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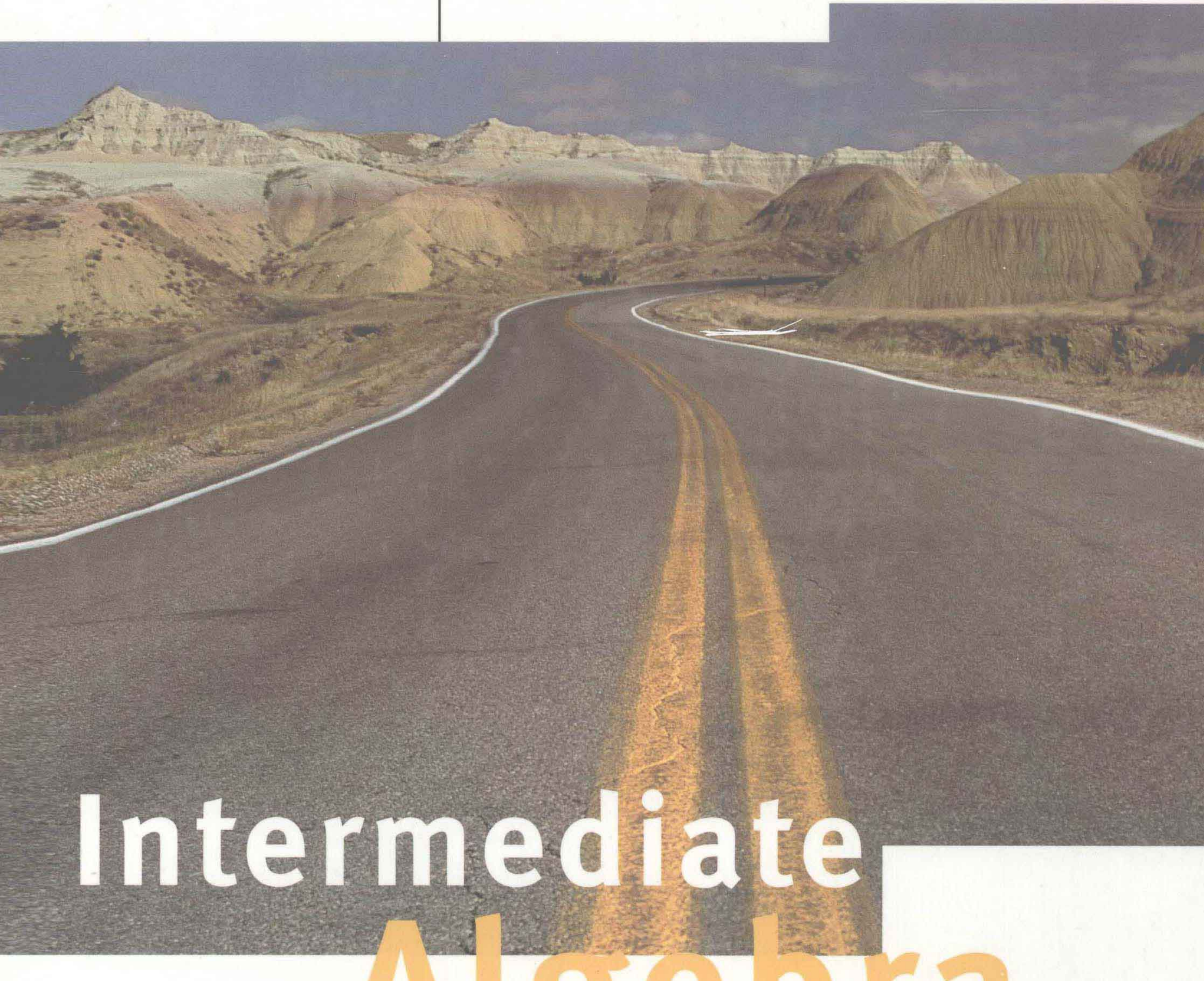

Intermediate Algebra

SECOND EDITION

INTERMEDIATE ALGEBRA

Second Edition

Elaine Hubbard

KENNESAW STATE UNIVERSITY

Ronald D. Robinson

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Preface

The Approach

Every learning theory emphasizes the value of widening the sensory spectrum. To accomplish this in teaching mathematics, we believe that one must give students a visual connection that allows students to "see" mathematics in context.

In this second edition, we continue to use our extensive teaching experience to create a balance between traditional approaches and the use of a graphing calculator. We have developed an approach to teaching with a graphing calculator that works successfully for us, for our colleagues, and for students.

The Exploration/Discovery format of the first edition has been revised to "Exploring the Concept." In this new feature, we begin at a visual, concrete level at which concepts and relationships are illustrated and outcomes are suggested. By experimenting and asking "What if?" questions, the instructor can help students to become active participants in the learning process.

As in the previous edition, we strive to maintain a proper perspective. The focus is on mathematics, with the graphing calculator serving as a tool for better understanding.

Modeling and Real-Life Applications

Each chapter begins with a presentation of real data and background information on a topic of interest. This topic is pursued further in a Group Project within the chapter and in a Chapter Project at the end of the chapter. In addition to this thread, a large number of modeling problems have been added to this edition. These exercises contain actual data (with sources), tables, graphs, and guidance in modeling, analyzing, and interpreting the data.

Most exercise sets contain real-life applications that we have written in the student's experiential context. Some sections are devoted exclusively to such applications.

Other New Features

As was true for our first edition, we have written this book with careful attention given to AMATYC's *Crossroads in Mathematics* standards. Two major elements of this document are the use of a graphing calculator and the inclusion of real-data examples and exercises. We have expanded and improved in both of these areas.

In addition, we have added the critical-thinking feature, "Think About It," to each section. In the area of written and verbal communication skills, we have continued to include a generous number of writing exercises.

In the following pages, the special features of the text are highlighted and discussed in detail.

