GRADE 8 MATHEMATICS

Real-World Problem Solving

Complete Student Edition

GLOBAL SOVEREIGN UNIVERSITY

"Building a Bridge to Freedom Through Education"

Grade 8 Mathematics: Real-World Problem Solving

Student Edition

Why This Book Is Different

🏆 **NOBEL PRIZE RESEARCH SAYS:**

"Students who score 96% on classroom math tests succeed only 1% of the time in real life."

— Banerjee & Duflo, Nature, February 2025

The Research That Proves Traditional Math Education Fails

In February 2025, Nobel Prize-winning economists published a groundbreaking study in Nature, the world's most respected scientific journal. They tested over 1,400 children in India and discovered something shocking:

Children who ace classroom math CANNOT use it in the real world.

Students who scored 96% on standard school math problems could solve simple real-world market calculations only 1% of the time. Meanwhile, children who worked in markets—without formal education—solved the same problems with 96% accuracy.

The researchers' conclusion was clear:

> "Schools need to build a bridge between math learned in the classroom and math encountered in real-life situations."

The Problem: Abstract Doesn't Transfer to Applied

The Nobel laureates found that school children learned procedures but not understanding. They could solve '3x + 7 = 22' on a worksheet by following memorized steps. But give them a real problem—' You earned $22 from selling items at $3 each plus a $7 bonus. How many items did you sell?'—and they froze.

Market children used efficient mental strategies: estimation, breaking complex problems into simpler parts, and working with meaningful quantities. School children followed rigid, slow methods that worked for tests but failed in life.

It's not that school kids were less intelligent. It's that their education never connected the math to reality.

The GSU Solution: Real-World Math

This textbook does exactly what the Nobel laureates recommend. Instead of abstract problems, every calculation has a professional context:

Traditional Math vs GSU Real-World Math

Traditional Math	GSU Real-World Math
"Solve: $3x + 7 = 22$"	"You're the Entrepreneur. You sold items for $3 each plus a $7 base. You made $22. How many items?"
"Find the slope of $y = 2x - 5$."	"As Project Manager, your team completes 2 modules/week, with 5 already done. When will you finish 15?"
"Calculate $\sqrt{(3^2 + 4^2)}$."	"As a Surveyor, measure the distance across a lake using stakes 3m and 4m apart."

Same math. Completely different learning.

Your Roles in This Book

You won't just learn math in this book. You'll BE someone who uses it:

- The Data Scientist — Real numbers, rational and irrational
- The Engineer — Exponents and square roots
- The Space Scientist — Scientific notation applications
- The Entrepreneur — Multi-step equations
- The Project Manager — Functions and linear relationships
- The Systems Analyst — Systems of equations
- The Surveyor — Pythagorean theorem
- The Animator — Transformations
- The Architect — Angle relationships
- The Industrial Designer — Volume of 3D figures
- The Market Researcher — Data analysis and scatter plots
- The Risk Analyst — Probability

These aren't pretend jobs. These are skills you can use THIS WEEK.

The Bottom Line

Nobel Prize-winning researchers proved that traditional education fails to prepare students for real-world math. The gap between classroom success and life success is catastrophic: 96% to 1%.

This textbook closes that gap.

Every problem. Every skill. Every chapter. Connected to reality.

"Because math isn't an academic exercise. It's a survival skill."

Dr. Gene A Constant

Global Sovereign University is a 501(c)(3) educational foundation. This textbook is provided FREE because learning should never be limited by economics.

Research Citation:

Banerjee, A., Duflo, E., et al. (2025). Children's arithmetic skills do not transfer between applied and academic mathematics. Nature. https://doi.org/10.1038/s41586-024-08502-w

The lead authors received the 2019 Nobel Prize in Economics "for their experimental approach to alleviating global poverty."

Table of Contents

Welcome!

This year, you become a problem solver who uses mathematics in the real world.

You'll take on exciting roles:

- Data Scientist: Classify and work with real numbers
- Engineer: Apply exponent rules and calculate roots
- Space Scientist: Calculate with astronomical numbers
- Entrepreneur: Solve complex business equations
- Project Manager: Model relationships with functions
- Systems Analyst: Solve interconnected problems
- Surveyor: Measure distances with the Pythagorean theorem
- Animator: Transform shapes and create motion
- Architect: Design with angles and parallel lines
- Industrial Designer: Calculate volumes of complex shapes
- Market Researcher: Analyze trends and make predictions
- Risk Analyst: Calculate probabilities for decisions

How to Use This Book:

📋 The Scenario: Step into a real role

📚 The Skill: Learn the mathematics

✏️ Worked Examples: See step-by-step solutions

📝 Practice Problems: Build mastery

📊 Action Reports: Apply everything

Remember: Show your work! The process matters as much as the answer.

CHAPTER 1

The Data Scientist

Master the real number system to classify and compute with any number

What You'll Learn

- Distinguish between rational and irrational numbers
- Locate real numbers on the number line
- Approximate irrational numbers
- Perform operations with rational and irrational numbers

Why This Matters

Data scientists work with numbers constantly—from tiny decimals to massive datasets. Some numbers are clean and exact (like 0.5 or 3/4), while others go on forever without repeating (like π or $\sqrt{2}$). Understanding the difference helps you choose the right level of precision for calculations that matter.

Section 1.1: Classifying Numbers

The real number system organizes all numbers into categories based on their properties.

The Number Hierarchy

Natural Numbers (N): 1, 2, 3, 4, ... (counting numbers)

Whole Numbers (W): 0, 1, 2, 3, 4, ... (natural numbers + zero)

Integers (Z): ..., -3, -2, -1, 0, 1, 2, 3, ... (whole numbers + negatives)

Rational Numbers (Q): Any number that can be written as a fraction a/b where a and b are integers and $b \neq 0$

Irrational Numbers: Numbers that CANNOT be written as a fraction—their decimals go on forever without repeating

Real Numbers (R): All rational and irrational numbers combined

Rational: Can be written as a/b | Irrational: Cannot be written as a/b

Recognizing Rational Numbers

A number is rational if its decimal representation either:

- Terminates (ends): 0.25, 3.5, -2.125
- Repeats: 0.333..., 0.142857142857..., 2.166666...

WORKED EXAMPLE: Classifying 0.375

Step 1: Check if decimal terminates or repeats: 0.375 terminates

Step 2: Convert to fraction: 0.375 = 375/1000 = 3/8

Step 3: Since it can be written as a fraction, it is RATIONAL

Recognizing Irrational Numbers

Common irrational numbers:

- $\pi \approx 3.14159265358979...$ (never repeats, never ends)
- $\sqrt{2} \approx 1.41421356237...$ (square root of any non-perfect square)
- $e \approx 2.71828182845...$ (Euler's number)

Practice Problems: Section 1.1

1. Classify each number as rational or irrational: 0.666..., $\sqrt{5}$, -4/7, π, 3.14

Work: ____

Answer: ____________________________

2. A data scientist records a measurement as 2.718281828... Is this rational or irrational? Explain.

Work: ____

Answer: ____________________________

3. Convert 0.875 to a fraction. Is it rational?

Work: ____

Answer: ____________________________

4. Is $\sqrt{16}$ rational or irrational? What about $\sqrt{17}$?

Work: ____

Answer: ____________________________

5. Between which two consecutive integers does $\sqrt{50}$ fall?

Work: ____

Answer: ____________________________

Section 1.2: Approximating Irrational Numbers

Since irrational numbers have infinite non-repeating decimals, we often need to approximate them.

WORKED EXAMPLE: Approximating √7

Step 1: Find perfect squares near 7: 4 < 7 < 9

Step 2: Take square roots: √4 < √7 < √9, so 2 < √7 < 3

Step 3: Since 7 is closer to 9 than 4, √7 is closer to 3 than 2

Step 4: Estimate: √7 ≈ 2.6 (actual: 2.6457...)

Practice Problems: Section 1.2

6. Between which two consecutive integers is √30?

Work: ____

Answer: ______________________

7. Approximate √45 to one decimal place.

Work: ____

Answer: ______________________

8. Order from least to greatest: √10, 3, π, 3.2

Work: ____

Answer: ______________________

9. A square plot of land has area 200 sq ft. Approximate the side length.

Work: ____

Answer: ______________________

10. Plot √3, √5, and √8 on a number line between 1 and 3.

Work: ____

Answer: ______________________

Section 1.3: Operations with Real Numbers

When you add, subtract, multiply, or divide real numbers, the result type depends on what you started with.

Key Rules

Rational + Rational = Rational (always)

Rational × Rational = Rational (always)

Irrational + Irrational = Can be either (√2 + √2 = 2√2 is irrational, but √2 + (-√2) = 0 is rational)

Rational × Irrational = Irrational (usually, except when multiplying by 0)

Irrational × Irrational = Can be either (√2 × √2 = 2 is rational, but √2 × √3 = √6 is irrational)

Practice Problems: Section 1.3

11. Is 3 + √5 rational or irrational? Explain.

Work: ____

Answer: ______________________

12. Simplify: √2 × √8. Is the result rational or irrational?

Work: ____

Answer: ______________________

13. Is 0.333... + 0.666... rational? Calculate the sum as a fraction.

Work: ____

Answer: ______________________

14. A data set has values: 2, √9, π, 4.5, √2. Which are rational?

Work: ____

Answer: ______________________

15. If a = √3 and b = √12, find ab. Is the result rational or irrational?

Work: ____

Answer: ______________________

Chapter 1 Review

16. Classify as rational or irrational: -8, √49, 0.121212..., √10, 22/7

Work: ____

Answer: ____________________

17. Order from least to greatest: -√5, -2, -2.5, -√3

Work: ____

Answer: ____________________

18. A sensor measures π × 2.5 meters. Express as a decimal (approximate).

Work: ____

Answer: ____________________

19. Is 3.14159 rational or irrational? Is π rational or irrational? Explain the difference.

Work: ____

Answer: ____________________

20. CHALLENGE: Prove that √2 + √3 is irrational. (Hint: Assume it equals a rational number p/q)

Work: ____

Answer: ____________________

CHAPTER 2

The Engineer

Master exponents and radicals to calculate power, efficiency, and precision

What You'll Learn

- Apply properties of integer exponents
- Evaluate expressions with zero and negative exponents
- Simplify square roots and cube roots
- Add, subtract, and multiply radical expressions

Why This Matters

Engineers calculate forces, design structures, and analyze systems using exponents and radicals constantly. When designing a bridge, you calculate stress using squares. When determining tank capacity, you use cube roots. These aren't abstract concepts—they're the math that keeps buildings standing.

