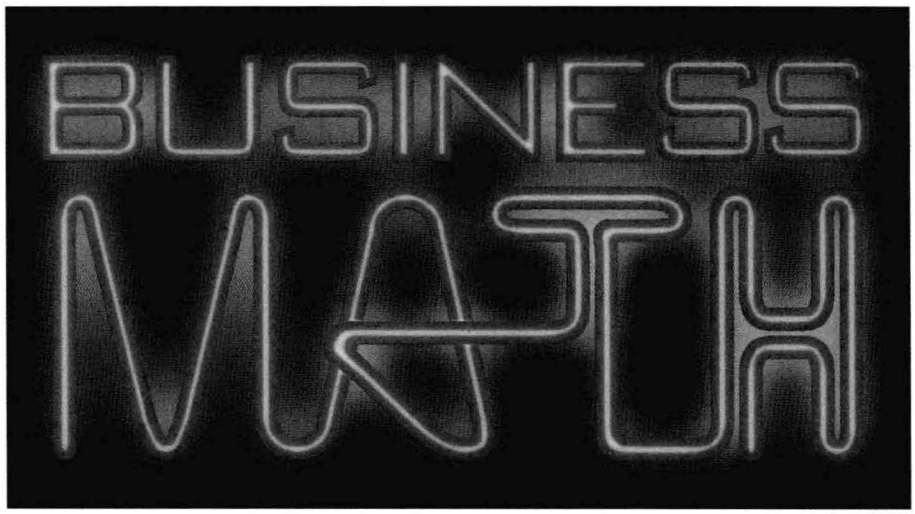
BUSINESS MATH

THIRD EDITION

LLOYD D. BROOKS



Third Edition

LLOYD D. BROOKS, Ed.D.

THE UNIVERSITY OF MEMPHIS
MEMPHIS, TENNESSEE

EMCParadigm

Developmental Editor: Cynthia Miller

Copyeditor: Carol Kennedy

Text/Cover Design: Queue Publishing Services

Desktop Production and Illustrations: Tim Heitman

Acknowledgments: We wish to thank the following instructors and technical experts who contributed to this book:

Mr. Leo Gafney
Consultant
Lakeville, CT

Ms. Debbie West
Draughons Junior College
Nashville, TN

Ms. Donna McFalls
West Tennessee Business College
Jackson, TN 38302

Library of Congress Cataloging in Publication Data

Brooks, Lloyd D.
Business math / Lloyd D. Brooks. -- 3rd. ed.
p. cm.
Rev. ed. of: College business mathematics. c1988.
Includes index.
ISBN 1-56118-657-0
1. Business mathematics. I. Brooks, Lloyd D.
College business mathematics. II. Title.
HF5691.B764 1996
650'.01'513--dc20 94-21341
CIP

Published by: EMC/Paradigm
300 York Ave.
St. Paul, MN 55101
800-535-6865

E-mail questions or comments regarding this text may be sent to PUBLISH@emcp.COM.

Printed in the United States of America

10 9 8 7 6 5 4 3 2

PREFACE

Interest, insurance, mortgage, sales tax—you have probably heard these terms; but do you know what they mean? Which of these are a consideration in your life?

Whether it's reconciling a bank statement, making payments on a car, or buying stocks from a major corporation, business math is prevalent in almost everyone's life. Therefore, it is important to learn the principles of business math in order to make informed decisions about your personal and professional life.

This text has been developed to make the study of business math comprehensive and interesting. It combines real-life applications of business math with easy-to-comprehend instruction and analysis. The best way to learn business math is to solve problems, and this text has been structured to provide ample practice with a wide variety of problems. For each concept presented, a model problem demonstrates how the solution is reached. Then you are asked to apply your skills to solve a similar problem on your own. There are several of these problems throughout each chapter to provide immediate practice and feedback. By working these problems, as well as the applications at the end of each chapter, you will discover the basics of business mathematics and how to apply the concepts in this book to your life.

FEATURES

This text contains several features and tools to help you learn business math:

Unit Introduction

A brief introduction presents the topics that will be covered within the unit. The units are broken down into different types of business mathematics, such as marketing mathematics, and accounting and financial mathematics.

Chapter Performance Objectives

Each chapter begins with objectives that state the learning benchmarks and standards established for each chapter.

Marginal Notes

Terms and concepts that may be unfamiliar are explained in the margin to help build vocabulary and conceptual understanding

Model Problems

Following each concept within a chapter, a model problem is worked out to illustrate how the solution is reached.