The goals of this book are to provide an effective instructional framework for the classroom and to engage students in a better understanding of the nature of mathematics in their personal and career lives. We earnestly hope that our work will promote achievement and success for all.

Supplements

Instructor's Annotated Edition This version of the text includes answers to the odd- and even-numbered exercises listed consecutively, as well as the answers to Think About It and Looking Ahead. Instructor annotations are highlighted in red. To help instructors better plan students' homework assignments in accordance with their teaching styles and strategies, graphing calculator icons are now used in the Instructor's Annotated Edition to identify problems best completed using a graphing calculator. Similarly, Concept Extension exercises are identified with the notation CE. The graphing calculator icons and CE notation do *not* appear in the student text.

Student Solutions Manual All solutions to the odd-numbered exercises are worked out in this manual.

Instructor's Resource Manual All solutions to the even-numbered exercises and three forms of sample tests per chapter are included.

Test Item File This printed manual contains over 2500 multiple-choice and free-response test questions.

Computerized Testing A computerized test bank of multiple-choice and free-response test questions for Windows or Macintosh is available.

Tutorial Software This tutorial software is organized according to the text and provides students with the opportunity to solve problems in the areas in which they need additional practice. Versions for Macintosh and IBM-Windows are available.

Graphing Calculator Keystroke Guide This guide offers valuable support and keystroke instruction for several calculator models, including the TI-83. A Key Word icon in the text alerts students to specific keystroke information in this supplement.

Videotapes A series of videotapes for instructors provides a thorough review of concepts and worked-out examples to reinforce lessons within the text.

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ELAINE HUBBARD
RONALD D. ROBINSON

Opening Features

Chapter Opener

Each chapter begins with a short introduction to a real-data application. This opening topic is continued as a Group Project later in the chapter and as a Chapter Project at the end of the chapter. The chapter opener also includes a helpful overview of the topics that will be covered in the chapter and a list of the section titles.

Chapter 2

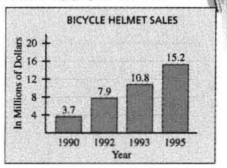
The Coordinate Plane and Functions

2.1 The Coordinate Plane
2.2 The Graph of an Expression
2.3 Relations and Functions
2.4 Functions: Notation and Evaluation
2.5 Analysis of Functions

As more and more states enacted helmet laws for bicycle riders, the sales of helmets increased dramatically. The bar graph shows the sales (in millions of dollars) of bicycle helmets for selected years in the period 1990–1995. (Source: U.S. Bicycle Federation.)

We can write a **function** to model the trend in helmet sales during this time, and we can graph the function in a **coordinate system.** Both the function and the graph can be used, for example, to estimate the helmet sales for 1991 or to predict sales after 1995. (For more on this topic, see Exercises 79–82 at the end of Section 2.4, and see the Chapter Project.)

In this chapter we introduce the coordinate plane for associating ordered pairs of real numbers with points. We learn how to graph an expression in the coordinate plane, and we introduce the basic features of the graphing calculator. The remainder of the chapter is devoted to the important topic of functions, including graphs, notation, evaluation, and analysis.



(Source: U.S. Bicycle Federation.)

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2.4 FUNCTIONS: NOTATION AND EVALUATION

Function Notation • Evaluating Functions

Function Notation

Consider the function defined by the equation $y = 2x + 1$. For convenience, we often use **function notation** to name the function and to indicate the value of the function.

$$f(x) = 2x + 1$$

The notation $f(x)$ is read "f of x." In this notation, the name of the function is f, the variable (domain element) is x, and the value of the function (range element) corresponding to x is $f(x)$.

Note: The parentheses in the notation $f(x)$ does *not* indicate multiplication. We read $f(x)$ as "f of x," *not* "f times x."

Just as we can use symbols other than x as a variable, we can use letters other than f to name a function. Each of the following defines the same function.

$$f(x) = x^2 - 3x + 4 \qquad g(t) = t^2 - 3t + 4 \qquad g(w) = w^2 - 3w + 4$$

Evaluating Functions

Determining the value of $f(x)$ for a specific value of x is called **evaluating the function.**

EXPLORING THE CONCEPT

Using function notation for evaluating functions usually helps to sell students on the value of the notation.

Point out that the x-coordinate is the value of the variable and the y-coordinate is the value of the function.

LEARNING TIP

Keep relating an expression and its value to points of a graph. If $f(2) = 6$, then $(2, 6)$ is a point of the graph of f. As you study mathematics, go slowly and take the time to visualize.

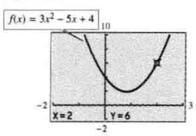
Evaluating Functions

To indicate the value of the function $f(x) = 3x^2 - 5x + 4$ when x has a value of 2, we write $f(2)$. To evaluate $f(2)$, replace each occurrence of the variable with 2.

$$f(x) = 3x^2 - 5x + 4$$
$$f(2) = 3(2)^2 - 5(2) + 4 = 12 - 10 + 4 = 6$$

We also can use a graph to estimate the value of a function. Figure 2.34 shows the graph of $f(x) = 3x^2 - 5x + 4$ with the tracing cursor on (2, 6). Note that the first coordinate is the value of x, and the second coordinate is $f(2) = 6$.

Figure 2.34

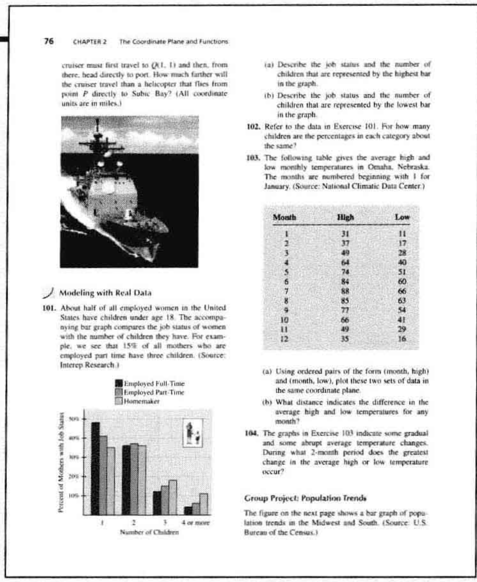


Section Opener

Each section begins with a list of subsection titles that provides a brief outline of the material that follows.

