ANNOTATED INSTRUCTOR'S EDITION

Precalculus

Enhanced with Graphing Utilities

Eighth Edition

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Contents

Three Distinct Series to Meet Varied Instructional Needs

Students have different goals, learning styles, and levels of preparation. Instructors have different teaching philosophies, styles, and techniques. Rather than write one series to fit all, the Sullivans have written three distinct series. All share the same goal—to develop a high level of mathematical understanding and an appreciation for the way mathematics can describe the world around us. The manner of reaching that goal, however, differs from series to series.

Enhanced with Graphing Utilities Series

This series provides a thorough integration of graphing utilities into topics, allowing students to explore mathematical concepts and encounter ideas usually studied in later courses. Many examples show solutions using algebra side-by-side with graphing techniques. Using technology, the approach to solving certain problems differs from the Contemporary (Flagship) or Concepts through Functions Series, while the emphasis on understanding concepts and building strong skills is maintained. Texts in this series are *College Algebra, Algebra & Trigonometry*, and *Precalculus.*

Flagship Series

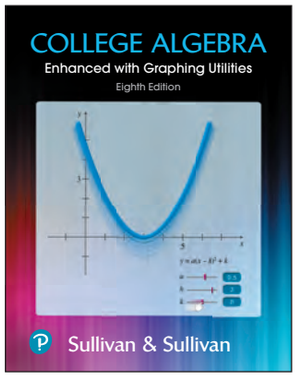
The Flagship Series is the most traditional in approach, yet modern in its treatment of precalculus mathematics. In each text, needed review material is included and is referenced when it is used. Graphing utility coverage is optional and can be included or excluded at the discretion of the instructor. Texts in this series are *College Algebra, Algebra & Trigonometry, Trigonometry: A Unit Circle Approach*, and *Precalculus.*

Concepts through Functions Series

This series differs from the others, utilizing a functions approach that serves as the organizing principle tying concepts together. Functions are introduced early in various formats. This approach supports the Rule of Four, which states that functions are represented symbolically, numerically, graphically, and verbally. Each chapter introduces a new type of function and then develops all concepts pertaining to that particular function. The solutions of equations and inequalities, instead of being developed as stand-alone topics, are developed in the context of the underlying functions. Graphing utility coverage is optional and can be included or excluded at the discretion of the instructor. Texts in this series are *College Algebra; Precalculus, with a Unit Circle Approach to Trigonometry; Precalculus, with a Right Triangle Approach to Trigonometry.*

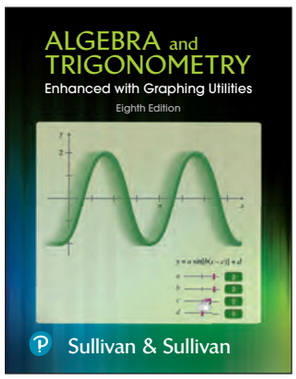
The Enhanced with Graphing Utilities Series

College Algebra, Eighth Edition



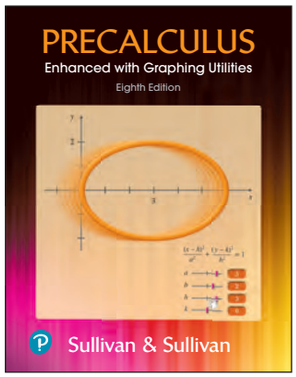
This text provides an approach to college algebra that completely integrates graphing technology without sacrificing mathematical analysis and conceptualization. The text has three chapters of review material preceding the chapter on functions. Graphing calculator usage is integrated throughout. After completing this text, a student will be prepared for trigonometry, finite mathematics, and business calculus.

Algebra & Trigonometry, Eighth Edition



This text contains all the material in *College Algebra*, but it also develops the trigonometric functions using a right triangle approach and shows how that approach is related to the unit circle approach. Graphing techniques are emphasized, including a thorough discussion of polar coordinates, parametric equations, and conics using polar coordinates. Vectors in the plane, including the dot product, sequences, induction, and the binomial theorem are also presented. After completing this text, a student will be prepared for finite mathematics, business calculus, and engineering calculus.