Apply Your Skills

Following the Model Problems within a chapter, Apply Your Skills exercises provide an immediate opportunity to solve problems related to each topic.

Performance Applications

At the end of each chapter, drill-and-practice problems provide ample practice solving the chapter problems.

Chapter Practice Tests

At the end of each chapter is a sample test to provide additional practice solving the chapter problems.

Connections

Connections exercises ask questions about real-life documents, such as USA Today charts, to demonstrate everyday uses for business math.

Decisions

Decisions exercises require you to make effective business and financial decisions.

Chapter Reviews and Quick References

A review appears at the end of each chapter that highlights key points, formulas, examples, and page references.

Communications

Communications exercises appear at the end of each unit and teach you how to communicate and comprehend the language of business math.

Unit Self Tests

At the end of each unit is a sample test to provide additional practice solving the problems contained in the unit.

STUDENT SUPPLEMENTS

Student Solutions Manual

Solutions to end-of chapter Performance Applications, and Connections, Decisions, and Communications problems are given for student reinforcement.

Electronic Calculator

An electronic calculator is included with the textbook for use when solving business math problems

The Net Effect

The Net Effect is a software program designed to provide authentic practice in business math. You are invited to complete real-life business math tasks as an employee in a retail music store. The tasks take place in several areas of the business and involve a variety of business documents. This program is available on 3.5" disks and CD-ROM.

CONTENTS

Page	Photo Credits
1	International Stock Photography/Bill Tucker
2	International Stock Photography/Roger Markham Smith
44	International Stock Photography/Wayne Sproul
60	International Stock Photography/Kachaturian
103	International Stock Photography/Frank Maresca
104	International Stock Photography/Russell Clemens
116	International Stock Photography/Richard Hackett
130	International Stock Photography/Michael Phillip Manheim
156	Image Bank/HMS Images
190	International Stock Photography/Peter Russell Clemens
212	International Stock Photography/Jeff Greenberg
252	International Stock Photography/Peter Russell Clemens
274	International Stock Photography/Peter Langone 3486
310	International Stock Photography/Richard Hackett
333	International Stock Photography/Frank Maresca
354	Photo Edit/David Young-Wolf
396	International Stock Photography/JG Mason
415	International Stock Photography/Bill Stanton
472	International Stock Photography/Hal Kern

Chapter 1

ADDITION AND SUBTRACTION

Performance Objectives

1. Determine the place value of numbers.
2. Round whole numbers in a verbal format.
3. Group digits to increase computational speed.
4. Read numbers and estimate solutions to increase accuracy.
5. Add digits in vertical and horizontal formats.
6. Subtract digits in vertical and horizontal formats.

The growth of microcomputers has made the processing of numerical data even more important than in the past. This equipment can process millions of values in a few seconds. Ironically, however, the electronic equipment in use today makes the study of business mathematics more essential than ever. To use the equipment effectively, you must first understand business mathematical procedures.

Although business mathematics applications require very precise results, computations are often logical and fairly easy to learn. Most problems result not from a lack of knowledge, but from a lack of attention to details, which then causes errors. Several factors can contribute to increased accuracy, as illustrated in Figure 1.1.

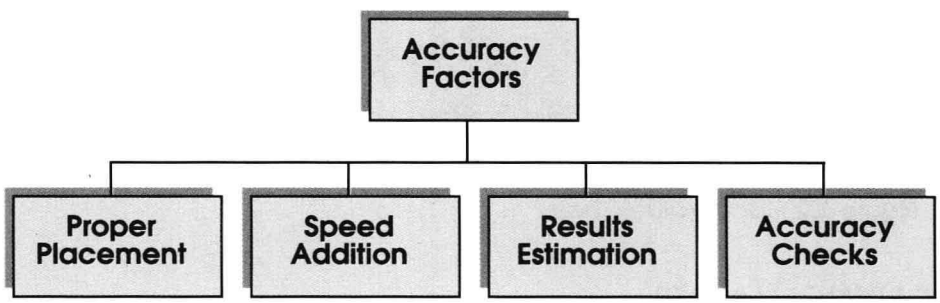


Figure 1.1 Accuracy Factors

PLACE VALUE

From prehistoric times to the present, people have used symbols to represent quantities. The Romans used seven letters to express numerical values, whereas the Egyptians used symbols. Most modern countries use the decimal number system, which is based on the ten digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Place value *is a system whereby the position of the digit determines its value.*

Electronic calculators and computers use the decimal system to process numerical values. The value of each digit depends on its place in relation to the decimal point. Each number place has a value ten times greater than the number place to its right. For example, 40 is ten times greater than 4, and 400 is 10 times greater than 40.