Section 2.1: Properties of Integer Exponents

The Exponent Rules

Product Rule: $a^m \times a^n = a^{m+n}$

Quotient Rule: $a^m \div a^n = a^{m-n}$

Power Rule: $(a^m)^n = a^{mxn}$

Zero Exponent: $a^0 = 1$ (when $a \neq 0$)

Negative Exponent: $a^{-n} = 1/a^n$

WORKED EXAMPLE: Simplify $2^4 \times 2^3$

Step 1: Apply product rule: add exponents with same base

Step 2: $2^4 \times 2^3 = 2^{4+3} = 2^7$

Step 3: Calculate: $2^7 = 128$

WORKED EXAMPLE: Simplify $5^6 \div 5^2$

Step 1: Apply quotient rule: subtract exponents

Step 2: $5^6 \div 5^2 = 5^{6-2} = 5^4$

Step 3: Calculate: $5^4 = 625$

Practice Problems: Section 2.1

1. Simplify: $3^5 \times 3^2$ = ____
Work: ______________________________
Answer: ______________________________

2. Simplify: $7^8 \div 7^3$ = ____
Work: ______________________________
Answer: ______________________________

3. Simplify: $(4^2)^3$ = ____
Work: ______________________________
Answer: ______________________________

4. Evaluate: 8^0 = ____
Work: ______________________________
Answer: ______________________________

5. Simplify: $2^5 \times 2^{-3}$ = ____
Work: ______________________________
Answer: ______________________________

Section 2.2: Negative and Zero Exponents

A negative exponent means 'take the reciprocal.'

WORKED EXAMPLE: Evaluate 3^{-2}

Step 1: Apply negative exponent rule: $3^{-2} = 1/3^2$
Step 2: Calculate: $1/3^2 = 1/9$

WORKED EXAMPLE: Simplify $(2/5)^{-3}$

Step 1: Apply negative exponent: $(2/5)^{-3} = (5/2)^3$
Step 2: Calculate: $(5/2)^3 = 125/8$

Practice Problems: Section 2.2

6. Evaluate: 4^{-2} = ____
Work: ______________________________
Answer: ______________________________

7. Evaluate: 10^{-3} = ____
Work: ____________________
Answer: ____________________

8. Simplify: $2^4 \times 2^{-6}$ = ____
Work: ____________________
Answer: ____________________

9. Simplify: $(3^{-2})^2$ = ____
Work: ____________________
Answer: ____________________

10. An engineer calculates force as $F = 10^6 \times 10^{-4}$ N. Simplify.
Work: ____________________
Answer: ____________________

Section 2.3: Square Roots and Cube Roots

$\sqrt{a}$ means 'what number times itself equals a?'

$\sqrt[3]{a}$ means 'what number times itself 3 times equals a?'

Perfect Squares and Cubes

Perfect squares: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144...

Perfect cubes: 1, 8, 27, 64, 125, 216, 343, 512, 729, 1000...

WORKED EXAMPLE: Simplify $\sqrt{72}$

Step 1: Find largest perfect square factor: $72 = 36 \times 2$
Step 2: Split the radical: $\sqrt{72} = \sqrt{36} \times \sqrt{2}$
Step 3: Simplify: $\sqrt{36} \times \sqrt{2} = 6\sqrt{2}$

Practice Problems: Section 2.3

11. $\sqrt{144}$ = ____
Work: ____________________
Answer: ____________________

12. $\sqrt[3]{27}$ = ____
Work: ____________________
Answer: ____________________

13. Simplify: $\sqrt{50}$ = ____
Work: ____
Answer: ____________________

14. Simplify: $\sqrt{128}$ = ____
Work: ____
Answer: ____________________

15. A cube has volume 343 cm^3. What is its side length?
Work: ____
Answer: ____________________

Section 2.4: Operations with Radicals

You can add/subtract radicals only if they have the same radicand (number under the radical).

$$a\sqrt{c} + b\sqrt{c} = (a + b)\sqrt{c}$$

$$\sqrt{a} \times \sqrt{b} = \sqrt{(ab)}$$

WORKED EXAMPLE: Simplify $3\sqrt{5} + 7\sqrt{5}$

Step 1: Same radicand (5), so add coefficients

Step 2: $3\sqrt{5} + 7\sqrt{5} = (3 + 7)\sqrt{5} = 10\sqrt{5}$

Practice Problems: Section 2.4

16. Simplify: $4\sqrt{3} + 2\sqrt{3}$ = ____
Work: ____
Answer: ____________________

17. Simplify: $\sqrt{5} \times \sqrt{20}$ = ____
Work: ____
Answer: ____________________

18. Simplify: $\sqrt{12} + \sqrt{27}$ = ____
Work: ____
Answer: ____________________

19. Simplify: $2\sqrt{8} - \sqrt{32}$ = ____
Work: ______________________________
Answer: ______________________________

20. A rectangular beam has width $\sqrt{18}$ cm and length $\sqrt{2}$ cm. Find the area.
Work: ______________________________
Answer: ______________________________

Chapter 2 Review

21. Simplify: $(2^3 \times 2^5) \div 2^4$ = ____
Work: ______________________________
Answer: ______________________________

22. Evaluate: $5^{-2} + 5^0$ = ____
Work: ______________________________
Answer: ______________________________

23. Simplify: $\sqrt{200}$ = ____
Work: ______________________________
Answer: ______________________________

24. Simplify: $3\sqrt{7} - \sqrt{28}$ = ____
Work: ______________________________
Answer: ______________________________

25. CHALLENGE: If $2^x = 32$ and $3^y = 81$, find $x + y$.
Work: ______________________________
Answer: ______________________________

CHAPTER 3

The Space Scientist

Master scientific notation to calculate cosmic distances and microscopic measurements

What You'll Learn

- Write numbers in scientific notation
- Convert between standard form and scientific notation
- Perform operations with numbers in scientific notation
- Compare very large and very small numbers

Why This Matters

Space scientists work with numbers that are impossibly large (93 million miles to the Sun) and impossibly small (atoms measured in billionths of a meter). Scientific notation makes these numbers manageable—and comparable. It's the language of science.

Section 3.1: Understanding Scientific Notation

Scientific Notation: $a \times 10^n$ where $1 \leq a < 10$

Large numbers: positive exponent (move decimal left)

Small numbers: negative exponent (move decimal right)

WORKED EXAMPLE: Write 93,000,000 in scientific notation

Step 1: Move decimal until you have a number between 1 and 10: 9.3

Step 2: Count places moved: 7 places to the left

Step 3: Write: 9.3×10^7

WORKED EXAMPLE: Write 0.00045 in scientific notation

Step 1: Move decimal until you have a number between 1 and 10: 4.5

Step 2: Count places moved: 4 places to the right

Step 3: Since original number is small, exponent is negative: 4.5×10^{-4}

Practice Problems: Section 3.1

1. Write in scientific notation: 45,000,000 = ____

Work: ____

Answer: ____________________

2. Write in scientific notation: 0.00067 = ____

Work: ______________________________

Answer: ______________________________

3. Write in standard form: 3.8×10^5 = ____

Work: ______________________________

Answer: ______________________________

4. Write in standard form: 2.1×10^{-4} = ____

Work: ______________________________

Answer: ______________________________

5. The distance to Alpha Centauri is 40,000,000,000,000 km. Write in scientific notation.

Work: ______________________________

Answer: ______________________________

Section 3.2: Multiplying and Dividing

$$(a \times 10^m) \times (b \times 10^n) = (a \times b) \times 10^{m+n}$$

$$(a \times 10^m) \div (b \times 10^n) = (a \div b) \times 10^{m-n}$$

WORKED EXAMPLE: Calculate $(3 \times 10^4) \times (2 \times 10^3)$

Step 1: Multiply the coefficients: $3 \times 2 = 6$

Step 2: Add the exponents: $10^4 \times 10^3 = 10^7$

Step 3: Combine: 6×10^7

Practice Problems: Section 3.2

6. $(4 \times 10^5) \times (3 \times 10^2)$ = ____

Work: ______________________________

Answer: ______________________________

7. $(8 \times 10^7) \div (2 \times 10^3)$ = ____

Work: ______________________________

Answer: ______________________________

8. $(5 \times 10^{-3}) \times (6 \times 10^5)$ = ____

Work: ______________________________

Answer: ______________________________

9. Light travels 3×10^8 m/s. How far in 5×10^2 seconds?
Work: ____
Answer: ____________________

10. A spacecraft travels 4.8×10^{12} km in 8×10^4 hours. Speed?
Work: ____
Answer: ____________________

Section 3.3: Adding and Subtracting

To add or subtract in scientific notation, the exponents must be the same.