Modeling with Real Data

In accordance with the current standards of professional organizations such as AMATYC and NCTM, we have added an abundance of exercises in the general category of Modeling with Real Data. Students are taught how to organize and interpret data, how to model it with mathematical functions, and how to use such models to extrapolate and predict. Sourced data from a variety of subjects are used in dedicated blocks of modeling exercises, Group Projects, and Chapter Projects.



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cruiser must first travel to $Q(1, 1)$ and then, from there, head directly to port. How much farther will the cruiser travel than a helicopter that flies from point P directly to Subic Bay? (All coordinate units are in miles.)

Modeling with Real Data

101. About half of all employed women in the United States have children under age 18. The accompanying bar graph compares the job status of women with the number of children they have. For example, we see that 15% of all mothers who are employed part time have three children. (Source: Interep Research.)

(a) Describe the job status and the number of children that are represented by the highest bar in the graph.

(b) Describe the job status and the number of children that are represented by the lowest bar in the graph.

102. Refer to the data in Exercise 101. For how many children are the percentages in each category about the same?

103. The following table gives the average high and low monthly temperatures in Omaha, Nebraska. The months are numbered beginning with 1 for January. (Source: National Climatic Data Center.)

Month	High	Low
1	31	11
2	37	17
3	49	28
4	64	40
5	74	51
6	84	60
7	88	66
8	85	63
9	77	54
10	66	41
11	49	29
12	35	16

(a) Using ordered pairs of the form (month, high) and (month, low), plot these two sets of data in the same coordinate plane.

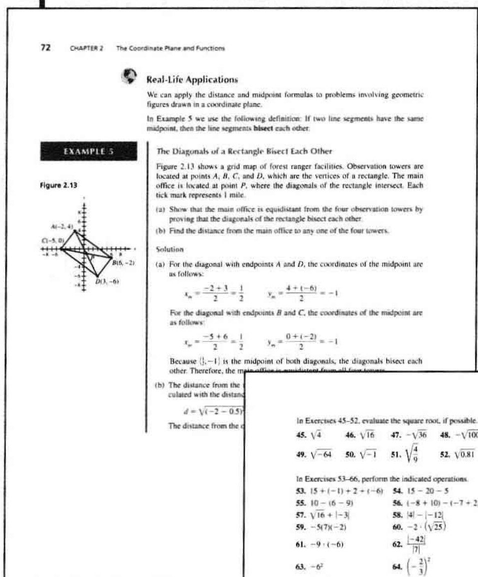
(b) What distance indicates the difference in the average high and low temperatures for any month?

104. The graphs in Exercise 103 indicate some gradual and some abrupt average temperature changes. During what 2-month period does the greatest change in the average high or low temperature occur?

Group Project: Population Trends

The figure on the next page shows a bar graph of population trends in the Midwest and South. (Source: U.S. Bureau of the Census.)

Real Data and Real Life



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Real-Life Applications

We can apply the distance and midpoint formulas to problems involving geometric figures drawn in a coordinate plane.

In Example 5 we use the following definition: If two line segments have the same midpoint, then the line segments **bisect** each other.

EXAMPLE 5

Figure 2.13

The Diagonals of a Rectangle Bisect Each Other

Figure 2.13 shows a grid map of forest ranger facilities. Observation towers are located at points A, B, C, and D, which are the vertices of a rectangle. The main office is located at point P, where the diagonals of the rectangle intersect. Each tick mark represents 1 mile.

(a) Show that the main office is equidistant from the four observation towers by proving that the diagonals of the rectangle bisect each other.

(b) Find the distance from the main office to any one of the four towers.

Solution

(a) For the diagonal with endpoints A and D, the coordinates of the midpoint are as follows:

$$x_m = \frac{-2+3}{2} = \frac{1}{2} \qquad y_m = \frac{4+(-6)}{2} = -1$$

For the diagonal with endpoints B and C, the coordinates of the midpoint are as follows:

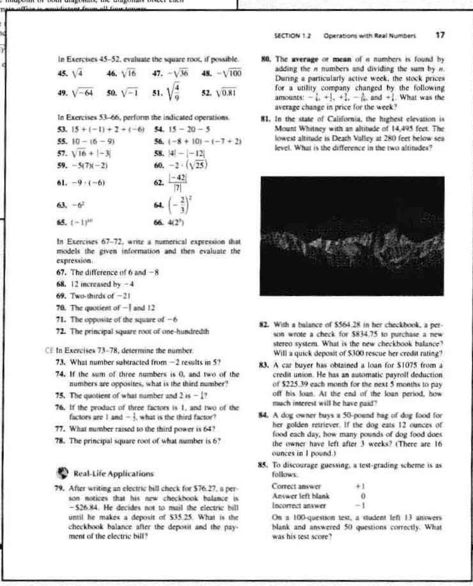
$$x_m = \frac{-5+6}{2} = \frac{1}{2} \qquad y_m = \frac{0+(-2)}{2} = -1$$

Because $(\frac{1}{2}, -1)$ is the midpoint of both diagonals, the diagonals bisect each other. Therefore, the m…

(b) The distance from the … culated with the distan…

$d = \sqrt{(-2-0.5)…}$

The distance from the …



SECTION 1.2 Operations with Real Numbers 17

In Exercises 45–52, evaluate the square root, if possible.