The value is determined by the position relative to the decimal point.

Number place determines a number's actual value. Figure 1.2 shows the values of various positions to the left and right of the decimal point.

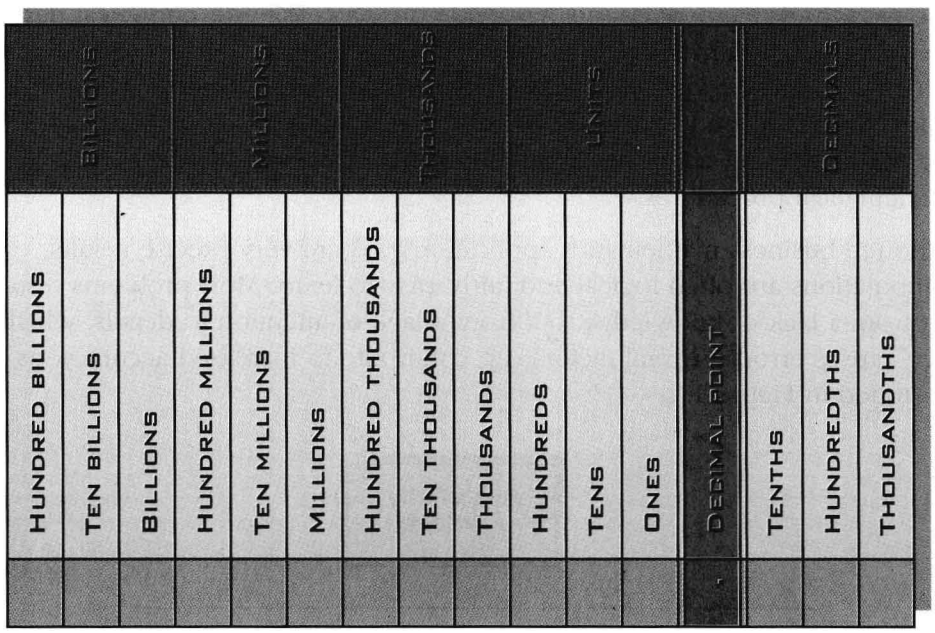


Figure 1.2 Place Value Chart

READING VALUES

Rounding *provides a method to estimate or determine an approximate answer.*

Numbers are read according to their position in the place value chart.

Whole numbers should be separated into groups of three digits, with a comma separating each group. Name each group, such as millions, thousands, hundreds, units, and so forth. Begin at the left of the number and then read the numerals in each group, indicating the name as the group is read. However, the group name *units* is not stated.

The decimal point is used to separate units from decimal portions of the number. The word *and* is used to indicate the decimal point in reading the number. For example, the number **2,456,208.45** is read as **two million, four hundred fifty-six thousand, two hundred eight, and forty-five hundredths.** Commas are used to separate digits into groups of three placed from left to right. Other examples are shown in Model 1.1.

Reading numbers is especially important when communicating by telephone. For example, a customer requesting an account balance will be misinformed if an amount is read incorrectly.

Reading numbers

MODEL 1.1

7	read *seven*
214	read *two hundred fourteen*
12,716	read *twelve thousand, seven hundred sixteen*
7,204,000	read *seven million, two hundred four thousand*
4.2	read *four and two-tenths*
18.35	read *eighteen and thirty-five hundredths*
0.421	read *four hundred twenty-one thousandths*
$12.45	read *twelve dollars and forty-five cents*
18%	read *eighteen percent*

Apply Your Skills

Indicate how each of the following numbers should be read.

(a) 345 _____

(b) 1,382 One thousand three hundred eighty-two

(c) 425.84 four hundred twenty thousand and eighty four

(d) $27.53 twenty-seven & 53 hundreds hundredths

(e) 14.2% fourteen point two percent

INCREASING SPEED BY GROUPING

Speed is important in making mathematical computations by hand. One way to add numbers quickly is to identify groupings of two or more numbers that total 10, because addition in groups of 10 is relatively fast. See Model 1.2.

