INSTRUCTOR'S EDITION

Elementary Algebra

Graphs & Authentic Applications

Third Edition

Jay Lehmann

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Pearson

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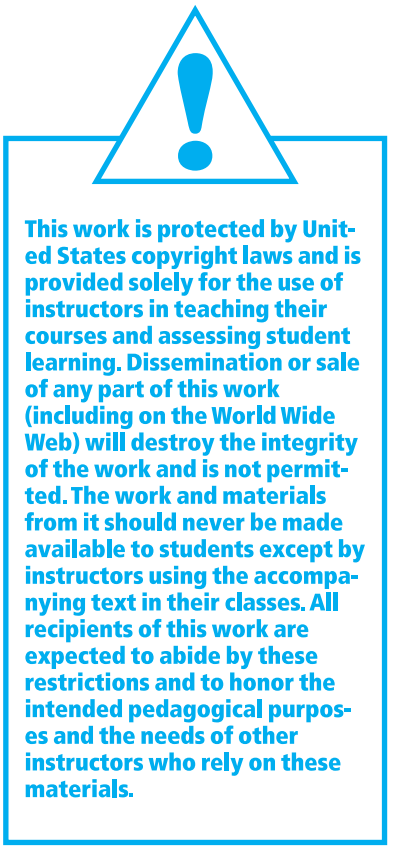

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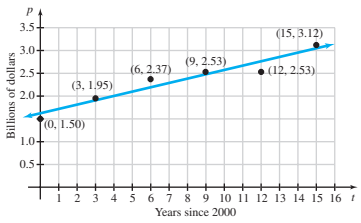

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Year	Percent of Eligible Voters Who Voted
1980	59.2
1984	59.9
1988	57.4
1992	61.9
1996	54.2
2000	54.7
2004	63.8
2008	63.6
2012	57.5
2016	60.0

Percentages of Adult Internet Users Who Use Social Networking Sites (p. 170)

Year	Percent
2010	60
2011	65
2012	67
2013	73
2014	74
2015	76

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Year	Revenue (billions of dollars)
2009	5.4
2010	7.0
2011	7.5
2012	6.7
2013	9.0
2014	9.9
2015	11.2

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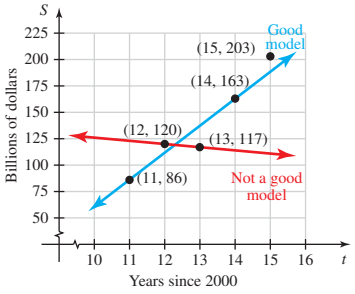

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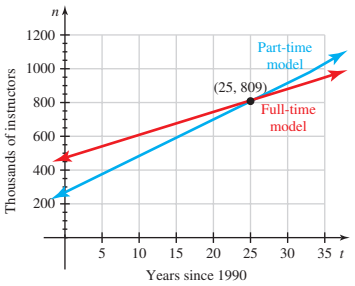

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Percentages of 10th Graders Who Have Used Marijuana in the Past 30 Days (p. 377)

Year	Percent
2008	13.8
2009	15.9
2010	16.7
2011	17.6
2012	17.0
2013	18.0
2014	16.6
2015	14.8

Worldwide iPhone Sales (p. 474)

Year	Sales (millions)
2007	1.4
2009	20.7
2011	72.3
2013	150.3
2015	231.2

Percentages of Lawyers Who Are Women (pp. 521–522)

Year	Percent
1970	5
1980	14
1990	24
2000	30
2010	33
2017	35

Numbers of Households Burglarized (p. 541)

Year	Number of Households Burglarized (millions)	Total Number of Households (millions)
2011	1.63	118.7
2012	1.56	121.1
2013	1.43	122.5
2014	1.27	123.2
2015	1.13	124.6

Numbers of 3D Movie Screens (p. 623)

Year	Number of Screens (thousands)
2010	14.7
2011	25.6
2012	33.1
2013	36.8
2014	38.4

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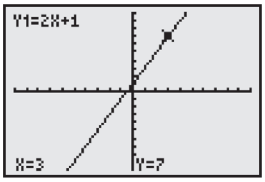


Preface

''The question of common sense is always, 'What is it good for?'—a question which would abolish the rose and be answered triumphantly by the cabbage.''

