

BUSINESS MATHEMATICS FOR COLLEGES

REVISED EDITION

IRWIN

VAZSONYI & BRUNELL



Revised Edition

BUSINESS MATHEMATICS FOR COLLEGES

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Preface

This book is designed to develop the mathematical knowledge needed by college students to meet the demands of modern business. Our emphasis is not on the theory of business mathematics but on developing the ability to solve practical business problems quickly and accurately.

The material provides a solid coverage of the most basic and frequently occurring business situations in such fields as accounting, retailing, marketing, consumer mathematics, and so on. General business methods are introduced step by step so the student's comprehension is steadily strengthened and enlarged. By solving problems of increasing difficulty, the student develops and reinforces confidence, and overcomes the fear of mathematics, so common in our society.

The first three chapters refresh and strengthen the student's skills in basic arithmetic processes. The text is flexible so that some instructors may cover this fundamental material rapidly; some more slowly. A special section in Chapter 1 highlights the problem-solving approach. Here the student learns to recognize the relationships (formulas) in the word problems to be solved.

Once students have mastered the skill of basic arithmetic processes and problem solving, they are ready to move into the carefully selected sequence of business problems. Then they can test and further develop their knowledge and know-how for solving such problems.

Each chapter begins with a statement of what the student will learn and why. Then the business principles involved are explained and illustrated in plain English, and pertinent definitions and appropriate business terminology are introduced. Solutions to examples are spelled out in detail to teach the student suitable problem-solving skills. General procedures for solving problems are stated in full without omission of steps so that even a student who misses some classroom explanation can acquire the required knowledge. The most important rules and formulas are set in frames so the student can quickly master the techniques required to solve problems.

Great care has been taken to provide a large number of practical assignments. Only by solving true-to-life business problems can students reinforce what they have learned. The alternate assignments at the end of the book are coordinated with the assignments in the text. The instructor can use the alternate assignments in introducing the concepts of the lesson, or for additional review, remedial work, and so on.

A comprehensive Instructor's Edition containing solutions to all assignments, a complete testing program, including pretests and solutions, is available. Each test has two forms, so that instructors can use these tests on an alternate-semester basis, alternate-section basis, or alternate-row basis. Also included in each chapter of the Instructor's Edition are behavioral

objectives, pointing out clearly the business methods and techniques pertinent to each concept and giving the instructor and student sample test items.

FEATURES OF THE REVISED EDITION

On the basis of extensive classroom testing and discussion with instructors, we have completely revised this book. While we have not changed our basic objectives, we have redesigned the layout, made the book more compact, rearranged material, introduced new material, and removed sexism, all with the single goal of making the process of instruction more effective. Reviews from colleagues and preliminary testing show that the new edition will be a welcome improvement to both student and instructor and will be even more popular than the first edition. Here are some of the specific improvements.

Chapter 2. Deposits, checks, and bank statement reconciliation are now in this chapter.

Chapter 3. An improved method to compute the least common denominator is presented.

Chapter 5. FICA and federal tax calculations are updated and extended to include married persons. The percentage method of calculating income tax is added. Calculation of wages by straight piece rate is included. The entire payroll section of the book is upgraded.

Chapter 6. The units-of-production method of depreciation is added.

Chapter 7. A table for numerical date of each day of the year is added to facilitate interest calculation. Discounting of notes is now in this chapter.

Chapter 8. Rule of 78 is added. Present value of money and financial discount are now in this chapter.

Chapter 9. Inventory valuation and merchandise turnover are added.

Chapter 10. Stocks and bonds are completely rewritten and latest commission rates are given.

It is a pleasure to acknowledge our indebtedness to Jeff Hooper of Mesa Community College, Mesa, Arizona, and Janet Rickley of North Central Technical College, Mansfield, Ohio, who reviewed the manuscript and provided valuable advice and assistance in preparing the text. Special thanks are due to Pat Helton for typing assistance and to Laura T. Vazsonyi for painstaking editorial assistance.

December 1978

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1

THE DECIMAL NUMBER SYSTEM AND THE
FOUR ARITHMETIC OPERATIONS

KEY CONCEPTS COVERED IN THIS CHAPTER

Addition
Subtraction
Multiplication
Division
How to solve word problems

WHAT YOU WILL
LEARN AND WHY

To have and to hold a good job you must know how to work with numbers. Can you figure your take-home pay, deductions, bank balance, taxes and so on? You must learn how to do calculations both by hand and by calculator. Do not believe that a calculator nor even a computer makes it unnecessary for you to know business mathematics, or that you can get correct answers automatically. On the contrary, the need and opportunities for applying business mathematics are growing by leaps and bounds. To have a working knowledge of the subject you need know-how and much practice. This book will give you both. However, you must learn to walk before you run. So in this chapter we start with basic arithmetic. But first you must learn about the number system we and calculators use.

