Preface

*Finite Mathematics with Applications* is an applications-centered text for students in business, management, and natural and social sciences. It covers the basics of college algebra, followed by topics in finite mathematics. The text can be used for a variety of different courses, and the only prerequisite is a basic course in algebra. Chapter 1 provides a thorough review of basic algebra for those students who need it.

It has been our primary goal to present sound mathematics in an understandable manner, proceeding from the familiar to new material, and from concrete examples to general rules and formulas. There is an ongoing focus on real-world problem solving, and almost every section includes relevant, contemporary applications.

New to This Edition

We have revised and added content, updated and added new applications, fine-tuned pedagogical devices, and evaluated and enhanced the exercise sets. In addition, both the functionality of MyLab™ Math and the resources within it have been greatly improved and expanded for this edition. These improvements were incorporated after careful consideration and much feedback from those who teach this course regularly. Following is a list of some of the more substantive revisions made to this edition.

- We updated or added real-world data for hundreds of examples and exercises. We have tried to make this text the most relevant and interesting of its kind, and the main way we do this is by immersing ourselves in the kinds of applications that we know from experience will motivate students. We realize that motivating reluctant learners is a major part of this course; the applications in this text are designed to give instructors a big advantage in facing this challenge.
- We analyzed aggregated student usage and performance data from MyLab Math for the previous edition of this text. The results of this analysis helped improve the quality and quantity of exercises that matter the most to instructors and students. Also, within exercise sets, we improved even-odd pairing of exercises and better graded them by level.
- In Chapter 5, we changed the notation for financial formulas to match the notation used in the TVM Solver from the TI-84 calculator.
- We added weighted averages to Section 10.2 so that students can understand applications such as calculating their own final grade when different components of a course are weighted at different percentages.
- We moved the discussion about boxplots from Section 10.4 to Section 10.3 because boxplots are tools for visualizing variation, and variation is discussed in Section 10.3.
- Material in the previous edition on using the normal distribution to approximate the binomial distribution in Section 10.5 was consolidated and moved to Section 10.4. The normal approximation to the binomial is not as important a topic today as it once was because technology makes calculating exact binomial probabilities easy. However, the conceptual understanding of the ideas can be important for students to learn, so we condensed the material and put it in the section on the normal distribution.
- Labels for the applications in the previous edition were very general (e.g., Business, Life Sciences). In this edition, we made them more specific (e.g., Google Profits) to pique student interest and to allow students to find applications that relate to their specific major and areas of interest.
The copy below is an example of the efforts put forth to update each chapter. To see this type of detailed information for all chapters in the text, please see the “Features” portion of the Pearson online catalog for this text.

**New to Chapter 4**

- In Section 4.1, updated application Examples 5 and 6 and Checkpoint 7 with data on wine consumption and assets of AIG. Replaced or updated ten of the exercises with current data on the assets of Prudential Financial, Inc.; Netflix costs; GDP for China and the U.S.; asset management; imports from Vietnam; and subprime mortgages.
- Replaced Examples 1 and 2 in Section 4.2 with current data on debt in the U.S. and on sales of single-family homes. Updated Example 4 with more recent data on infant mortality rates. Replaced Example 6 and Checkpoint 4 with a current example on the price of scrap steel. Replaced or updated eleven of the application exercises with data on wind power, oil production, office rent, personal consumption, Medicare expenditures, Chinese assets in banks, Internet access in China, seat-belt use, death rates, food assistance, and labor force participation.
- In Section 4.3, added a graph of several logarithmic functions of different bases to help students visualize logarithmic functions better. Replaced an application example with a current logarithmic model function on wind energy generated in the U.S. Updated or replaced eight of the application exercises with data on health insurance costs, dairy expenditures, credit union assets, border patrol budgets, opioid deaths, iPhone sales, and vehicle miles traveled.
- In Section 4.4, utilized color to indicate nonpossible solutions to logarithmic equations more clearly. Replaced Example 7 and Checkpoint 7 with a new example on new jobs added to the U.S. economy. Also added a new example and checkpoint (using data on the digital grocery market) to illustrate solving for \( x \) with logarithmic and exponential equations. Updated or replaced twelve of the application exercises with data on foreign earnings, nursing degrees, veterans’ benefits, Snapchat users, wind energy, Japanese messaging, CVS Health earnings and revenue, the number of teachers in the U.S., Best Buy revenue, Twitter stock price, and outstanding loans in U.S. banks.
- In the Review Exercises, updated or replaced ten of the application exercises with current data on exports to Mexico, Royal Caribbean share price, the number of murders in Chicago, crude oil and coal futures, recent earthquakes, FedEx profits, Starbucks and Dunkin’ Donuts App users, and bank capital.
- Updated Case Study examples and exercises with more recent data and graphs from gapminder.org.