—James Russell Lowell

These words seem to suggest that poet and editor James Russell Lowell (1819–1891) took Elementary Algebra. How many times have your students asked, "What is it good for?" After years of responding "You'll find out in the next course," I began an ongoing quest to develop a more satisfying and substantial response to my students' query.

This ongoing quest has led me to author three algebra texts and, most recently, a new stat prep text, *A Pathway to Introductory Statistics*. I have a passion for using authentic data, centered around a curve-fitting approach to help students learn in context.

Curve-Fitting Approach Although there are many ways to center an Elementary Algebra course around authentic applications, I chose a curve-fitting approach for several reasons. A curve-fitting approach

- allows great flexibility in choosing interesting, authentic, current situations to model.
- emphasizes key concepts and skills in a natural, substantial way.
- deepens students' understanding of equations in two variables because it requires students to describe these equations graphically, numerically, symbolically, and verbally.
- unifies the many diverse topics of a typical Elementary Algebra course.

There is yet one more reason I chose a curve-fitting approach. An Elementary Algebra course is meant to prepare some students for a Calculus STEM track and others for Statistics, Liberal Arts Math, and so on (non-STEM tracks). This is a great challenge because Calculus, Statistics, and so on are vastly different courses not only in content but also in the type of problem solving they require. Teaching algebra with curve fitting empowers instructors to prepare students for all types of content and problem solving.

To fit a curve to data, students learn the following four-step modeling process:

1. Examine the data set to determine which type of model, if any, to use.
2. Find an equation of the model.
3. Verify that the model fits the data.
4. Use the model to make estimates and predictions.

This four-step process weaves together topics that are crucial to the course. Students must notice numerical patterns from data displayed in tables, recognize graphical patterns in scatterplots, find equations of models, graph models, and solve equations.

Not only does curve fitting foster cohesiveness within chapters, but it also creates a parallel theme for each set of chapters that introduces and discusses a new type of model. This structure enhances students' abilities to observe similarities and differences among fundamental models such as linear models, quadratic models, rational models, and radical models.

Curve fitting serves as a portal for students to see the usefulness of mathematics so they become fully engaged in the class. Once involved, students are more receptive to all aspects of the course.

NEW TO THE THIRD EDITION

Students will benefit from the following changes to the third edition of *Elementary Algebra: Graphs and Authentic Applications*:

- In previous editions, all authentic data sets in the print text were represented by similar, yet generic (inauthentic), data sets in MyLab Math to provide algorithmically-generated similar exercises for students completing homework in MyLab Math. However, in the new edition, where possible, MyLab Math exercises maintain the authenticity of the data. This has been accomplished by sampling from a large data set to generate six authentic data sets that inherit the same trend.
- ***MyLab Math Exercises***: The number of skill, modeling, and conceptual exercises in MyLab Math has been increased to fully capture the spirit of the print textbook. In fact, for the first time ever, Related Review exercises (described later in the preface) will be assignable in MyLab Math.
- ***Large Data Sets***: Many students who use this textbook will not perform regression analysis in their careers, but some *will* work with large data sets. Such work will also help prepare students to take Statistics. With this in mind, new exercises that involve large data sets have been sprinkled throughout the textbook. They directly follow the heading "Large Data Sets." The data sets consist of as many as thousands of rows and tens of columns of data.
- DATA ***Downloadable Data Sets***: To support the appropriate use of technology when completing exercises and labs, data sets that consist of 16 or more data values can now be downloaded as Excel files at MyLab Math and at the Pearson Downloadable Student Resources for Math and Statistics website: http://www.pearsonhighered.com/mathstatsresources. These data sets in MyLab Math can also be opened in StatCrunch. Exercises that involve such data sets are flagged in the print textbook by the icon DATA.
- ***Augmented Data Sets***: To make the data sets as current and relevant as possible, 162 data sets in examples and exercises have been augmented to include values for recent years.
- ***New Data Sets***: 212 data sets in examples and exercises have been replaced with more compelling and contemporary topics such as immigration, national health care, and trust in the mass media.
- ***Climate Change Labs***: All eight Climate Change labs have been updated to address the latest data and political events concerning this incredibly important global issue.
- ***Graphing Calculator Instructions***: Appendix A, which consists of TI-83/TI-84 graphing calculator instructions, was available only online in the previous edition. To make the appendix more accessible to students, it is now included in the textbook.
- ***StatCrunch Instructions***: Some departments that require StatCrunch for their Statistics courses introduce StatCrunch in their Elementary Algebra courses. To support such departments, Appendix B, which contains StatCrunch instructions, has been added to the textbook.
- ***Section Opener Explorations***: Explorations that can be used at the start of a section have been moved from the preceding section to the current section. The new placement will visually remind instructors to assign such explorations and make it easier for students to access them.
- ***Statistics Terminology***: To better support students who will take Statistics, the terminology has been improved: The words *scattergram*, *independent variable*, and *dependent variable* have been replaced with *scatterplot*, *explanatory variable*, and *response variable*.