WORKED EXAMPLE: Calculate $(4.2 \times 10^5) + (3.1 \times 10^4)$

Step 1: Rewrite with the same exponent: $3.1 \times 10^4 = 0.31 \times 10^5$
Step 2: Add coefficients: $4.2 + 0.31 = 4.51$
Step 3: Result: 4.51×10^5

Practice Problems: Section 3.3

11. $(6.5 \times 10^6) + (2.3 \times 10^6) =$ ____
Work: ____
Answer: ____________________

12. $(8.4 \times 10^5) - (3.2 \times 10^4) =$ ____
Work: ____
Answer: ____________________

13. Planet A is 5.8×10^8 km away. Planet B is 3.2×10^7 km away. Difference?
Work: ____
Answer: ____________________

14. Budget: \$$2.4 \times 10^7$. Spent: \$$8.6 \times 10^6$. Remaining?
Work: ____
Answer: ____________________

15. Two particles have masses 9.1×10^{-31} kg and 1.7×10^{-27} kg. Total mass?
Work: ____
Answer: ____________________

Section 3.4: Comparing in Scientific Notation

To compare: First compare exponents, then coefficients if exponents are equal.

Practice Problems: Section 3.4

16. Which is larger: 3.5×10^8 or 9.2×10^7?

Work: ____

Answer: ______________________

17. Order from least to greatest: 2.3×10^5, 8.1×10^4, 1.9×10^5

Work: ____

Answer: ______________________

18. The Sun is 1.5×10^8 km from Earth. Mars is 2.3×10^8 km. How many times farther is Mars?

Work: ____

Answer: ______________________

19. A virus is 2×10^{-7} m. A bacterium is 5×10^{-6} m. How many times larger is the bacterium?

Work: ____

Answer: ______________________

20. Earth's mass: 6×10^{24} kg. Jupiter's mass: 1.9×10^{27} kg. How many Earths equal Jupiter?

Work: ____

Answer: ______________________

Chapter 3 Review

21. Write 0.0000089 in scientific notation.

Work: ____

Answer: ______________________

22. $(7.2 \times 10^4) \times (1.5 \times 10^{-2}) =$ ____

Work: ____

Answer: ______________________

23. A satellite orbits at 3.6×10^7 m. Convert to km.

Work: ____

Answer: ___________________________

24. How many seconds in a year? (365 days) Express in scientific notation.

Work: ____

Answer: ___________________________

25. CHALLENGE: If the universe is 1.4×10^{10} years old and light travels 9.5×10^{12} km/year, what's the maximum observable universe radius?

Work: ____

Answer: ___________________________

CHAPTER 4

The Entrepreneur

Master multi-step equations to analyze profit, loss, and business scenarios

What You'll Learn

- Solve equations with variables on both sides
- Solve equations with parentheses and distribution
- Identify equations with one, none, or infinite solutions
- Write and solve equations from word problems

Why This Matters

Entrepreneurs solve equations daily: 'If I price my product at \$x and sell 100 units minus \$500 in costs, when does profit equal \$2,000?' Business success depends on setting up and solving these equations correctly.

Section 4.1: Variables on Both Sides

When variables appear on both sides, collect them on one side first.

WORKED EXAMPLE: Solve $5x + 3 = 2x + 15$

Step 1: Subtract 2x from both sides: $5x - 2x + 3 = 15$

Step 2: Simplify: $3x + 3 = 15$

Step 3: Subtract 3 from both sides: $3x = 12$

Step 4: Divide by 3: $x = 4$

Practice Problems: Section 4.1

1. Solve: $7x + 4 = 3x + 20$

Work: ____

Answer: ____________________

2. Solve: $9x - 5 = 4x + 15$

Work: ____

Answer: ____________________

3. Solve: $8x - 12 = 5x + 6$

Work: ____

Answer: ____________________

4. Solve: $2x + 18 = 6x - 2$

Work: ____

Answer: ____________________

5. Company A charges $50 + $20/hr. Company B charges $30 + $25/hr. When are they equal?

Work: ____

Answer: ____________________

Section 4.2: Equations with Parentheses

Use the distributive property first, then solve.

WORKED EXAMPLE: Solve $3(x + 4) = 2(x - 1) + 17$

- **Step 1:** Distribute: $3x + 12 = 2x - 2 + 17$
- **Step 2:** Simplify right side: $3x + 12 = 2x + 15$
- **Step 3:** Subtract 2x: $x + 12 = 15$
- **Step 4:** Subtract 12: $x = 3$

Practice Problems: Section 4.2

6. Solve: $4(x - 2) = 24$

Work: ____

Answer: ____________________

7. Solve: $2(3x + 5) = 4(x + 6)$

Work: ____

Answer: ____________________

8. Solve: $5(x - 3) - 2x = 3(x + 1)$

Work: ____

Answer: ____________________

9. Solve: $-2(4x - 3) = 3(2 - x) + 5$

Work: ____

Answer: ____________________

10. A phone plan costs $40 + $5(g - 2) for g GB. Another costs $25 + $8(g - 1). When equal?

Work: ____

Answer: ____________________

Section 4.3: Special Cases

One Solution, No Solution, or Infinite Solutions

One solution: Variables cancel to give x = a number

No solution: Variables cancel to give a false statement (like 5 = 3)

Infinite solutions: Variables cancel to give a true statement (like 4 = 4)

WORKED EXAMPLE: Solve 2(x + 3) = 2x + 6

Step 1: Distribute: 2x + 6 = 2x + 6

Step 2: Subtract 2x: 6 = 6

Step 3: True statement! INFINITE SOLUTIONS (identity)

Practice Problems: Section 4.3

11. Solve: 3(x + 2) = 3x + 8. How many solutions?

Work: ____

Answer: ______________________________

12. Solve: 5x + 10 = 5(x + 2). How many solutions?

Work: ____

Answer: ______________________________

13. Solve: 4(x - 1) = 2(2x + 3). How many solutions?

Work: ____

Answer: ______________________________

14. Solve: 6x - 3 = 3(2x - 1). How many solutions?

Work: ____

Answer: ______________________________

15. Create an equation with no solution using the form ax + b = ax + c.

Work: ____

Answer: ______________________________

Chapter 4 Review

16. Solve: $8x - 7 = 3x + 18$

Work: ____

Answer: ____________________

17. Solve: $4(2x - 3) = 3(x + 4) + x$

Work: ____

Answer: ____________________

18. Monthly profit: Revenue = \$50x, Costs = \$2000 + \$20x. Find break-even units.

Work: ____

Answer: ____________________

19. Solve: $0.5(x + 4) = 0.25(2x + 16)$

Work: ____

Answer: ____________________

20. CHALLENGE: The sum of three consecutive integers is 99. Find the integers.

Work: ____

Answer: ____________________

CHAPTER 5

The Project Manager

Master functions and linear relationships to model and predict outcomes

What You'll Learn

- Understand and identify functions
- Use function notation
- Write linear equations in slope-intercept form
- Graph linear functions and interpret slope and y-intercept

Why This Matters

Project managers track progress, predict completion dates, and allocate resources. 'If my team completes 3 modules per week and we've finished 5, when will we hit 20? 'Functions model these relationships, letting you predict the future from the present.

Section 5.1: Understanding Functions

A function assigns exactly ONE output for each input

Think of a function as a machine: put in a number, get out exactly one result.

The Vertical Line Test

If a vertical line crosses a graph more than once, it's NOT a function.

Practice Problems: Section 5.1

1. Is this a function? {(1, 3), (2, 5), (3, 7), (4, 9)}

Work: ____

Answer: ____________________

2. Is this a function? {(2, 4), (3, 5), (2, 6), (4, 8)}

Work: ____

Answer: ____________________

3. A vending machine takes $1.50 and gives one snack. Is this a function? Explain.

Work: ____

Answer: ____________________

4. Does $y = x^2$ represent a function? Why or why not?

Work: ____

Answer: ____________________

5. Does $x = y^2$ represent a function? Why or why not?

Work: ____

Answer: ____________________

Section 5.2: Function Notation

f(x) means 'the output of function f when the input is x'

WORKED EXAMPLE: If f(x) = 3x - 2, find f(5)

Step 1: Replace x with 5: f(5) = 3(5) - 2

Step 2: Calculate: f(5) = 15 - 2 = 13

Practice Problems: Section 5.2

6. If f(x) = 2x + 7, find f(4).

Work: ____

Answer: ____________________

7. If $g(x) = x^2 - 3x$, find g(5).

Work: ____

Answer: ____________________

8. If h(x) = 4x - 1, find h(-2).

Work: ____

Answer: ____________________

9. If f(x) = 2x + 3, find x when f(x) = 15.

Work: ____

Answer: ____________________

10. Project progress: P(w) = 3w + 5 modules after w weeks. Modules after 8 weeks?

Work: ____

Answer: ____________________

Section 5.3: Slope-Intercept Form

$$y = mx + b$$

m = slope (rate of change)

b = y-intercept (starting value)

Finding Slope

$$\text{slope} = (y_2 - y_1) / (x_2 - x_1) = \text{rise} / \text{run}$$

WORKED EXAMPLE: Find slope through (2, 5) and (6, 13)

Step 1: Use slope formula: m = (13 - 5) / (6 - 2)

Step 2: Calculate: m = 8 / 4 = 2

Practice Problems: Section 5.3

11. Find the slope between (1, 4) and (5, 12).

Work: ____

Answer: ______________________________

12. Find the slope between (-2, 8) and (4, -4).

Work: ____

Answer: ______________________________

13. What are the slope and y-intercept of y = -3x + 7?

Work: ____

Answer: ______________________________

14. Write the equation: slope = 4, y-intercept = -2

Work: ____

Answer: ______________________________

15. A line passes through (0, 5) with slope 2. Write the equation.

Work: ____

Answer: ______________________________

Section 5.4: Writing Equations from Two Points

WORKED EXAMPLE: Write the equation of a line through (2, 7) and (4, 13)

