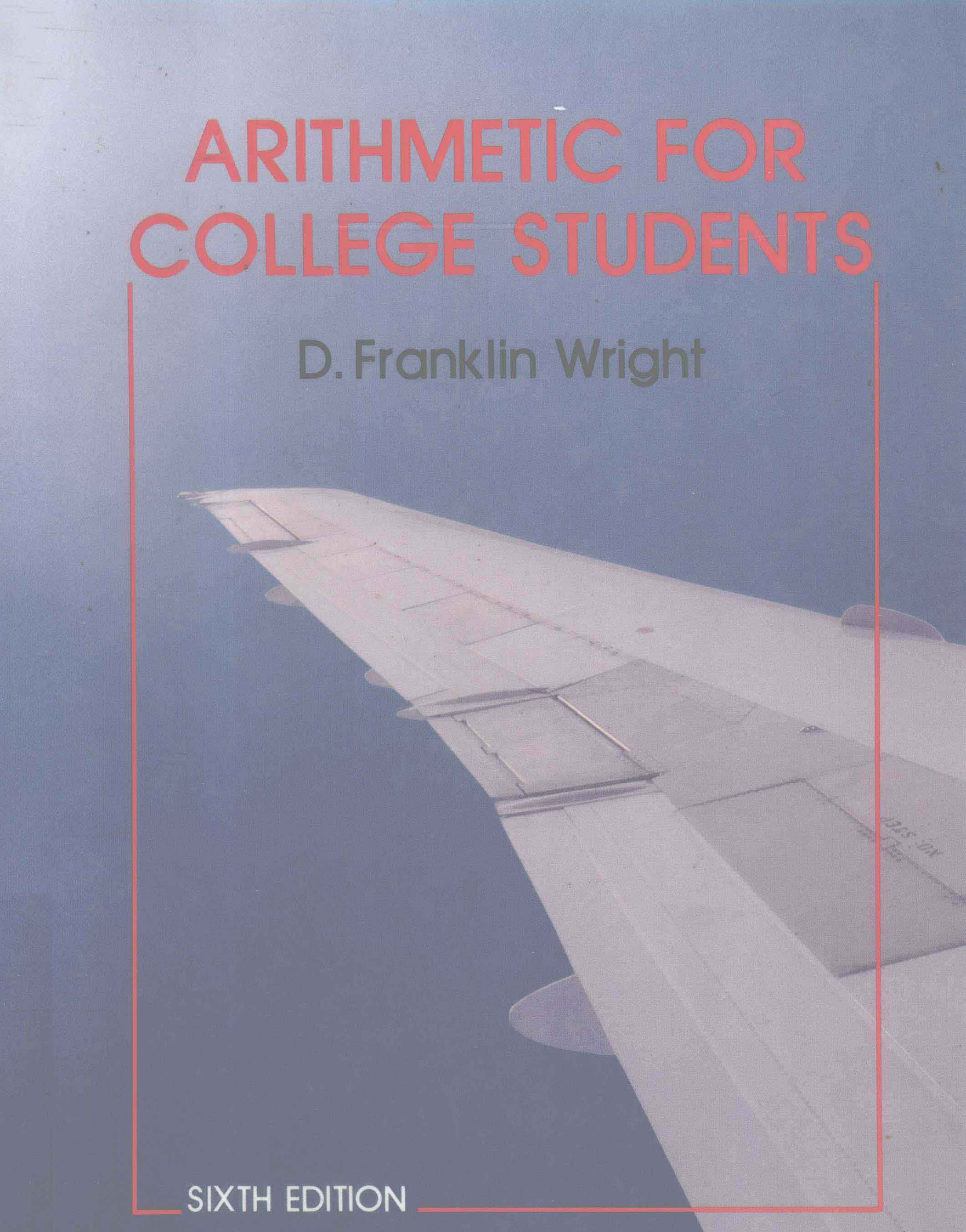
ARITHMETIC FOR COLLEGE STUDENTS

D. Franklin Wright



SIXTH EDITION

Sixth Edition

Arithmetic for College Students

D. Franklin Wright
CERRITOS COLLEGE

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Preface

The Purpose

The goal of the Sixth Edition of *Arithmetic for College Students* is to provide:

1. a review of arithmetic concepts and skills;
2. practical consumer applications that emphasize the need for understanding mathematics in everyday life; and
3. an introduction to geometric and algebraic concepts to encourage the students to continue their education in mathematics.

This text is intended to be a learning tool for students who have had difficulty in mathematics and to motivate them to overcome past failures in understanding and comprehension and move forward with confidence.