- ***Graphing Linear Equations and Linear Models***: The technique of graphing equations of the forms $x = a$ and $y = b$ has been moved from Section 3.2 to Section 3.1. This way, all equations of the forms $y = mx + b$ and $x = a$ are now contained within one section (3.1), and Section 3.2 is now devoted to unit analysis and graphing linear models.
- ***Color***: More color has been used to enhance connections between equations, graphs, tables, and coordinates of ordered pairs.

CONTINUED FROM THE SECOND EDITION

Unique Organization Many college students who take Elementary Algebra had significant difficulties with the equivalent courses in high school. These students face a greater challenge in the college courses because they must complete the course in one semester, rather than two. Instead of presenting the material in the "same old way," this textbook provides a unique organization that will better aid students in succeeding. Three key aspects of the organization—providing the "big picture," early graphing, and spiraling of concepts—are described in the following paragraphs.

Providing the Big Picture The text uses modeling to provide the "big picture" before going into details. For example, Chapter 1 gives an overview of linear modeling, which is the main theme of Chapters 1–6, and Section 7.2 provides an overview of quadratic modeling, which is a major focus of Chapters 7–9. Using modeling to provide the big picture not only is good pedagogy, but also sets the tone that this course will be different, interesting, alive, and relevant, inviting students' creativity into the classroom.

Early Graphing In Chapter 3, students learn to graph linear equations only in the forms $y = mx + b$ and $x = a$. This way, they can focus on the fundamental concepts of slope and y-intercept. As many professors have reported, students do exceedingly well in Chapter 3. This early-graphing organization postpones simplifying expressions and solving equations, buying students a bit more time to find their "sea legs" before moving on to the more challenging symbolic manipulation work in Chapter 4. By the time that students reach Section 5.1, they are ready to graph equations that are not in slope-intercept form, but can be put into it.

The early-graphing approach also enables students to solve equations graphically as well as symbolically. Most of Chapters 4–11 include exercises that reinforce the connection between graphing and solving equations or systems of equations.

Spiraling of Concepts If a concept is never revisited, students may not retain it. Fortunately, curve fitting naturally revisits concepts as students' tool bag of models grows. In each modeling section, exercises require students to compare the implications of using the various types of equations to model authentic situations. In addition, students' retention of key concepts can be enhanced in Chapters 5–11 by completing two special types of exercises, **Related Review** and **Expressions, Equations, and Graphs**. These types of exercises are described in greater detail later in the preface.

Modeling Exercises To give this third edition a current and lively feel, the vast majority of the hundreds of modeling exercises in the text have been updated or replaced. Most of the application exercises contain tables of data, but some describe data in paragraph form to give students practice in picking out relevant information and defining variables. Both types of applications are excellent preparation for subsequent courses (especially Statistics).

Group Explorations All sections of this text contain one or two explorations that support student investigation of a concept. Instructors can use explorations as collaborative activities during class time or as part of homework assignments. The "Section Opener" explorations are meant to have students discover the section's concepts at the start of class. The other explorations are designed to have students apply concepts they have learned in the section in new ways. Both types of explorations can empower students to become active explorers of mathematics and open the door to the wonder and beauty of the subject.

Taking It to the Lab Sections Laboratory assignments have been included at the end of most chapters to deepen students' understanding of concepts and the scientific method. These labs reinforce the idea that mathematics is useful. They are also an excellent avenue for more in-depth writing assignments.