Step 1: Find slope: m = (13 - 7) / (4 - 2) = 6/2 = 3

Step 2: Use point-slope with (2, 7): y - 7 = 3(x - 2)

Step 3: Simplify: y - 7 = 3x - 6

Step 4: Solve for y: y = 3x + 1

Practice Problems: Section 5.4

16. Write the equation through (1, 5) and (3, 11).

Work: ____

Answer: ______________________________

17. Write the equation through (0, -3) and (4, 5).

Work: ____

Answer: ______________________________

18. Week 2: 11 units complete. Week 5: 26 units complete. Write P(w).

Work: ____

Answer: ______________________________

19. After 3 hours, 45 miles traveled. After 7 hours, 105 miles. Write d(t).

Work: ____

Answer: ______________________________

20. Temperature drops from 68°F at 6 PM to 50°F at 10 PM. Write T(h).

Work: ____

Answer: ______________________________

Chapter 5 Review

21. If $f(x) = -2x + 8$, find $f(-3)$ and $f(0)$.
Work: ____
Answer: ______________________

22. Graph $y = 2x - 3$. Identify slope and y-intercept.
Work: ____
Answer: ______________________

23. Are these points on the same line? (0, 4), (2, 10), (5, 19)
Work: ____
Answer: ______________________

24. Gym membership: \$50 signup + \$30/month. Write $C(m)$ and find cost for 1 year.
Work: ____
Answer: ______________________

25. CHALLENGE: Two lines: $y = 2x + 5$ and $y = -x + 8$. Where do they intersect?
Work: ____
Answer: ______________________

CHAPTER 6

The Systems Analyst

Master systems of equations to solve interconnected business problems

What You'll Learn

- Understand systems of linear equations
- Solve systems by graphing
- Solve systems by substitution
- Solve systems by elimination

Why This Matters

Systems analysts solve problems with multiple constraints: 'If we sell x units of Product A and y units of Product B, total revenue must equal $10,000 AND total units must be 500. 'Two equations, two unknowns—systems thinking.

Section 6.1: Understanding Systems

A system of equations is two or more equations with the same variables.

The solution is the point (x, y) that makes BOTH equations true.

Types of Solutions

One solution: Lines intersect at one point

No solution: Lines are parallel (never intersect)

Infinite solutions: Lines are the same (overlap completely)

Practice Problems: Section 6.1

1. Is (3, 5) a solution to: $y = 2x - 1$ and $y = x + 2$? Check both equations.

Work: ____

Answer: ____________________

2. Is (4, 7) a solution to: $y = 3x - 5$ and $y = x + 3$?

Work: ____

Answer: ____________________

3. What does it mean if two lines have the same slope but different y-intercepts?

Work: ____

Answer: ____________________

Section 6.2: Solving by Graphing

WORKED EXAMPLE: Solve by graphing: y = x + 1 and y = -x + 5

Step 1: Graph y = x + 1 (slope 1, y-intercept 1)
Step 2: Graph y = -x + 5 (slope -1, y-intercept 5)
Step 3: Find intersection point: (2, 3)
Step 4: Check: 3 = 2 + 1 ✓ and 3 = -2 + 5 ✓

Practice Problems: Section 6.2

4. Solve by graphing: y = 2x - 1 and y = -x + 5
Work: ____
Answer: ______________________

5. Solve by graphing: y = x + 3 and y = x - 2. What happens?
Work: ____
Answer: ______________________

Section 6.3: Solving by Substitution

Substitution works best when one equation is already solved for a variable.

WORKED EXAMPLE: Solve: y = 3x - 4 and 2x + y = 11

Step 1: Substitute first equation into second: 2x + (3x - 4) = 11
Step 2: Simplify: 5x - 4 = 11
Step 3: Solve: 5x = 15, so x = 3
Step 4: Find y: y = 3(3) - 4 = 5
Step 5: Solution: (3, 5)

Practice Problems: Section 6.3

6. Solve by substitution: y = 2x + 1 and 3x + y = 16
Work: ____
Answer: ______________________

7. Solve by substitution: x = 4y - 3 and 2x + 3y = 5
Work: ____
Answer: ______________________

8. Solve: y = x - 5 and 4x - 2y = 14
Work: ____
Answer: ______________________

9. Adult tickets \$12, child tickets \$8. Total 45 tickets, revenue \$460. Find each.

Work: ____

Answer: ____________________

10. Sum of two numbers is 50. One is 8 more than the other. Find both.

Work: ____

Answer: ____________________

Section 6.4: Solving by Elimination

Elimination adds or subtracts equations to eliminate one variable.

WORKED EXAMPLE: Solve: $3x + 2y = 16$ and $3x - 2y = 8$

Step 1: Add equations to eliminate y: $6x = 24$

Step 2: Solve: $x = 4$

Step 3: Substitute back: $3(4) + 2y = 16$

Step 4: Solve: $12 + 2y = 16$, so $y = 2$

Step 5: Solution: $(4, 2)$

Practice Problems: Section 6.4

11. Solve by elimination: $2x + 3y = 13$ and $2x - 3y = -1$

Work: ____

Answer: ____________________

12. Solve by elimination: $4x + y = 14$ and $2x + y = 8$

Work: ____

Answer: ____________________

13. Solve: $3x + 4y = 25$ and $5x - 4y = 7$

Work: ____

Answer: ____________________

14. Solve: $2x + 5y = 19$ and $3x + 2y = 12$

Work: ____

Answer: ____________________

15. A store sold 100 items: phones at $200 and cases at $25. Revenue: $8,450. Find each.

Work: ____

Answer: ____________________

Chapter 6 Review

16. Solve any method: $y = 4x - 7$ and $y = 2x + 3$

Work: ____

Answer: ____________________

17. Solve any method: $5x + 2y = 24$ and $3x - 2y = 8$

Work: ____

Answer: ____________________

18. Solve: $4x + 3y = 31$ and $2x + 5y = 29$

Work: ____

Answer: ____________________

19. Boat speed 20 mph still water. Downstream 25 mph, upstream 15 mph. Find current speed.

Work: ____

Answer: ____________________

20. CHALLENGE: Find a, b if system has no solution: $y = 3x + a$ and $y = bx + 5$

Work: ____

Answer: ____________________

CHAPTER 7

The Surveyor

Master the Pythagorean theorem to calculate distances and verify right angles

What You'll Learn

- Understand the Pythagorean theorem
- Find missing sides of right triangles
- Determine if a triangle is a right triangle
- Apply the theorem to real-world problems

Why This Matters

Surveyors measure land without walking every inch. Need to know the distance across a lake? Use the Pythagorean theorem. Checking if a corner is exactly 90°? That's the 3-4-5 rule. This ancient formula is used every day in construction, navigation, and design.

Section 7.1: The Pythagorean Theorem

$$a^2 + b^2 = c^2$$

Where a and b are the legs (sides that form the right angle)

And c is the hypotenuse (longest side, opposite the right angle)

WORKED EXAMPLE: Find c when a = 6 and b = 8

Step 1: Use Pythagorean theorem: $a^2 + b^2 = c^2$

Step 2: Substitute: $6^2 + 8^2 = c^2$

Step 3: Calculate: $36 + 64 = c^2$

Step 4: Simplify: $100 = c^2$

Step 5: Take square root: $c = 10$

Practice Problems: Section 7.1

1. Find c: a = 3, b = 4

Work: ____

Answer: ______________________

2. Find c: a = 5, b = 12

Work: ____

Answer: ______________________

3. Find c: $a = 8$, $b = 15$
Work: ____
Answer: ____________________

4. A ladder reaches 12 ft up a wall, with its base 5 ft from the wall. Ladder length?
Work: ____
Answer: ____________________

5. A 50-inch TV is measured diagonally. If width is 40 in, what's the height?
Work: ____
Answer: ____________________

Section 7.2: Finding a Leg

WORKED EXAMPLE: Find a when b = 9 and c = 15

Step 1: Rearrange: $a^2 = c^2 - b^2$
Step 2: Substitute: $a^2 = 15^2 - 9^2$
Step 3: Calculate: $a^2 = 225 - 81 = 144$
Step 4: Take square root: $a = 12$

Practice Problems: Section 7.2

6. Find a: $b = 24$, $c = 25$
Work: ____
Answer: ____________________

7. Find b: $a = 20$, $c = 29$
Work: ____
Answer: ____________________

8. A 17-ft ladder leans against a wall with base 8 ft away. Height reached?
Work: ____
Answer: ____________________

9. A support wire is 41 m long, anchored 9 m from a pole. Pole height?
Work: ____
Answer: ____________________

10. A kite is 80 m away horizontally, string 100 m. Height of kite?

Work: ____

Answer: ____________________

Section 7.3: Is It a Right Triangle?

If $a^2 + b^2 = c^2$, it's a right triangle. If not, it isn't.

Common Pythagorean Triples

3-4-5 and multiples (6-8-10, 9-12-15, ...)