Precalculus, Eighth Edition



This text contains a review chapter before covering the traditional precalculus topics of functions and their graphs, polynomial and rational functions, and exponential and logarithmic functions. The trigonometric functions are introduced using a unit circle approach and show how it is related to the right triangle approach. Graphing techniques are emphasized, including a thorough discussion of polar coordinates, parametric equations, and conics using polar coordinates. Vectors in the plane and in space, including the dot and cross products, sequences, induction, and the binomial theorem are also presented. Graphing calculator usage is integrated throughout. The final chapter provides an introduction to calculus, with a discussion of the limit, the derivative, and the integral of a function. After completing this text, a student will be prepared for finite mathematics, business calculus, and engineering calculus.

Preface to the Instructor

As professors at an urban university (Michael Sullivan) and a community college (Michael Sullivan III), we are aware of the varied needs of students in this course. Such students range from those who have little mathematical background and are fearful of mathematics courses to those with a strong mathematical education and a high level of motivation. For some of your students, this will be their last course in mathematics, whereas others will further their mathematical education. We have written this text with both groups in mind.

As a teacher, and as an author of precalculus, engineering calculus, finite mathematics, and business calculus texts, Michael Sullivan understands what students must know if they are to be focused and successful in upper-level math courses. As an instructor and an author of a developmental mathematics series, Michael's son and co-author, Michael Sullivan III, understands the trepidations and skills that students bring to the Precalculus course. As the father of current college students, Michael III realizes that today's college students demand a variety of media to support their education. This text addresses that demand by providing technology and video support that enhances understanding without sacrificing math skills. Together, we have taken great pains to ensure that the text offers solid, student-friendly examples and problems, as well as a clear and seamless writing style.

A tremendous benefit of authoring a successful series is the broad-based feedback we receive from teachers and students. We are sincerely grateful for their support. Virtually every change in this edition is the result of their thoughtful comments and suggestions. We are confident that, building on the success of the first seven editions and incorporating many of these suggestions, we have made *Precalculus Enhanced with Graphing Utilities*, 8th Edition, an even better tool for learning and teaching. We continue to encourage you to share with us your experiences teaching from this text.

Features in the Eighth Edition

A descriptive list of the many special features of *Precalculus* can be found in the front of this text. This list places the features in their proper context as building blocks of an overall learning system that has been carefully crafted over the years to help students get the most out of the time they put into studying. Please take the time to review this and to discuss it with your students at the beginning of your course. Our experience is that when students utilize these features, they are more successful in the course.

New to the Eighth Edition

New Within the Textbook

All of the exercises and examples in the text have been reviewed and analyzed, and we have incorporated feedback from users of the text. All time-sensitive problems have been updated to the most recent information available. Here are the new features of this edition:

- **Challenge Problems** – These problems appear in the Applications and Extensions part of the section exercises and are designed to challenge students. Full solutions are in the back of the Annotated Instructor's Edition and in the Instructor's Solution Manual.
- **"Need to Review?" feature** – We placed reminders in the margin for key review topics. The reminders point students to the location of the review material in the textbook.
- **Chapter Projects** – The projects have been enhanced to give students an up-to-the-minute experience. Many of these projects require the student to research information online in order to solve problems.
- **Interactive Figure Exercises** – We have added this new category of exercises that require students to manipulate an interactive figure to solve. The interactive figures may be found at `bit.ly/2MibgaO` or in the Video and Resource Library of MyLab Math, and were created by author Michael Sullivan III in GeoGebra. These exercises are labeled with the icon .
- **Expanded! Retain Your Knowledge Problems** – These problems, which were new to the previous edition, are based on learning research, including a study of precalculus students at University of Louisville entitled "Spaced retrieval practice increases college students' short- and long-term retention of mathematics knowledge" (Hopkins et al, 2016). The Retain Your Knowledge problems were so well received that we have expanded them in this edition. Moreover, while the focus remains to help students maintain their skills, in most sections, problems were chosen that preview skills required to succeed in subsequent sections or in calculus ( ). All answers to Retain Your Knowledge problems are given in the back of the text and these problems are available in the prebuilt assignments in the Assignment Manager in MyLab Math.
- **Key to Exercise Types** – To help you navigate the features of the exercise sets, we've included a key at the bottom of the first page of each section's exercises.

Now Work 1. Modeling 1. Writing/Discussion
Calculus Preview Interactive Figure

- **Graphing Utility Screen Captures** – In several instances we have added Desmos screen captures along with the TI-84 Plus CE screen captures. These updated screen captures provide alternative ways of visualizing concepts and making connections between equations, data, and graphs in full color.

