Using & Understanding Mathematics

A Quantitative Reasoning Approach

Third Edition

Bennett   Briggs

6TH EDITION

Using & Understanding
MATHEMATICS
A Quantitative Reasoning Approach

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PEARSON

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Math for College, Career, and Life

We use math in our day-to-day lives even when we don't realize it. The goal of this book is to increase mathematical literacy so we use it more effectively in everyday life. Mathematics can help us to understand a variety of topics and issues, making us more aware of both the uses and abuses of math. The ultimate goal is to become better educated citizens and be successful in our college experiences, our careers, and our lives.

Each chapter offers an **Activity** designed to spur discussion of some interesting facet of the topics covered in the chapter. [p. 286, 5A]

ACTIVITY
Cell Phones and Driving

Use this activity to gain a sense of the kinds of problems this chapter will enable you to study. Additional activities are available online in MyMathLab.

Is it safe to use a cell phone while driving? The science of statistics provides a way to approach this question, and the results of many studies indicate that the answer is no. The National Safety Council estimates that approximately 1.6 million car crashes each year (more than a quarter of the total) are caused by some type of distraction, most commonly the use of a cell phone for talking or texting. In fact, some studies suggest that merely talking on a cell phone makes you as dangerous as a drunk driver. As preparation for your study of statistics in this chapter, work
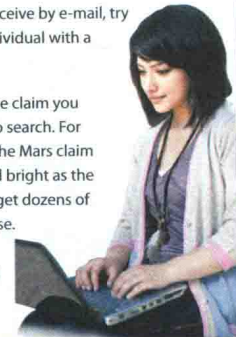
IN YOUR WORLD
Web Searches to Verify Web Sources

While some information on the Web is inaccurate or biased, the Web is also a great source for checking the accuracy of information. A good way to start is with "fact checking" websites, as long as you also verify that the fact checkers have a reputation for fairness and accuracy. A few reputable fact-checking sites include:

· To check the validity of messages you receive by e-mail, try TruthOrFiction.com, run by a private individual with a reputation for fairness and accuracy.

If none of those sources has covered the claim you are investigating, try a plain language Web search. For example, if you type the first sentence of the Mars claim ("On August 27, Mars will look as large and bright as the full Moon…") into a search engine, you'll get dozens of hits that discuss the claim and why it is false. Of course, if your search turns up conflicting claims about accuracy, you'll still need to decide which claims to believe.

···rg, supported by the non-
···lic Policy Center; PolitiFact.
···he Fact Checker," a blog
···dd claims, Snopes.com

IN YOUR WORLD

47. **Political Action.** This unit outlined numerous budgetary problems facing the U.S. government, as they stood at the time the book was written. Has there been any significant political action to deal with any of these problems? Learn what, if anything, has changed over the past couple of years, then write a one-page position paper outlining your own recommendations for the future.

48. **Debt Problem.** How serious a problem is the gross debt? Find arguments on both sides of this question. Summarize the arguments, and state your own opinion.

In Your World boxes focus on topics that students are likely to encounter in the world around them, whether in the news, in consumer decisions, or in political discussions. This is further enhanced with In Your World exercises, designed to spur additional research or discussion that will help students relate the unit content to the themes of college, careers, and life. [p. 281, 4F and p. 11, 1A,]

Does It Make Sense? questions test conceptual understanding by asking students to decide whether the given statements are sensible and to explain why or why not. These questions encourage students to stop and think critically about a problem rather than just focusing on getting an answer. [p. 352, 5E]

DOES IT MAKE SENSE?

Decide whether each of the following statements makes sense (or is clearly true) or does not make sense (or is clearly false). Explain your reasoning.

7. There is a strong negative correlation between the price of tickets and the number of tickets sold. This suggests that if we want to sell a lot of tickets, we should lower the price.

8. There is a strong positive correlation between the amount of time spent studying and grades in mathematics classes. This suggests that if you want to get a good grade, you should spend more time studying.