5-12-13 and multiples

8-15-17

7-24-25

Practice Problems: Section 7.3

11. Is a triangle with sides 9, 12, 15 a right triangle?

Work: ____

Answer: ____________________

12. Is a triangle with sides 7, 10, 12 a right triangle?

Work: ____

Answer: ____________________

13. Is a triangle with sides 20, 21, 29 a right triangle?

Work: ____

Answer: ____________________

14. A surveyor measures a corner with legs 6m and 8m, diagonal 10.2m. Is it 90°?

Work: ____

Answer: ____________________

15. Find the missing value for a Pythagorean triple: 9, __, 15

Work: ____

Answer: ____________________

Section 7.4: Real-World Applications

Practice Problems: Section 7.4

16. Distance between points (0, 0) and (6, 8) on a coordinate plane?

Work: ____

Answer: ____________________

17. A ship sails 30 km east, then 40 km north. Straight-line distance from start?

Work: ____

Answer: ____________________

18. A ramp must rise 4 ft over a horizontal run of 12 ft. Ramp length?

Work: ____

Answer: ____________________

19. A baseball diamond has 90-ft sides. Distance from home to second base?

Work: ____

Answer: ____________________

20. A surveyor needs to measure across a pond. She marks 60m and 80m legs. Direct distance?

Work: ____

Answer: ____________________

Chapter 7 Review

21. Find the hypotenuse: legs = 11 and 60

Work: ____

Answer: ____________________________

22. Find the leg: other leg = 45, hypotenuse = 53

Work: ____

Answer: ____________________________

23. Verify: 11, 60, 61 is a Pythagorean triple.

Work: ____

Answer: ____________________________

24. A 26-ft pole is stabilized by a wire from its top to a point 10 ft from the base. Wire length?

Work: ____

Answer: ____________________________

25. CHALLENGE: Find the distance from (2, 3) to (7, 15).

Work: ____

Answer: ____________________________

CHAPTER 8

The Animator

Master transformations to create movement and design in the coordinate plane

What You'll Learn

- Perform translations, reflections, and rotations
- Identify and describe transformations
- Understand dilations and scale factors
- Compose multiple transformations

Why This Matters

Animators bring characters to life by transforming shapes frame by frame. Translations make things slide, rotations make them spin, reflections create mirror images, and dilations change size. Every video game, animated movie, and digital effect uses these four transformations.

Section 8.1: Translations

A translation slides a figure without rotating or flipping it.

$$(x, y) \to (x + a, y + b)$$

where a = horizontal shift, b = vertical shift

WORKED EXAMPLE: Translate (3, 5) by (4, -2)

Step 1: Add horizontal shift: 3 + 4 = 7

Step 2: Add vertical shift: 5 + (-2) = 3

Step 3: New point: (7, 3)

Practice Problems: Section 8.1

1. Translate (2, 4) by (5, 3). New coordinates?

Work: ____

Answer: ______________________

2. Translate (-1, 6) by (-3, -4). New coordinates?

Work: ____

Answer: ______________________

3. Triangle ABC has vertices A(1, 2), B(4, 2), C(2, 5). Translate by (3, -1). Find new vertices.

Work: ______________________________

Answer: ______________________________

4. A character at (10, 8) moves (-6, 4). New position?

Work: ______________________________

Answer: ______________________________

5. Point P(5, -2) becomes P'(1, 3). Describe the translation.

Work: ______________________________

Answer: ______________________________

Section 8.2: Reflections

Reflection Rules

Over x-axis: (x, y) → (x, -y)

Over y-axis: (x, y) → (-x, y)

Over y = x: (x, y) → (y, x)

Over y = -x: (x, y) → (-y, -x)

Practice Problems: Section 8.2

6. Reflect (4, 7) over the x-axis.

Work: ______________________________

Answer: ______________________________

7. Reflect (-3, 5) over the y-axis.

Work: ______________________________

Answer: ______________________________

8. Reflect (2, 8) over the line y = x.

Work: ______________________________

Answer: ______________________________

9. Triangle with vertices (1, 1), (4, 1), (2, 4). Reflect over y-axis.

Work: ______________________________

Answer: ______________________________

10. Point A(-2, 5) becomes A'(-2, -5). Over which line was it reflected?

Work: ____

Answer: ____________________

Section 8.3: Rotations

Rotation Rules (about origin)

90° counterclockwise: (x, y) → (-y, x)

180°: (x, y) → (-x, -y)

270° counterclockwise (or 90° clockwise): (x, y) → (y, -x)

Practice Problems: Section 8.3

11. Rotate (3, 5) 90° counterclockwise about the origin.

Work: ____

Answer: ____________________

12. Rotate (4, -2) 180° about the origin.

Work: ____

Answer: ____________________

13. Rotate (-1, 6) 270° counterclockwise about the origin.

Work: ____

Answer: ____________________

14. Triangle A(2, 1), B(5, 1), C(3, 4) rotated 90° CCW. Find new vertices.

Work: ____

Answer: ____________________

15. Point (5, 2) becomes (-2, 5). What rotation occurred?

Work: ____

Answer: ____________________

Section 8.4: Dilations

$(x, y) \rightarrow (kx, ky)$ where k is the scale factor

$k > 1$: enlargement

$0 < k < 1$: reduction

$k < 0$: enlargement/reduction with 180° rotation

Practice Problems: Section 8.4

16. Dilate (4, 6) by scale factor 2 centered at origin.

Work: ____

Answer: ____________________

17. Dilate (10, 15) by scale factor 0.5 centered at origin.

Work: ____

Answer: ____________________

18. Rectangle vertices (0, 0), (4, 0), (4, 3), (0, 3). Dilate by $k = 3$.

Work: ____

Answer: ____________________

19. A figure dilates from area 20 sq units to 180 sq units. Scale factor?

Work: ____

Answer: ____________________

20. Point (3, 2) becomes (9, 6). What was the scale factor?

Work: ____

Answer: ____________________

Chapter 8 Review

21. Translate (5, -3) by (-2, 4), then reflect over x-axis.

Work: ____

Answer: ____________________

22. Rotate (4, 1) 90° CCW, then dilate by factor 2.

Work: ____

Answer: ____________________

23. Identify the transformation: A(2, 5) → A'(5, 2)

Work: ____

Answer: ____________________

24. Which transformations preserve congruence? (translation, rotation, reflection, dilation)

Work: ____

Answer: ____________________

25. CHALLENGE: A triangle with area 12 is dilated, then dilated again by k=2. Final area 108. First k?

Work: ____

Answer: ____________________

CHAPTER 9

The Architect

Master angle relationships to design structures with precision

What You'll Learn

- Identify and calculate angles formed by parallel lines and transversals
- Apply the triangle angle sum theorem
- Work with exterior angles of triangles
- Understand and apply angle-angle similarity

Why This Matters

Architects design buildings with precise angles. Roof pitches, window frames, support beams—every angle must be calculated exactly. When parallel support beams are cut by a diagonal brace, specific angle relationships emerge. Understanding these relationships ensures structures are stable and beautiful.

Section 9.1: Angles with Parallel Lines

Key Angle Pairs

Corresponding angles: same position, same side of transversal → EQUAL

Alternate interior angles: opposite sides, between parallels → EQUAL

Alternate exterior angles: opposite sides, outside parallels → EQUAL

Co-interior (same-side interior) angles: same side, between parallels → SUPPLEMENTARY (sum = 180°)

Practice Problems: Section 9.1

1. Lines m and n are parallel. If angle 1 = 65°, what is its corresponding angle?

Work: ____

Answer: ____________________

2. Alternate interior angles measure 3x + 10 and 5x - 20. Find x and the angle measures.

Work: ____

Answer: ____________________

3. Co-interior angles measure 2x and 3x + 30. Find x and the angle measures.

Work: ____

Answer: ____________________

4. If two parallel beams are cut by a diagonal brace at 72°, what is the alternate interior angle?

Work: ____

Answer: ____________________

5. Prove: If alternate interior angles are equal, the lines are parallel.

Work: ____

Answer: ____________________

Section 9.2: Triangle Angle Sum

The sum of angles in any triangle = 180°

WORKED EXAMPLE: Find x in a triangle with angles 45°, 60°, and x°

Step 1: Use angle sum: 45 + 60 + x = 180

Step 2: Simplify: 105 + x = 180

Step 3: Solve: x = 75°

Practice Problems: Section 9.2

6. Triangle angles: 35°, 75°, x°. Find x.

Work: ____

Answer: ____________________

7. Isosceles triangle: base angles both 55°. Find the vertex angle.

Work: ____

Answer: ____________________

8. Triangle angles: x°, 2x°, 3x°. Find all three angles.

Work: ____

Answer: ____________________

9. Right triangle: one acute angle is 32°. Find the other acute angle.

Work: ____

Answer: ____________________

10. Equilateral triangle: find each angle measure.

Answer: ____________________

Section 9.3: Exterior Angles

Exterior angle = sum of two remote interior angles

WORKED EXAMPLE: Find the exterior angle if remote interior angles are 40° and 65°

Step 1: Apply theorem: exterior = 40 + 65

Step 2: Calculate: exterior = 105°

Practice Problems: Section 9.3

11. Remote interior angles are 48° and 67°. Find the exterior angle.

Work: ______________________________

Answer: ______________________________

12. Exterior angle is 130°. One remote interior is 55°. Find the other.

Work: ______________________________

Answer: ______________________________

13. Exterior angle = 4x, remote interiors are x and 2x + 15. Find x.

Work: ______________________________

Answer: ______________________________

14. A roof pitch creates an exterior angle of 145°. One interior angle is 90°. Find the other.

Work: ______________________________

Answer: ______________________________

15. Prove: An exterior angle is always greater than either remote interior angle.

Work: ______________________________

Answer: ______________________________

Section 9.4: Similar Triangles (AA Similarity)

If two angles of one triangle equal two angles of another, the triangles are similar

Similar triangles have equal angles and proportional sides.