Content Changes

Chapter 1

- Section 1.1 has been reorganized to only include an introduction to graphing and graphing utilities.
- NEW Section 1.2 The Distance and Midpoint Formulas
- NEW Section 1.3 Example 5 Testing an Equation for Symmetry

Chapter 2

- NEW Section 2.1 Objective 1 Describe a Relation
  - NEW Example 1 Describing a Relation demonstrates using the Rule of Four to express a relation numerically, as a mapping, and graphically given a verbal description.
- NEW Section 2.2 Example 4 Energy Expended

Chapter 3

- Section 3.3 now introduces the concept of concavity for a quadratic function.
- NEW Section 3.3 Example 3 Graphing a Quadratic Function Using Its Vertex, Axis, and Intercepts
- Section 3.3 Example 8 Analyzing the Motion of a Projectile (formerly in Section 3.4)
- NEW Section 3.4 Example 4 Fitting a Quadratic Function to Data

Chapter 4

- Previous Section 4.1 has been revised and split into two sections:
  - 4.1 Polynomial Functions
  - 4.2 Graphing Polynomial Functions; Models
- NEW Section 4.2 Example 2 Graphing a Polynomial Function (a 4th degree polynomial function)

Chapter 5

- NEW Section 5.2 Objective Verify a Function Defined by an Equation is an Inverse Function

Chapter 6

- NEW Section 6.1 Example 6 Field Width of a Digital Lens Reflex Camera Lens
- Sections 6.4 and 6.5 were reorganized for increased clarity. Two new objectives were added to Section 6.5.

Chapter 7

- Sections 7.1 and 7.2 were reorganized for increased clarity. Four new objectives were added to Section 7.1. The objectives in Section 7.2 were reordered.

Chapter 9

- Section 9.3 DeMoivre's Theorem was rewritten to support the exponential form of a complex number.
  - Euler's Formula is introduced to express a complex number in exponential form. The exponential form is used to compute products and quotients.
  - DeMoivre's Theorem is expressed using the exponential form of a complex number. The exponential form is used to find complex roots.

Chapter 11

- NEW Section 11.5 Example 1 Identifying Proper and Improper Rational Expressions

Chapter 12

- NEW Section 12.3 Objective 5 Solving Annuity Problems Using Formulas

Appendix A

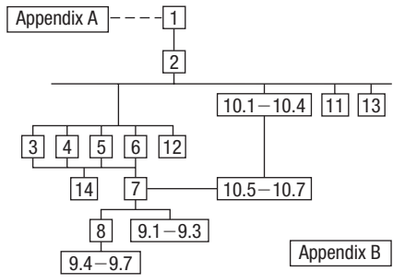
- Section A.10 Objective 3 now includes rationalizing the numerator. Problems 69–76 provide practice.

New Within MyLab Math

- **Setup & Solve Exercises** require students to show how they set up a problem as well as the solution, better mirroring what is required of them on tests. We have included both the "traditional" and Setup & Solve versions of exercise within MyLab to provide you with more options for assessing students.
- **Integrated Review** content and assessments help you provide students with the remediation they need, when they need it. Integrated Review consists of:
  - **Skills Check Quizzes** by chapter assess the prerequisite skills students need for that chapter.
  - **Skills Review Homework**, again by chapter, is personalized (based on the results of the Skills Check Quiz) to provide students with help on the prerequisite skills they are lacking. Students receive just the help they need—no more, no less.
  - **Intermediate Algebra eText, Exercises, Videos, and Worksheets—**For students who need more help (or for co-requisite courses), we've included the contents of a streamlined Intermediate Algebra course within this MyLab course. There's no need to go elsewhere for remediation.
- **Interactive Figures** (formerly titled Guided Visualizations) have been expanded to support teaching and learning. The figures (created in GeoGebra by author Michael Sullivan III) illustrate key concepts and allow manipulation. They have been designed to be used in lecture as well as by students independently.
- **Enhanced Sample Assignments** are pre-made section-level assignments that address key concepts within the section and help keep previously learned skills fresh with Retain Your Knowledge questions. They are assignable and editable.

Using the Eighth Edition Effectively with Your Syllabus

To meet the varied needs of diverse syllabi, this text contains more content than is likely to be covered in a Precalculus course. As the chart illustrates, this text has been organized with flexibility of use in mind. Within a given chapter, certain sections are optional (see the details that follow the accompanying figure) and can be omitted without loss of continuity.