Some of the labs are about climate change and have been written at a higher reading level than the rest of the text in order to give students a sense of what it is like to perform research. Students will find that by carefully reading (and possibly rereading) the background information, they can comprehend the information and apply concepts they have learned in the course to make estimates and predictions about this compelling, current, and authentic situation.

Balanced Extensive Homework Sections Most exercise sets contain a large number of modeling, skill, and conceptual exercises to allow professors maximum flexibility in setting assignments.

Related Review These exercises (in every section of Chapters 5–11) relate current concepts to previously learned concepts. Such exercises assist students in seeing the "big picture" of the course. This exercise type is now also assignable in MyLab Math.

Expressions, Equations, and Graphs These exercises (in every section of Chapters 5–11) help students gain a solid understanding of these three core concepts, including how to distinguish among them.

Technology The text assumes students have access to technology such as the TI-83 or TI-84 graphing calculator, Excel, or StatCrunch. Technology of this sort allows students to construct scatterplots and check the fit of a model quickly and accurately. It also empowers students to verify their results from Homework exercises and efficiently explore mathematical concepts in the Group Explorations.

The text supports instructors in holding students accountable for all aspects of the course without the aid of technology, including finding equations of linear models. (Linear regression equations are included in the Answers section because it can be difficult or impossible to anticipate which points a student will choose in trying to find a reasonable equation.)

Appendix A: Using a TI-83 or TI-84 Graphing Calculator Appendix A contains step-by-step instructions for using the TI-83 and TI-84 graphing calculators. A subset of this appendix can serve as a tutorial early in the course. In addition, when the text requires a new calculator skill, students are referred to the appropriate section in Appendix A.

Appendix B: Using StatCrunch Appendix B contains step-by-step instructions for using StatCrunch. The appendix describes how to enter data and construct scatterplots.

Exposition If students can't make sense of the prose, it doesn't matter how precise it is. One of my top goals is to write descriptions that are straightforward, accessible, clear, and rigorous.

Tips for Success Many sections close with tips that are intended to help students succeed in the course. A complete listing of these tips is included in the Index.

Warnings These are discussions (flagged by the margin entry "WARNING") that address students' common misunderstandings about key concepts and help students avoid such misunderstandings.

Chapter Opener Each chapter begins with a description of an authentic situation that can be modeled by the concepts discussed in the chapter.

GETTING IN TOUCH

I would love to hear from you and would greatly appreciate receiving your comments regarding this text. If you have any questions, please ask them, and I will respond.

Thank you for your interest in preserving the rose.

Jay Lehmann
MathNerdJay@aol.com

Resources for Success

Get the Most Out of MyLab Math

for *Elementary Algebra,* Third Edition, by Jay Lehmann

When it comes to developmental math, one size does not fit all. Jay Lehmann's *Elementary Algebra* offers market-leading content written by an author-educator, tightly integrated with the #1 choice in digital learning—MyLab Math. MyLab Math courses can be tailored to the needs of instructors and students, while weaving the author's voice and unique approach into all elements of the course. Learning mathematical concepts through authentic data comes through from the text to the MyLab course seamlessly.

Take advantage of the following resources to get the most out of your MyLab Math course.