Addition in groups of 10

MODEL 1.2

Group digits in multiples of ***10****.*

$$\begin{array}{r} (6\ 4)\ 10 \\ (3\ 7)\ 10 \\ 8 \\ \hline 28 \end{array} \qquad \begin{array}{r} (1\ 2\ 7)\ 10 \\ (8\ 2)\ 10 \\ \hline 20 \end{array} \qquad \begin{array}{r} 10\ \langle 7\ 2\ 3 \rangle\ 10 \\ 8 \\ 1 \\ \hline 21 \end{array}$$

Apply Your Skills

Which values should be grouped to speed addition for the following addition problem?

7
4
3
6
2

(a) _____

(b) _____

Practice makes grouping values easier and increases speed in manual addition. When a calculator or computer is used, the numbers should be entered in order without grouping because the values are recorded into memory as they are entered from the keyboard.

In Model 1.3, group the numbers from top to bottom as you add. To check the accuracy of your answer, add the numbers again by grouping the values from bottom to top. If you obtain the same answer twice, you can be reasonably certain that the answer is correct. Even when using a calculator, performing the addition twice is always recommended.

MODEL 1.3

Add the digits two times to assure the same answer for accuracy.

Checking the accuracy of addition

788	763
272	124
835	343
125	768
988	132
3,008	2,130

Apply Your Skills

Check the accuracy of the following addition problem. What is the correct answer? _____

1,243
302
3,428
8,319

INCREASING ACCURACY BY ROUNDING

Compare the estimated answer with the computed answer.

A second way to increase accuracy is to estimate the answer first and then compare the estimated answer with the computed answer to see if they are similar. To estimate, round the numbers to a specific digit, such as the hundreds place or the tenths place.

In *rounding* to the hundreds place, for example, if the digit that was in the tens place is 5 or more, increase the digit in the hundreds place by 1. Otherwise, the digit in the hundreds place is unchanged. Then convert all digits to the right of the hundreds place to zeros. Model 1.4 illustrates typical rounding of numbers.

Rounding is designed to make it easier to estimate or approximate the actual answer. The procedure for rounding values is fairly easy, as illustrated below.

Step 1 Choose the digit for rounding.

Step 2 If the digit to the right of the digit chosen for rounding is **5** or greater, increase the chosen digit by **1**. If the digit to the right of the digit chosen for rounding is **4** or less, do not increase the chosen digit.

Step 3 Unless rounding involves decimal values, change digits to the right of the digit chosen to zeros.

To see how these rounding procedures work in practice, the value 4,867 is rounded to the thousands position.

Step 1 Decide on the digit for rounding—thousands position in this example, **4**,867.

Step 2 Since the digit (**8** in this example) to the right of the digit chosen is 5 or greater, the digit **4** is increased by **1**. The value **4** is changed to a **5**. This is called rounding up.

Step 3 The remaining digits are then changed to zeros to provide the following value: **5,000.** Therefore, the value 4,867 has been rounded to 5,000.

For an example involving a decimal value, assume that the value 4.638 is rounded to the tenths position. The rounding procedures used above can be repeated.

After rounding, zeros to the far right of the decimal point are usually dropped. For example, 8.65 rounds to 8.7.

Step 1 Decide on the digit for rounding—tenths position in the example, 4.**6**38.

Step 2 Since the digit to the right of the chosen digit (**3** in this example) is 4 or less, the digit chosen for rounding (tenths) is not changed.

Step 3 The remaining digits are then dropped to provide the following value: **4.6.** Therefore, the value 4.638 has been rounded to 4.6.

MODEL 1.4

Rounding values

46	rounded to tens	50
342	rounded to hundreds	300
562	rounded to hundreds	600
3,728	rounded to thousands	4,000
8.65	rounded to tenths	8.7
29.42	rounded to tenths	29.4
9.236	rounded to hundredths	9.24
8.923	rounded to hundredths	8.92
5.34%	rounded to tenths	5.3%
$4.55	rounded to dollars	$5.00

Apply Your Skills

Round each of the following numbers as indicated.

(a) 379 rounded to hundreds 400

(b) 2,701 rounded to thousands 3000

(c) 8.28 rounded to tenths 8.3

(d) 4.2519 rounded to hundredths 4.25

(e) $27.58 rounded to dollars 28.00

Perform the exercise in Model 1.5 to determine if your answer equals the answer given. First, compute the exact answer. Then compute the estimated answer to see if they are close.

