Introductory and Intermediate ALGEBRA

A Custom Edition for University of Cincinnati Math 132, 133, 134

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Taken from
Beginning and Intermediate Algebra, Second Editon
K. Elayn Martin-Gay

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by K. Elayn Martin-Gay

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Objectives for Introductory and Intermediate Algebra

Compiled by Professor Connie Roth
With assistance from
Professor Susan Fasce
Professor Sherrin Rawlings
Professor Hadi Rhabarri
Professor Bela Zemanski
Professor James Maratta

Introductory Algebra I

Textbook: Beginning & Intermediate Algebra (2^{nd} edition) by K. Elayn Martin-Gay

Course Content: Chapter One – 1.2 to 1.8
Chapter Two – 2.1 to 2.7
Section 8.4 should be taught right after Section 2.6 and before Section 2.7
Chapter Three – 3.1 to 3.7
Chapter Eight – 8.4

Introductory algebra is a beginning course. For many of our students it is their first encounter with algebra, and the emphasis should be on concepts. This is not the course to look at multiple variations on a particular topic; think simple. Problems should be mostly straightforward.

Chapter One: Review of Real Numbers (6 days)

1. Order of Operations (2 days)
- Positive numbers only
  (a) whole numbers or fractions
  (b) 2 levels of parentheses, 3 different operations

2. Signed Numbers – Emphasis on integers (2 days)
- Rules for addition, then rules for multiplication (exponents) and division. Go through the order of operations with all five operations

3. Combining like terms (1 day)
- Like terms - rules for addition and subtraction – integer and fraction coefficients

4. Evaluating expressions – mostly 1 or 2 variables (1 day)
- Evaluate expressions for particular value(s) of the variable(s) – check to see if an equation or inequality is true for a particular set of value(s) for the variable(s)

Chapter Two: Equations, Inequalities, and Problem Solving (10 days)

1. Solving Linear Equations – $3x = 12$, $x + 3 = -2$, $2(3x - 1) = -3(2 - x)$, etc. (3 days)
- keep equations simple – emphasize what it means to solve an equation
  talk about undoing operations and the order of undoing operations

2. Solving a simple formula for a variable: $A = lw$, solve for l; $P = 2l + 2w$, solve for w, etc. (2 days)

- Talk about similarity to 1. – don't use very complicated formulae – try to get student to be at ease when working with several variables in a formula

3. Application Problems -- just 2 or 3 kinds (2 days)

- The concept of solving word problems-what you are looking for-how to organize the information so that you can solve the problem-when are you finished solving the problem-how to check your solution-how many solutions are there

4. Solving percent equations & problems containing percents (1 day)
5. Absolute value equations (Section 8.4 should be taught right after section 2.6 and before section 2.7) (1 day)
6. Linear Inequalities (1 day)

- Graph solution sets on a number line
- Use interval notation

<u>Chapter Three: Graph and Functions</u> (8 days)

1. Plotting points: Basic rectangular coordinate system

2. Graphing equations (Section 3.2) (1 day)

- Identify linear equations
- Graph equation by plotting ordered pair solutions
  – Concentrate on linear equations

3. Functions (Section 3.3: Skip relation) (1 day)

- Introduce function notation
- Evaluate function at given value of x
- Basic definition of domain & range of a functions

4. Graphing a linear equation (2 days)

- By plotting any 2 or more points on the line
- By plotting intercepts
- Graph vertical and horizontal lines
- Special case: Vertical line
- Special case: Horizontal line

5. Slope of a line ($\frac{1}{2}$ day)

- Calculate the slope algebraically (from the definition of slope) and relate its numerical value to steepness and direction
- Know by their equations whether two lines are parallel or not

6. Find equations of lines ($1\frac{1}{2}$ days)

- Given two points
- Given slope and one point
- Special case: Vertical line
- Special case: Horizontal line
- Applications of equations of lines

7. Solve linear inequalities in two variables– same type as linear equations (2 days)

- $y = mx + b$ and the solution to $mx + b \geq y$, $mx + b > y$, $mx + b \leq y$, or $mx + b < y$

Introductory Algebra II

Textbook: Beginning & Intermediate Algebra (2^{nd} edition) by K. Elayn Martin-Gay