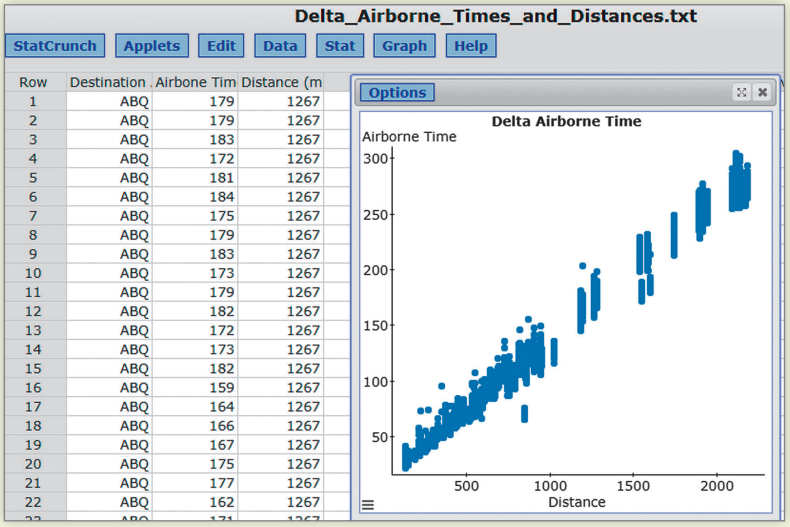
Conceptual Understanding and Motivation

New! Large Data Sets in exercises and explorations get students accustomed to working with as many as thousands of rows of data. Data sets that involve 16 or more values are available for download to support the appropriate use of technology. Noted with a DATA icon, these exercises are ideal for using technology, like StatCrunch or Excel, to analyze the data and synthesize concepts. In today's age of "big data," it's important for students to see how technology can efficiently and accurately help when working with large data sets.

Large Data Sets

47. DATA Access the data about airborne times and distances of Delta Airlines flights, which are available at MyLab Math and at the Pearson Downloadable Student Resources for Math & Stats website. Let T be the airborne time (in minutes) and D be the distance (in miles) for a flight.

- **a.** Construct a scatterplot of the data.
- **b.** Give a possible reason why the scatterplot consists of vertically aligned clumps of data points.
- **c.** On the basis of just the scatterplot, guess whether Delta offers more *routes* that are less than 1000 miles or greater than 1000 miles. On the basis of just the scatterplot, why is it not possible to be sure?

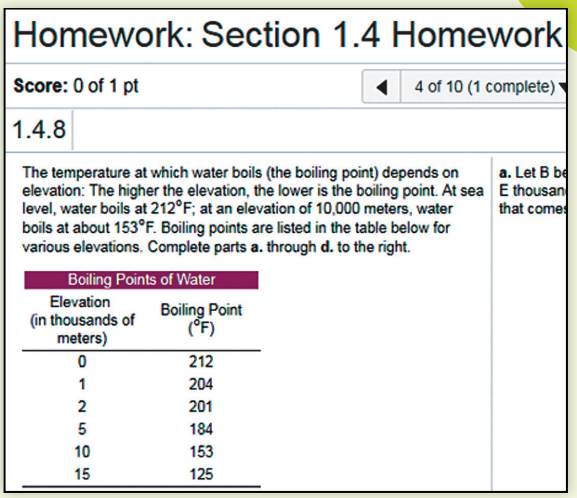


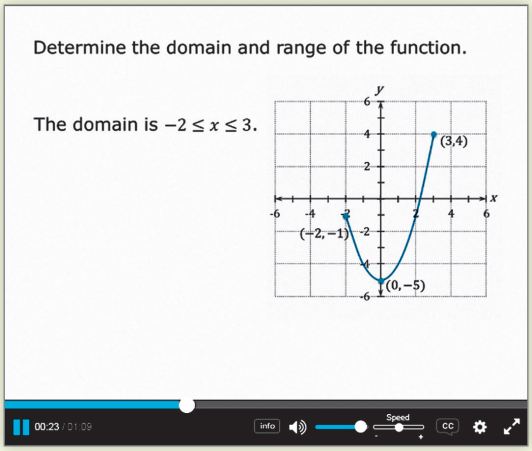
New! StatCrunch is a web-based statistical software available from within the MyLab Math course that students can use to easily analyze data sets from exercises and the text. Through StatCrunch users can access tens of thousands of shared data sets, create and conduct online surveys, perform complex analyses using the powerful statistical software, and generate compelling reports.

pearson.com/mylab/math

Pearson MyLab

New! Select exercises with authentic data have been carefully revised to retain authentic data values, even when regenerating algorithmically. Oftentimes students sacrifice working with real-world data when they regenerate exercises with new values in MyLab Math. In this revision, the author has taken special care to ensure that many exercises' algorithmic versions of the question still ask the student to work with actual data pulled from real-world situations.

