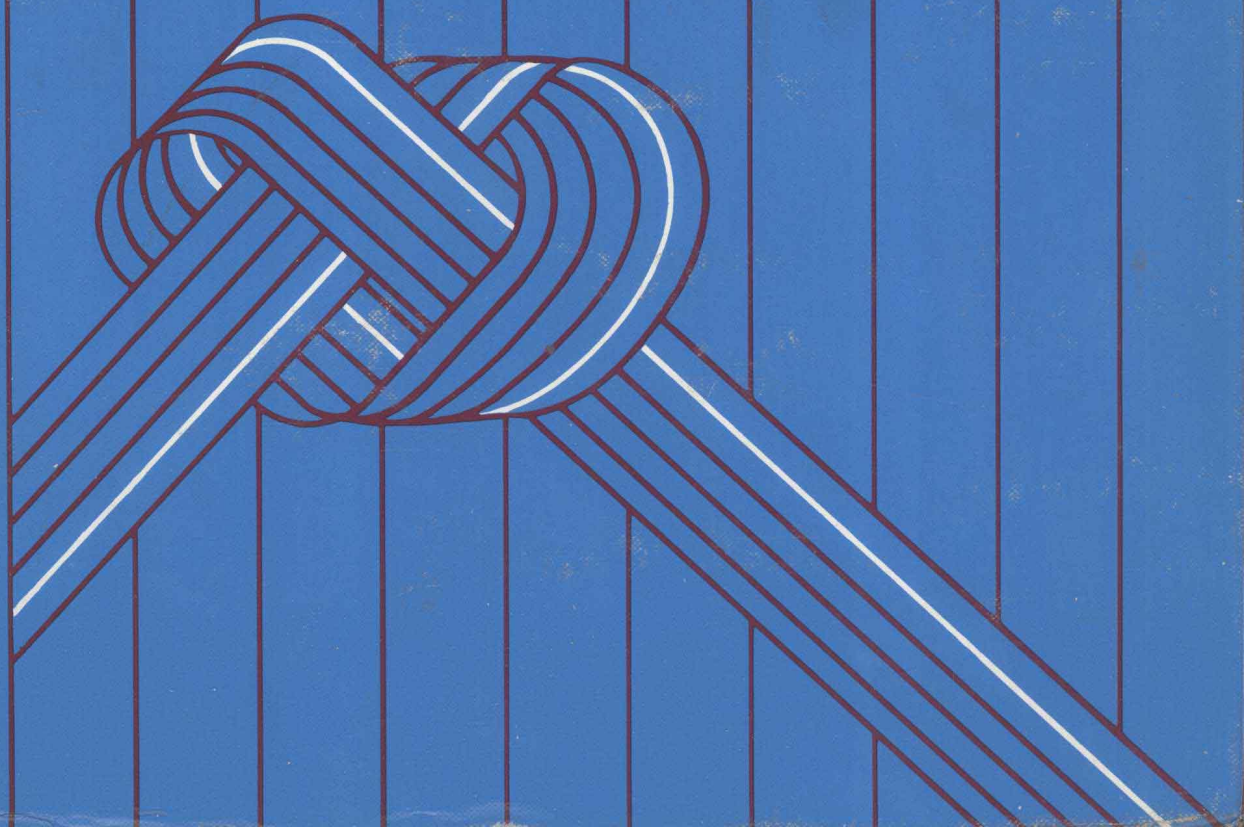
Robert H. Nicholson

Mathematics for Business and Economics



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Preface

The ever-increasing complexity of our modern economic structure and the impact on business of the computer as a computational tool have produced quantum leaps in quantitative training in business and economics and in other professional fields. This new focus has come primarily from the changing demands of employment within traditional industry, the emerging high-technology fields, the service sector, and government. As a result, many college and university courses in applied mathematics now stress business applications.

This text is designed specifically to meet the current demand for a compact and relevant text; that is, one that stresses brief theoretical explanations, easily understood applications, and the interpretation of quantitatively structured problems. The author's intent is to provide the methodology and techniques applicable to quantitative problems faced by a range of individuals with diverse interests. An attempt is made to keep applications as universal as possible so that each person can adapt them more easily to his or her specific field. Unnecessary mathematical jargon is eliminated without a loss in precision.

Several specific features of this book deserve elaboration. First, all concepts are presented by means of brief theoretical explanations relying on a minimum of proofs. Examples are introduced at the early stages of each topic. However, readers are offered explanations which are adequate for understanding a wide range of related applications. Applications are kept numerically simple and easy to comprehend so that principles are reinforced.

Second, the relation between problem formulation, mathematical computation, and the interpretation of results is emphasized throughout the book. The author believes that the ability to formulate quantitative problems from unstructured real-world situations and to translate the results of the analysis back to the real world is a skill equal in importance to computational ability. Thus, the issues of model formulation and construction are addressed in the text.

Finally, the book provides discussions of how aids such as the computer and hand calculator are used in specific analyses and of computational methods which have been modified because of computerized analyses. However, reliance on the computer has not been used as a justification for omitting computational methods which may be helpful in explaining particular analytical techniques. The relation between mathematical analysis and the computer is incorporated into the overall problem-solving process where appropriate.

The sequence to the chapters and the emphases given to topics within chapters are designed to make mathematics a relevant field of study. A basic theme of this book is that mathematics need not be, nor appear to be, abstract, but that it should provide a set of techniques which can be used to better understand the various business-related disciplines.

Little previous exposure to college-level mathematics is necessary to use this text. A familiarity with the basic terminology of management science and economics may be helpful in understanding some of the applications but is not a prerequisite for an overall comprehension of the material.

