that section, together with necessary "pre-skills."

Definitions and Rules Key words are defined and rules (or procedures) are clearly delineated in boxes set apart from the rest of the material. These features build vocabulary and aid students in communicating mathematics. Each mathematical term appears in bold type when it first occurs in the text.

Study Hints These student notes found in the margin aid students in learning the material.

Warm-Ups Students are directed to a Warm-Up after each worked example. The Warm-Up parallels the example, reinforcing the concept just taught and building student confidence while also allowing students to interact immediately with the material. These special exercises appear right before the section exercises, and answers to all Warm-Ups are in the back of the text.

Connections to ...

- *Probability and Statistics* Topics in probability and statistics are introduced throughout the text and reinforced periodically. Topics include mean, median, mode, standard deviation, range, line graphs, histograms, pie charts, and naming probabilities.

- *Geometry and Measurement* Topics in geometry and measurement are introduced throughout the text and reinforced periodically. Topics include area and perimeter of plane figures, surface area and volume of rectangular solids, cylinders, spheres and pyramids, similar triangles, parallel lines cut by a transversal, changing units, and scientific notation.

Problem-Solving Preparation Problem solving is emphasized throughout the text. A useful set of problem-solving strategies is developed in the text so that students learn to approach problems in an organized, efficient manner. Students are taught to reason mathematically using a four-step procedure modeled on Polya's problem-solving work.

Estimation Throughout the text, estimation is taught and reinforced, where appropriate, to promote number sense.

Functions and Set Notation Functions and set notation are introduced early and reinforced throughout the text. Students completing this text will be well prepared for intermediate algebra.

Assessment

We have incorporated a variety of assessment features into this text. Instructors might want to use a portfolio of these (and possibly also Warm-Ups, Excursions, Writer's Block, and Error Alert features) in evaluating student knowledge.

Skills Check The Skills Check sections determine whether students have the prerequisite skills necessary for that chapter. Passing this test does not allow a student to "skip" the chapter; instead, it lets them know if they are ready to begin. Students who miss problems are referred to appropriate sections for review.

Section Exercise Sets These exercises provide review and practice for all skills taught in the section. Exercises are arranged in pairs; answers to odd-numbered problems are at the back of the text.

Mixed Practice In all sections except the first section in a chapter, there are mixed practice problems that review and reinforce skills previously taught in that chapter. Answers to the odd-numbered problems are at the back of the text.

Chapter Review These exercises are divided into two sets. The first group of exercises provides a section-by-section review of the chapter's work. The second set is a mixed review that is not section referenced. All answers appear in the back of the text.

Chapter Test This test follows the chapter review material. It is mastery-based and contains three questions for each section goal in a chapter. Questions are organized by section goal, and answers do *not* appear in the back of the text (solutions can be found in the Solutions Manual). A student who answers two questions correctly out of each group of three has most likely mastered the objective. The Chapter Test takes approximately one hour to complete. An additional Chapter Test as well as suggestions for Assessment

Alternatives—in keeping with the standards recommended by AMATYC and NCTM—appear in the Instructor's Resource Manual.

Cumulative Review Beginning with Chapter 2, a Cumulative Review section appears at the end of each chapter. This review reinforces skills taught in all previous chapters including the current one. The exercises are mixed. Answers to all these problems are at the back of the text.

Supplements

FOR INSTRUCTOR USE

Instructor's Annotated Edition The Instructor's Annotated Edition is an exact replica of the student text but also includes answers to all the exercises as well as helpful *Instructor Notes* in the margins. These Instructor Notes provide hints for teaching students, including those with learning or perceptual difficulties, and cautions about possible student misunderstandings.

Instructor's Resource Manual with Test Bank The *Instructor's Resource Manual* contains information about how to organize a laboratory course using this text. Suggestions are also given about the use of cooperative learning groups and for working with students with certain types of perceptual or learning disabilities. There is also a section on how students can gain math confidence as well as a section listing the AMATYC standards. Finally, there is an additional Chapter Test for each chapter in the text. The questions are in random order and are slightly more challenging than the Chapter Tests in the text.