45. $\sqrt{4}$ **46.** $\sqrt{16}$ **47.** $-\sqrt{36}$ **48.** $-\sqrt{100}$

49. $\sqrt{-64}$ **50.** $\sqrt{-1}$ **51.** $\sqrt{\frac{4}{9}}$ **52.** $\sqrt{0.81}$

In Exercises 53–66, perform the indicated operations.

53. $15 + (-1) + 2 + (-6)$ **54.** $15 - 20 - 5$

55. $10 - (6 - 9)$ **56.** $(-8 + 10) - (-7 + 2)$

57. $\sqrt{16} + |-3|$ **58.** $|4| - |-12|$

59. $-5(7)(-2)$ **60.** $-2 \cdot (\sqrt{25})$

61. $-9 \cdot (-6)$ **62.** $\frac{|-42|}{|7|}$

63. -6^2 **64.** $\left(-\frac{2}{3}\right)^2$

65. $(-1)^{10}$ **66.** $4(2^3)$

In Exercises 67–72, write a numerical expression that models the given information and then evaluate the expression.

67. The difference of 6 and −8

68. 12 increased by −4

69. Two-thirds of −21

70. The quotient of [illegible] and 12

71. The opposite of the square of −6

72. The principal square root of one-hundredth

CE In Exercises 73–78, determine the number.

73. What number subtracted from −2 results in 5?

74. If the sum of three numbers is 0, and two of the numbers are opposites, what is the third number?

75. The quotient of what number and 2 is [illegible]?

76. If the product of three factors is 1, and two of the factors are 1 and [illegible], what is the third factor?

77. What number raised to the third power is 64?

78. The principal square root of what number is 6?

Real-Life Applications

79. After writing an electric bill check for \$76.27, a person notices that his new checkbook balance is −\$26.84. He decides not to mail the electric bill until he makes a deposit of \$35.25. What is the checkbook balance after the deposit and the payment of the electric bill?

80. The **average** or **mean** of n numbers is found by adding the n numbers and dividing the sum by n. During a particularly active week, the stock prices for a utility company changed by the following amounts: [illegible]. What was the average change in price for the week?

81. In the state of California, the highest elevation is Mount Whitney with an altitude of 14,495 feet. The lowest altitude is Death Valley at 280 feet below sea level. What is the difference in the two altitudes?

82. With a balance of \$564.28 in her checkbook, a person wrote a check for \$834.75 to purchase a new stereo system. What is the new checkbook balance? Will a quick deposit of \$300 rescue her credit rating?

83. A car buyer has obtained a loan for \$1075 from a credit union. He has an automatic payroll deduction of \$225.39 each month for the next 5 months to pay off his loan. At the end of the loan period, how much interest will he have paid?

84. A dog owner buys a 50-pound bag of dog food for her golden retriever. If the dog eats 12 ounces of food each day, how many pounds of dog food does the owner have left after 3 weeks? (There are 16 ounces in 1 pound.)

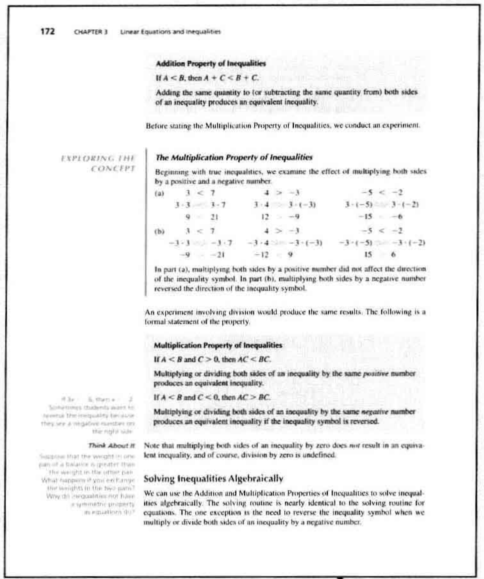
85. To discourage guessing, a test-grading scheme is as follows.

Correct answer	+1
Answer left blank	0
Incorrect answer	−1

On a 100-question test, a student left 13 answers blank and answered 50 questions correctly. What was his test score?

Real-Life Applications

The majority of application problems are written in the context of real-life knowledge and experience. Some sections are devoted exclusively to examples and exercises involving real-life applications, and most other sections contain dedicated blocks of such problems. Connecting mathematics with students' view of the world is in accordance with national standards and leads students to a better understanding of the practical nature of the discipline.



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Addition Property of Inequalities

If $A < B$, then $A + C < B + C$.

Adding the same quantity to (or subtracting the same quantity from) both sides of an inequality produces an equivalent inequality.

Before stating the Multiplication Property of Inequalities, we conduct an experiment.

EXPLORING THE CONCEPT

The Multiplication Property of Inequalities

Beginning with true inequalities, we examine the effect of multiplying both sides by a positive and a negative number.

(a) $3 < 7$ $\quad 4 > -3 \quad -5 < -2$

$3 \cdot 3 < 3 \cdot 7 \quad 3 \cdot 4 > 3 \cdot (-3) \quad 3 \cdot (-5) < 3 \cdot (-2)$

$9 < 21 \quad 12 > -9 \quad -15 < -6$

(b) $3 < 7 \quad 4 > -3 \quad -5 < -2$

$-3 \cdot 3 > -3 \cdot 7 \quad -3 \cdot 4 < -3 \cdot (-3) \quad -3 \cdot (-5) > -3 \cdot (-2)$

$-9 > -21 \quad -12 < 9 \quad 15 > 6$

In part (a), multiplying both sides by a positive number did not affect the direction of the inequality symbol. In part (b), multiplying both sides by a negative number reversed the direction of the inequality symbol.

An experiment involving division would produce the same results. The following is a formal statement of the property.

Multiplication Property of Inequalities

If $A < B$ and $C > 0$, then $AC < BC$.

Multiplying or dividing both sides of an inequality by the same *positive* number produces an equivalent inequality.