Chapter 1 Graphs

A quick coverage of this chapter, which is mainly review material, will enable you to get to Chapter 2, "Functions and Their Graphs," earlier.

Chapter 2 Functions and Their Graphs

This is perhaps the most important chapter. Section 2.6 is optional.

Chapter 3 Linear and Quadratic Functions

Topic selection depends on your syllabus. Sections 3.2 and 3.4 may be omitted without loss of continuity.

Chapter 4 Polynomial and Rational Functions

Topic selection depends on your syllabus.

Chapter 5 Exponential and Logarithmic Functions

Sections 5.1–5.6 follow in sequence. Sections 5.7, 5.8, and 5.9 are optional.

Chapter 6 Trigonometric Functions

Section 6.6 may be omitted in a brief course.

Chapter 7 Analytic Trigonometry

Sections 7.2 and 7.7 may be omitted in a brief course.

Chapter 8 Applications of Trigonometric Functions

Sections 8.4 and 8.5 may be omitted in a brief course.

Chapter 9 Polar Coordinates; Vectors

Sections 9.1–9.3 and Sections 9.4–9.7 are independent and may be covered separately.

Chapter 10 Analytic Geometry

Sections 10.1–10.4 follow in sequence. Sections 10.5, 10.6, and 10.7 are independent of each other, but each requires Sections 10.1–10.4.

Chapter 11 Systems of Equations and Inequalities

Sections 11.2–11.7 may be covered in any order, but each requires Section 11.1. Section 11.8 requires Section 11.7.

Chapter 12 Sequences; Induction; The Binomial Theorem

There are three independent parts: Sections 12.1–12.3, Section 12.4, and Section 12.5.

Chapter 13 Counting and Probability

The sections follow in sequence.

Chapter 14 A Preview of Calculus: The Limit, Derivative, and Integral of a Function

If time permits, coverage of this chapter will provide your students with a beneficial head start in calculus. The sections follow in sequence.

Appendix A Review

This appendix consists of review material. It may be used as the first part of the course or later as a just-in-time review when the content is required. Specific references to this appendix occur throughout the text to assist in the review process.

Appendix B The Limit of a Sequence; Infinite Series

This section represents a more thorough treatment of sequences and series.

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Chicago State University
Michael Sullivan III
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*Get the **most** out of*

MyLab Math

Pearson MyLab

MyLab Math for *Precalculus Enhanced with Graphing Utilities 8e*
by Michael Sullivan & Michael Sullivan III
(access code required)

MyLab Math is tightly integrated with each author's style, offering a range of author-created resources, so your students have a consistent experience.

Preparedness

Preparedness is one of the biggest challenges in many math courses. Pearson offers a variety of content and course options to support students with just-in-time remediation and key-concept review as needed.

Integrated Review in MyLab Math

Integrated Review can be used in corequisite courses or simply to help students who enter a course without a full understanding of prerequisite skills and concepts. Premade, editable Integrated Review assignments are available to assign in the Assignment Manager.

- Students begin each chapter by completing a Skills Check to pinpoint which topics, if any, they need to review.
- Personalized review homework provides extra support for students who need it on just the topics they didn't master in the preceding Skills Check.
- Additional review materials including videos featuring Michael Sullivan III, worksheets, and Sullivan's *Algebra Review* text, are available.

pearson.com/mylab/math

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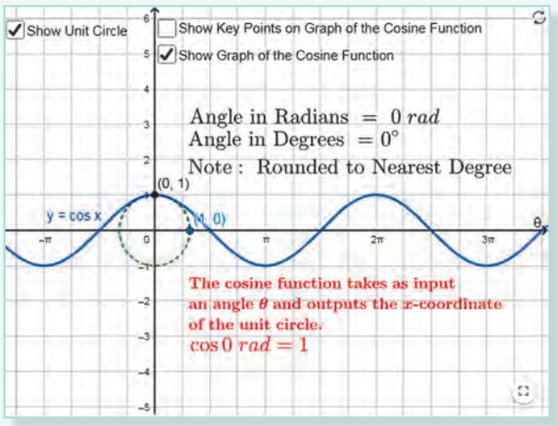
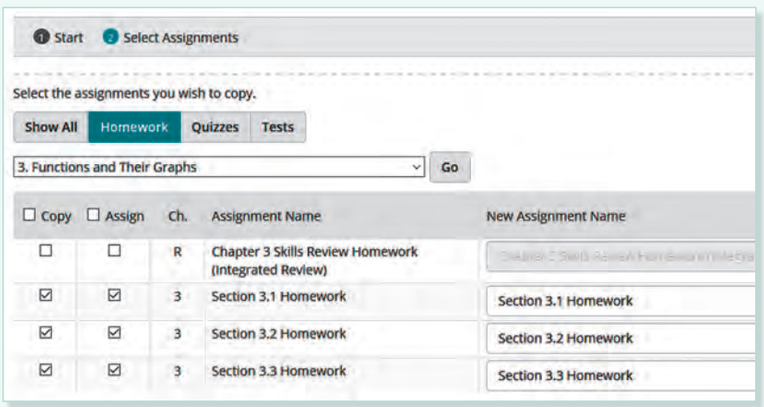
New! Interactive Figures