Why Should You Care About Quantitative Reasoning?

Quantitative reasoning is the ability to interpret and reason with information that involves numbers or mathematical ideas. It is a crucial aspect of literacy, and it is essential in making important decisions and understanding contemporary issues.

The topics covered in this text will help you work with quantitative information and make critical decisions. For example:

- You should possess strong skills in critical and logical thinking so that you can make wise personal decisions, navigate the media, and be an informed citizen. For example, do you know why you'd end up behind if you accepted a temporary 10% pay cut now and then received a 10% pay raise later? This particular question is covered in Unit 3A, but throughout the book you'll learn how to evaluate quantitative questions on topics ranging from personal decisions to major global issues.

- You should have a strong number sense and be proficient at estimation so that you can put numbers from the news into a context that makes them understandable. For example, do you know how to make sense of the more than $17 trillion federal debt? Unit 3B discusses how you can put such huge numbers in perspective, and Unit 4F discusses how the federal debt grew so large.

- You should possess the mathematical tools needed to make basic financial decisions. For example, do you enjoy a latte every morning before class? Sometimes two? Unit 4A explores how such a seemingly harmless habit can drain more than $2400 from your wallet every year.

- You should be able to read news reports of statistical studies in a way that will allow you to evaluate them critically and decide whether and how they should affect your personal beliefs. For example, how should you decide whether a new opinion poll accurately reflects the views of Americans? Chapter 5 covers the basic concepts that lie behind the statistical studies and graphics you'll see in the news, and discusses how you can decide for yourself whether you should believe a statistical study.

- You should be familiar with basic ideas of probability and risk and be aware of how they affect your life. For example, would you pay $20,000 for a product that, over 20 years, will kill nearly as many people as live in San Francisco? In Unit 7D, you'll see that the answer is very likely yes—just one of many surprises that you'll encounter as you study probability in Chapter 7.

- You should understand how mathematics helps us study important social issues, such as global warming, the growth of populations, the depletion of resources, apportionment of Congressional representatives, and methods of voting. For example, Unit 12D discusses the nature of redistricting and how gerrymandering has made congressional elections less competitive than they might otherwise be.

In sum, this text will focus on understanding and interpreting mathematical topics to help you develop the quantitative reasoning skills you will need for college, career, and life.

This book is dedicated to everyone who wants a better understanding of our world, and especially to those who have struggled with mathematics in the past. We hope this book will help you achieve your goals.

And it is dedicated to those who make our own lives brighter, especially Lisa, Julie, Katie, Grant, and Brooke.

PREFACE

"Human history becomes more and more a race between education and catastrophe."

—H. G. Wells,
The Outline of History, 1920

To the Student

There is no escaping the importance of mathematics in the modern world. However, for most people, the importance of mathematics lies not in its abstract ideas, but in its application to personal and social issues. This book is designed with such practical considerations in mind. In particular, we've designed this book with three specific purposes:

- To prepare you for the mathematics you will encounter in other **college** courses, particularly core courses in social and natural sciences.

- To develop your ability to reason with quantitative information in a way that will help you achieve success in your **career**.

- To provide you with the critical thinking and quantitative reasoning skills needed to understand major issues in **life**.

We hope this book will be useful to everyone, but it is designed primarily for those who are *not* planning to major in a field that requires advanced mathematical skills. In particular, if you've ever felt any fear or anxiety about mathematics, we've written this book with you in mind. Through this book, you will discover that mathematics is much more important and relevant to your life than you had guessed and not as difficult as previously imagined.

Whatever your interests—social sciences, environmental issues, politics, business and economics, art and music, or any of many other topics—you will find many relevant and up-to-date examples in this book. But the most important idea to take away from this book is that mathematics can help you understand a variety of topics and issues, making you a more aware and better educated citizen. Once you have completed your study of this book, you should be prepared to understand most quantitative issues that you will encounter.