THE DECIMAL NUMBER SYSTEM

We do not know the name of the Hindu who devised the *decimal number system* in the 1st century, but we do know that it was the Arabs who introduced this number system to Europe in the 12th century.

The number 325 is a decimal number and it

has three digits: 3, 2, and 5. The 5 is in the *unit place* or *position*; the 2 is in the *tens position* ($2 \times 10 = 20$); the 3 is in the *hundreds position* ($3 \times 100 = 300$).

The numbers 15, 315, 1,520 are whole numbers. The number .1 is one tenth; .5 is five tenths; .01 is one hundredth; .75 is seventy-five hundredths. These are not whole numbers, but *decimal numbers*. The decimal point shows you do not have a whole number—only part of a number.

One more thing about decimals: a number like 25.71 is sometimes called a *mixed decimal*. It is made up of the whole number 25 and the decimal .71.

ARITHMETIC OPERATIONS

Suppose there are three people in a room, and two more enter. You count 1, 2, 3, 4, 5. You combine the 3 and 2 into a single *sum* or *total* of 5. You add 3 and 2. *Counting* is the foundation of working with numbers.

When you add 3 and 2 to get 5, you perform the *addition operation*. When you subtract 3 from 10 to get 7, you perform *subtraction*. When you multiply 3 by 5 to get 15, you perform *multiplication*; and when you divide 20 by 4 to get 5, you perform *division*.

ADDITION

HOW TO ADD

Look at the six whole numbers:

$$\begin{array}{r}
 15 \\
 542 \\
 3 \\
 2,314 \\
 515 \\
 \hline
 3,389
 \end{array}
 \begin{array}{l}
 \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} \text{addends} \\
 \text{sum or total}
 \end{array}$$

The first five numbers, the *addends*, are given. From these five addends you get a new number: the *sum* or *total*. You *add* the given numbers to get your answer.

By addition you get the sum of the next four decimal addends:

$$\begin{array}{r}
 15.02 \\
 3.00 \\
 .51 \\
 \hline
 123.05 \\
 141.58
 \end{array}
 \begin{array}{l}
 \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{addends} \\
 \text{sum or total}
 \end{array}$$

You must add to get a sum or total.

Often it is easier to get *subtotals* and then the *grand total*:

$$\begin{array}{r}
 25.15 \\
 3.07 \\
 \hline
 123.01 \quad 151.23 \\
 61.42 \\
 .91 \\
 \hline
 543.10 \quad 646.93 \\
 41.50 \\
 24.00 \\
 \hline
 1.50 \quad 25.50 \\
 \hline
 823.66
 \end{array}
 \begin{array}{l}
 \left. \begin{array}{l} \\ \\ \\ \\ \end{array} \right\} \text{addends} \\
 \begin{array}{l} \text{subtotals} \\ \text{grand total} \end{array}
 \end{array}$$

The plus sign (+) is a symbol indicating addition:

$$2 + 3 + 7 = 12$$

HOW TO PROVE YOUR ANSWER: THE REVERSE ORDER METHOD

We all make mistakes. The trick is to find and correct them. A good way to prove your addition is to repeat it in reverse order. Suppose you have

added from top to bottom. Do your proving by adding from bottom to top.

$$\begin{array}{r}
 141.58 \\
 15.02 \\
 3.00 \\
 .51 \\
 \hline
 123.05 \\
 141.58
 \end{array}
 \begin{array}{l}
 \text{proof sum or total} \\
 \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{add down to solve, then up to prove} \\
 \text{sum or total}
 \end{array}$$

If the answers do not agree, add again.

HOW TO SAVE TIME

When you add a long column of numbers, it is easy to get mixed up and to make errors which waste time. Even if you use a calculator you can get the wrong answer. A good way to make certain that you get the correct answer is to break a big problem into a few small ones. If you have a long column of numbers to add, break them into groups of five and get the subtotals. Then add the subtotals to get the grand total.

$$\begin{array}{r}
 17.51 \\
 5.27 \\
 123.18 \\
 17.10 \\
 \hline
 3.00 \quad 166.06 \quad \text{subtotal} \\
 23.80 \\
 231.51 \\
 81.17 \\
 48.62 \\
 \hline
 7.13 \quad 392.23 \quad \text{subtotal} \\
 121.00 \\
 42.91 \\
 \hline
 5.85 \quad 169.76 \quad \text{subtotal} \\
 \hline
 728.05 \quad \text{grand total}
 \end{array}$$

HOW TO WORK WITH TABLES

How much meat did Jones Market sell on Thursday? How much in groceries on Saturday? What were the total sales on Wednesday? What were the total sales of meat for the entire week? You can find the answers from the table on the next page.