Course Content: Chapter Five – 5.1 to 5.6
Chapter Six – 6.1 to 6.7
Chapter Seven – 7.1 to 7.8

Chapter Five: Exponents and Polynomials (6 days)

1. Exponents

- Concept of Exponents (Integer exponents only) (2 days)
- Define and explain exponent notation
- Product rule
- Quotient rule
- Zero exponent concept
- Negative exponent concept
- Power rules
- Simplifying exponential expressions
- Scientific notation as an example of using exponents

2. Polynomial

- Identifying degree, terms, & coefficients (4 days)
- Find $P(-2)$, if $P(x) = 2x^2 - 5x + 9$
- Write polynomials in descending order
- Adding, and subtracting polynomials
- Multiplying polynomials
  (a) mono x mono
  (b) mono x poly
  (c) binomials using foil
  (d) special products
  any two polynomials – distributive property
- Dividing polynomials
  (a) poly / monomial
  (b) poly / binomial (Long division only)

Chapter Six: Factoring Polynomials (10 days)

1. Factoring polynomials (6 days)

- Factor out the GCF
- Factor by grouping of four terms
- Factoring trinomials: $x^2 + bx + c$ and $ax^2 + bx + c$
- Special factoring formulas: $x^2 - a^2 = (x + a)(x - a)$, $x^3 \pm a^3 = (x + a)(x^2 \mp ax + a^2)$

2. Solving polynomial equations using factoring (4 days)

- The zero factor property $ab = 0 \Rightarrow a = 0$ or $b = 0$
- Write quadratic equation in standard form
- Solve quadratic equations using factoring
- Solve applications/examples by factoring

Chapter Seven: Rational Expressions (8 days)

1. Concept of rational expressions

- Determine values for which rational expressions are defined
- The three associated signs with any fraction $(\frac{y}{-x} = -\frac{y}{x}, \frac{-y}{x} = -\frac{y}{x}, \frac{-y}{-x} = \frac{y}{x})$
- Simplify rational expressions

2. Arithmetic operation using rational expressions (4 days)

- Add and subtract rational expressions – like and unlike denominators, common Denominator, LCD
- Multiply rational expressions
- Divide rational expressions
- Complex fractions, combining, clearing fractions

3. Solving rational equations (4 days)

- Setting up problems
- Solve some simple applications containing rational expressions
- motion problems
- work problems
- Solve equations containing rational expressions for a specified variable

INTERMEDIATE ALGEBRA

Textbook: Beginning & Intermediate Algebra (2nd edition) by K. Elayn Martin-Gay

Course Content: **Chapter Four – 4.1 to 4.4**
Chapter Nine – 9.1 to 9.7 (touch 9.7 lightly)
Chapter Eight – 8.1 (quick review), 8.3, 8.5
Chapter Ten – 10.1 to 10.7 (Skip 10.5)

Chapter Four: Solving Systems of Linear Equations (5 days)

1. Solve a system of linear equations in 2 variables by substitution
2. Solve a system of linear equations in 2 variables by graphing
3. Solve a system of linear equations in 2 variables by elimination
4. Solve geometric problems that can be modeled by a system of linear equations
5. Solve distance problems that can be modeled by a system of linear equations
6. Solve mixture problems that can be modeled by a system of linear equations

Chapter Nine: Radicals, Rational Exponents, and Complex Numbers (9 days)

1. Concept of the n-th root of a number – $\sqrt[n]{a} = b \leftrightarrow b^n = a$ (1 day)

- Find square roots and cube roots
- Identify rational and irrational numbers
- Find the n-th root

2. Simplifying radical expressions – $\sqrt[3]{64x^6y^5} = 4x^2y\sqrt[3]{y^2}$ (2 days)

- Use the product rule for radicals
- Use the quotient rule for radicals

3. Arithmetic of radical expressions - maximum of two factors in a product, etc. (2 days)

- Understand like radicals
- Add and subtract radical expressions
- Multiply radical expressions – be able to multiply binomials where all terms are square roots

4. Rational Exponents (2 days)

- Evaluate expressions of the form $a^{\frac{1}{n}}$
- Evaluate expressions of the form $a^{\frac{m}{n}}$

- Evaluate expressions of the form $a^{-\frac{m}{n}}$
- Convert between radical notation and rational exponent notation
- Use calculator to evaluate radicals

