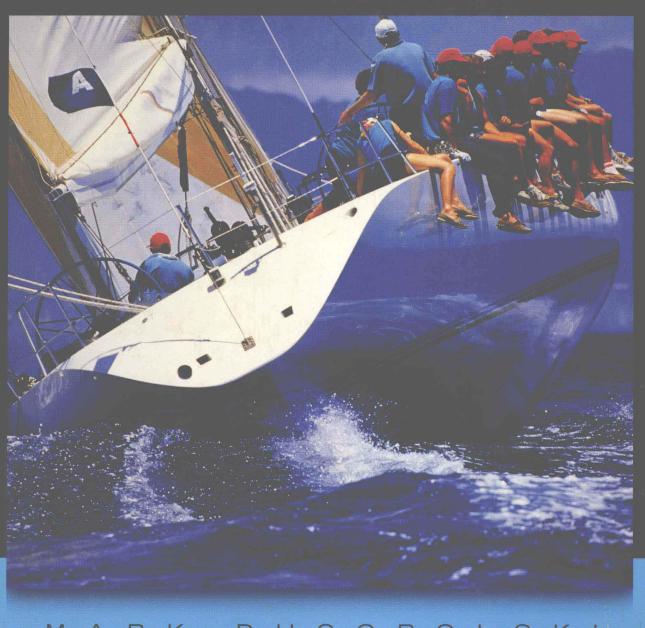# Precalculus

Functions and Graphs

MARK DUGOPOLSKI

PRECALCULUS

Functions and Graphs

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Addison
Wesley

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Preface

This text is designed for students who are preparing to study calculus. For those students, this text will provide the skills, understanding, and insights necessary for success in future math courses. A hallmark of this text is its focus on problem solving. Students are provided with numerous opportunities to reason and think their way through various problems. Practicing such critical thinking skills will prove of future benefit to all students. I believe that the mathematics presented here is interesting, useful, and worth studying. Getting students to feel this way has been one of my goals in writing this text.

Two versions of this text are available: *Precalculus: Functions and Graphs* and *Precalculus with Limits: Functions and Graphs*. *Precalculus: Functions and Graphs* contains all of the traditional precalculus topics. It is designed to build the skills and concepts that are necessary for success in calculus. *Precalculus with Limits: Functions and Graphs* contains two extra chapters—Chapter 12: *Analytic Geometry and Vectors in Three Dimensions* and Chapter 13: *Limits*. These extra chapters are designed for use in courses where a stronger preparation for calculus is desired. Both texts contain an appendix that summarizes basic algebra concepts. As a result, these texts are suitable for a wide range of courses of various lengths.

Use of Technology

I place emphasis on using graphic, numeric, and analytic points of view in discussion and in solving problems throughout the text. I also provide the opportunity for optional use of the graphing calculator as a tool to help students understand the concepts of algebra, and provide support for algebraic conclusions. Although the use of technology is optional, students who do not use a graphing calculator can still benefit from the technology discussions, as well as from the calculator-generated graphs that occur in the text. Any graphing utility or computer mathematics package can be used in place of the graphing calculator.

Due to the rapid changes in technology and the differences among brands, this text does not give specific instructions on how to use the various graphing calculators that are available. However, the *Graphing Calculator Manual* that accompanies this text provides students with keystroke operations for many of the more popular graphing calculators, using specific examples drawn from this text to illustrate the various functions of those calculators.

Text Features

Chapter Opener Each chapter begins with a discussion of real-world situations in which the mathematics of the chapter is used. Examples and exercises that relate back to the opener are included within the chapter.

Function Gallery These graphic galleries occur in the chapters where functions are discussed. They are used to summarize the basic functions along with their graphs and properties.

Foreshadowing Calculus This feature gives a brief indication of the connection between certain algebraic topics and calculus, and identifies topics that will be continued in calculus.

Graphing Calculator Discussions Optional graphing calculator discussions have been integrated into the text and are clearly marked by graphing calculator icons so that they can be easily skipped by those not using this technology.

Index of Applications The many applications contained within the text are listed in an Index of Applications that appears in the front of the text. The applications are page-referenced and grouped by subject matter.

For Thought Each exercise set begins with a set of true or false questions that review the basic concepts in that section, they help check student understanding before beginning the exercises, and offer opportunities for writing and/or discussion.

Exercise Sets The exercise sets in this book have been examined carefully to ensure that the exercises range from easy to challenging, and are arranged in order of increasing difficulty. In addition, there are hundreds of applications throughout the book that involve real-world situations and often cite data sources. The emphasis of these applications is on understanding concepts and relationships. Many regression problems have also been included in the text, so that students can start with real data, and use a calculator to obtain mathematical models of real problem situations. Optional exercises that require a graphing calculator are located throughout the exercise sets in the book and are marked with a graphing calculator icon.

Writing/Discussion and Cooperative Learning Exercises These exercises deepen understanding by getting students to express mathematical ideas in writing, or to their classmates during small group or team discussions.

Linking Concepts This feature appears at the end of nearly every exercise set. It is a multi-part exercise or exploration that can be used for individual or group work. This feature uses a concept from the current section along with concepts from preceding sections in the chapter and preceding chapters to solve problems that illustrate the links among various concepts. Some parts of these questions are open-ended, and require somewhat more thought than standard exercises. Answers to this feature are given only in the *Instructor's Solutions Manual*.

Highlights This end-of-chapter feature presents an overview of each section of the chapter, and is a useful summary of the basic information that students should have mastered in that chapter.