Interactive Figures, created in GeoGebra by Michael Sullivan III, bring mathematical concepts to life, helping students visualize the concept through guided exploration and purposeful manipulation. Assignable in MyLab Math with assessment questions to check students' conceptual understanding.





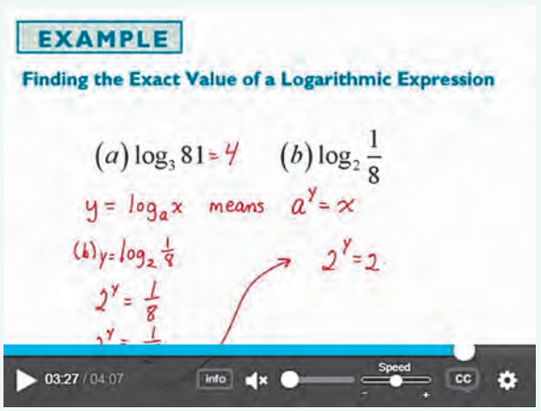
Enhanced Sample Assignments

The Sullivans make course set-up easier by giving instructors a starting point for each section. Enhanced Sample Assignments use a thoughtful mix of Sullivan hallmark practice problems that are geared to maximize students' performance—including Retain Your Knowledge exercises that improve students' recall of concepts learned earlier in the course.

Video Program and Resources

Author in Action Videos are actual classroom lectures by Michael Sullivan III with fully worked-out examples.

- **Video assessment questions** are available to assign in MyLab Math for key videos.
- **Updated!** The corresponding **Guided Lecture Notes** assist students in taking thorough, organized, and understandable notes while watching Author in Action Videos.



pearson.com/mylab/math

Resources for

Success

Pearson MyLab

Instructor Resources

Online resources can be downloaded at **pearson.com/mylab/math** or from **www.pearson.com.**

Annotated Instructor's Edition

ISBN - 0135813859 / 9780135813850
Shorter answers are on the page beside the exercises. Longer answers are in the back of the text.

Instructor's Solution Manual

Includes fully worked solutions to all exercises in the text.

Learning Catalytics Question Library

Questions written by Michael Sullivan III are available to deliver through Learning Catalytics to engage students in your course.

PowerPoint® Lecture Slides

Fully editable slides correlate to the textbook and include alternate classroom examples for every textbook objective.

Mini Lecture Notes

This guide includes additional examples and helpful teaching tips, by section.

TestGen®

TestGen (www.pearsoned.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.

Online Chapter Projects

Additional projects that give students an opportunity to apply what they learned in the chapter.

Student Resources

Additional resources to enhance student success.

Lecture Video

Author in Action videos are actual classroom lectures with fully worked-out examples presented by Michael Sullivan III. Videos are assignable within MyLab Math.

Chapter Test Prep Videos

Students can watch instructors work through step-by-step solutions to all chapter test exercises from the text.

Student's Solutions Manual

ISBN - 0135974453 / 9780135974452
Provides detailed worked-out solutions to odd-numbered exercises. Available within MyLab Math and in print.

Guided Lecture Notes

ISBN - 0135813697 / 9780135813690
These lecture notes assist students in taking thorough, organized, and understandable notes while watching Author in Action videos. Students actively participate in learning the *how* and *why* of important concepts through explorations and activities. The Guided Lecture Notes are available as PDFs and customizable Word files in MyLab Math. They are also available in print format.

Algebra Review

ISBN: 0131480065 / 9780131480063
Four chapters of Intermediate Algebra review. Perfect for a corequisite course or for individual review. Available in print form; PDFs are also available within MyLab Math.

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