5. Rationalizing numerator and denominator - Two terms denominator with square roots (1 day)

- Understand conjugates
- Be able to rationalize something like $\frac{5}{\sqrt[3]{9y^2}}$

6. Radical equations (1 day)

- Solve equations containing one radical
- Solve equations such as $\sqrt{x+4} = 2x-5$

7. Graphing radical functions
8. Complex numbers

- Understand $i = \sqrt{-1}$ and $i^2 = -1$
- Be able to add and subtract complex numbers

Chapter Eight: 8.1(Quick review), 8. 3 & 8.5 (2 days)

1. Quick review on solving linear and quadratic equations
2. Solving compound inequalities containing and cases, & or cases
3. Solving absolute value inequalities of the form $|x| < a$ and $|x| > a$

Chapter Ten: Quadratic Equations and Functions **(Skip 10.5)** (8 days)

1. Quadratic equations – factoring, completing the square, quadratic formula (5 days)

- Be able to solve quadratic equations using the square root property
- Be able to solve quadratic equations by completing the square
- Be able to solve quadratic equations by using the quadratic formula – understand what *a*, *b* and c are in the equation
- Solve miscellaneous equations that are quadratic in form
- Solve problems that lead to quadratic equations

2. Factorable polynomial inequalities & simple rational inequalities (1 day)

3. Graph quadratic functions (2 days)

- Know by looking at the function which way a parabola will open
- Be able to find the vertex and axis of symmetry of a parabola

PREFACE

ABOUT THIS BOOK

Beginning and Intermediate Algebra, Second Edition, was written to provide a **solid foundation in algebra** as well as to develop students' problem-solving skills. Specific care has been taken to ensure that students have the most **up-to-date and relevant** text preparation for their next mathematics course, as well as to help students succeed in nonmathematical courses that require a grasp of algebraic fundamentals. I have tried to achieve this by writing a user-friendly text that is keyed to objectives and contains many worked-out examples. The basic concepts of graphs and functions are introduced early, and problem solving techniques, real-life and real-data applications, data interpretation, appropriate use of technology, mental mathematics, number sense, critical thinking, decision-making, and geometric concepts are emphasized and integrated throughout the book.

The many factors that contributed to the success of the first edition have been retained. In preparing this edition, I considered the comments and suggestions of colleagues throughout the country, students, and many users of the prior edition. The AMATYC Crossroads in Mathematics: Standards for Introductory College Mathematics before Calculus and the MAA and NCTM standards (plus Addenda), together with advances in technology, also influenced the writing of this text.

Beginning and Intermediate Algebra, Second Edition, is **part of a series of texts** that can include *Basic College Mathematics* and *Prealgebra, Third Edition.* Also available are *Beginning Algebra, Third Edition, Intermediate Algebra, Third Edition,* and *Intermediate Algebra: A Graphing Approach, Second Edition.* Throughout the series, pedagogical features are designed to develop student proficiency in algebra and problem solving, and to prepare students for future courses.

KEY PEDAGOGICAL FEATURES IN THE SECOND EDITION

Readability and Connections I have tried to make the writing style as clear as possible while still retaining the mathematical integrity of the content. When a new topic is presented, an effort has been made to **relate the new ideas to those that students**

may already know. Constant reinforcement and connections within problem solving strategies, data interpretation, geometry, patterns, graphs, and situations from everyday life can help students gradually master both new and old information.

Problem-Solving Process This is formally introduced in Chapter 2 with a **new four-step process that is integrated throughout the text**. The four steps are Understand, Translate, Solve, and Interpret. The repeated use of these steps throughout the text in a variety of examples shows their wide applicability. Reinforcing the steps can increase students' confidence in beginning problems.

Applications and Connections Every effort was made to include as many accessible, interesting and relevant real-life applications as possible throughout the text in both worked-out examples and exercise sets. The applications **strengthen students' understanding of mathematics in the real world** and help to motivate students. They show connections to a wide range of fields including agriculture, astronomy, automotive ownership, business, chemistry, communication, computer technology, construction, consumer affairs, demographics, earth science, education, entertainment, environmental issues, finance and economics, food service, geography, government, hobbies, labor and career issues, life science, medicine, music, nutrition, physics, political science, population, recreation, sports, technology, transportation, travel, weather, and important related mathematical areas such as geometry and statistics. (See the Index of Applications on page xxiv.) Many of the applications are based on **recent and interesting real-life data**. Sources for data include newspapers, magazines, government publications, publicly held companies, special interest groups, research organizations, and reference books. Opportunities for obtaining your own real data with and without using the internet are also included.