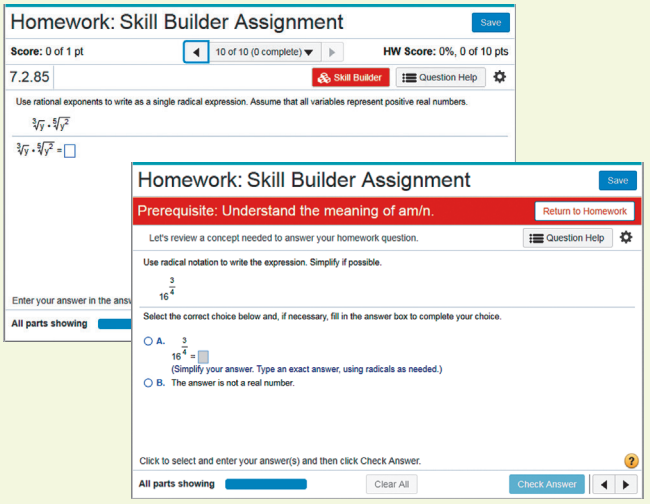




Updated! The video program provides students with extra help for each objective of the textbook. The videos highlight key examples, and a modern interface allows easy navigation. Videos have been updated to reflect all changes in the current edition.

Personalized Learning and Preparedness

New! Skill Builder exercises offer just-in-time additional adaptive practice. The adaptive engine tracks student performance and delivers questions to each individual that adapt to his or her level of understanding. This new feature allows instructors to assign fewer questions for homework, allowing students to complete as many or as few questions needed.



Enhanced Sample Assignments make course set-up easier by giving instructors a starting point for each section and chapter. Homework assignments have been carefully curated for this specific text and include a thoughtful mix of question types. Find these sample assignments in the Assignment Manager, under Copy and Assign Sample Assignments.

pearson.com/mylab/math

Resources for Success

Pearson MyLab

Instructor Resources

The following instructor resources are available to download from the Instructor Resource Center at www.pearson.com*, or in your MyLab Math course.*

Instructor's Resource Manual

This manual, written by the author, contains suggestions for pacing the course and creating homework assignments. It discusses how to incorporate technology and how to structure project assignments. The manual also contains section-by-section suggestions for presenting lectures and for undertaking the explorations in the text.

Power Points

These fully editable lecture slides include definitions, key concepts, and examples for use in a lecture setting and are available for each section of the text.

Instructor's Solutions Manual

This manual includes complete solutions to the even-numbered exercises in the text.

TestGen

TestGen enables instructors to build, edit, print, and administer tests by using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple, but equivalent, versions of the same question or test with the click of a button. Instructors can also modify test-bank questions or add new questions. Tests can be printed or administered online. The software and test bank are available for download from Pearson's online catalogue.

Student Resources

New! Concepts and Explorations Notebook: Working with Authentic Data

This new compelling resource for students correlates to the text and provides students with opportunities to dig into data and solve problems using pencil and paper. The workbook includes:

- Explorations that offer collaborative activities to support discovery of key concepts.
- Modeling exercises with authentic data that give students more practice on this multifaceted concept, that can be sometimes hard to fully accomplish through MyLab Math.
- Projects that can be either open-ended or more guided, and ask students to dig deeper into a data set and think critically.
- Graphing exercises that ask students to practice graphing on their own, beyond what they do in MyLab Math.
- Mini-Essay questions that prompt students to think conceptually, also beyond what they do in MyLab Math!

Student's Solutions Manual

This manual contains the complete solutions to the odd-numbered exercises in the Homework sections of the text.

To the Student

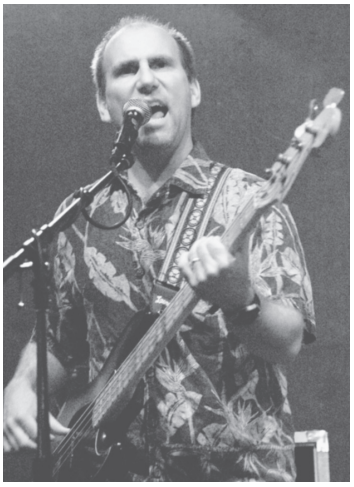
You are about to embark on an exciting journey. In this course, you will learn not only more about algebra but also how to apply algebra to describe and make predictions about authentic situations. "Authentic situations" might make you think twice, but this just means situations that are *really* happening in the world. This text contains data that describe hundreds of these situations. Most of the data have been collected from recent publications, so the information is current and of interest to the general public. There is data about profit from concerts, success in school, climate change, sports, and so on. I hope it interests you too.

Working with authentic data will make mathematics more meaningful. While working with data about authentic situations, you will learn mathematical concepts more easily because they will be connected to familiar contexts. And you will see that almost any situation can be viewed mathematically. That vision will help you understand the situation and make estimates and/or predictions.