**New to MyLab Math**

Many improvements have been made to the overall functionality of MyLab Math since the previous edition. Beyond that, however, we have also increased and improved the content specific to this text.

- Instructors now have more exercises than ever to choose from when assigning homework. Most new questions are application-oriented. There are approximately 5200 assignable exercises in MyLab Math for this text. New exercise types include:
  - Additional Conceptual Questions provide support for assessing concepts and vocabulary. Many of these questions are application-oriented.
  - Setup & Solve exercises require students to show how they set up a problem as well as the solution, which approximates more closely what is required of students on tests.
• The videos are all new, and they feature veteran instructors Thomas Hartfield (University of North Georgia), Mike Rosenthal (Florida International University), and Kate Haynes (Delaware Technical Community College).
  - Each section of the text now has an accompanying full lecture video. To make it easier for students to navigate to the content they need, each lecture video is segmented into shorter clips (labeled Introduction, Example, or Summary).
  - Both the video lectures and video segments are assignable within MyLab Math. We have included a Guide to Video-Based Assignments within the Instructor Resources section of MyLab Math that allows you to assign exercises for each video.
  - MathTalk and StatTalk videos highlight applications of the content of the course to business. The videos are supported by assignable exercises.
• A full suite of Interactive Figures has been added to support teaching and learning. The figures illustrate key concepts and allow manipulation. They have been designed to be used during lectures as well as by students working independently.
• An Integrated Review version of the MyLab Math course contains premade quizzes to assess the prerequisite skills needed for each chapter, plus personalized remediation for any gaps in skills that are identified.
• Study Skills Modules help students with the life skills that can make the difference between passing and failing.
• The Graphing Calculator Manual and Excel Spreadsheet Manual, both specific to this course, have been updated to support the TI-84 CE (color edition) and Excel 2016, respectively. Both manuals also contain additional topics to support the course.
• We heard from users that the Annotated Instructor Edition for the previous edition required too much flipping of pages to find answers, so MyLab Math now contains a downloadable Instructor Answers document—with all answers in one place. (This augments the downloadable Instructor Solutions Manual, which contains all solutions.)

Continued Pedagogical Support

• Real-Data Examples and Explanations: Real-data exercises have long been a popular and integral aspect of this text. A significant number of new real-data examples and exercises have also been introduced into the text. Applications are noted with a green header to indicate the subject of the problem so instructors or students can focus on applications that are in line with students' majors.
• Balanced Approach: Multiple representations of a topic (symbolic, numerical, graphical, verbal) are given when appropriate. However, we do not believe that all representations are useful for all topics, so effective alternatives are discussed only when they are likely to increase student understanding.
• Strong Algebra Foundation: The text begins with four thorough chapters of college algebra that can be used in a variety of ways based on the needs of the students and the goals of the course. Take advantage of the content in these chapters as needed so students will be more successful with later topics and future courses.
• Help for Skill Gaps: The Prerequisite Skills Test (for Chapters 1–4) at the front of the text can help students determine where remediation is needed. The text contains solutions to the test exercises to help students remediate any gaps in basic skills.
• Checkpoint exercises are marked with icons such as ✓ and provide an opportunity for students to stop, check their understanding of the specific concept at hand, and move forward with confidence. Answers to Checkpoint exercises are located at the end of the section to encourage students to work the problems before looking at the answers. (See pages 185 and 186.)
• **Caution** notes highlight common student difficulties or warn against frequently made mistakes. (See page 209.)

• **Exercises:** In addition to skill-based practice, conceptual, and application-based exercises, the text includes some specially marked exercises:
  - Writing Exercises (See page 188.)
  - Connection Exercises relate current topics to earlier sections (See page 213.)
  - Graphing Calculator Exercises (See page 205.)
  - Spreadsheet Exercises (See page 260.)

• **Example/Exercise Connection:** Selected exercises include a reference to related example(s) within the section (e.g., “See Examples 6 and 7”) to facilitate what students do naturally when they use a book—that is, look for specific examples when they get stuck on a problem. Later exercises leave this information out and provide opportunities for mixed skill practice.