If $A < B$ and $C < 0$, then $AC > BC$.

Multiplying or dividing both sides of an inequality by the same *negative* number produces an equivalent inequality if the inequality symbol is reversed.

Think About It

Note that multiplying both sides of an inequality by zero does *not* result in an equivalent inequality, and of course, division by zero is undefined.

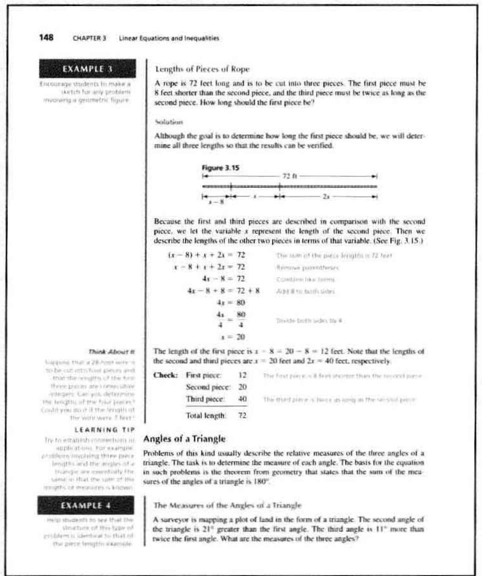
Solving Inequalities Algebraically

We can use the Addition and Multiplication Properties of Inequalities to solve inequalities algebraically. The solving routine is nearly identical to the solving routine for equations. The one exception is the need to reverse the inequality symbol when we multiply or divide both sides of an inequality by a negative number.

Exploring the Concept

This new pedagogical device guides students from concrete experiences to generalizations and formal rules. Students become active participants in the learning process by experimenting and asking "what if" questions.

Features for Discovery, Visualization, and Support



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EXAMPLE 3

Lengths of Pieces of Rope

A rope is 72 feet long and is to be cut into three pieces. The first piece must be 8 feet shorter than the second piece, and the third piece must be twice as long as the second piece. How long should the first piece be?

Solution

Although the goal is to determine how long the first piece should be, we will determine all three lengths so that the results can be verified.

Figure 3.15

Because the first and third pieces are described in comparison with the second piece, we let the variable x represent the length of the second piece. Then we describe the lengths of the other two pieces in terms of that variable. (See Fig. 3.15.)

$$(x - 8) + x + 2x = 72$$
$$x - 8 + x + 2x = 72$$
$$4x - 8 = 72$$
$$4x - 8 + 8 = 72 + 8$$
$$4x = 80$$
$$\frac{4x}{4} = \frac{80}{4}$$
$$x = 20$$

Think About It

The length of the first piece is $x - 8 = 20 - 8 = 12$ feet. Note that the lengths of the second and third pieces are $x = 20$ feet and $2x = 40$ feet, respectively.

Check: First piece: 12
Second piece: 20
Third piece: 40
Total length: 72

LEARNING TIP

Angles of a Triangle

Problems of this kind usually describe the relative measures of the three angles of a triangle. The task is to determine the measure of each angle. The basis for the equation in such problems is the theorem from geometry that states that the sum of the measures of the angles of a triangle is 180°.

EXAMPLE 4

The Measures of the Angles of a Triangle

A surveyor is mapping a plot of land in the form of a triangle. The second angle of the triangle is 21° greater than the first angle. The third angle is 11° more than twice the first angle. What are the measures of the three angles?

Examples

All sections contain numerous, titled Examples, many with multiple parts graded by difficulty. These Examples illustrate concepts, procedures, and techniques, and they reinforce the reasoning and critical thinking needed for problem solving. Detailed solutions include helpful comments that justify the steps taken and explain their purpose.

Figure 2.19

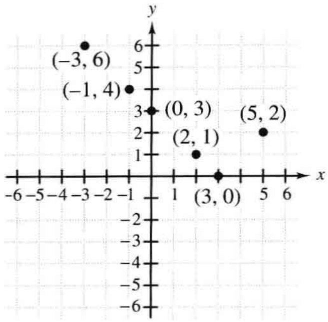


Figure 3.1

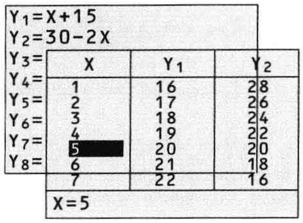
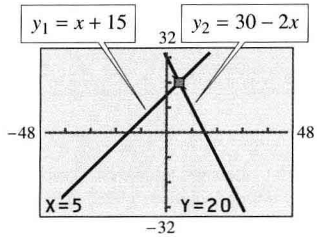


Figure 3.2



Graphs

Both traditional and calculator graphs are used throughout the exposition and exercises to assist students in visualizing concepts. Calculator displays are representative and are intended to resemble what students typically obtain on their own calculators.

Features for Discovery, Visualization, and Support

Decimal Usually you can set the number of decimal places that you want your calculator to display.

The set I of decimal numbers that neither terminate nor repeat is called the set of **irrational numbers.** Examples of irrational numbers are π and most square roots, such as $\sqrt{6}$, $\sqrt{15}$, and $-\sqrt{7}$. Note that $\sqrt{25} = 5$, and so $\sqrt{25}$ is a rational number.

Square Root Most calculators have a key for calculating square roots.

The rational numbers and the irrational numbers are two distinct sets of numbers. Taken together, the two sets form the set **R** of **real numbers.** We can think of the real numbers as all numbers with decimal representations. Figure 1.1 shows the relationships of the various sets of numbers that we have discussed.

Key Words

We indicate the appropriate use of a calculator with a Key Word and a short description of the pertinent calculator function. These Key Words appear at the initial point of use. Each Key Word references the accompanying *Graphing Calculator Keystroke Guide,* where specific keystroke information for several popular calculator models can be found, including the TI-83. Selected keys from typical graphing calculators are inside the back cover.