Many of the problems you will explore in this course involve data collected in a scientific experiment, survey, or census. The practical way to deal with such data sets is to use technology. So, a graphing calculator or computer system is probably required.

Analyzing authentic situations is a lifelong skill. We are living in the "age of data." In addition to working with data sets in this text, your instructor may assign some of the labs. Here you will collect data through experiment or research. This will give you a more complete picture of how you can use the approaches presented in this text in everyday life, and likely in your lifelong careers. Being able to work with and understand data can lead to higher-paying jobs and success.

Hands-on explorations are rewarding and fun. This text contains explorations with step-by-step instructions that will lead you to *discover* concepts, rather than hear or read about them. Because discovering a concept is exciting, it is more likely to leave a lasting impression on you. Also, as you progress through the explorations, your ability to make intuitive leaps will improve, as will your confidence in doing mathematics. Over the years, students have remarked to me time and time again that they never dreamed that learning math could be so much fun.



Jay has a wide variety of interests. He is pictured here playing with his rock band, The Procrastinistas. (Photo courtesy of Rick Gilbert)

This text contains special features to help you succeed. Many sections contain a Tips for Success feature. These tips are meant to inspire you to try new strategies to help you succeed in this course and future courses. If you browse through all the tips early in the course, you can take advantage of as many of them as you wish. Then, as you progress through the text, you'll be reminded of your favorite strategies. A complete listing of Tips for Success is included in the Subject Index.

Other special features that can support you include Warnings, which can help you avoid common misunderstandings; Key Points summaries, which can help you review and retain concepts and skills addressed in the chapter you have just read; Related Review exercises, which can help you understand current concepts in the context of previously learned concepts; and Expressions, Equations, and Graphs exercises, which can help you understand and distinguish among these three core concepts.

Feel free to contact me. It is my pleasure to read and respond to e-mails from students who are using my text. If you have any questions or comments about the text, feel free to contact me.

Jay Lehmann
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Peter Kay, *Western Illinois University*
Charles Klein, *De Anza College*
Julianne M. Labbiento, *Lehigh Carbon Community College*
Jason Malozzi, *Lehigh Carbon Community College*
Debra Martin, *Purdue University, Fort Wayne*
Diane Mathios, *De Anza College*
Jim Matovina, *Community College of Southern Nevada*
Jane E. Mays, *Grand Valley State University*
Scott McDaniel, *Middle Tennessee State University*
Tim Merzenich, *Chemeketa Community College*
R. Messer, *American River College*
Jason L. Miner, *Santa Barbara City College*
Nolan Mitchell, *Chemeketa Community College*
Camille Moreno, *Cosumnes River College*
Lisa Mosser, *Jackson Community College*
Ellen Musen, *Brookdale Community College*
Charlie Naffziger, *Central Oregon Community College*
Chris Nord, *Chemeketa Community College*
Donna Marie Norman, *Jefferson Community College*
Denise Nunley, *Glendale Community College*
Karen D. Pain, *Palm Beach State College*
Ernest Palmer, *Grand Valley State University*
Ellen Rebold, *Brookdale Community College*
Jody Rooney, *Jackson Community College*
James Ryan, *State Center Community College District, Clovis*
Barbara Savage, *Roxbury Community College*
Ned Schillow, *Lehigh Carbon Community College*
Ingrid Scott, *Montgomery College*
Kathy Self, *Georgia Military College—Milledgeville*
David Shellabarger, *Lane Community College*
Laura Smallwood, *Chandler-Gilbert Community College*
John Szeto, *Southeastern Louisiana University*
Janet Teeguarden, *Ivy Tech Community College*
Lorna TenEyck, *Chemeketa Community College*
Cindy Vanderlaan, *Purdue University, Fort Wayne*
Lenove Vest, *Lower Columbia College*
Ollie Vignes, *Southeastern Louisiana University*
Linda Wagner, *Purdue University, Fort Wayne*
Karen Wiechelman, *University of Louisiana at Lafayette*
Robin Williams, *Palomar College*
Lisa Winch, *Kalamazoo Valley Community College*
Cathy Zucco-Teveloff, *Rider University*

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