To the Instructor

Whether you've taught this course many times or are teaching it for the first time, you are undoubtedly aware that mathematics courses for nonmajors present challenges that differ from those presented by more traditional courses. First and foremost, there isn't even a clear consensus on what exactly should be taught in these courses. While there's little debate about what mathematical content is necessary for science,

technology, engineering, and mathematics (STEM) students—for example, these students all need to learn algebra and calculus—there's great debate about what we should teach non-STEM students, especially the large majority who will *not* make use of formal mathematics in their careers or daily lives.

As a result of this debate, core mathematics courses for non-STEM students fall into a broad and diverse range. Some schools require these students to take a traditional, calculus-track course, such as college algebra. Others have instituted courses that teach students about the ways in which contemporary mathematics contributes to society, focusing on mathematical ideas that students are unlikely to encounter elsewhere. These courses have their merits, and they can certainly be made interesting and relevant, but we believe there are better options because of the following important fact: The vast majority (typically 95%) of non-STEM students will *never* take another college mathematics course after completing their core requirements.

Given this fact, we believe it is essential to teach these students the mathematical ideas that they will *need* for their remaining college course work, their careers, and their daily lives. In other words, while there are many topics that might be new and interesting, we must emphasize those topics that are truly important to the future success of these students. The focus of this approach is less on formal calculation—though some is certainly required—and more on teaching students how to think critically with numerical or mathematical information. In the terminology adopted by MAA, AMATYC, and other mathematical organizations, students need to learn *quantitative reasoning* and to become *quantitatively literate*. There's been a recent rise in the popularity of quantitative reasoning courses for the non-STEM student. This book has been integral to the quantitative reasoning movement for years and continues to be at the forefront as an established entity designed to help you succeed in teaching quantitative reasoning to your students.

The Key to Success: A Context-Driven Approach

Broadly speaking, approaches to teaching mathematics can be divided into two categories:

- A *content-driven* approach is organized by mathematical ideas. After each mathematical topic is presented, examples of its applications are shown.

• A *context-driven* approach is organized by practical contexts. Applications drive the course, and mathematical ideas are presented as needed to support the applications.

The same content can be covered through either approach, but the context-driven approach has an enormous advantage: It motivates students by showing them directly how relevant mathematics is to their lives. In contrast, the content-driven approach tends to come across as "learn this content because it's good for you," causing many students to tune out before reaching the practical applications. For more details, see our article "General Education Mathematics: New Approaches for a New Millennium" (*AMATYC Review*, Fall 1999) or the discussion in the Epilogue of the book *Math for Life* by Jeffrey Bennett (Big Kid Science, 2014).

The Challenge: Winning Over Your Students

Perhaps the greatest challenge in teaching mathematics to students lies in winning them over—that is, convincing them that you have something useful to teach them. This challenge arises because by the time they reach college, many students dislike or fear mathematics. Indeed, the vast majority of students in general education mathematics courses are there not by choice, but because such courses are required for graduation. Reaching your students therefore requires that you teach with enthusiasm and convince them that mathematics is useful and enjoyable.

We've built this book around two important strategies that are designed to help you win students over:

• Confront negative attitudes about mathematics head on, showing students that their fear or loathing is ungrounded and that mathematics actually is relevant to their lives. This strategy is embodied in the Prologue of this book (pages P1–P13), which we urge you to emphasize in class. It continues implicitly throughout the rest of the text.

• Focus on goals that are meaningful to students—namely, on the goals of learning mathematics for *college, career,* and *life.* Your students will then learn mathematics because they will see how it affects their lives. This strategy forms the backbone of this book, as we have tried to build every unit around topics relevant to college, career, and life.

Modular Structure of the Book

Many of us would love to have a year or more to teach mathematics to general education students. Unfortunately, most schools have only a one-quarter or one-semester mathematics requirement, so we can cover only a fraction of the material we'd cover in an ideal course. This book is therefore organized with a modular structure that allows you to create a course to meet your (or your students') particular interests and constraints. The 12 chapters are organized broadly by contextual areas. Each chapter, in turn, is divided into a set of self-contained *units* that focus on particular concepts or applications. In most cases, you can cover chapters in any order; and while the units within each chapter build sequentially in terms of sophistication, in many cases you can skip certain units, particularly those toward the end of the chapter.

