

BUSINESS MATHEMATICS

A Collegiate Approach

FIFTH EDITION



Nelda W. Roueche

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PRENTICE HALL

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Preface

BUSINESS MATHEMATICS is a comprehensive course, giving students exposure to a wide range of mathematical procedures they may later encounter in business. In its presentation of this material, the timeliness, thoroughness, and effectiveness of *Business Mathematics: A Collegiate Approach* have enabled it to remain highly accepted nationwide for almost two decades. As in the past, this fifth edition incorporates recent trends and requirements for business procedures, and it responds to valuable suggestions offered by users of the previous editions.

This author's overriding concern has always been for the student. Extreme care is taken to present each topic in a clear and logical manner, with all steps included to facilitate understanding. In addition, concise discussions describe the business applications of each topic, so that the student can appreciate its relevance. Undoubtedly, this emphasis on the student's needs has contributed to the enduring acceptance of the text.

Business Mathematics sharpens the mathematical skills of students preparing to enter business employment as it simultaneously provides an introduction to accounting, finance, insurance, statistics, and other math-related subjects. If anything, the widespread use of calculators and computers in business has raised the expectation that employees will be knowledgeable in mathematical procedures. The fact that machines perform the final calculations in no way lessens the necessity that employees understand what needs to be done and the sequence of operations required. Thus, students anticipating a career in business should see this course as valuable preparation for a wide range of career opportunities.

The teaching methodology used in *Business Mathematics* has proved to be successful with many types of students and in many varied academic environments. The text is used extensively in the business programs of two-year community and technical colleges, as well as in the lower level programs at four-year colleges and universities. The book is taught most frequently as a one-term course; however, it contains sufficient material for a full year's sequence. Surveys reveal a wide diversity in the business mathematics topics at various institutions, as needed to coordinate with the overall curriculum at each; however, all instructors will find that this text incorporates their desired topics. Thus, selected topics can be studied in detail, or a broader range of topics may be presented in less depth by including initial examples and omitting certain subsequent ones.

Among the aspects that make *Business Mathematics* especially student oriented are the following features:

- The terminology and business applications of each topic are presented in a precise, readable discussion that is as concise as possible without sacrificing content. The first use of each important term is highlighted through the use of **boldface**. Moreover, each chapter concludes with a glossary that defines all the key terms of that chapter.
- The unusually large number of examples covers every type of problem that the student may be assigned. The thorough explanations include every step, to ensure that the student will understand the entire solution. In addition, illustrations of many business forms, notes, and statements are featured.
- The primary means by which students learn is through solving the problems, and over 1,000 problems are included. Each exercise set contains two types of problems: tabular problems designed for quick mastery of technique, followed by written "word" problems to ensure full understanding of the topic under discussion. All adjacent odd/even problems form a pair—providing one problem for classwork and a similar one for homework—and are arranged in order of increasing difficulty. Special care has been taken to use compatible number combinations, so as to emphasize the inherent business procedures and avoid tedious exercises in arithmetic.
- Student learning objectives introduce each chapter and describe the skills to be developed. Each objective is completely cross-referenced to the text, identifying the section and examples where the related information is explained, as well as which problems should be studied to accomplish that objective.
- Brief reviews of arithmetic, equations, and percent are included for the benefit of students whose math skills need refreshing. This essential review

is made more relevant by using review problems that are also business oriented, which contributes to the overall goals of the course.

- Elementary equation solving is used throughout the text in all topics where it is logical and natural to do so. Students can thus apply the same techniques to many topics and avoid trying to memorize several variations of each formula (which inexperienced math students find nearly impossible to do).
- Most business graduates are employed in retail businesses. Hence, a major portion of the text is devoted to topics related to retailing: commercial discounts, markup and markdown, profit and loss, installment buying, depreciation (including ACRS), taxes, insurance, payrolls, and so forth. Topics related to finance receive less emphasis, but are covered sufficiently to familiarize students with the fundamental aspects of investment and credit.
- Most reference tables that are required to solve problems are interspersed with their related topics. For convenience, however, all tables are then repeated in one group as an appendix. This allows students to use the tables during a quiz without having their textbooks open to the explanatory material.