• **Graphing Calculators and Spreadsheets:** It is assumed that all students have a calculator that will handle exponential and logarithmic functions. Graphing calculator and spreadsheet references are highlighted in the text so that those who use the technology can easily incorporate it and those who do not can easily omit it. Examples and exercises that require a graphing calculator are marked with $\int$ and those that require a spreadsheet are marked with $\square$, making it obvious where technology is being included.

• **Technology Tips:** These tips are placed at appropriate points in the text to inform students of various features of their graphing calculator, spreadsheet, or other computer programs. Note that Technology Tips designed for TI-84 CE also apply to the TI-84 Plus, TI-83, and TI-Nspire.

• **End-of-chapter materials:** are designed to help students prepare for exams. These materials include a List of Key Terms and Symbols and Summary of Key Concepts, as well as a thorough set of Chapter Review Exercises.

• **Case Studies:** appear at the end of each chapter and offer contemporary, real-world applications of some of the mathematics presented in the chapter. Not only do these provide an opportunity for students to see the mathematics they are learning in action, but they also provide at least a partial answer to the question, “What is this stuff good for?” These have been expanded to include options for longer-term projects if the instructor should choose to use them.

### Course Flexibility

The content of the text is divided into two parts:

1. **College Algebra** (Chapters 1–4)
2. **Finite Mathematics** (Chapters 5–10)

This coverage of the material offers flexibility, making the text appropriate for a variety of courses, including:

• **Finite Mathematics** (one semester or two quarters). Use as much of Chapters 1–4 as needed, and then go into Chapters 5–10 as time permits and local needs require.

• **College Algebra with Applications** (one semester or quarter). Use Chapters 1–8, with Chapters 7 and 8 being optional.

Pearson regularly produces custom versions of this text (and its accompanying MyLab Math course) to address the needs of specific course sequences. Custom versions can be produced for even smaller-enrollment courses due to advances in digital printing. Please contact your local Pearson representative for more details.

Copyright Pearson. All Rights Reserved.
Chapter interdependence is as follows:

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Algebra and Equations</td>
<td>None</td>
</tr>
<tr>
<td>2 Graphs, Lines, and Inequalities</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>3 Functions and Graphs</td>
<td>Chapters 1 and 2</td>
</tr>
<tr>
<td>4 Exponential and Logarithmic Functions</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>5 Mathematics of Finance</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>6 Systems of Linear Equations and Matrices</td>
<td>Chapters 1 and 2</td>
</tr>
<tr>
<td>7 Linear Programming</td>
<td>Chapters 3 and 6</td>
</tr>
<tr>
<td>8 Sets and Probability</td>
<td>None</td>
</tr>
<tr>
<td>9 Counting, Probability Distributions, and</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>Further Topics in Probability</td>
<td></td>
</tr>
<tr>
<td>10 Introduction to Statistics</td>
<td>Chapter 8</td>
</tr>
</tbody>
</table>

Acknowledgments

We wish to thank the following reviewers for their thoughtful feedback and helpful suggestions, without which we could not continue to improve this text.

John Altiere, Cleveland State University
Sviatoslav Archava, East Carolina University
Stephen Bast, Anne Arundel Community College
Phamuel Bediako, Delaware State University
Susan Bellini, Cleveland State University
Eric Erdmann, University of Minnesota, Duluth
Meghan Foster, American University
Lobna Mazzawi, Everett Community College
Thomas Milligan, University of Oklahoma
Margie Nowlin, Texas Christian University
David Stott, Sinclair Community College
Cong-Cong Xing, Nicholls State University

The following faculty members provided direction on the development of the MyLab Math course for this edition:

Vince Bander, Pierce College, Puyallup
Rachel Bates, Redlands Community College
Krista Blevins Cohmha, Midland College
Larry Cook, Taft College
Stanislav Dubrovskiy, Sierra College
Jeffrey K. Dyess, Bishop State Community College
Shurron Farmer, University of the District of Columbia
Tonia Garrett, San Jacinto College
Abe Haje, Lone Star College, University Park
Ray Hendrickson, Bucks County Community College
MaryAlice Howe, Bucks County Community College
Edgar Jasso, North Seattle College
Dynechia Jones, Baton Rouge Community College
Tiffany Jones, Baylor University
Shelley Lenahan, University of Alabama, Huntsville
Steven Mark, Wilmington University
Maria Mathews, Baldwin Wallace University
Janet Noah, Brookhaven College
Margie Torres Nowlin, All Saints Episcopal School
Rose L. Pugh, Bellevue College
Peggy M. Slavik, Baldwin Wallace University
Kay Tekumalla, Prince George's Community College
R. Vafa, Temple University
Rick L. Wing, San Francisco State University
Cong-Cong Xing, Nicholls State University
Ju Zhou, Kutztown University
We gratefully acknowledge Birmingham-Southern College and Cleveland State University for their wholehearted support of this edition. Bernadette Mullins thanks two BSC students who checked new content: Amer Babi and Adam Alden Pratt.