Model 1.5 shows that the estimated answer is close to the exact answer. If the estimated answer is much different from the computed exact answer, the numbers should be added again.

Rounding answers: Whole numbers

Exact	Rounded to hundreds
345.28	300
450.38	500
2,562.36	2,600
650.00	700
4,008.02	4,100

Apply Your Skills

Estimate the following solution by rounding each of the values to hundreds. What are the (a) exact and (b) estimated solutions?

348 _____

2,479 _____

620 _____

570 _____

(a) _____ (b) _____

MODEL 1.5

Rounding procedures:

1. *Identify digit for rounding.*
2. *Round up if digit to the right is 5 or more. Otherwise, do not change.*
3. *All digits to right of identified digit are changed to zeros (except for decimal values).*

Rounding can also be used to estimate the answer in adding decimal values, as shown in Model 1.6.

The estimated answer is reasonably close to the exact answer. This comparison is another way to ensure that computations are accurate.

Rounding answers: Decimals

Exact	Rounded to tenths
4.35	4.4
10.57	10.6
5.26	5.3
20.18	20.3

MODEL 1.6

Apply Your Skills

What are the (a) exact and (b) estimated (rounded to tenths) solutions for the following addition problem?

5.76 _____

2.23 _____

14.21 _____

10.79 _____

(a) _____ (b) _____

ADDING FIGURES HORIZONTALLY

Numbers are often arranged horizontally on business reports.

In hand calculations, horizontal addition is more difficult because the numbers are not aligned vertically for ease of reading. As in vertical addition, add the digits in the ones place first, then the digits in the tens place, and so on. With a calculator, of course, horizontal addition is as easy as vertical addition. Model 1.7 demonstrates horizontal addition.

MODEL 1.7

Horizontal addition is best performed with a calculator.

Horizontal addition

145 + 25 + 68 = ____ ____ **8** (carry 1 to tens place)

145 + 25 + 68 = ____ **3** **8** (carry 1 to hundreds place)

145 + 25 + 68 = **2** **3** **8**

Apply Your Skills

Compute the solutions to the following addition problems. Check your answers by adding values vertically and horizontally.

234	+	75	+	204	=	(a)	_____
27	+	102	+	82	=	(b)	_____
103	+	87	+	102	=	(c)	_____
(d) _____	+	(e) _____	+	(f) _____	=	(g)	_____

The accuracy of horizontal addition can be checked by adding the values horizontally and vertically as shown in Model 1.8. The sum of the vertical totals and the sum of the horizontal totals should be the same if all individual sums have been added correctly.

MODEL 1.8

Checking horizontal addition

42	+	36	+	45	=	123
32	+	18	+	19	=	69
35	+	16	+	32	=	83
109	+	70	+	96	=	**275**

You may now complete Performance Applications 1.1 and 1.2.

SUBRACTION

Finding the difference between two values is often necessary in business and personal applications. As shown in Model 1.9, the number subtracted is called the *subtrahend*, the number subtracted from is the *minuend*, and the resulting answer is the *difference*.

MODEL 1.9

Components of subtraction

$4,274.45	Minuend
- 1,121.28	Subtrahend
$3,153.17	Difference (Remainder)

Apply Your Skills

Donald Quinn's account with the bank had a $2,519.45 balance. He withdrew $57.37 from the account. What was the balance after the withdrawal?

_____

PROOF IN SUBTRACTION

Subtraction is the opposite of addition. Therefore, you can check or prove the accuracy of subtraction by adding the difference to the subtrahend to see if the resulting sum equals the minuend. You can check the subtraction in Model 1.9 by adding $1,121.28 + 3,153.17 = $4,274.45.

HORIZONTAL SUBTRACTION

Accounting records, journals, invoices, and charge account statements are often written in a horizontal format, as in 24 - 13 = 11. This horizontal arrangement makes it more difficult to align decimal points, as in 2.189 - 1.2 = .989, but the method used for horizontal subtraction is the same as for vertical subtraction.

ROUNDING ANSWERS IN SUBTRACTION

Estimating answers is also useful in subtraction. The procedure for rounding is like the one used for addition, discussed in Chapter 1. The subtrahend and minuend should be rounded to the same place, for example, tens or hundreds, as shown in Model 1.10.

Notice that the estimated answer is reasonably close to the actual answer. This is another safeguard to obtain the correct answer. Estimating becomes even more important when using a calculator because merely striking a wrong key can result in an error. Estimating fairly simple computations can be done mentally.