Prior to this fifth edition, business mathematics instructors at a number of colleges were surveyed to determine (a) whether any existing topics were considered obsolete and (b) whether any specific new topics were recommended. Consensus strongly reinforced the text's existing subject matter. In addition, a sizable portion of the respondents voiced a need for instruction in the use of hand-held calculators, as discussed in the first of the following items describing the new features in *Business Mathematics*:

- A new topic explains the use of hand-held LCD calculators, which are allowed (or even required) at many institutions, particularly after completion of the review chapters. This topic introduces all the basic functionality of the calculator, which instructors have found to be necessary instruction, and gives students general practice. Then, periodically throughout the text, boxed Calculator Techniques illustrate how to apply specific calculator operations to the current section's examples. Students should be encouraged to work through these Calculator Techniques using their calculators, rather than simply reading the techniques, so that the processes will be comprehended more thoroughly.
- Over 50% of the student problems are new in this edition. Survey respondents have highly praised the quality of the student problems,

stating that this is a primary feature which sets *Business Mathematics* apart from competing texts. The new problems update the text to reflect business trends, while providing instructors with fresh assignment selections.

- The depreciation chapter reflects changes in the ACRS method of depreciation as prescribed by the 1986 Tax Reform Act. This Act mandates certain depreciation procedures (primarily double declining balance with a subsequent switch to straight line) rather than issuing an ACRS rate table, as had been done previously. For convenience, however, the author has developed a rate table applicable to the new ACRS requirements. Thus, by using these factors the students can easily compute the annual ACRS depreciations, while they concentrate on learning to prepare depreciation schedules. Subsequent examples then present the traditional methods of depreciation calculation.
- Social security calculations, income tax withholding, and other payroll-related computations use the 1987 tables, rates, and forms. Also, revised payroll problems reflect somewhat higher wage rates (although staying in a range with which young adults first entering business employment can identify).
- The insurance chapter now includes information describing universal and variable life insurance, which have quickly become major policies within the insurance industry. Other recent industry data reveal that, for the first time, insurance settlements paid out as annuities exceed those paid as lump-sum distributions. This lends increased importance to the topic describing annuity options available as insurance settlements.
- Interest rates, prices, and wages in the examples and problems throughout the text have been adjusted to reflect current trends.

An extensive *Instructor's Manual* is available upon adoption of the text. For the instructor's convenience, complete solutions are included for all problems in the text. In addition, suggestions for organizing the course and teaching each chapter are offered, as well as sample quizzes and a final examination. Reflecting the wide acceptance of *Business Mathematics*, an extensive array of other supplementary materials is available for instructors and/or students, as follows:

- Student Study Guide
- Student Solutions Manual (available upon approval of the instructor or institution)
- Student Interactive Software
- Achievement Tests

- Test Item File
- Transparency Masters
- Gradebook/Class Record File Software (a sophisticated program for reading, analyzing, grading, and displaying student scores on course quizzes, exams, and other types of evaluations).
- “How to Study Mathematics” (a booklet)
- “Twin” (similar to “Lotus 1-2-3” program)

The content of this fifth edition is due in large measure to the contributions of the following people, to whom I express special appreciation:

- The instructors who participated in the pre-revision survey for this fifth edition. The time you took to respond is greatly appreciated, for your suggestions ensure a comprehensiveness and consensus that would be impossible to achieve, were the modifications derived only from this individual author. My thanks to the following survey participants: Professor Harriett Rice, Los Angeles City College; Professor Andrew R. Baglio, Becker Junior College; Dr. Dong H. Lee, Fairmont State College; Professor David C. Mayne, Anne Arundel Community College; Professor Claude J. Lowery, Jr., Northern Virginia Community College, Manassas, VA; Professor Patricia H. Eyer, Northern Virginia Community College, Annandale, VA; Professor Edward G. Magruder, Virginia Western Community College; Professor Paul L. McClellan, Volunteer State Community College; Professor Virginia H. Graves, Northern Virginia Community College, Alexandria, VA; Professor John DeNicolo, Orange County Community College; Professor Darlene Ward, Thomas Nelson Community College; Professor Julian Bernard, City University of New York, Bronx Community College; Professor Philip J. Adelman, DeVry Institute of Technology; Professor F. Christian Widmer, Tidewater Community College; Professor James O. McKenna, Northern Virginia Community College, Stirling, VA.
- Various users of previous editions who, over the years, have voluntarily sent suggestions for course content or for teaching approaches that they have found to be particularly effective. Such contributions are always invited and are often incorporated into the next edition.
- Janice Ceverha, who was responsible for the computer word processing of the *Instructor's Manual*. Naturally, these mathematical solutions require many specialized techniques not normally associated with ordinary text processing. Ms. Ceverha exerted special effort to develop the procedures

that produce the exact mathematical formats she has achieved. In addition, she assisted greatly with the proofreading.