In row 3, column 4, you find that Jones sold on Thursday \$14,728 worth of meat; row 1, column 6, on Saturday \$30,417 worth of groceries; row 6, column 3, on Wednesday his total sales were \$64,546; row 3, column 7, the sale of meat for the entire week was \$101,897.

		Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
	<i>Department</i>	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>	<i>Saturday</i>	<i>Total</i>
Row 1	Grocery	\$12,385	\$ 9,732	\$28,521	\$16,201	\$22,480	\$30,417	\$119,736
Row 2	Bakery	3,296	1,832	3,987	2,561	3,075	3,996	18,738
Row 3	Meat	11,644	9,569	20,629	14,728	15,842	29,485	101,897
Row 4	Produce	5,734	4,984	6,596	7,295	6,982	9,048	40,639
Row 5	Dry goods	2,920	3,516	4,813	3,046	3,987	4,565	22,847
Row 6	Total	\$35,979	\$29,633	\$64,546	\$43,831	\$52,366	\$77,511	\$303,857

Note that you get the *row sums* in column 7 by adding the numbers in each row *horizontally*; you get the *column sums* in row 6 by adding the numbers in each column *vertically*. The \$303,857 in row 6, column 7 is the *grand total*: the sum of the totals in row 6, or the sum of the totals in column 7. You add the numbers in the bottom

row horizontally, and/or add the numbers in the last column vertically to get the same grand total.

If you find it difficult to add numbers horizontally in a row, copy them vertically and then add.

You are now ready to complete Assignment 1-1. Alternate Assignment A1-1 will be found on page 221.

ASSIGNMENT 1-1 Working with addition

Name _____

Date _____

A. Adding vertically:

1. Add each column vertically. Show all your work.

Example.

```

735
1,270
  65
 158
4,701
  19
  21
  17
   5
---
6,929
    
```

(a)

```

678
  14
2,075
  718
   83
---
    
```

(b)

```

1,973
24,814
   707
  9,610
   701
---
    
```

(c)

```

$ .83
  1.75
101.31
   7.07
 18.70
---
    
```

(d)

```

$ 1.78
  78.61
117.70
   9.91
100.40
---
    
```

Check your answers by adding from the bottom up.

2. Some of the following totals are wrong. Cross out the wrong answer and write the correct answer below it.

Example.

```

$47.87
  3.78
  7.97
 14.79
$64.41
 74.41
    
```

(a)

```

$ 78.99
 16.87
   5.91
 10.78
   8.70
---
$121.25
    
```

(b)

```

$ 14.70
   1.81
101.07
   9.18
---
$126.76
    
```

(c)

```

$ 78.14
   7.85
  14.85
   7.18
102.10
---
$210.22
    
```

(d)

```

765
1,071
  970
  831
  989
---
4,706
    
```

(e)

```

$210.75
   3.88
   5.70
   6.91
175.73
   7.80
---
$411.77
    
```

Check your answers by adding from the bottom up.

3. Add the following using the subtotal method.

Example.

```

$ 817.90
  42.70
  781.75
   97.61
1,070.71
  245.70
   70.10
  153.70
---
2,810.67
    
```

(a)

```

$1,707.81
  415.91
3,700.83
  487.51
1,007.07
  619.90
   37.91
    4.81
---
617.00
    
```

(b)

```

$ 410.70
  317.45
1,700.37
   97.71
  345.54
1,900.14
   910.70
1,787.75
   86.75
---
2,945.15
    
```

(c)

```

$ 57.10
 160.75
   94.61
   75.50
 175.80
   45.70
  100.70
1,093.33
  714.80
   57.75
   107.95
   84.70
---
    
```


(d)

\$1,000.75
 45.81
 175.00
 87.75
 193.47
 83.75
 146.32
 2,037.41
 1.70
3,147.83

(e)

\$ 817.95
 1,781.83
 1,840.91
 781.60
 970.71
 792.60
 810.19
989.17

Check your answers by adding from the bottom up.

- B. Add horizontally (across); then add vertically (up and down). NOTE: Sums of horizontal totals must equal sums of vertical totals.**

Example.