We also thank our accuracy checkers, who did an excellent job of checking both text and exercise answers: Stephen Bast and Cong-Cong Xing. Thanks also to the supplements authors: Salvatore Sciandra, Chris True, and Stela Pudar-Hozo.

We want to thank the staff of Pearson Education for their assistance with and contributions to this book, particularly Jeff Weidenaar, Kathy Manley, Jenn Snyder, Emily Ockay, Kristina Evans, and Jean Choe. Finally, we wish to express our appreciation to Sherrill Redd of Aptara Corporation, who was a pleasure to work with.

John P. Holcomb, Jr.
Bernadette Mullins
MyLab™ Math Online Course
for Finite Mathematics with Applications in the Management, Natural, and Social Sciences, 12e
(access code required)

MyLab™ Math is available to accompany Pearson's market-leading text offerings. To give students a consistent
tone, voice, and teaching method, each text's flavor and approach are tightly integrated throughout the accompa-
nying MyLab Math course, making learning the material as seamless as possible.

PREPAREDNESS
One of the biggest challenges in applied math courses is making sure students are adequately prepared with
the prerequisite skills needed to complete their course work successfully. MyLab Math supports students with
just-in-time remediation and key-concept review.

NEW! Integrated Review Course An Integrated Review version of the MyLab Math course contains
premade, assignable quizzes to assess the prerequisite skills needed for each chapter, plus personalized
remediation for any gaps in skills that are identified. Therefore, each student receives just the help that he or she
needs—no more, no less.

Study Skills Modules Study skills modules help students with the life skills that can make the difference
between passing and failing.

DEVELOPING DEEPER UNDERSTANDING
MyLab Math provides content and tools that help students build a deeper understanding of course content than
would otherwise be possible.

Exercises with Immediate Feedback
Homework and practice exercises for this text regenerate algorithmically to
give students unlimited
opportunity for practice and
mastery. MyLab Math
provides helpful feedback
when students enter
incorrect answers and
includes the optional
learning aids Help Me Solve
This, View an Example,
videos, and/or the eText.

pearson.com/mylab/math
NEW! Setup & Solve Exercises  These exercises require students to show how they set up a problem as well as the solution, better mirroring what is required of students on tests.

NEW! Additional Conceptual Questions  Additional Conceptual Questions provide support for assessing concepts and vocabulary. Many of these questions are application-oriented. They are clearly labeled “Conceptual” in the Assignment Manager.

NEW! Interactive Figures  A full suite of Interactive Figures has been added to support teaching and learning. The figures illustrate key concepts and allow manipulation. They have been designed for use during lectures as well as by students working independently.

NEW! Instructional Videos  The instructional videos for this course are all new, featuring veteran instructors Thomas Hartfield (University of North Georgia) Mike Rosenthal (Florida International University), and Kate Haynes (Delaware Technical Community College).

- Each section of the text now has an accompanying full lecture video. To make it easier for students to navigate to the content they need, each lecture video is segmented into shorter clips (labeled Introduction, Example, or Summary).

- Both the video lectures and video segments are assignable within MyLab Math. We have included a Guide to Video-Based Assignments within the Instructor Resources section of MyLab Math that allows you to assign exercises for each video.

In addition, the MathTalk and StatTalk videos connect the content of the course to business and management applications. The videos are supported by assignable exercises.

pearson.com/mylab/math
Technology Manuals and Projects (downloadable)

- Graphing Calculator Manual and Projects by Chris True, University of Nebraska

These manuals, both specific to this course, have been updated to support the TI-84 CE (color edition) and Excel 2016, respectively. Instructions are ordered by mathematical topic. The files can be downloaded from within MyLab Math.

Student’s Solutions Manual (softcover and downloadable)

Written by Salvatore Sciandra from Niagara County Community College, the Student’s Solutions Manual contains worked-out solutions to all the odd-numbered exercises and all Chapter Review and Case Studies. This manual is available in print and can be download from within MyLab Math.

A Complete eText   Students get unlimited access to the eText within any MyLab Math course using that edition of the textbook. The Pearson eText app allows existing subscribers to access their titles on an iPad or Android tablet for either online or offline viewing.