Function Notation

Consider the function defined by the equation $y = 2x + 1$. For convenience, we often use **function notation** to name the function and to indicate the value of the function.

$$f(x) = 2x + 1$$

The notation $f(x)$ is read "f of x." In this notation, the name of the function is f, the variable (domain element) is x, and the value of the function (range element) corresponding to x is $f(x)$.

Note: The parentheses in the notation $f(x)$ does *not* indicate multiplication. We read $f(x)$ as "f of x," *not* "f times x."

Just as we can use symbols other than x as a variable, we can use letters other than f to name a function. Each of the following defines the same function.

$$f(x) = x^2 - 3x + 4 \qquad g(t) = t^2 - 3t + 4 \qquad g(w) = w^2 - 3w + 4$$

Notes

Special remarks and cautionary notes that offer additional insight appear throughout the text.

In Chapter 1 we briefly considered equations and methods for testing whether numbers were solutions of equations. Now we present a more formal treatment of these topics along with some related vocabulary.

Definition of Equation

An **equation** is a statement that two algebraic expressions have the same value.

The expressions to the left and right of the equality symbol are called the *left side* and

15 ← right side

variable, we try to find replacements for that variable that call such replacements **solutions** of the equation.

Note: Because a table or a graph may or may not reveal an exact solution, we generally refer to solutions obtained in these ways as *estimates*. All solutions should be verified by substitution.

Here is a summary of the graphing approach to solving an equation.

Equation Solving: The Graphing Method

1. Graph y_1 = left side of the original equation.
2. Graph y_2 = right side of the original equation.
3. Trace to the point of intersection.
4. The x-coordinate of that point is the solution of the equation.
5. The y-coordinate is the value of both the left side and the right side of the original equation when x is replaced with the solution.

Definitions, Properties, and Procedures

Important definitions, properties, and procedures are shaded and titled for easy reference.

LEARNING TIP

Consider writing a word equation before you attempt to write an algebraic equation. For example, if you know or can represent the three quantities, then writing "original price − discount = sale price" gives you a guide for writing the actual equation.

When an item is placed on sale, the amount by which the price is reduced is called the **discount,** which is expressed as a percentage of the **original price.**

Retail store owners buy their goods at **wholesale prices.** Then, to cover overhead and the profit they want to make, they add an amount called **markup,** which is expressed as a percentage of the wholesale price. The result is the **retail price.**

EXAMPLE 2 Wholesale Price Plus Markup Equals Retail Price

All the goods at a hobby store are marked up 40%. If the retail price of one item is $32.13, what was the wholesale cost to the store owner?

Help the students translate this information into equations.

Original price − discount = sale price

Wholesale price + markup = retail price

Solution

Let w = the wholesale cost.

$$\text{Markup} = 0.40w \qquad \text{Markup} = 40\% \text{ of wholesale cost}$$

$$w + 0.40w = 32.13 \qquad \text{Wholesale cost} + \text{markup} = \text{retail price}$$

$$1.00w + 0.40w = 32.13$$

$$1.40w = 32.13$$

$$\frac{1.40w}{1.40} = \frac{32.13}{1.40}$$

$$w = 22.95$$

The wholesale cost was $22.95.

Think About It

Suppose that the wholesale price of an item is w and that the retail price reflects a 30% markup. If the item is later sold at a 20% discount, will the seller make money or lose money?

Fixed and Variable Costs

The cost of doing business can be separated into two components. One is the **fixed cost,** which is a cost that is incurred even if no products are sold or no service is rendered. The other component is the **variable cost,** which is a cost that depends on the number of products produced or sold or on the amount of service rendered.

Learning Tip

Every section now has at least one Learning Tip that offers students helpful strategies and alternative ways of thinking about concepts.

Think About It

New to the Second Edition, Think About It is a question or series of questions that requires critical thinking and reasoning in order to broaden and extend concepts. These questions are designed to spark students' imagination and interest and appear in the margin of each section. Answers appear in the Instructor's Annotated Edition.

End-of-Section Features

A typical section ends with Quick Reference and Section Exercises.

3.2 QUICK REFERENCE

Properties of Equations

- **Equivalent equations** are equations that have exactly the same solution sets.
- An equivalent equation results when
  1. the same quantity is added to or subtracted from both sides of an equation (Addition Property of Equations).
  2. both sides of an equation are multiplied or divided by the same nonzero quantity (Multiplication Property of Equations).
  3. the two sides of an equation are swapped (Symmetric Property of Equations).
  4. an expression in an equation is replaced with an equivalent expression (Substitution Property of Equations).

Applying the Properties

- The Addition Property of Equations can be used to eliminate a variable term from one side of an equation and to isolate a variable term.
- The Multiplication Property of Equations can be used to isolate a variable by eliminating the coefficient of the isolated variable term.

Quick Reference

Quick Reference appears at the end of all sections except those dealing exclusively with applications. These detailed summaries of the important rules, properties, and procedures are grouped by subsection for a handy reference and review tool.

Exercises

A typical exercise set in each section includes exercises from each of the following groups: Concepts and Skills (including Writing and Concept Extension), Real-Life Applications and Modeling with Real Data, Group Project, and Challenge.

Concepts and Skills

Most exercise sets begin with the basic skills and concepts discussed within the text. These include Writing Exercises, designed to help students gain confidence in their ability to communicate, and Concept Extension exercises, which go slightly beyond the text examples. The Concept Extension exercises are identified in the Instructor's Annotated as CE.

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3.2 EXERCISES

Concepts and Skills

1. What are equivalent equations?

2. What is an important advantage of the algebraic method over the graphing method for solving equations?

3. Consider the following two equations.

(i) $x + 2 = 3$ (ii) $-2x = 6$

When we solve these equations, explain why we *add* -2 to both sides of the first equation and *divide* both sides by -2 in the second equation.