227 + 316 + 234 =	<u>777</u>	Check: 1,216 1,456 1,684 <u>4,356</u>
107 + 401 + 75 =	<u>583</u>	
785 + 432 + 810 =	<u>2,027</u>	
97 + 307 + 565 =	<u>969</u>	
<u>1,216</u> + <u>1,456</u> + <u>1,684</u> =	<u>4,356</u>	

1.

24 + 53 + 85 + 19 = _____
 52 + 76 + 24 + 35 = _____
61 + 42 + 87 + 36 = _____
 _____ + _____ + _____ + _____ = _____

Check:

2.

8 + 538 + 802 = _____
 217 + 9 + 54 = _____
 102 + 36 + 376 = _____
4 + 38 + 23 = _____
 _____ + _____ + _____ = _____

Check:

3.

\$ 3.10 + \$ 2.05 + \$ 6.70 + \$ 8.75 = \$ _____
 7.15 + 8.07 + 5.70 + 3.08 = \$ _____
 8.95 + 7.65 + 8.09 + 4.15 = \$ _____
 7.00 + 8.60 + 9.90 + 7.75 = \$ _____
4.75 + 7.80 + 8.75 + 9.10 = \$ _____
 \$ _____ + \$ _____ + \$ _____ + \$ _____ = \$ _____

Check:

4.

\$ 70.95 + \$ 17.75 + \$ 18.07 = \$ _____
 67.07 + 87.45 + 75.67 = \$ _____
 94.70 + 83.97 + 47.16 = \$ _____
47.07 + 51.70 + 17.90 = \$ _____
 \$ _____ + \$ _____ + \$ _____ = \$ _____

Check:

5.

\$171.75 + \$278.50 + \$107.50 = \$ _____
 241.75 + 116.75 + 197.75 = \$ _____
 81.60 + 170.40 + 180.60 = \$ _____
107.50 + 71.75 + 75.25 = \$ _____
 \$ _____ + \$ _____ + \$ _____ = \$ _____

Check:

SUBTRACTION

WHAT IS SUBTRACTION?

Subtraction is the inverse or opposite operation of addition.

Example. A car dealer has 15 cars. He sells 3. How many remain?

$$\begin{array}{r} 15 \text{ minuend} \\ - 3 \text{ subtrahend} \\ \hline 12 \text{ difference or remainder} \end{array}$$

$$\begin{array}{l} 12 + 3 = 15 \\ 15 - 3 = 12 \end{array}$$

Here 15, the number from which you subtract, is the *minuend*; 3, the number you subtract, is the *subtrahend*; and 12, the answer or result, is the *difference* or *remainder*.

Example using decimals.

$$\begin{array}{r} 152.50 \text{ minuend} \\ - 50.00 \text{ subtrahend} \\ \hline 102.50 \text{ difference or remainder} \end{array}$$

To find the difference of two numbers, you subtract the smaller (the subtrahend) from the larger (the minuend):

$$\text{Minuend} - \text{Subtrahend} = \text{Difference}$$

HOW TO PROVE YOUR ANSWER

Add the difference to the subtrahend. The sum must equal the minuend. If you use a calculator the difference will already be in the calculator.

Example.

difference	102.50	} addends
subtrahend	+ 50.00	
minuend	152.50	

You are now ready to complete Assignment 1-2. Alternate Assignment A1-2 starts on page 223.

ASSIGNMENT 1-2 Working with subtraction

Name _____

Date _____

A. Subtract and prove by addition.

Example.
$$\begin{array}{r} \$7,642.78 \\ - 794.71 \\ \hline \$6,848.07 \end{array}$$

Proof:
$$\begin{array}{r} \$6,848.07 \\ + 794.71 \\ \hline \$7,642.78 \end{array}$$

1.
$$\begin{array}{r} \$4,071.79 \\ - 781.87 \\ \hline \end{array}$$

Proof:

2.
$$\begin{array}{r} \$1,730.98 \\ - 731.99 \\ \hline \end{array}$$

Proof:

3.
$$\begin{array}{r} \$781.70 \\ - 681.79 \\ \hline \end{array}$$

Proof:

4.
$$\begin{array}{r} \$170.91 \\ - 79.19 \\ \hline \end{array}$$

Proof:

5.
$$\begin{array}{r} \$196.69 \\ - 69.96 \\ \hline \end{array}$$

Proof:

B. Subtract horizontally and prove.

Example.

MEN'S CLOTHING DEPARTMENT APRIL, 19—

Item	Units purchased	Units sold	Units remaining
Suits	710	475	235
Slacks	1,170	945	225
Shirts (dress)	4,500	2,375	2,125
Total	6,380	3,795	2,585

Proof:

Total units purchased 6,380
 Total units sold 3,795
 Remaining 2,585