Practice Problems: Section 9.4

16. Triangle ABC: angles 50°, 60°, 70°. Triangle DEF: angles 50°, 60°, x°. Find x. Are they similar?

Work: ____

Answer: ____________________

17. Two similar triangles have sides 3, 4, 5 and 6, 8, x. Find x.

Work: ____

Answer: ____________________

18. A 6-ft person casts a 4-ft shadow. A tree casts a 20-ft shadow. Tree height?

Work: ____

Answer: ____________________

19. Triangle sides 5, 12, 13. Similar triangle has shortest side 15. Find other sides.

Work: ____

Answer: ____________________

20. Two triangles: angles 30°, 60°, 90° and 30°, 60°, 90°. Must they be similar? Congruent?

Work: ____

Answer: ____________________

Chapter 9 Review

21. Parallel lines cut by transversal. One angle = 118°. Find all 8 angles.

Work: ____

Answer: ___________________________

22. Triangle angles: (x + 20)°, (2x - 10)°, (x + 30)°. Find all angles.

Work: ____

Answer: ___________________________

23. Exterior angle = 5x - 10, remote interiors = 2x + 5 and x + 15. Find x.

Work: ____

Answer: ___________________________

24. A ramp rises 3 ft over 12 ft. A larger ramp rises 5 ft. Horizontal distance?

Work: ____

Answer: ___________________________

25. CHALLENGE: In triangle ABC, angle A = 40°. BD bisects angle B, CD bisects angle C. Find angle BDC.

Work: ____

Answer: ___________________________

CHAPTER 10

The Industrial Designer

Master volume calculations to design products and containers

What You'll Learn

- Calculate volume of cylinders
- Calculate volume of cones
- Calculate volume of spheres
- Solve real-world problems involving volume

Why This Matters

Industrial designers create everything from soda cans to storage tanks. How much liquid fits in that bottle? How much material for that cone-shaped funnel? How much air in that basketball? Volume calculations are essential for product design.

Section 10.1: Volume of Cylinders

$$V = \pi r^2 h$$

where r = radius of the base circle and h = height

WORKED EXAMPLE: Find volume: cylinder with radius 5 cm, height 12 cm

Step 1: Use the formula $V = \pi r^2 h$

Step 2: Substitute: $V = \pi \times 5^2 \times 12$

Step 3: Calculate: $V = \pi \times 25 \times 12 = 300\pi$

Step 4: Approximate: $V \approx 942.48$ cm³

Practice Problems: Section 10.1

1. Find volume: cylinder with r = 4 in, h = 10 in. (Leave answer in terms of π)

Work: ____

Answer: ____________________

2. Find volume: cylinder with diameter 14 cm, height 8 cm.

Work: ____

Answer: ____________________

3. A water tank has radius 3 m and height 7 m. Volume in cubic meters?

Work: ____

Answer: ____________________

4. A can has volume 350 cm^3 and height 12 cm. Find the radius.
Work: ____
Answer: ____________________

5. How many liters fit in a cylinder with r = 10 cm, h = 20 cm? (1 L = 1000 cm^3)
Work: ____
Answer: ____________________

Section 10.2: Volume of Cones

$$V = (1/3)\pi r^2 h$$

A cone's volume is exactly 1/3 of a cylinder with the same base and height.

WORKED EXAMPLE: Find volume: cone with radius 6 cm, height 9 cm

Step 1: Use the formula $V = (1/3)\pi r^2 h$
Step 2: Substitute: $V = (1/3) \times \pi \times 6^2 \times 9$
Step 3: Calculate: $V = (1/3) \times \pi \times 36 \times 9 = 108\pi$
Step 4: Approximate: $V \approx 339.29$ cm^3

Practice Problems: Section 10.2

6. Find volume: cone with r = 3 in, h = 8 in.
Work: ____
Answer: ____________________

7. Find volume: cone with diameter 10 cm, height 15 cm.
Work: ____
Answer: ____________________

8. An ice cream cone has r = 2 in, h = 6 in. Volume of ice cream it holds?
Work: ____
Answer: ____________________

9. A cone has volume 100π cm^3 and height 12 cm. Find the radius.
Work: ____
Answer: ____________________

10. A funnel (cone) has radius 8 cm and volume 384π cm^3. Find the height.
Work: ____
Answer: ____________________

Section 10.3: Volume of Spheres

$$V = (4/3)\pi r^3$$

WORKED EXAMPLE: Find volume: sphere with radius 6 cm

Step 1: Use the formula $V = (4/3)\pi r^3$
Step 2: Substitute: $V = (4/3) \times \pi \times 6^3$
Step 3: Calculate: $V = (4/3) \times \pi \times 216 = 288\pi$
Step 4: Approximate: $V \approx 904.78\ cm^3$

Practice Problems: Section 10.3

11. Find volume: sphere with $r = 9$ in.
Work: ____
Answer: ____________________

12. Find volume: sphere with diameter 20 cm.
Work: ____
Answer: ____________________

13. A basketball has diameter 24 cm. Volume of air inside?
Work: ____
Answer: ____________________

14. A sphere has volume $36\pi\ in^3$. Find the radius.
Work: ____
Answer: ____________________

15. Compare: sphere $r = 3$ vs. cube side $= 6$. Which has greater volume?
Work: ____
Answer: ____________________

Section 10.4: Composite Figures

For composite figures, break them into basic shapes and add/subtract volumes.

Practice Problems: Section 10.4

16. A cone (r = 4, h = 6) sits on a cylinder (r = 4, h = 10). Total volume?

Work: ____

Answer: ____________________

17. A hemisphere (r = 5) tops a cylinder (r = 5, h = 8). Total volume?

Work: ____

Answer: ____________________

18. A cylinder (r = 6, h = 15) has a cone-shaped hole (r = 6, h = 15) drilled out. Remaining volume?

Work: ____

Answer: ____________________

19. An ice cream cone holds 8π in^3 of cone + hemisphere scoop (r = 2). Total?

Work: ____

Answer: ____________________

20. A capsule is a cylinder (r = 3, h = 10) with hemisphere ends. Total volume?

Work: ____

Answer: ____________________

Chapter 10 Review

21. A silo is a cylinder ($r = 8m$, $h = 20m$) topped with a hemisphere. Total volume?

Work: ____

Answer: ______________________

22. Water fills a cone at 5 cm^3/sec. How long to fill a cone with $r = 6cm$, $h = 9cm$?

Work: ____

Answer: ______________________

23. A ball (sphere $r = 6$) is dropped in a cylinder ($r = 6$, $h = 20$). Water rises. How much?

Work: ____

Answer: ______________________

24. Three tennis balls ($r = 3.5$ cm each) fit in a cylindrical can. Can dimensions and volume?

Work: ____

Answer: ______________________

25. CHALLENGE: A cone, cylinder, and sphere all have radius 4 and height/diameter 8. Order by volume.

Work: ____

Answer: ______________________

CHAPTER 11

The Market Researcher

Master data analysis to find patterns and make predictions

What You'll Learn

- Construct and interpret scatter plots
- Identify correlation (positive, negative, none)
- Draw and use lines of best fit
- Use two-way tables to analyze categorical data

Why This Matters

Market researchers analyze data to predict consumer behavior. Is there a relationship between advertising spending and sales? Do age and product preference correlate? Scatter plots and trend lines reveal patterns that guide million-dollar decisions.

Section 11.1: Scatter Plots

A scatter plot shows the relationship between two quantitative variables.

Each point represents one data pair (x, y).

Types of Correlation

Positive correlation: As x increases, y tends to increase

Negative correlation: As x increases, y tends to decrease

No correlation: No clear pattern between x and y

Practice Problems: Section 11.1

1. Study hours vs test scores: Positive, negative, or no correlation? Explain.

Work: ____

Answer: ____________________

2. Temperature vs ice cream sales: Positive, negative, or no correlation?

Work: ____

Answer: ____________________

3. Shoe size vs IQ: Positive, negative, or no correlation?

Work: ____

Answer: ____________________

4. Car age vs resale value: Positive, negative, or no correlation?

Work: ____

Answer: ____________________

5. Data: (1,3), (2,5), (3,4), (4,7), (5,8). Plot and describe correlation.

Work: ____

Answer: ____________________

Section 11.2: Lines of Best Fit

A line of best fit (trend line) approximates the overall trend in a scatter plot.

It passes through the 'middle' of the data points, minimizing distances.

WORKED EXAMPLE: Data suggests trend line $y = 2x + 1$. Predict y when $x = 10$.

Step 1: Substitute $x = 10$ into equation: $y = 2(10) + 1$

Step 2: Calculate: $y = 21$

Practice Problems: Section 11.2

6. Line of best fit: $y = 3x + 5$. Predict y when $x = 8$.

Work: ____

Answer: ____________________

7. Line of best fit: $y = -2x + 50$. Predict y when $x = 15$.

Work: ____

Answer: ____________________

8. Ad spending (x thousands) vs sales (y thousands): $y = 4.5x + 10$. Predict sales for $5000 ad spend.

Work: ____

Answer: ____________________

9. Data points: (2, 9), (4, 15), (6, 21), (8, 27). Find a line of best fit.

Work: ____

Answer: ____________________

10. Using your line from #9, predict y when $x = 12$.

Work: ____

Answer: ____________________

Section 11.3: Interpreting Slope and Intercept

In context, slope represents the rate of change.

The y-intercept represents the starting value when x = 0.

Practice Problems: Section 11.3

11. Sales = 500 + 20(advertising). What does the 20 mean? The 500?

Work: ____

Answer: ____________________

12. Cost = 2.50x + 150. x = units produced. Interpret slope and y-intercept.

Work: ____

Answer: ____________________

13. Test score = 60 + 5(hours studied). Interpret and predict score for 8 hours.

Work: ____

Answer: ____________________

14. Weight loss = -0.5(weeks) + 200. Starting weight? Rate of loss? Weight after 10 weeks?

Work: ____

Answer: ____________________

15. A researcher finds height (cm) = 75 + 6(age in years) for children ages 2-12. Interpret.

Work: ____

Answer: ____________________

Section 11.4: Two-Way Tables

Two-way tables organize categorical data by two variables.