4. The following are possible first steps in solving the equation $\frac{2}{3}x = 10$. Explain why each approach is correct.

(i) Multiply both sides by $\frac{3}{2}$.
(ii) Divide both sides by $\frac{2}{3}$.
(iii) Multiply both sides by 3 and then divide both sides by 2.

In Exercises 5–20, solve the equation algebraically and verify the solution. For special cases, write the solution set.

5. $5x + 8 = 23$ **6.** $4n - 7 = -35$
7. $7x - 5 = 8x + 7$ **8.** $7 + 8x = 4x - 13$
9. $3(3 - 2x) = 33 - 2x$
10. $2(3y + 8) = -2(2 - y)$
11. $7w - 5 = 11w - 5 - 4w$
12. $9w + 7 = 16w + 7(1 - w)$
13. $9x + 5 = 5x + 3(x - 1)$
14. $11x + 2(4 - 3x) = 3(3 - x) + 15$
15. $16 + 7(6 - x) = 15 - 4(x + 2)$
16. $7 - 4(t - 3) = 6t - 3(t + 3)$
17. $2(3a + 2) = 2(a + 1) + 4a$
18. $8t - 7 - 3t = 5t + 2$
19. $-2(x + 5) = 5(1 - x) + 3(7 - x)$
20. $2y - 3(2y - 3) = 2y - 5(3y - 4)$

In Exercises 5–20, encourage the use of a calculator for verifying solutions.

21. Consider solving the equation $\frac{1}{3} - 2x = \frac{2}{5}$. To clear fractions, we multiply both sides by 15. Why is it necessary to multiply $2x$ by 15?

22. What is the solution set of $3x = 2x$? Now divide both sides of $3x = 2x$ by x. What is the solution set of the resulting equation? Why are the equations not equivalent?

In Exercises 23–32, solve the given equation and use your calculator to verify the solution.

23. $2x - \frac{3}{4} = -\frac{5}{6}$ **24.** $\frac{2}{15}y + \frac{3}{5} = 2 - \frac{2}{3}y$
25. $\frac{y}{2} + \frac{y}{4} = \frac{7}{8} - \frac{y}{8}$ **26.** $\frac{5 + 3x}{2} + 7 = 2x$
27. $\frac{5}{4}(x + 2) = \frac{x}{2}$
28. $\frac{1}{4}(x - 4) = \frac{1}{3}(x + 6)$
29. $x + \frac{3x - 1}{9} = 4 + \frac{3x + 1}{3}$
30. $\frac{2x}{5} - \frac{2x - 1}{2} = \frac{x}{5}$
31. $\frac{1}{4} + \frac{1}{6}(4a + 5) = 2(a - 3) + \frac{5}{12}$
32. $\frac{5}{6}(1 - t) - \frac{t}{2} = -\frac{1}{3}(1 - 3t)$

Using a calculator to verify solutions is particularly helpful for more complicated equations.

In Exercises 33–36, solve the given equation and use your calculator to verify the solution.

33. $2.6 = 0.4z + 1$
34. $1 - 0.3c = -0.5$
35. $0.08x + 0.15(x + 200) = 7$
36. $0.6(2x + 1) - 0.4(x - 2) = 1$

CE In Exercises 37–42, determine whether the given equations are equivalent equations.

37. $x + 4 = 7$ and $3x - 5 = 4$
38. $\frac{1}{3}x = 2$ and $x + 3 = 9$
39. $x + 3 = 4 + x$ and $2x - 3 = 4 + 2x$
40. $x + 3 = 3 + x$ and $2x - 5 = -(5 - 2x)$

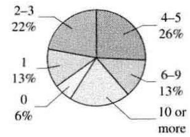
End-of-Section Features

Group Project

Group Projects now appear in the exercises for many sections. These series of exercises focus on real data and allow students to work together to solve problems. An index of Group Projects is inside the back cover.

Group Project: ATM Cards

Research indicates that about 60% of American adults have automatic teller machine (ATM) cards. The accompanying pie chart shows the percentages of those cardholders who use their cards a certain number of times per month. (Source: Research Partnership.)



91. What percent of the cardholders use their cards fewer than four times per month?

92. What percent of the cardholders use their cards at least ten times per month?

93. Why does the data not allow you to determine the actual number of cardholders in any of the categories?

94. Bank fees for ATM use have increased dramatically. Do you think that higher fees might affect the percentages shown in the pie chart? If so, in what way?

Graphing Calculator Icon

Exercises best completed with a graphing calculator are now identified by icon in the Instructor's Annotated Edition. The icons do not appear in the student text to allow instructors flexibility in planning assignments and to help students determine appropriate use.

69. If the population continues to grow according to the function P, what is the projected population in the year 2000?

70. Does the shape of the graph suggest that the gray wolf population will increase indefinitely? What natural factors might change the shape of the graph in the future?

Challenge

In Exercises 71–76, use the integer setting to graph each function. Then write the set of x-values for which

(a) $y \le 0$. (b) $y \ge 0$.

71. $y = x - 3$ **72.** $y = x + 4$

73. $y = x^2 - 9$ **74.** $y = 9 - x^2$

75. $y = \sqrt{x}$ **76.** $y = |x| + 1$

77. (a) Draw a graph of the following piece-wise function.

$$f(x) = \begin{cases} x + 3, & x < 0 \\ 5, & x = 0 \\ -x, & x > 0 \end{cases}$$

(b) What is the absolute maximum of the function?

(c) In words, how would you describe your estimate of the range of the function?