Helpful Hints Helpful Hints contain practical advice on applying mathematical concepts. These are found throughout the text and **strategically placed** where students are most likely to need immediate reinforcement. They are highlighted in a box for quick reference and, as appropriate, an indicator line is used to precisely identify the particular part of a problem or concept being discussed. For instance, see pages 90 and 365.

Visual Reinforcement of Concepts The text contains numerous graphics, models, and illustrations to visually clarify and reinforce concepts. These include **new and updated** bar graphs and circle graphs in two and three dimensions, line graphs, calculator screens, application illustrations, photographs, and geometric figures. There are now **approximately 1,000 figures**.

Real World Chapter Openers The new two-page chapter opener focuses on how math is used in a specific career, provides links to the World Wide Web, and references a "Spotlight on Decision Making" feature within the chapter for further exploration of the **career and the relevance of algebra**. For example, look at the opener for Chapter 4. The opening pages also contain a list of section titles, and an introduction to the mathematics to be studied together with mathematical connections to previous chapters in the text.

Student Resource Icons At the beginning of each section, videotape, tutorial software CD Rom, Student Solutions Manual, and Study Guide icons are displayed. These icons help remind students that these learning aids are available should they choose to use them to review concepts and skills at their own pace. These items have **direct correlation to the text** and emphasize the text's methods of solution.

Chapter Highlights Found at the end of each chapter, the Chapter Highlights contain key definitions, concepts, *and* examples to **help students understand and retain** what they have learned.

Chapter Project This feature occurs at the end of each chapter, often serving as a chapter wrap-up. For **individual or group completion**, the multi-part Chapter Project, usually hands-on or data based, allows students to problem solve, make interpretations, and to think and write about algebra.

In addition, a reference to alternative or additional Real World Activities is given. This **internet option** invites students to find and retrieve real data for use in solving problems. Visit the Real World Activities Website by going to http://www.prenhall.com/martin-gay.

Functional Use of Color and New Design Elements of this text are highlighted with color or design to make it easier for students to read and study. Special care has been taken to use color within solutions to examples or in the art to **help clarify, distinguish, or connect concepts**. For example, look at page 301 in Section 5.3.

EXERCISE SETS

Each text section ends with an exercise set, usually divided into two parts. Both parts contain graded exercises. The **first part is carefully keyed** to at least one worked example in the text. Once a student has gained confidence in a skill, the **second part contains exercises not keyed to examples**. Exercises and examples marked with a video icon ( ) have been worked out step-by-step by the author in the videos that accompany this text.

Throughout the text exercises there is an emphasis on **data and graphical interpretation** via tables, charts, and graphs. The ability to interpret data and read and create a variety of types of graphs is developed gradually so students become comfortable with it. Similarly, throughout the text there is integration of **geometric concepts**, such as perimeter and area. Exercises and examples marked with a geometry icon ( ) have been identified for convenience.

Each exercise set contains one or more of the following features.

Spotlight on Decision Making These unique **new, specially designed applications** help students develop their decision-making and problem-solving abilities, skills useful in mathematics and in life. Appropriately placed before an exercise set begins, students have an opportunity to immediately practice and reinforce basic algebraic concepts found in the accompanying section in relevant, accessible contexts. There is an emphasis on workplace or job-related career situations (such as the decisions of a Meteorologist in Section 3.1, a phychologist in Section 9.6, or a Webmaster in Section 11.4) as well as decision making in general (such as choosing a credit card in Section 6.5 or deciding between two job offers in Section 4.3).

Mental Mathematics These problems are found at the beginning of many exercise sets. They are mental warm-ups that **reinforce concepts** found in the accompanying section and increase students' confidence before they tackle an exercise set. By relying on their own mental skills, students increase not only their confidence in themselves but also their number sense and estimation ability.