They help identify patterns and associations.

Practice Problems: Section 11.4

16. 100 students surveyed: 40 prefer pizza, 35 prefer tacos, 25 prefer burgers. 60 are girls. 25 girls prefer pizza. Complete a two-way table.

Work: ____

Answer: ____________________

17. From your table in #16, what percent of girls prefer pizza?

Work: ____________________

Answer: ____________________

18. From your table, what percent of pizza-lovers are girls?

Work: ____________________

Answer: ____________________

19. 200 customers: 120 bought Product A, 80 bought B. 150 were repeat customers. 90 repeat customers bought A. Make a two-way table.

Work: ____________________

Answer: ____________________

20. From #19, are repeat customers more likely to buy A or B?

Work: ____________________

Answer: ____________________

Chapter 11 Review

21. Describe the correlation: as exercise increases, resting heart rate tends to decrease.

Answer: ____________________

22. Line of best fit: $y = -3x + 100$. Predict y when $x = 25$.

Work: ____________________

Answer: ____________________

23. Revenue = 1000 + 150(employees). Interpret slope. Predict revenue with 20 employees.

Work: ____________________

Answer: ____________________

24. Why might correlation not imply causation? Give an example.

Work: ____________________

Answer: ____________________

25. CHALLENGE: Data shows strong positive correlation between firefighters sent and fire damage. Does sending fewer firefighters reduce damage? Explain.

Work: ____________________

Answer: ____________________

CHAPTER 12

The Risk Analyst

Master probability to assess risks and make informed decisions

What You'll Learn

- Calculate theoretical and experimental probability
- Use sample spaces and organized lists
- Calculate compound probability (independent and dependent events)
- Use simulations to estimate probability

Why This Matters

Risk analysts help companies make decisions under uncertainty. What's the probability a product will fail? What are the odds of two system failures on the same day? Insurance, investment, and business strategy all depend on understanding probability.

Section 12.1: Basic Probability

P(event) = favorable outcomes / total possible outcomes

Probability ranges from 0 (impossible) to 1 (certain).

Can also be expressed as a percent (0% to 100%).

Practice Problems: Section 12.1

1. A standard die is rolled. P(rolling a 5)?

Work: ____

Answer: ____________________

2. A standard die is rolled. P(rolling even)?

Work: ____

Answer: ____________________

3. A bag has 5 red, 3 blue, 2 green marbles. P(red)?

Work: ____

Answer: ____________________

4. A spinner has 8 equal sections numbered 1-8. P(prime number)?

Work: ____

Answer: ____________________

5. A card is drawn from a standard 52-card deck. P(heart)?

Work: ____

Answer: ____________________

Section 12.2: Compound Events - Independent

Independent events: The outcome of one doesn't affect the other.

$$P(A \text{ and } B) = P(A) \times P(B)$$

WORKED EXAMPLE: Two coins are flipped. P(both heads)?

Step 1: Events are independent

Step 2: P(head on first) = 1/2

Step 3: P(head on second) = 1/2

Step 4: P(both heads) = 1/2 × 1/2 = 1/4

Practice Problems: Section 12.2

6. A die is rolled twice. P(6, then 6)?

Work: ____

Answer: ____________________

7. A coin is flipped 3 times. P(all heads)?

Work: ____

Answer: ____________________

8. P(rain today) = 0.3, P(rain tomorrow) = 0.4. P(rain both days)?

Work: ____

Answer: ____________________

9. A machine has 2% defect rate. Two items checked. P(both defective)?

Work: ____

Answer: ____________________

10. Spinner A: 3 sections (1,2,3). Spinner B: 4 sections (1,2,3,4). P(both show 2)?

Work: ____

Answer: ____________________

Section 12.3: Compound Events - Dependent

Dependent events: The outcome of one affects the probability of the other.

$$P(A \text{ and } B) = P(A) \times P(B|A)$$

P(B|A) means 'probability of B given that A already happened'

WORKED EXAMPLE: Draw 2 cards without replacement. P(both aces)?

Step 1: P(first ace) = 4/52

Step 2: After drawing an ace, P(second ace) = 3/51

Step 3: P(both aces) = (4/52) × (3/51) = 12/2652 = 1/221

Practice Problems: Section 12.3

11. Bag: 6 red, 4 blue marbles. Draw 2 without replacement. P(both red)?

Work: ____

Answer: ____________________

12. Bag: 6 red, 4 blue. Draw 2 without replacement. P(first red, then blue)?

Work: ____

Answer: ____________________

13. 5 boys, 7 girls in a group. Two picked randomly. P(both girls)?

Work: ____

Answer: ____________________

14. A deck of cards. Draw 2 without replacement. P(both hearts)?

Work: ____

Answer: ____________________

15. 10 tickets in a hat, 3 winners. You draw 2. P(winning at least one)?

Work: ____

Answer: ____________________

Section 12.4: Sample Spaces and Simulations

A sample space lists all possible outcomes.

Simulations use random trials to estimate probability.

Practice Problems: Section 12.4

16. List the sample space for flipping a coin twice.

Work: ____

Answer: ____________________

17. List the sample space for rolling a die and flipping a coin.

Work: ____

Answer: ____________________

18. How many outcomes in the sample space for rolling 3 dice?

Work: ____

Answer: ____________________

19. A simulation runs 1000 trials of an event. 230 successes. Estimated P(success)?

Work: ____

Answer: ____________________

20. Theoretical P(event) = 0.25. After 200 trials, expected successes?

Work: ____

Answer: ____________________

Chapter 12 Review

21. A bag has 8 white, 5 black, 7 gray marbles. P(not white)?

Work: ____

Answer: ____________________

22. Two dice rolled. P(sum = 7)?

Work: ____

Answer: ____________________

23. 3 coins flipped. P(exactly 2 heads)?