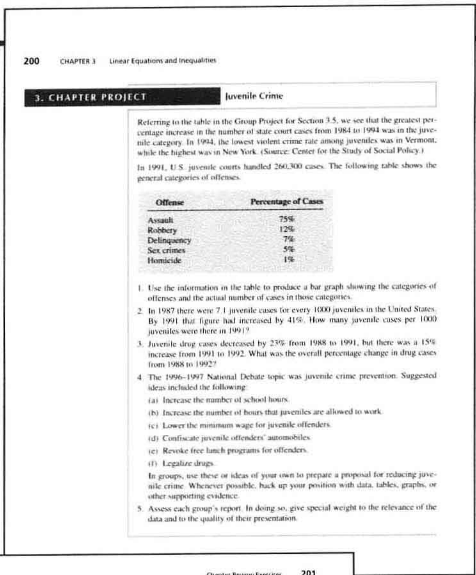
78. Consider the **constant function** $g(x) = 5$.

(a) What are the domain and range of g?

(b) We say that a function f is an **increasing function** if $f(x_2) \ge f(x_1)$ when $x_2 > x_1$ for all x in the domain of f. Explain why function g is an increasing function.

Challenge

These problems appear at the end of most exercise sets and offer more challenging work than the standard and Concept Extension problems.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3. CHAPTER PROJECT Juvenile Crime

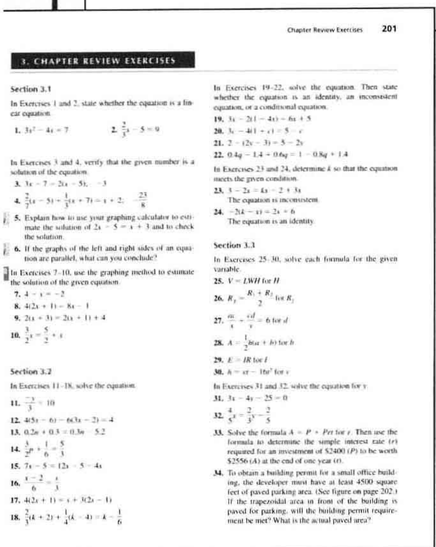
Offense	Percentage of Cases
Assault	75%
Robbery	12%
Delinquency	7%
Sex crimes	5%
Homicide	1%

Chapter Project

Each Chapter Project is the culmination of the real-data application introduced in the chapter opener and continued in a Group Project. These more in-depth projects emphasize the organization, modeling, and interpretation of data, and they provide opportunities for students to report their findings. Topics are listed in the Contents. Answers appear in the Instructor's Annotated Edition.

Chapter Review Exercises

Each chapter ends with a set of review exercises. These exercises include helpful section references that direct students to the appropriate sections for review. The answers to the odd-numbered review exercises are included at the back of the text.


Chapter Review Exercises 201

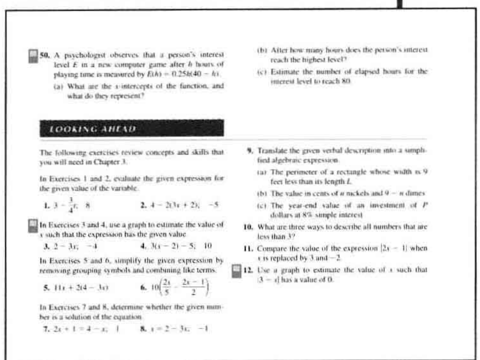
3. CHAPTER REVIEW EXERCISES

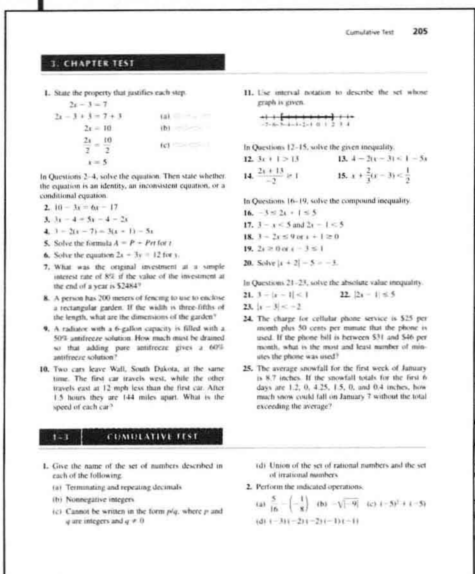
End-of-Chapter Features

At the end of each chapter, these features appear in the following order: Chapter Project, Chapter Review Exercises, Looking Ahead (except Chapter 12), Chapter Test, Cumulative Test (at the end of selected chapters).

Looking Ahead

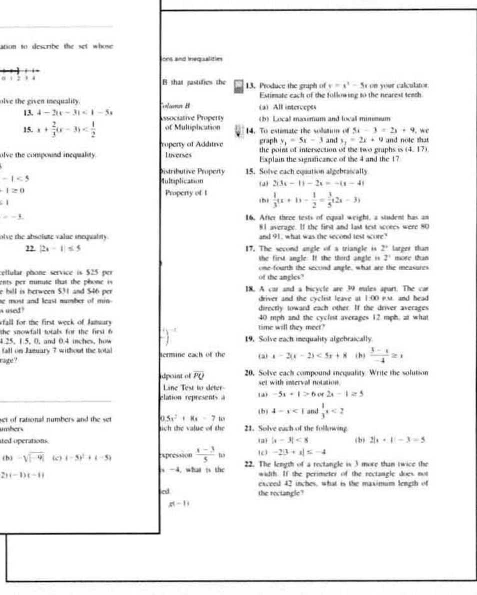
New to the second edition, this short list of review exercises focuses on previously discussed skills and concepts that will be needed in the upcoming chapter. Answers are included in the Instructor's Annotated Edition.


LOOKING AHEAD


Cumulative Test 205

3. CHAPTER TEST

1–3 CUMULATIVE TEST



Chapter Test

A Chapter Test follows each chapter review. The answers to all the test questions, with the appropriate section references, are included at the back of the text.

Cumulative Test

A Cumulative Test appears at the end of Chapters 3, 5, 7, 10 and 12. The answers to all the test questions, with section references, are included at the back of the text.

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