Chapter Review Exercises These exercises are designed to help students review the chapter without reference to the individual sections, and prepare students for the Chapter Test.

Chapter Test The problems in the Chapter Test are designed to measure students' readiness for a classroom test. Instructors may also use them as a model for their own end-of-chapter tests.

Tying It All Together These exercises help students review selected concepts from the present and prior chapters, and require students to integrate multiple concepts and skills.

Acknowledgments

I also give special thanks to my retired editor Bill Poole, who got me started on this project, my current editor Anne Kelly, my project editor Ellen Keohane, and the entire Addison-Wesley team for their assistance, encouragement, and direction throughout the project: Peggy McMahon, Becky Anderson, Barbara Atkinson, and Rebecca Martin.

Very special thanks go to my wife and daughters who always give me love, encouragement, and support.

M.D.
Hammond, Louisiana

Supplements

■ **Student's Solutions Manual**

ISBN 0-201-73459-1

Edgar N. Reyes, Southeastern Louisiana University

Contains complete solutions to all odd numbered graphical and numerical exercises. Ask your bookstore about ordering.

■ **Graphing Calculator Manual**

ISBN 0-201-73458-3

Provides instructions and keystroke operations for TI graphing calculators models. Also contains worked-out examples taken directly from the text.

■ **Addison-Wesley Math Tutor Center**

The Addison-Wesley Math Tutor Center is staffed by qualified mathematics instructors who provide students with tutoring on examples and exercises from the textbook. Tutoring is available via toll-free telephone, fax, e-mail, or whiteboard technology and is available five days a week, seven hours a day.

■ **Web site**

www.aw.com/dugopolski

The Web site for this book has been designed to increase student success in the course by offering section-by-section tutorial help, additional group projects, downloadable programs for TI graphing calculators, on-line practice quizzes, selected solutions for Chapters 1 and 2, PowerPoint slides, and author study tips.

■ **InterAct Math Tutorial CD-ROM**

ISBN 0-201-73464-8

Get practice and tutorial help! This interactive tutorial software provides algorithmically generated practice exercises that correlate directly to the exercises in the text. A detailed worked-out example and guided solution accompany each practice exercise. The software recognizes common student errors and provides feedback.

■ **MathXL® (12-month registration)**

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The MathXL Web site provides diagnostic testing and tutorial help, all on-line using InterAct Math tutorial software and TestGen-EQ testing software. Students can take

chapter tests correlated to this textbook, receive individualized study plans based on those test results, work practice problems and receive tutorial instruction for areas in which they need improvement, and take further tests to gauge their progress. Instructors can customize tests and track all student test results, study plans and practice work. The site is free when an access code is bundled with a new text.

■ Videotapes

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Instructors present material and concepts from every section of the text in a format that stresses student interaction. The presentation includes examples and problems from the text and supports an approach that emphasizes technology, visualization, and problem solving.

■ Digital Video Tutor

ISBN 0-201-75610-2

The videos for this text are now available on CD-ROM. The complete set of digitized videos, now affordable and portable for student use at home or on campus, is ideal for distance learning or supplemental instruction.

Supplements

FOR THE INSTRUCTOR

■ **Instructor's Edition**

ISBN 0-201-73461-3

This specially bound version of the student edition contains answers to both even- and odd-numbered exercises at the back of the text.

■ **Instructor's Solutions Manual**

ISBN 0-201-73479-6
Edgar N. Reyes, Southeastern Louisiana University

Includes worked-out solutions to all exercises in the exercise sets, including the For Thought and Linking Concepts exercises.

■ **Instructor's Testing Manual**

Rebecca Muller, Southeastern Louisiana University
ISBN 0-201-73460-5

This manual contains six alternative forms of tests per chapter (two are multiple choice). Answer keys are included.

■ **Web site**

www.aw.com/dugopolski

This Web site contains additional resources for the instructor, including PowerPoint slides, student profiles, and on-line discussion board.

■ **TestGen-EQ with Quizmaster-EQ**

ISBN 0-201-73465-6

Available on dual-platform Windows/Macintosh CD-ROM, TestGen enables instructors to build, edit, print, and administer tests using a computerized test bank of questions. The program also offers many options for organizing and displaying test banks and tests according to chapter content of the text. Tests can be printed or saved for on-line testing via a network or the Web, and the software can generate a variety of grading reports for tests and quizzes.

■ MathXL®

The MathXL Web site provides diagnostic testing and tutorial help, all on-line using InterAct Math tutorial software and TestGen-EQ testing software. Students can take chapter tests correlated to this textbook, receive individualized study plans based on those test results, work practice problems and receive tutorial instruction for areas in which they need improvement, and take further tests to gauge their progress. Instructors can customize tests and track all student test results, study plans and practice work. The site is free when an access code is bundled with a new text. Contact your local Addison-Wesley sales representative for a 24-month Instructor Coupon Access Code.

■ MyMathLab.com

MyMathLab.com is a one-step solution for creating and managing an on-line mathematics course for distance learning or to supplement a traditional or self-paced course. It is based on Addison-Wesley Mathematics textbooks and integrates interactive multimedia instruction. MyMathLab.com is powered by CourseCompass, a version of Blackboard™ designed specifically for Addison-Wesley, and offers a suite of communication tools that allows users to send e-mail, participate in bulletin board discussions, schedule class chats, provide collaboration tools for students, and more. For more information, visit our Web site at http://www.mymathlab.com or contact your Addison-Wesley representative for a live demonstration.

Index of Applications

Contents

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