- Susan Jacob, editor of business education textbooks at Prentice Hall, who coordinated activities with many different people in order to greatly expand the selection of supplementary materials available with this fifth edition. Also, Nancy McDermott, editor of supplemental books, whose hard work ensures that the supplementary materials are of high quality and are available concurrently with the text.
- Nicholas Romanelli, production editor for this fifth edition, who, from this author's experience over two decades, stands out as an unusually professional and qualified production editor. Mr. Romanelli was most cooperative, taking great care to develop a book format that is extremely attractive typographically and also meets the author's needs for educational effectiveness. In addition, he was very thorough in cross-checking text references, in coordinating the art work and typesetting, and in handling the myriad of other details required for publication.
- My children, Michelle, Jay, John, and Courtney, who defy the generation gap and make my efforts worthwhile by exclaiming how proud they are of their mother's accomplishments. And especially to my husband, Dan Taylor, who has given me continuous encouragement during the long months of this revision, despite being almost a bachelor husband in the meanwhile.

It is my sincere hope that all who teach or study *Business Mathematics* will find it to be a very worthwhile experience.

NELDA W. ROUECHE

Austin, Texas

To The Student

THIS AUTHOR has not forgotten what it is like to be a student. I clearly remember wishing that a book had more examples, or trying to determine what happened in the steps that were left out, or wondering what some vague explanation was supposed to mean. So when I began *Business Mathematics: A Collegiate Approach*, it was designed not for the instructor, but especially for you, the student.

The author is also aware that, unfortunately, many people cringe whenever the word “math” is mentioned. Please don’t! You need not be a genius to learn business math. Successful completion of business math requires only two things—time and effort. If you are willing to supply these, you can be assured that your efforts will be rewarded. And you will find it is well worth the effort required, for business math is a very practical course. It will acquaint you with a large number of business procedures where math is required. Regardless of what business position you may later accept, almost any mathematics required by that job will have been introduced in business math. (The text will serve as a good on-the-job reference book after you graduate.)

Some math books are used only as a source of assignment problems. That is not the case with this text; it is intended to be read. Read it carefully and thoroughly. The explanations will familiarize you with the business applications of each topic and the special terminology associated with it. The examples include *every* type of problem which you will be required to solve, so study them carefully. If you are not sure whether you could work out a similar problem, take out a pencil and paper and try working the example itself (without looking at the

calculation in the text). Make a practice of reading each section before it is discussed in class; this will enable you to better understand the instructor's discussion and examples. Never try to complete the problems until you have first read the lesson. If something seems unclear when you first read it, read it again.

Of course, you will want to keep a notebook for taking notes in class. Try to take very complete notes on both the instructor's lecture and examples. Also use the notebook to record your own helpful hints, such as a way you have discovered for recognizing a problem, a mistake you have made and need to be alert for, the best method for solving a certain type of problem, some important point you need to remember, and so on. Things which you understand clearly at one point can become hazy later on unless you have made notes as a reminder.

When working out the assigned problems, use a dark *pencil* (everybody makes a few careless mistakes) and don't skip steps, unless you are quite adept at math. If a set of problems requires a formula, write it with each problem. Always start by listing the information which is given and indicating what must be found. Allow plenty of space for each problem; many mistakes are made because the problem becomes so crowded that the student cannot read his/her numbers or determine what the sequence of steps has been. Always complete the entire assignment, referring back to the examples when necessary. If you absolutely cannot solve a problem, ask for assistance from your instructor; (s)he is there to help you learn and will be happy to answer your questions.