The Style

This mathematically accurate text has an informal style and nontechnical explanations. The emphasis is on *why* procedures work, as well as *how* to follow them in the many examples and exercises in this edition. Point-by-point explanations are incorporated within the examples for better understanding. All important procedures and rules are given in an easy-to-read list format and highlighted in boxes for easy reference. Practice Problems (with answers) in almost every section reinforce students' understanding of the concepts and provide the instructor with immediate classroom feedback.

New to the Sixth Edition

ESTIMATING

Methods of estimating answers are introduced in the discussion of whole numbers in Chapter 1. These methods are reinforced and expanded with decimals in Chapter 5 and with percents in Chapter 7.

CUMULATIVE REVIEWS

Beginning with Chapter 2, each chapter contains a Cumulative Review of topics chosen from previous chapters to maintain skill levels and help students understand the building-block nature of mathematics.

CHAPTER SUMMARIES

The Chapter Summaries have a new format organized by Key Terms and Ideas, Rules and Properties, and Procedures, to help students organize the concepts and processes developed in the chapter for a better understanding.

APPLICATIONS

Additional word problems have been added throughout the text. Section 1.8 now contains new material on applications and word-problem solving techniques. There are several enhancements to Chapter 8 on consumer applications including the addition of the compound interest formula (with use of calculators emphasized), a brief discussion of inflation in Section 8.2, and a new section on buying and owning a car.

EXERCISES

The exercise sets have been expanded to include more than 5200 exercises, an increase of over 16 percent from the fifth edition. The Answer Key at the back of the text lists answers to all the exercises except those numbered as multiples of 4. (Answers to exercises numbered as multiples of 4 are included in the Instructor's Guide.) The Answer Key also contains all the answers to the Review Questions, Chapter Tests, and Cumulative Reviews.

REORGANIZATION

Many sections have been revised with improved explanations. Chapter 9 on measurement has been reorganized to include both the metric and U.S. Customary systems. Chapter 10 is a new chapter on geometry that involves length, area, and volume from Chapter 9 as well as properties of angles and triangles that were previously in an appendix.

Special Features

1. Each chapter includes:
   - a Chapter Summary of key terms and ideas, rules and properties, and procedures;
   - a Chapter Review similar to the exercises (all answers are in the Answer Key);
   - a Chapter Test similar to a test students can expect to take (The Answer Key includes section references that direct students to the appropriate places for additional review.); and
   - a Cumulative Review that reinforces concepts and techniques learned in earlier chapters.
2. All important procedures and rules are highlighted in an easy-to-read list format.
3. Meaningful word problems are provided throughout the text.
4. Calculators are used in special sections on practical applications.
5. Practice Problems at the end of most sections reinforce students' understanding and give the instructor immediate feedback.

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The Content

Chapter 1, **Whole Numbers,** provides a review of the basic operations with whole numbers. The value of estimating answers for reasonableness has been made an integral part of this chapter, and Section 1.8 has been expanded to contain several types of applications and an organized approach to solving word problems.

Chapter 2, **Prime Numbers,** forms the foundation for the text. It introduces the basic ideas of exponents, order of operations, tests for divisibility, and prime numbers that are used throughout the text. To avoid confusion with the more important topic of least common multiple (LCM), the related topic of greatest common divisor (GCD) is discussed in Appendix III. This material can easily be incorporated with Chapter 2 if desired.

Chapter 3, **Fractions,** makes use of prime numbers and prime factorization techniques developed in Chapter 2. Many students have told me that fractions make more sense with this approach and that working with fractions is no longer a series of mysterious steps they cannot remember. These techniques carry over nicely into algebra and give students new confidence in working with algebraic fractions.

Chapter 4, **Mixed Numbers,** covers mixed numbers in a chapter separate from fractions, which allows division with fractions and order of operations with fractions to be discussed twice. This split of topics also clarifies the distinction between working with mixed numbers and working with simple fractions.

Chapter 5, **Decimal Numbers,** emphasizes reading and writing decimal numbers as well as the basic operations and rounding off. Estimating answers is now an important part of this chapter.

Chapter 6, **Ratio and Proportion,** includes the topic of unit pricing, a particularly practical application of ratios. Proportions directly related to nursing are discussed and included in the exercises. The instructor might choose to introduce the use of hand-held calculators in Chapter 6.

Chapter 7, **Percent,** uses the tools of ratio and proportion and techniques for solving simple equations developed in Chapter 6 to solve problems and applications involving percent. The basic approach is the use of the formula $R \times B = A$, where the rate R is in decimal form. Students should be encouraged to use calculators throughout this chapter in preparation for the more complex consumer applications in Chapter 8. A new section on estimating with percents has been added to help students gain a general understanding of percent.