Prerequisite Mathematical Background

Because of its modular structure, this book can be used by students with a wide range of mathematical backgrounds. Many of the units require nothing more than arithmetic and a willingness to think about quantitative issues in new ways. Only a few units use techniques of algebra or geometry, and those skills are reviewed as they arise. This book should therefore be accessible to any student who has completed two or more years of high school mathematics. However, *this book is not remedial*: Although much of the book relies on mathematical techniques from secondary school, the techniques always arise in applications that students generally are not taught in high school and that require students to demonstrate their critical thinking skills.

For courses in which students do require more extensive prerequisite review, we have created a version of the *Using & Understanding Mathematics* MyMathLab course called *Using & Understanding Mathematics with Integrated Review* that includes just-in-time review of select topics where appropriate.

Changes in the Sixth Edition

We've been pleased by the positive responses of so many users to prior editions of this text. Nevertheless, a book that relies heavily on facts and data always requires a major updating effort to keep it current, and we are always looking for ways to improve clarity and pedagogy. As a result, users of prior editions will find many sections of this book to have been substantially revised or rewritten. Throughout the book we have added more examples and exercises pertaining to vocational careers, which should make the material more relevant to a wider variety of students. We have also made many other changes; while these are too many to list here, they include the following:

Chapter Openers   Each chapter now opens with a multiple-choice question designed to illustrate an important way in which the chapter content connects with

the book themes of *college*, *careers*, and *life*. These questions can spur lively in-class or online discussions.

Chapter 1   We significantly revised several units in Chapter 1. In particular, Unit 1A has been expanded to include a focus on evaluation of media information, and we rewrote portions of Units 1C and 1D to help students better understand and interpret Venn diagrams and tests of validity.

Chapter 2   We rewrote and reorganized Units 2A and 2B so basic ideas of units and systems of standardized units are now all covered in Unit 2A while Unit 2B focuses on more sophisticated problem solving with units.

Chapters 3 and 4   These two chapters contain several units that revolve around economic data—such as census data, the consumer price index, interest rates, taxes, and the federal budget—which obviously required major updates given the changes that have occurred in the U.S. economy in the four years since the previous edition was published.

Chapters 5 and 6   These chapters focus on statistical data, which means we updated or replaced large sections of the chapter content to reflect current data.

Chapter 7   We significantly revised the discussion of several key probability ideas to help students better understand them and overcome misconceptions.

Chapters 8 and 9   Units 8B, 8C, and 9C all rely heavily on population data, which means we revised significant portions of these units to reflect the 2010 U.S. Census and updated global demographic data.

Chapter 12   We significantly rewrote major portions of this chapter, particularly in Units 12A and 12C, both to update the political data and to clarify key concepts including those of preference schedules and redistricting.

Pedagogical Features

Besides the main narrative of the text, this book includes the following features, each designed with a specific pedagogical purpose in mind.

Chapter Overview   Each chapter begins with a brief overview and a unit-by-unit listing of key content, designed both to show students how the chapter is organized and to help instructors decide which units to cover in class. It is then followed by a multiple-choice question designed to illustrate an important way in which the chapter

content connects with the book themes of *college*, *careers*, and *life*.

Chapter Activity   After the overview, each chapter offers an activity designed to spur student discussion of some interesting facet of the topics covered in the chapter. The activities may be done either individually or in small groups. An Activity Manual containing additional activities is available in the Tools for Success section of MyMathLab.

Time Out to Think   Appearing throughout the book, the "Time Out to Think" features pose short conceptual questions designed to help students pause and reflect on important new ideas. They also serve as excellent starting points for class discussions and/or clicker questions.

Summary Boxes   Flowing right along with the narrative are boxes that summarize key ideas, definitions, and formulas.