Work: ____

Answer: ____________________

24. System A has 95% reliability, System B has 90%. P(both work)?

Work: ____

Answer: ____________________

25. CHALLENGE: A password is 4 digits (0-9, repeats allowed). P(all same digit)?

Work: ____

Answer: ____________________

EXTRA PRACTICE

Additional problems for each chapter to build mastery

Chapter 1 Extra Practice: Real Numbers

1. Classify: $\sqrt{64}$, $\sqrt{65}$, 0.123123..., $\pi/2$

Work: ____

Answer: ______________________

2. Order from least to greatest: $\sqrt{12}$, 3.5, $\sqrt{15}$, 4

Work: ____

Answer: ______________________

3. Simplify: $\sqrt{18} + \sqrt{50}$

Work: ____

Answer: ______________________

4. Between which integers is $\sqrt{85}$?

Work: ____

Answer: ______________________

5. Is $3\sqrt{2} + 5$ rational or irrational?

Work: ____

Answer: ______________________

Chapter 2 Extra Practice: Exponents and Radicals

6. Simplify: $(3^4 \times 3^{-2}) \div 3^3$

Work: ______________________________

Answer: ______________

7. Simplify: $\sqrt{180}$

Work: ______________________________

Answer: ______________

8. Evaluate: $2^{-3} + 4^{-1}$

Work: ______________________________

Answer: ______________

9. Simplify: $5\sqrt{3} \times 2\sqrt{6}$

Work: ______________________________

Answer: ______________

10. Simplify: $\sqrt[3]{64} + \sqrt{81}$

Work: ______________________________

Answer: ______________

Chapter 3 Extra Practice: Scientific Notation

11. Write in scientific notation: 0.0000456

Work: ______________________________

Answer: ______________

12. $(2.4 \times 10^6) \times (5 \times 10^{-3}) =$ ____

Work: ______________________________

Answer: ______________

13. $(9.6 \times 10^8) \div (3.2 \times 10^5) =$ ____

Work: ______________________________

Answer: ______________

14. Compare: 5.2×10^7 vs 8.1×10^6

Work: ______________________________

Answer: ______________________________

15. A light-year is 9.46×10^{12} km. Alpha Centauri is 4.37 light-years away. Distance in km?

Work: ______________________________

Answer: ______________________________

Chapter 4 Extra Practice: Multi-Step Equations

16. Solve: $8x - 5 = 3x + 20$

Work: ______________________________

Answer: ______________________________

17. Solve: $4(2x - 3) = 3(x + 4) - 1$

Work: ______________________________

Answer: ______________________________

18. Solve: $6x + 10 = 2(3x + 5)$. How many solutions?

Work: ______________________________

Answer: ______________________________

19. Cell plan A: $45 + $0.05/text. Plan B: $30 + $0.08/text. When equal?

Work: ______________________________

Answer: ______________________________

20. Solve: $\frac{1}{2}(4x - 8) = x + 6$

Work: ______________________________

Answer: ______________________________

Chapters 5-6 Extra Practice: Functions and Systems

21. If $f(x) = -3x + 10$, find $f(-2)$.

Work: ______________________________

Answer: ______________________________

22. Find slope and y-intercept: $4x + 2y = 10$

Work: ______________________________

Answer: ______________________________

23. Write equation through (2, 5) and (6, 13).
Work: ____
Answer: ____________________

24. Solve by substitution: $y = 3x - 1$ and $2x + y = 14$
Work: ____
Answer: ____________________

25. Solve by elimination: $3x + 4y = 18$ and $5x - 4y = 6$
Work: ____
Answer: ____________________

Chapters 7-8 Extra Practice: Pythagorean Theorem and Transformations

26. Find c: $a = 15$, $b = 20$
Work: ____
Answer: ____________________

27. Is 9, 40, 41 a Pythagorean triple?
Work: ____
Answer: ____________________

28. Distance from (1, 2) to (7, 10)?
Work: ____
Answer: ____________________

29. Rotate (5, -3) 90° counterclockwise about origin.
Work: ____
Answer: ____________________

30. Reflect (4, 7) over $y = x$.
Work: ____
Answer: ____________________

Chapters 9-10 Extra Practice: Angles and Volume

31. Parallel lines cut by transversal. One angle = 72°. Find its alternate interior angle.

Work: ______________________________

Answer: ______________________________

32. Triangle angles: 2x, 3x, 4x. Find all angles.

Work: ______________________________

Answer: ______________________________

33. Volume of cylinder: r = 7, h = 10. (Leave in terms of π)

Work: ______________________________

Answer: ______________________________

34. Volume of cone: r = 9, h = 12.

Work: ______________________________

Answer: ______________________________

35. Volume of sphere: r = 6.

Work: ______________________________

Answer: ______________________________

Chapters 11-12 Extra Practice: Data and Probability

36. Line of best fit: y = 2.5x + 8. Predict y when x = 12.

Work: ______________________________

Answer: ______________________________

37. Describe correlation: As study time increases, test scores tend to increase.

Work: ______________________________

Answer: ______________________________

38. P(rolling two dice and getting sum of 9)?

Work: ______________________________

Answer: ______________________________

39. Bag: 7 red, 5 blue. Draw 2 without replacement. P(both blue)?

Work: ______________________________

Answer: ______________________________

40. A coin is flipped 4 times. P(exactly 3 heads)?

Work: ____

Answer: ___________________________

ANSWER KEY

Check your work and learn from mistakes

Chapter 1: Real Numbers

1. 0.666... = rational (repeating), √5 = irrational, -4/7 = rational, π = irrational, 3.14 = rational (terminating)

2. Irrational (non-repeating, non-terminating decimal suggesting e)

3. 0.875 = 7/8, rational

4. √16 = 4 (rational, perfect square); √17 ≈ 4.12 (irrational)

5. Between 7 and 8 (since 49 < 50 < 64)

6. Between 5 and 6 (since 25 < 30 < 36)

7. √45 ≈ 6.7

8. √10 ≈ 3.16, so the order is 3, π (3.14), √10, 3.2

9. √200 ≈ 14.1 ft

10. √3 ≈ 1.7, √5 ≈ 2.2, √8 ≈ 2.8

11-15. [See detailed solutions in teacher guide]

16-20. [See detailed solutions in teacher guide]

Chapter 2: Exponents and Radicals

1. 3^7 = 2187

2. 7^5 = 16807

3. 4^6 = 4096

4. 8^0 = 1

5. 2^2 = 4

6. 4^{-2} = 1/16

7. 10^{-3} = 0.001

8. 2^{-2} = 1/4

9. 3^{-4} = 1/81

10. 10^2 = 100 N

11. $\sqrt{144} = 12$

12. $\sqrt[3]{27} = 3$

13. $\sqrt{50} = 5\sqrt{2}$

14. $\sqrt{128} = 8\sqrt{2}$

15. $\sqrt[3]{343} = 7$ cm

16-20. $6\sqrt{3}$; 10; $5\sqrt{3}$; 0; 6 cm^2

21-25. $2^4 = 16$; 1.04; $10\sqrt{2}$; $\sqrt{7}$; $x + y = 9$

Chapter 3: Scientific Notation

1. 4.5×10^7

2. 6.7×10^{-4}

3. 380,000

4. 0.00021

5. 4×10^{13} km

6-10. 1.2×10^8; 4×10^4; 3×10^3; 1.5×10^{11} m; 6×10^7 km/hr

11-15. 8.8×10^6; 8.08×10^5; 5.48×10^8 km; 1.54×10^7; ~3×10^{-27} kg

16-20. 3.5×10^8; 8.1×10^4, 1.9×10^5, 2.3×10^5; ~1.5×; 25×; ~316 Earths

21-25. 8.9×10^{-6}; 1.08×10^3; 3.6×10^4 km; ~3.15×10^7 s; ~1.33×10^{23} km

Chapter 4: Multi-Step Equations

1. $x = 4$

2. $x = 4$

3. $x = 6$

4. $x = 5$

5. 4 hours

6. $x = 8$

7. $x = 7$

8. No solution

9. $x = 1$

10. 5 GB

11-15. No solution; Infinite; No solution; Infinite; Answers vary

16-20. $x = 5$; $x = 6$; 67 units; Infinite solutions; 32, 33, 34

Chapters 5-6: Functions and Systems

Chapter 5: 1. Yes; 2. No (2 maps to 4 and 6); 6. 15; 7. 10; 8. -9; 9. $x = 6$; 10. 29 modules

11. $m = 2$; 12. $m = -2$; 13. $m = -3$, $b = 7$; 14. $y = 4x - 2$; 15. $y = 2x + 5$

16-20. $y = 3x + 2$; $y = 2x - 3$; $P(w) = 5w + 1$; $d(t) = 15t$; $T(h) = -4.5h + 68$

21-25. $f(-3) = 14$, $f(0) = 8$; $m = 2$, $b = -3$; No; $C(m) = 50 + 30m$, \$410; (1, 7)

Chapter 6: 1. Yes; 2. Yes; 4. (2, 3); 5. No solution (parallel)

6-10. (3, 7); (1, 2); (2, 3); 25 adults, 20 children; 21 and 29

11-15. (3, 2); (3, 2); (4, 3); (2, 3); 35 phones, 65 cases

16-20. (5, 13); (4, 2); (4, 3); 2.5 mph; $b = 3$, any $a \neq 5$

Chapters 7-8: Pythagorean Theorem and Transformations

Chapter 7: 1. $c = 5$; 2. $c = 13$; 3. $c = 17$; 4. 13 ft; 5. 30 in

6-10. $a = 7$; $b = 21$; 15 ft; 40 m; 60 m

11-15. Yes; No; Yes; No (should be 10); 12

16-20. 10 units; 50 km; ~12.6 ft; ~127.3 ft; 100 m

21-25. 61; 28; Yes ($11^2 + 60^2 = 61^2$); ~24.2 ft; 13 units

Chapter 8: 1. (7, 7); 2. (-4, 2); 3. A'(4, 1), B'(7, 1), C'(5, 4); 4. (4, 12); 5. (-4, 5)

6-10. (4, -7); (3, 5); (8, 2); (-1, 1), (-4, 1), (-2, 4); x-axis

11-15. (-5, 3); (-4, 2); (6, 1); (-1, 2), (-1, 5), (-4, 3); 90° CCW

16-20. (8, 12); (5, 7.5); All × 3; $k = 3$; $k = 3$

21-25. (3, -1); (2, 8); Reflection over $y = x$; T, R, R (not dilation); $k = 3$

Chapters 9-10: Angles and Volume

Chapter 9: 1. 65°; 2. $x = 15$, angles = 55°; 3. $x = 30$, angles = 60° and 120°; 4. 72°

6-10. 70°; 70°; 30°, 60°, 90°; 58°; 60°

11-15. 115°; 75°; $x = 25$; 55°; Exterior > either remote (since exterior = sum)

16-20. $x = 70°$, yes; $x = 10$; 30 ft; 36, 48; Similar but not necessarily congruent

21-25. 118°, 62°, etc.; 35°, 60°, 85°; $x = 10$; 20 ft; 110°

Chapter 10: 1. 160π in³; 2. 392π cm³; 3. 63π m³; 4. $r \approx 3.04$ cm; 5. ~6.28 L

6-10. 24π in³; $125\pi/3$ cm³; 8π in³; $r = 5$ cm; $h = 18$ cm

11-15. 972π in³; $4000\pi/3$ cm³; 2304π cm³; $r = 3$ in; Cube (216 > 113.1)

16-20. 192π; $250\pi/3 + 200\pi$; 360π; $8\pi + 16\pi/3$; $90\pi + 36\pi$

21-25. $1408\pi/3$ m³; ~113 sec; 8 cm rise; $r = 3.5$, $h = 21$, $V = 257.25\pi$; Sphere < Cone < Cylinder

Chapters 11-12: Data and Probability

Chapter 11: 1-5. Positive; Positive; None; Negative; Positive moderate

6-10. 29; 20; $32,500; $y = 3x + 3$; 39

11-15. Slope = revenue per $ of advertising, intercept = base revenue; Per-unit cost, fixed cost; ~100; 195 lbs; 6 cm/year growth rate

16-20. [Table solutions]; ~42%; ~63%; [Table solutions]; Yes, 90/120 = 75% vs 60/80 = 75%

21-25. Negative; 25; 4000; Correlation ≠ causation; Larger fires need more firefighters

Chapter 12: 1. 1/6; 2. 1/2; 3. 1/2; 4. 4/8 = 1/2 (primes: 2,3,5,7); 5. 13/52 = 1/4

6-10. 1/36; 1/8; 0.12; 0.0004; 1/12

11-15. 30/90 = 1/3; 24/90 = 4/15; 42/132 = 7/22; 156/2652 = 1/17; ~47%

16-20. {HH, HT, TH, TT}; 12 outcomes; 216; 0.23; 50

21-25. 12/20 = 3/5; 6/36 = 1/6; 4/8 = 1/2; 0.855; 1/1000

Extra Practice Answers

1. $\sqrt{64} = 8$ (rational), $\sqrt{65}$ (irrational), 0.123123... (rational), $\pi/2$ (irrational)
2. $\sqrt{12}$, 3.5, $\sqrt{15}$, 4
3. $3\sqrt{2} + 5\sqrt{2} = 8\sqrt{2}$
4. Between 9 and 10
5. Irrational
6. $3^{-1} = 1/3$
7. $6\sqrt{5}$
8. 1/8 + 1/4 = 3/8
9. $10\sqrt{18} = 30\sqrt{2}$
10. 4 + 9 = 13

11-40. [See teacher guide for complete solutions.]