Chapter 8, **Consumer Applications (with Calculators),** illustrates the importance of mathematics in everyday life. Section 8.2 now includes the formula for compound interest, with related directions on how to use a

calculator. Also, Section 8.4 (Buying and Owning a Car) is new, and Section 8.5 (Reading Graphs) now discusses histograms.

Chapter 9, **Measurement,** has been reorganized to include both the metric and U.S. Customary systems as well as tables of equivalent measures in the two systems. Denominate numbers and applications in medicine are also discussed.

Chapter 10, **Geometry,** is a new chapter which includes the formulas for perimeter, area, and volume that had been integrated with the discussion of measurement in the previous edition. The discussion on angles and triangles has been taken from the appendix and made an integral part of this chapter on elementary geometric concepts. The Pythagorean Theorem is developed as a geometric concept and provides an early introduction to radicals and simplifying radical expressions.

Chapter 11, **Signed Numbers,** is the beginning of the **prealgebra** part of the text. The term *signed number* is used to indicate that positive and negative fractions and decimals are discussed as well as integers. Number lines are used to introduce the elementary operations of addition and subtraction with signed numbers.

Chapter 12, **Solving Equations,** includes work with formulas to reinforce and generalize the techniques for solving equations.

Chapter 13, **Real Numbers and Graphing,** contains several topics that will give continuing students a head start in algebra. These topics include real numbers, graphing straight lines and parabolas, and the distance and midpoint formulas.

There are three appendixes:

I. Ancient Numeration Systems

II. Base Two and Base Five

III. Greatest Common Divisor (GCD)

Accuracy

In any mathematics text a reliable and correct presentation is of utmost importance. Both the exposition and the answer section of the Sixth Edition have been thoroughly checked by independent accuracy reviewers to ensure that they are of the highest quality.

Additional Aids

- *Instructor's Guide.* This guide contains discussions of each chapter, the answers to the exercises numbered as multiples of four, and sample tests for each chapter. These tests are designed to be pulled out for easy reproduction. There are four

tests for each chapter, two containing open-ended questions and two containing multiple-choice questions. Also, there are four forms of each of the three comprehensive tests in the guide.

- *Student Solutions Guide.* This manual contains the solutions to all the odd-numbered section exercises and chapter test questions in the text.
- *HeathTest Plus.* This new, versatile test-generating program allows instructors to customize tests for their own classes. It contains over 1700 test items, each of which can be chosen in a multiple-choice or open-ended format and offers full graphics capability (including mathematical symbols). With this program instructors can preview questions on-screen and then add each item to a test with one keystroke. Random generation of test items by chapter is possible. In addition, instructors may edit existing items or add new items either to the data base or to individual tests. Tests may be saved and then printed in multiple scrambled versions. Answer keys are generated automatically.

  Hardware requirements: IBM PC or compatible, two disk drives, IBM graphics-compatible dot-matrix printer or laser printer.

  Items included: one program disk, test item disks, User Manual/Printed Test Item File.

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D. Franklin Wright

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CHAPTER

1 Whole Numbers

1.1 READING AND WRITING WHOLE NUMBERS

The Hindu-Arabic system that we use was invented about A.D. 800. It is called the **decimal system** (**deci** means ten in Latin). This system allows us to add, subtract, multiply, and divide more easily and faster than any of the ancient number systems. For example, multiplying 22 by 3 in the Roman system would appear as

$$\begin{array}{r} \text{XXII} \\ \text{III} \\ \hline \text{LXVI} \end{array} \qquad \text{while we might write} \qquad \begin{array}{r} 22 \\ \times\ 3 \\ \hline 66 \end{array}$$

A discussion of several ancient number systems is included in Appendix I. As we develop operations with the decimal system throughout the text, advantages of the decimal system over the other systems will become more and more evident.

The decimal system (or base ten system) is a **place value system** that depends on three things:

1. The **ten digits:** 0, 1, 2, 3, 4, 5, 6, 7, 8, 9;
2. The **placement** of each digit; and
3. The **value** of each place.

The **decimal point** is the beginning point for writing digits. The value of each place to the left of the decimal point has a **power of ten** (1, 10, 100, 1000, and so on) as its place value. (See Figure 1.1.)