Examples and Case Studies   Numbered examples are designed to build understanding and to offer practice with the types of questions that appear in the exercises. Each example is accompanied by a "Now Try" tag that relates the example to specific similar exercises. Occasional case studies go into more depth than the numbered examples.

In Your World   These boxes focus on topics that students are likely to encounter in the world around them, whether in the news, in consumer decisions, or in political discussions. Examples include topics such as how to understand jewelry purchases, how to invest money in a sensible way, and how the chained consumer price index (CPI) differs from the standard CPI. This is further enhanced with a section of In Your World exercises in the exercise sets.

Brief Review   This feature reviews key mathematical skills that students should have learned previously but in which many students still need review and practice. They appear in the book wherever a particular skill is first needed, and exercises based on the review boxes can be found at the end of the unit.

Using Technology   These features give students clear instructions in the use of various technologies for computation, including scientific calculators, Microsoft Excel, and online technologies such as those built in to Google. Book-specific TI Tech Tips containing instructions for computations with a graphing calculator, such as the TI-83 and TI-84, are available in the Tools for Success section of MyMathLab.

Margin Features

- *By the Way* features contain interesting notes and asides relevant to the topic at hand.
- *Historical Note* remarks give historical context to the ideas presented in the chapter.
- *Technical Note* comments contain details that are important mathematically, but generally do not affect students' understanding of the material.

Mathematical Insight
This feature builds upon mathematical ideas in the main narrative but goes somewhat beyond the level of other material in the book. Examples include boxes on the proof of the Pythagorean theorem, on Zeno's paradox, and on derivations of the financial formulas used for savings plans and mortgage loans.

Chapter Summary
Appearing at the end of each chapter, the Chapter Summary offers a detailed outline of the chapter that students can use as a study guide.

Assessment Opportunities

Exercises are presented in various categories, making it easier for instructors to create assignments with a variety of problem types.

Quick Quiz
This ten-question quiz appears at the end of each unit and allows students to check whether they understand key concepts before starting the exercise set. Note that students are asked not only to choose the correct multiple-choice answer but also to write a brief explanation of the reasoning behind their choice. Answers are included in the back of the text.

Review Questions
Designed primarily for self-study, these questions ask students to summarize the important ideas covered in the unit and generally can be answered simply by reviewing the text.

Does It Make Sense?
These qualitative questions test conceptual understanding by asking students to decide whether the given statements are sensible and to explain why or why not.

Basic Skills & Concepts
These questions offer practice with the concepts covered in the unit. They can be used for homework assignments or for self-study (answers to most odd-numbered exercises appear in the back of the book). All of these questions are referenced by "Now Try" suggestions in the unit.

Further Applications
Through additional applications, these exercises extend the ideas and techniques covered in the text.

In Your World
These questions are designed to spur additional research or discussion that will help students relate the unit content to the book themes of college, careers, and life.

Using Technology
These exercises, which support the Using Technology features, give students an opportunity to practice calculator or software skills introduced in the text.

Supplements

Student Supplements

Student's Study Guide and Solutions Manual
(ISBN 0-321-91532-1/978-0-321-91532-0)
James Lapp

- Includes detailed, worked-out solutions to the odd-numbered unit exercises.
- More than just a solutions manual, this supplement provides study tips and additional guidance.

Instructor Supplements

Instructor's Edition
(ISBN 0-321-91529-1/978-0-321-91529-0)

- Answers to all of the exercises and Quick Quizzes are included in the back of the book.

The following supplements are ONLINE ONLY and are available for download in the Pearson Higher Education catalog at www.pearsonhighered.com/irc or within your MyMathLab course.

Activity Manual
Shane Goodwin, *Brigham Young University–Idaho*, and Suzanne Topp, *Salt Lake Community College*

- More than 20 activities correlated to the textbook for those who wish to incorporate a more hands-on approach.
- Can be completed by students individually or in a group.
- Includes instructor notes with background information and discussion points.
- Available within MyMathLab.