Writing Exercises These exercises now found in almost every exercise set are marked with the icon ( ). They require students to **assimilate information** and provide a written response to explain concepts or justify their thinking. Guidelines

recommended by the American Mathematical Association of Two Year Colleges (AMATYC) and other professional groups recommend incorporating writing in mathematics courses to reinforce concepts. Writing opportunities also occur within features such as Spotlight on Decision Making and Chapter Projects.

Data and Graphical Interpretation Throughout the text there is an emphasis on data interpretation in exercises via tables, bar charts, line graphs, or circle graphs. The ability to interpret data and read and create a variety of graphs is **developed gradually** so students become comfortable with it.

Calculator Explorations and Exercises These optional explorations offer guided instruction, through examples and exercises, on the proper use of **scientific and graphing calculators or computer graphing utilities as tools in the mathematical problem-solving process**. Placed appropriately throughout the text, these explorations reinforce concepts or motivate discovery learning.

Additional exercises building on the skills developed in the Explorations may be found in exercise sets throughout the text and are marked with the icon  for scientific calculator use or with the icon  for graphing calculator use.

Review Exercises These exercises occur in each exercise set (except for those in Chapter 1). These problems are **keyed to earlier sections** and review concepts learned earlier in the text that are needed in the next section or in the next chapter. These exercises show the **links between earlier topics and later material**.

A Look Ahead These exercises occur at the end of some exercise sets. This section contains examples and problems similar to those found in a subsequent algebra course. "A Look Ahead" is presented as **a natural extension of the material** and contains an example followed by advanced exercises.

In addition to the approximately 7000 exercises within sections, exercises may also be found in the Vocabulary Checks, Chapter Reviews, Chapter Tests, and Cumulative Reviews.

Vocabulary Checks Vocabulary checks, **new to this edition**, provide an opportunity for students to become more familiar with the use of mathematical terms as they strengthen their verbal skills.

Chapter Review and Chapter Test The end of each chapter contains a review of topics introduced in the chapter. The review problems are keyed to sections. The chapter test is not keyed to sections.

Cumulative Review Each chapter after the first contains a **cumulative review of all chapters beginning with the first** up through the chapter at hand. Each problem contained in the cumulative review is actually an earlier worked example in the text that is referenced in the back of the book along with the answer. Students who need to see a complete worked-out solution, with explanation, can do so by turning to the appropriate example in the text.

KEY CONTENT FEATURES IN THE SECOND EDITION

Overview This new edition retains many of the factors that have contributed to its success. Even so, **every section of the text was carefully re-examined**. Throughout the new edition you will find numerous new applications, examples, and many real-life applications and exercises. Some sections have internal re-organization to better clarify and enhance the presentation.

Table of Content Changes in the Second Edition The second edition includes a **new Chapter 8, Transitions to Intermediate Algebra**. Although intermediate algebra topics are woven into earlier chapters where appropriate, the purpose of this chapter is to help students make the transition from beginning algebra to intermediate algebra. For example, Chapter 8 contains types of equations and inequalities normally found in intermediate algebra, such as absolute value equations and inequalities, system of equations in three variables as well as matrices and determinants.

By moving these intermediate algebra topics to Chapter 8, **Chapters 2 and 3 were combined to form a new Chapter 2, Equations, Inequalities, and Problem Solving**. As a result, **graphing is now covered in Chapter 3, Graphs and Functions**. A new Section 3.1 is devoted to introducing the rectangular coordinate system and creating scatter diagrams from real data. Functions are introduced in Section 3.3 and continually revisited to help students fully understand and see the importance of this topic. For example, see Sections 3.4, 5.3, 6.8, and 7.1 just to name a few.

Increased Integration of Geometry Concepts In addition to the traditional topics in beginning algebra courses, this text contains a strong emphasis on problem solving, and geometric concepts are integrated throughout. The geometry concepts presented are those most important to a students' understanding of algebra, and I have included **many applications and exercises** devoted to this topic. These are marked with the icon △. Also, geometric figures, a review of angles, lines, and special triangles, are covered in the appendices. The inside front cover provides a quick reference of geometric formulas.

Real Numbers and Algebraic Expressions Chapter 1 now begins with Tips for Success in Mathematics (Section 1.1). Chapter 1 has been streamlined and refreshed for **greater efficiency and relevance**. New applications and real data enhance the chapter.