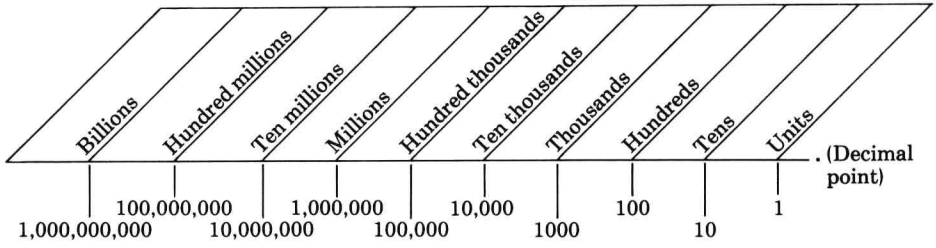

Figure 1.1

When a digit is written in a place, the value of the digit is to be multiplied by the value of the place. The value of any number is found by adding the results of multiplying the digits and place values. For example,

$$\underbrace{6}_{100}\ \underbrace{9}_{10}\ \underbrace{3}_{1}$$ ← digits (standard notation)
← place values

$693 = 6(100) + 9(10) + 3(1) = 600 + 90 + 3$ **(expanded notation)**

NOTE: Writing a number next to a number in parentheses means to multiply.

In **expanded notation** the values represented by each digit in standard notation are added. The English word equivalents can then be easily read from these sums. If a number has more than four digits, commas are placed to separate every three digits beginning from the right. Commas are used in the same manner in the word equivalents.

NOTE: In this text, we have chosen not to use commas in numbers with four digits. This choice is a matter of style. You may use commas in four-digit numbers if you prefer.

EXAMPLES Each number is written in standard notation and in expanded notation and in its English word equivalent. If no decimal point is written, it is understood to be to the right of the rightmost digit.

1. 573 (standard notation)

   $573 = 5(100) + 7(10) + 3(1)$
   $= 500 + 70 + 3$ (expanded notation)

   five hundred seventy-three

2. 4862

$$4862 = 4(1000) + 8(100) + 6(10) + 2(1)$$
$$= 4000 + 800 + 60 + 2 \quad \text{(expanded notation)}$$

four thousand eight hundred sixty-two

3. 8007

$$8007 = 8(1000) + 0(100) + 0(10) + 7(1)$$
$$= 8000 + 0 + 0 + 7$$

eight thousand seven

4. 1,590,768

$$1{,}590{,}768 = 1(1{,}000{,}000) + 5(100{,}000) + 9(10{,}000) + 0(1000) + 7(100) + 6(10) + 8(1)$$
$$= 1{,}000{,}000 + 500{,}000 + 90{,}000 + 0 + 700 + 60 + 8$$

one million, five hundred ninety thousand, seven hundred sixty-eight

Whole numbers are those numbers used for counting and the number 0. They are the decimal numbers with digits written to the left of the decimal point and with only 0's (or no digits at all) written to the right of the decimal point. Decimal numbers with digits to the right of the decimal point will be discussed in Chapter 5.

We use the letter **W** to represent all whole numbers:

$$0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, \ldots$$

The three dots indicate that the pattern is to continue without end.

Note four things when reading or writing whole numbers:

1. The word **and** does not appear in English word equivalents. **And** is said only when reading a decimal point. (See Chapter 5.)
2. Digits are read in groups of three.
3. Commas are used to separate groups of three digits **if a number has more than four digits.**
4. Hyphens (-) are used to write English words for the two-digit numbers from 21 to 99 except for those that end in 0.

PRACTICE PROBLEMS	Write the following numbers in expanded notation and in their English word equivalents.	ANSWERS
	1. 512	**1.** 500 + 10 + 2 Five hundred twelve
	2. 6394	**2.** 6000 + 300 + 90 + 4 Six thousand three hundred ninety-four
	3. Write one hundred eighty thousand, five hundred forty-three as a decimal numeral.	**3.** 180,543

Exercises 1.1

Did you read the explanation and work through the examples before beginning these exercises?

Write the following decimal numbers in expanded notation and in their English word equivalents.

1. 37	**2.** 84	**3.** 98	**4.** 56
5. 122	**6.** 493	**7.** 821	**8.** 1976
9. 1892	**10.** 5496	**11.** 12,517	**12.** 42,100
13. 243,400	**14.** 891,540	**15.** 43,655	**16.** 99,999
17. 8,400,810	**18.** 5,663,701		**19.** 16,302,590
20. 71,500,000	**21.** 83,000,605		**22.** 152,403,672
23. 679,078,100	**24.** 4,830,231,010		**25.** 8,572,003,425

Write the following numbers as decimal numbers.

26. seventy-six

27. one hundred thirty-two

28. five hundred eighty

29. three thousand eight hundred forty-two

30. two thousand five

31. one hundred ninety-two thousand, one hundred fifty-one

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