Instructor's Solutions Manual
James Lapp

- Includes detailed, worked-out solutions to all of the exercises in the text.

Instructor's Testing Manual
Dawn Dabney

- Provides four alternative tests per chapter, including answer keys.

TestGen®

- Enables instructors to build, edit, print, and administer tests, using a computerized bank of questions developed to cover all the objectives of the text.
- Algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button.
- Tests can be printed or administered online.

PowerPoint® Lecture Presentation

- Classroom presentation slides.
- Includes lecture content and key graphics from the book.

MyMathLab & MathXL

MyMathLab® Online Course (access code required)

MyMathLab delivers **proven results** in helping individual students succeed.

- MyMathLab has a consistently positive impact on the quality of learning in higher education math instruction. MyMathLab can be successfully implemented in any environment—lab-based, hybrid, fully online, traditional—and demonstrates the quantifiable difference that integrated usage has on student retention, subsequent success, and overall achievement.
- MyMathLab's comprehensive online gradebook automatically tracks your students' results on tests, quizzes, homework, and in the study plan. You can use the gradebook to quickly intervene if your students have trouble, or to provide positive feedback on a job well done. The data within MyMathLab is easily exported to a variety of spreadsheet programs, such as Microsoft Excel. You can determine which points of data you want to export, and then analyze the results to determine success.

MyMathLab provides **engaging experiences** that personalize, stimulate, and measure learning for each student.

- **Personalized Learning:** MyMathLab offers several features that support adaptive learning: personalized homework and the adaptive study plan. These features allow your students to work on what they need to learn when it makes the most sense, maximizing their potential for understanding and success.

- **Exercises:** The homework and practice exercises in MyMathLab are correlated to the exercises in the textbook, and they regenerate algorithmically to give students unlimited opportunity for practice and mastery. The software offers immediate, helpful feedback when students enter incorrect answers.
- **Multimedia Learning Aids:** Exercises include guided solutions, sample problems, animations, videos, and eText access for extra help at point-of-use.
- **Expert Tutoring:** Although many students describe the whole of MyMathLab as "like having your own personal tutor," students using MyMathLab do have access to live tutoring from Pearson, from qualified math and statistics instructors.

And, MyMathLab comes from an **experienced partner** with educational expertise and an eye on the future.

- Knowing that you are using a Pearson product means knowing that you are using quality content. That means that our eTexts are accurate and our assessment tools work. It means we are committed to making MyMathLab as accessible as possible. MyMathLab exercises are compatible with the JAWS 12/13 screen reader, which enables multiple-choice and free-response problem-types to be read and interacted with via keyboard controls and math notation input. More information on this functionality is available at http://mymathlab.com/accessibility.
- Whether you are just getting started with MyMathLab, or have a question along the way, we're here to help you learn about our technologies and how to incorporate them into your course.

To learn more about how MyMathLab combines proven learning applications with powerful assessment, visit *www.mymathlab.com* or contact your Pearson representative.

Specific to the Using and Understanding Mathematics MyMathLab course:

- A new section of Getting Ready questions provides the ability to offer remediation for students who need it, similar to the Brief Reviews in the text.
- A question type applying the math concepts to a real-world situation using excerpts from current news articles.
- An Activity Manual correlated to the textbook contains additional activities that can be completed by students individually or in a group. Instructor notes with background information and discussion points are included.
- TI technology tips aligned with the location in the textbook in terms of the specific section and page number.
- Bonus unit on Mathematics and Business.

- Live RSS feeds from news sources such as ABC News are available so instructors and students have access to regular news updates. These articles can be used in class discussions and projects, as appropriate.

MyMathLab® Ready to Go Course (access code required)

These new Ready to Go courses provide students with all the same great MyMathLab features, but make it easier for instructors to get started. Each course includes pre-assigned homework and quizzes to make creating a course even simpler. Ask your Pearson representative about the details for this particular course or to see a copy of this course.