SUPPORTING INSTRUCTION

MyLab Math comes from an experienced partner with educational expertise and an eye on the future. It provides resources to help you assess and improve students’ results at every turn, and unparalleled flexibility to create a course tailored to you and your students.

Learning Catalytics™   Now included in all MyLab Math courses, this student response tool uses students’ smartphones, tablets, or laptops to engage them in more interactive tasks and thinking during lecture. Learning Catalytics fosters student engagement and peer-to-peer learning with real-time analytics. Access prebuilt exercises created specifically for this course.

pearson.com/mylab/math
PowerPoint® Lecture Resources (downloadable) Slides contain presentation resources such as figures, feature boxes, and key examples from the text. They can be downloaded from within MyLab Math or from Pearson's online catalog, www.pearson.com.

Comprehensive Gradebook The gradebook includes enhanced reporting functionality such as item analysis and a reporting dashboard to allow you to manage your course efficiently. Student performance data is presented at the class, section, and program levels in an accessible, visual manner so you will have the information you need to keep your students on track.

TestGen TestGen® (www.pearson.com/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. 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. The software and test bank are available for download from Pearson's online catalog, www.pearson.com. The questions are also assignable in MyLab Math.

Instructor's Solutions Manual (downloadable) Written by Salvatore Sciandra from Niagara County Community College, the Instructor's Solutions Manual contains detailed solutions to all text exercises, suggested course outlines, and a chapter interdependence chart. It can be downloaded from within MyLab Math or from Pearson's online catalog, www.pearson.com.

Instructor's Answers (downloadable) These handy chapter-by-chapter documents provide answers to all Student Edition exercises in one place for easy reference by instructors. They are downloadable from within MyLab Math or from Pearson's online catalog, www.pearson.com.

Accessibility Pearson works continuously to ensure our products are as accessible as possible to all students. We are working toward achieving WCAG 2.0 Level AA and Section 508 standards, as expressed in the Pearson Guidelines for Accessible Educational Web Media, www.pearson.com/mylab/math/accessibility.
The key to succeeding in this course is to remember that mathematics is not a spectator sport. You can’t expect to learn mathematics without doing mathematics any more than you could learn to swim without getting wet. You must take an active role and use all the resources at your disposal: your instructor, your fellow students, this book, and the supplements that accompany this book. Following are some general tips on how to be successful in the course and some specific tips on how to get the most out of this text and supplementary resources.

Ask Questions! Remember the words of the great Hillel: “The bashful do not learn.” There is no such thing as a “dumb question” (assuming, of course, that you have read the book and your class notes and attempted the homework). Your instructor will welcome questions that arise from a serious effort on your part. So get your money’s worth: Ask questions!

Read the Book Interactively! There is more to a math textbook than just the exercise sets. Each section introduces topics carefully with many examples—both mathematical and contextual. Take note of the “Caution” and “Note” comments, and bookmark pages with key definitions or formulas. After reading the example, try the Checkpoint exercise that appears next to it in the margin to check your understanding of the concept. This will help you solidify your understanding or diagnose if you do not fully understand the concept. The answers to the Checkpoint exercises are right after the homework exercises in each section. Resist the temptation to flip to the answer until you’ve worked the problem completely!

Take Advantage of the Supplementary Material! Many resources are at your disposal within and outside the text. Take the time to interact with them and determine which resources suit your learning style best.

• If your instructor allows the use of graphing calculators and/or spreadsheets, work through the examples and exercises marked with or . Some instructors may make this material part of the course, whereas others will not require you to use technology. If your instructor asks that you use technology, a Graphing Calculator Manual and an Excel Spreadsheet Manual are available in MyLab Math. In addition, there are Technology Tips throughout the text that describe the proper menu or keys to use for various procedures on a graphing calculator. Note that Technology Tips for the TI-84+ CE also apply to TI-83+, TI-Nspire, and usually TI-83.

• MyLab Math has a variety of types of resources to help you learn, including videos for every section of the text; Interactive Figures to help visualize difficult concepts; unlimited practice and assessment on newly learned or prerequisite skills; and access to the Student Solutions Manual, Graphing Calculator Manual, Excel Spreadsheet Manual, and a variety of helpful reference cards.

Do Your Homework! Whether the homework is paper and pencil or assigned online, you must practice what you have learned. This is your opportunity to practice those essential skills needed for passing this course and those skills needed for application in future courses or your career.

We wish you the best in your efforts throughout this course, in future courses, and beyond school.

John and Bernadette