Never hesitate to ask questions in class—especially not for fear of what other students may think. If you go on to the next section with a question still in mind, you may find yourself unable to understand the topic discussed there. (Besides, when one student has a question, others usually have the same question. But everyone can't wait for someone else to speak up!)

The first step in preparing for an hour quiz is to keep all the problems that you have worked out organized so that you can study them. Sometimes things you thought you knew may be hard to reproduce, so practice writing all the formulas that may be included on the quiz. Test yourself on the problems: Read the problems and briefly write down the steps or formulas that would be required, or simply set up the problem. Then check what you have written against a similar problem that you have worked previously. (It is seldom necessary to work a review problem completely; if you can set it up correctly, you can almost certainly solve it.) Review the chapter learning objectives as well as the glossaries.

During a quiz, work as quickly as possible without being careless. When quizzes are returned to you, correct your errors and save the quiz papers as study material for the final exam.

As indicated above, this study plan will require substantial time and effort, but you will also learn much useful information in the process. Best wishes for success in business math, and good luck in the business world.

NELDA W. ROUECHE

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1

Review of Operations

Objectives

Upon completion of Chapter 1, you will be able to:

- 1.** Define and use correctly the terminology associated with each topic.
- 2.** Multiply efficiently using
 - a. Numbers containing zeros (example: $307 \times 1,400$) (Section 1; Examples 1, 2; Problems 1, 2);
 - b. Decimal numbers with fractions (example: $15 \times 3.5\frac{1}{4}$) (Example 3);
 - c. Numbers with exponents (example: 3^4) (Example 4).
- 3.** Simplify fractions containing
 - a. Decimal parts (example: $\frac{6}{1.5}$);
 - b. Fractional parts (example: $\frac{6}{1\frac{1}{2}}$) (Section 1; Example 5; Problems 3, 4).
- 4.** Find negative differences (losses) (Section 1; Example 6; Problems 3, 4).
- 5.** Simplify expressions containing parentheses of the type $S(1 - dt)$ or $P(1 + rt)$ (Section 1; Examples 7–9; Problems 5, 6).
- 6.** Round off numbers to a specified decimal place (Section 1; Example 10; Problems 7, 8).
- 7.** Round a multiplication product to an accurate number of digits, based on the digits of the original numbers (Section 1; Example 11; Problems 9–12).
- 8.** Using a hand-held LCD calculator (battery or solar powered), perform computations for:
 - a. Basic arithmetic (Section 2; Example 1; Problems 1, 2);
 - b. Percent calculations (Example 2; Problems 3, 4); and
 - c. Memory operations (Example 3; Problems 5, 6).

THE NORMAL day-to-day operations of most businesses require frequent computations with numbers. Many of these computations are done in modern business by calculators and computers. Some computations, however, are still performed manually. And even those processes whose final calculations will be done automatically must first be set up correctly, so that the proper numbers will be fed into the machines and the proper operation performed. You will also have an opportunity to practice using a calculator for basic operations.

1 Arithmetic Techniques

The following topics are presented to eliminate some of the weaknesses which many students often have in working with specific types of numbers. A more comprehensive review is included as Appendix A, "Arithmetic," for those students who need further practice.

MULTIPLICATION

Whenever a number is to be multiplied by some *number ending in zeros*, the zeros should be written to the right of the actual problem; the zeros are then brought down and affixed to the right of the product without actually entering into the **operation**. If either number contains a decimal, this also does not affect the problem until the operation has been completed.

Example 1

(a) $125 \times 40.$

$$\begin{array}{r} 125 \\ \times 40 \\ \hline 5,000 \end{array}$$

(b) $2.13 \times 1,500.$

$$\begin{array}{r} 2.13 \\ \times 1500 \\ \hline 1065 \\ 213 \\ \hline 3,195.00 \end{array}$$

(c) $13,000 \times 18.$

$$\begin{array}{r} 18 \\ \times 13,000 \\ \hline 54 \\ 18 \\ \hline 234,000 \end{array}$$

When multiplying by a *number containing inner zeros*, students often write whole rows of zeros unnecessarily to assure themselves that the other digits will be aligned correctly. The useless zeros can be eliminated if you will remember the following rule: On each line of multiplication, the first digit written down goes directly underneath the digit that was used for multiplying.