Co-Requisite MyMathLab Course with Integrated Review (access code required)

The co-requisite course integrates just-in-time review of developmental algebra throughout the college-level quantitative reasoning course.

MathXL® Online Course (access code required)

MathXL® is the homework and assessment engine that runs MyMathLab. (MyMathLab is MathXL plus a learning management system.)

With MathXL, instructors can:

- Create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to the textbook.
- Create and assign their own online exercises and import TestGen tests for added flexibility.
- Maintain records of all student work tracked in MathXL's online gradebook.

With MathXL, students can:

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Access supplemental animations and video clips directly from selected exercises.

MathXL is available to qualified adopters. For more information, visit our website at www.mathxl.com, or contact your Pearson representative.

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LITERACY FOR THE MODERN WORLD

Equations are just the boring part of mathematics.

—*Stephen Hawking, physicist*

If you're like most students enrolled in a course using this text, you may think that your interests have relatively little to do with mathematics. But as the quote from Stephen Hawking indicates, mathematics is much more than equations, which is why this text will focus more on mathematical ideas and thinking. As you will see, this type of mathematical thinking is critical today for almost every career, as well as for the decisions and issues that we face daily as citizens in a modern technological society. In this Prologue, we'll discuss why mathematics is so important, why you may be better at it than you think, and how this course can provide you with the quantitative skills needed for your college courses, your career, and your life.

Q **Imagine that you're at a party and you've just struck up a conversation with a dynamic, successful lawyer. Which of the following are you most likely to hear her say during the course of your conversation?**

Ⓐ "I really don't know how to read very well."

Ⓑ "I can't write a grammatically correct sentence."

Ⓒ "I'm awful at dealing with people."

Ⓓ "I've never been able to think logically."

Ⓔ "I'm bad at math."

A We all know that the answer is E, because we've heard it so many times. Not just from lawyers, but from businessmen and businesswomen, actors and athletes, construction workers and sales clerks, and sometimes even teachers and CEOs. It would be difficult to imagine these same people admitting to any of choices A through D, but many people consider it socially acceptable to say that they are "bad at math." Unfortunately, this social acceptability comes with some very negative social consequences. You can probably think of a few already. For more, see the discussion under Misconception Seven on page P-7.

Job Satisfaction

Each chapter in this book will begin with an activity, which you may do individually or in groups. For this Prologue, we begin with an activity that will help you examine the role of mathematics in careers. Additional activities are available online in MyMathLab.

Top 20 Jobs for Job Satisfaction

1. Mathematician
2. Actuary (works with insurance statistics)
3. Statistician
4. Biologist
5. Software Engineer
6. Computer Systems Analyst
7. Historian
8. Sociologist
9. Industrial Designer
10. Accountant
11. Economist
12. Philosopher
13. Physicist
14. Parole Officer
15. Meteorologist
16. Medical Laboratory Technician
17. Paralegal Assistant
18. Computer Programmer
19. Motion Picture Editor
20. Astronomer

Source: JobsRated.com.

Everyone wants to find a career path that will bring lifelong job satisfaction, but what careers are most likely to do that? A recent survey evaluated 200 different jobs according to five criteria: salary, long-term employment outlook, work environment, physical demands, and stress. The table to the left shows the top 20 jobs according to this survey. Notice that most of the top 20 jobs require mathematical skills, and all of them require an ability to reason with quantitative information.

You and your classmates can conduct your own smaller study of job satisfaction. There are many ways to do this, but here is one procedure you might try:

❶ Each of you should identify at least three people with full-time jobs to interview briefly. You may choose parents, friends, acquaintances, or just someone whose job interests you.

❷ Identify an appropriate job category for each interviewee (similar to the categories in the table to the left). Ask each interviewee to rate his or her job on a scale of 1 (worst) to 5 (best) on each of the five criteria: salary, long-term employment outlook, work environment, physical demands, and stress. You can then add the ratings for the five criteria to come up with a total "job satisfaction" rating for each job.

❸ Working together as a class, compile the data to rank all the jobs. Show the final results in a table that ranks the jobs in order of job satisfaction.