Early and Intuitive Introduction to Graphs and Functions As bar and line graphs are gradually introduced in Chapters 1 and 2, an emphasis are placed on the notion of paired data. This leads naturally to the concepts of ordered pair and the rectangular coordinate system introduced in Chapter 3. This edition offers more real data and conceptual type applications and further strengthens the introduction to slope.

Once students are comfortable with graphing equations, functions are introduced in Chapter 3. The concept of function is illustrated in numerous ways to ensure student understanding: by listing ordered pairs of data, showing rectangular coordinate system graphs, visually representing set correspondences, and including numerous real-data and conceptual examples. **The importance of a function is continuously reinforced** by not treating it as a single, stand-alone topic but by constantly integrating functions in appropriate sections of this text.

Increased Attention to Problem Solving Building on the strengths of the prior edition, a special emphasis and strong commitment are given to contemporary, accessible, and practical applications of algebra. **Real data** was drawn from a variety of sources including internet sources, magazines, newspapers, government publications, and reference books. **Unique Spotlight on Decision Making exercises and a new four-step problem-solving process are incorporated throughout** to focus on helping to build students problem-solving skills.

Increased Opportunities for Using Technology Optional explorations for a calculator or graphing calculator (or graphing utility such as Texas Instruments Interactive), are integrated appropriately **throughout the text** in Calculator Explorations features and in exercises marked with a calculator icon. The Martin-Gay **Companion Website** includes links to internet sites to allow opportunities for finding data and using it for problem solving such as with the accompanying on-line Real World Activities.

The Website also includes links to search potential mathematically related careers branching from the chapter openers. Instructors may also choose from a variety of **distance learning or on-line delivery options** including Blackboard or Web CT.

New Examples Detailed step-by-step examples were added, deleted, replaced, or updated as needed. Many of these reflect real life. **Examples are used in two ways**. Often there are numbered, formal examples, and occasionally an example or application is used to introduce a topic or informally discuss the topic.

New Exercises A significant amount of time was spent on the exercise sets. New exercises and examples **help address a wide range of student learning styles and abilities**. The text now includes the following types of exercises: spotlight on decision making exercises, mental math, computational exercises, real-life applications, writing exercises, multi-part exercises, review exercises, a look ahead exercises, optional calculator or graphing calculator exercises, data analysis from tables and graphs, vocabulary checks, and projects for individual or group assignment. Also available are new on-line Real World Activities accessed via this textbook's companion website, and a selection of group activities in a worksheet ready, easy to use format, found in the Instructor's Resource Manual with Tests.

Enhanced Supplements Package The new Second Edition is supported by a wealth of supplements designed for **added effectiveness and efficiency**. New items include the MathPro 4.0 Explorer tutorial software together with a unique video clip feature, a new computerized testing system TestGenEQ, and an expanded and improved Martin-Gay companion website. Some highlights in print materials include the addition of teaching tips in the Annotated Instructor's Edition, and an expanded Instructor's Resource Manual with Tests including additional exercises and short group activities in a ready-to use-format. Please see the list of supplements for descriptions.

OPTIONS FOR ON-LINE AND DISTANCE LEARNING

For maximum convenience, Prentice Hall offers on-line interactivity and delivery options for a variety of distance learning needs. Instructors may access or adopt these in conjunction with this text, *Beginning and Intermediate Algebra*.

Companion Website

Visit *http://www.prenhall.com/martin-gay*

The companion Website includes basic distance learning access to provide links to the text's Real World Activities, career-related sites referenced in the chapter opening pages and a selection of on-line self quizzes. E-mail is available. For quick reference, the inside front cover of this text also lists the companion Website URL.

WebCT

WebCT includes distance learning access to content found in the Martin-Gay Companion Website plus more. WebCT provides tools to create, manage, and use on-line course materials. Save time and take advantage of items such as on-line help, communication tools, and access to instructor and student manuals. Your college may already have WebCT's software installed on their server or you may choose to download it. Contact your local Prentice Hall sales representative for details.

Blackboard

Visit *http://www.prenhall.com/demo*

For distance learning access to content and features from the Martin-Gay Companion Website plus more, Blackboard provides simple templates and tools to create,