The *Test Bank* contains about 2000 test items. Items are grouped by section and goal and are also available in the Computerized Test Generator.

Computerized Test Generator The Computerized Test Generator is the electronic version of the printed Test Bank. This user-friendly software permits an instructor to construct an unlimited number of customized tests from the 2000 test items offered. **On-line testing** and **gradebook** functions are also provided. It is available in Windows for the IBM PC and compatible computers.

Solutions Manual The Solutions Manual contains full, worked-out solutions to all exercises in the text.

FOR STUDENT USE

Student Journal This journal, which comes with the student edition, contains interactive chapter summaries in which students must write their own summaries as prompted by questions. Each chapter summary covers all the definitions and rules in that chapter and asks students to provide definitions, complete statements and diagrams, fill in the blanks, and write explanations in their own words.

Computer Tutor The Computer Tutor is a text-specific, networkable, interactive, algorithmically driven software package. This powerful ancillary features full-color graphics, algorithmic exercises with extensive hints, animated solution steps, and a comprehensive classroom management system. It is available

for the IBM PC and compatible computers and the Macintosh. A computer disk icon  appears in the Section Goals box as a reminder that each section is covered in the tutor.

Videos Within each section of the text, a videotape icon  appears in the Section Goals box. The icon contains the reference number of the appropriate video, making it easy for students to find the extra help they may need. Each video opens with a relevant application which is then solved at the end of the lesson.

Student Solutions Manual The Student Solutions Manual contains full, worked-out solutions to all the exercises whose answers are at the back of the text, namely all the Warm-Ups, the odd-numbered section exercises, all the Chapter Review exercises, and all the Cumulative Review exercises.

Acknowledgments

Many people have helped us directly with this project. In particular, we wish to thank Cindy Harvey, Kathy Deselle, George McLean, Dawn Nuttall, and Maureen O'Connor.

A special thanks must go to JoAnne Kennedy at LaGuardia Community College for authoring the Test Bank, Solutions Manual, and Student Solutions Manual, and to Mary Margaret Shoaf at Baylor University for authoring the Calculator Corners.

Through the years, each of us has people that inspire us, offer us opportunities, and teach us important lessons. The following have contributed to our growth in various ways: Mary Ellen Bohan; the late Ann Braddy; Mrs. Breiner; Mac Callaham; the late Tom Clarke; Tom Davis; the late Mary P. Dolciani Halloran and her husband James Halloran; Henry Edwards, Jr.; George Grossman; Eleanore Kantowski; Mrs. Leonardi; the late Sarah Anna Mathis; Ed Millman; the late Len Pikaart; Henry Pollack; Donna Shalala; June Smith; Andre Thibodeau; the late Mr. Towson; Zalman Usiskin; Bill Williams; Jim Wilson; and Gloria Wolinsky.

We would also like to thank the following reviewers for their suggestions:

Kathleen Burk, *Pensacola Junior College,* FL; Dennis Ebersole, *Northampton County Area Community College,* MA; Mitchel Fedak, *Community College of Allegheny County,* Boyce Campus, PA; Judy Godwin, *Collin County Community College,* TX; Karen Graham, *University of New Hampshire;* Rose Ann Haw, *Mesa Community College,* AZ; Edith Hays, *Texas Woman's University;* Georgia K. Mederer; William Radulovich, *Florida Community College,* Jacksonville; James Ryan, *Madera Community College,* CA; Lauri Semarne; Thomas Walsh, *City College of San Francisco;* Susan White, *DeKalb College,* GA; and Kenneth Word, *Central Texas College.*

And, of course, our families contributed most of all!

S.P.C. and B.J.B.

INDEX OF APPLICATIONS

Health and Physical Fitness Applications

Interest Applications

Miscellaneous Applications

Number Games Applications

Sports and Competition Applications

Time and Distance Applications

CONTENTS