❹ Discuss the results. Are they consistent with the survey results shown in the table? Do they surprise you in any way? Will they have any effect on your own career plans?

What Is Quantitative Reasoning?

Literacy is the ability to read and write, and it comes in varying degrees. Some people can recognize only a few words and write only their names; others read and write in many languages. A primary goal of our educational system is to provide citizens with a level of literacy sufficient to read, write, and reason about the important issues of our time.

Today, the abilities to interpret and reason with **quantitative information**—information that involves mathematical ideas or numbers—are crucial aspects of literacy. These abilities, often called **quantitative reasoning** or **quantitative literacy**, are essential to understanding issues that appear in the news every day. The purpose of this book is to help you gain skills in quantitative reasoning as it applies to issues you will encounter in

- your subsequent coursework,
- your career, and
- your daily life.

Quantitative Reasoning and Culture

Quantitative reasoning enriches the appreciation of both ancient and modern culture. The historical record shows that nearly all cultures devoted substantial energy to mathematics and to science (or to observational studies that predated modern science). Without a sense of how quantitative concepts are used in art, architecture, and science, you cannot fully appreciate the incredible achievements of the Mayans in Central America, the builders of the great city of Zimbabwe in Africa, the ancient Egyptians and Greeks, the early Polynesian sailors, and countless others.

Similarly, quantitative concepts can help you understand and appreciate the works of the great artists. Mathematical concepts play a major role in everything from the work of Renaissance artists like Leonardo da Vinci and Michelangelo to the pop culture of television shows like *The Big Bang Theory*. Other ties between mathematics and the arts can be found in both modern and classical music, as well as in the digital production of music. Indeed, it is hard to find popular works of art, film, or literature that do not rely on mathematics in some way.

> Mathematics knows no races or geographic boundaries; for mathematics, the cultural world is one country.
> —*David Hilbert (1862–1943), mathematician*

Quantitative Reasoning in the Work Force

Quantitative reasoning is important in the work force. A lack of quantitative skills puts many of the most challenging and highest-paying jobs out of reach. Table P.1 defines skill levels in language and mathematics on a scale of 1 to 6, and Table P.2 shows the typical levels needed in many jobs.

Note that the occupations requiring high skill levels are generally the most prestigious and highest paying. Note also that most of these occupations call for high skill levels in *both* language and math, refuting the myth that if you're good at language you don't have to be good at mathematics, and vice versa.

TABLE P.1 ▸ Skill Levels

Level	Language Skills	Math Skills
1	Recognizes 2500 two- or three-syllable words. Reads at a rate of 95–120 words per minute. Writes and speaks simple sentences.	Adds and subtracts two-digit numbers. Does simple calculations with money, volume, length, and weight.
2	Recognizes 5000–6000 words. Reads 190–215 words per minute. Reads adventure stories and comic books, as well as instructions for assembling model cars. Writes compound and complex sentences with proper grammar and punctuation.	Adds, subtracts, multiplies, and divides all units of measure. Computes ratio, rate, and percentage. Draws and interprets bar graphs.
3	Reads novels and magazines, as well as safety rules and equipment instructions. Writes reports with proper format and punctuation. Speaks well before an audience.	Understands basic geometry and algebra. Calculates discount, interest, profit and loss, markup, and commissions.
4	Reads novels, poems, newspapers, and manuals. Prepares business letters, summaries, and reports. Participates in panel discussions and debates. Speaks extemporaneously on a variety of subjects.	Has true quantitative reasoning abilities. Understands logic, problem solving, ideas of statistics and probability, and modeling.
5	Reads literature, book and play reviews, scientific and technical journals, financial reports, and legal documents. Can write editorials, speeches, and critiques.	Knows calculus and statistics. Is able to deal with econometrics.
6	Same types of skills as level 5, but more advanced.	Works with advanced calculus, modern algebra, and statistics.

Source: Data from the *Wall Street Journal*.