The textbook is adaptable to either one- or two-semester courses, and only the depth to which each topic is covered must be adjusted. Thus, if it is used for a one-semester course, instructors will not have to omit chapters and topics in a way which might reduce the book's usefulness. Alternatively, sufficient material and examples are included for a two-semester course which presents each topic in more detail. The book also may be used for courses in mathematical analysis either at the undergraduate level or for "refresher" courses at the introductory graduate level.

Thus, this book offers several distinct advantages to the student of mathematical analysis. The following chapter-by-chapter description further explains some of its techniques and learning aids.

The book contains 14 chapters. The first chapter is an overview of mathematical terms and problem-solving methodology which serves as an introduction to applied mathematics. In this chapter, readers will immediately encounter business use of the fundamentals of mathematics. Particular emphasis is on developing, understanding, and interpreting mathematical models. As this chapter makes clear, mathematical models provide a framework for applying mathematics to real-world problems.

Chapter 2 includes a review of basic mathematical concepts. Topics included are set theory, the real number system and its properties, exponents, and factoring. This chapter will be a helpful review for readers and will serve as a foundation for the study of applied mathematics.

Chapter 3 gives a summary of many of the mathematical functions used in business-oriented models. This material serves as the conceptual framework for many of the applications and models found in the text. Of special significance in this chapter are the definitions of a relation and a function.

Overall, the first three chapters provide an introduction to applied mathematics. That is, mathematical models provide the analytical structure within which basic mathematical concepts and functions are employed. These first three chapters will prepare and stimulate readers for the more specialized topics of later chapters.

Chapters 4 to 7 include topics in linear mathematics. Chapter 4 discusses linear functions and their characteristics. Here, the emphasis is on understanding the slope and intercept of a linear function. Chapter 5 extends this introduction to examine the solution of systems of linear equations and systems of linear inequalities. Matrix algebra, an additional set of techniques for working with groups of numbers and particularly for solving systems of linear equations, is the topic of Chapter 6.

The fundamentals of linear programming are covered in Chapter 7. This topic combines some of the earlier material on equations and inequalities with matrix algebra in describing a technique applied to many business problems. In general, linear programming is a method for addressing problems of optimization (e.g., minimizing cost or maximizing profit) given a set of constraints (e.g., maintaining product-quality standards or producing with a limited pool of resources). The placement of this chapter within the book and the particular focus of its presentation offer two advantages. First, following the chapter on matrix algebra, linear programming can be discussed using the concept of a matrix and the techniques of matrix algebra where applicable. Second, the chapter emphasizes computer-generated solutions to linear programming problems and the interpretation of such solutions. Thus, the "by-hand" computations of linear programming are discussed for completeness, but the focus is on the interpretation of results. These two aspects of Chapter 7 will enrich the reader's understanding of this topic and increase his or her ability to apply linear programming to problems in related courses or in business.

Chapter 8 broadens the scope of the book by introducing four of the nonlinear functions used in business analysis: quadratic, cubic, exponential, and logarithmic functions. Particular emphasis is placed on the uses of the constant e ($e = 2.71828\ldots$) in analytical models.

The mathematics of finance is the topic of Chapter 9. This technique-oriented discussion uses many of the functional forms of Chapter 8 and applies them to problems involving various time and interest-rate considerations. The use of financial tables to solve problems is stressed in this chapter.

Differential and integral calculus are discussed in the next three chapters (Chapters 10, 11, and 12). These topics will include reference to both linear and nonlinear relations. Consequently, readers will find helpful at this point the material on functions found in Chapters 3 and 8.

Some of the specific topics included in these chapters are optimization techniques, evaluation of rates of change, area estimation, and the analysis of constrained functions. Chapter 11 is particularly important as it covers many of the business applications of differential calculus. The more theoretical discussions of Chapters 10 and 12 include very few proofs and are linked with applications as an essential part of the presentation. Thus, the entire presentation of calculus is at an applied level.

The principles of probability are included in Chapter 13. This material builds on the discussion of sets in Chapter 2 and that of integral calculus in Chapter 12. This chapter is not intended to be a course in business statistics, but rather is offered as an additional component of a complete overview of applied mathematics. For some, Chapter 13 also will provide introductory material for subsequent courses in sampling and statistical inference.

The final chapter (Chapter 14) is a restatement of the relation between problem formulation, mathematical models, and quantitative techniques. These three topics are the components of modern quantitative business analysis. In this summary chapter, the techniques of Chapters 3 to 13 are presented in a condensed way that reinforces their connection to the process of mathematical modeling. Many textbooks in applied mathematics do not stress this linkage adequately and in the proper perspective. The textbook theme of mathematical modeling is thus stressed in Chapter 14.

Problem sets including conceptual, computational, and application questions are presented within each chapter and at the end of each. The noncomputational review questions at the end of each chapter provide readers with a means of summarizing the definitions and concepts presented in the chapter. These questions may be particularly helpful in clarifying concepts before application problems are attempted. Answers to selected problems are included at the end of the book. The objectives of the problem sets are (1) to test an understanding of important concepts, (2) to extend this knowledge to business applications, and (3) to relate each topic to ideas presented earlier in the text.

In all, the book presents a unified approach to many different aspects of applied mathematics. Topics continually are related so that students will become more flexible in using a particular technique or combinations of techniques in solving problems.

It is anticipated that, after study of this text, readers will have acquired an appreciation of the business uses of applied mathematics. It is hoped that this book will be beneficial to both their education and their professional development.

I would like to express my thanks for the many useful comments and suggestions provided by colleagues who reviewed this text during the course of its development, especially to Allen Ashley, Adelphi University; Paul Baum, California State University, Northridge; Carl Cowen, Purdue University; Robert Limburg, St. Louis Community College; and Charles Margenthaler, Loyola College.

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