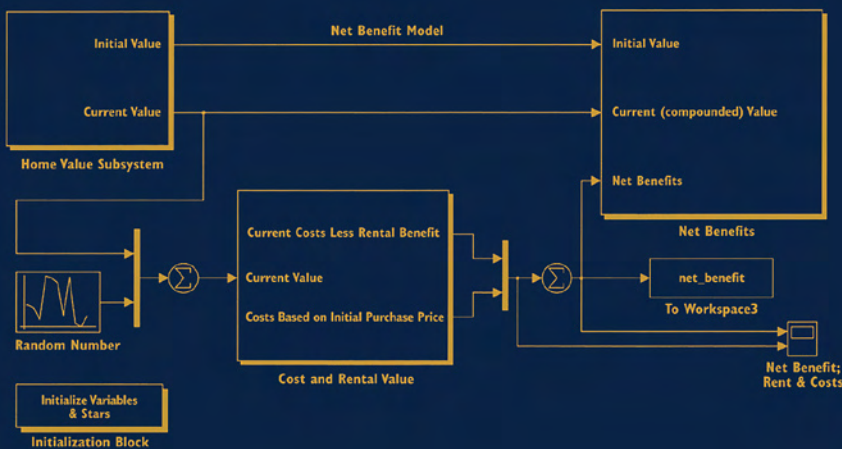


# Business Economics and Finance with MATLAB®, GIS, and Simulation Models



Patrick L. Anderson



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*Patrick L. Anderson*  
*Principal, Anderson Economic Group*



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## *Dedication*

This book is dedicated to the memory of Lt. Robert Regan and firefighters Joseph Agnello and Peter Anthony Vega, who fell in the line of duty on September 11, 2001, rescuing people in the Marriott World Trade Center—including the author, who is forever indebted.



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# 1

## *How to Use This Book*

### **Organization of the Book**

This book is organized into chapters, each covering a topic. Sections in each of the chapters describe in more detail one aspect of the topic. Most readers will want to read a few chapters immediately and then return to cover specific topics as their interests warrant.

The chapters proceed as follows:

1. The first chapter describes the organization and purpose of the book as well as how to acquire the business economics toolbox prepared by the author for readers of the book. It also provides certain maxims of business economics. Almost all readers will want to review this chapter first.
2. The second chapter contrasts business economics with academic economics and discusses why simulation models in general, and MATLAB and Simulink in particular, offer advantages to the practicing economist.<sup>1</sup> Most readers will benefit from this chapter.
3. The third chapter describes the MATLAB and Simulink environment and provides guidelines for creating and using models in this environment. Style guidelines are presented that help make such models easier to understand and debug.
4. Chapter 4 focuses on data. We present methods to get your data into the MATLAB environment and to report it out. The chapter also contains a specific introduction to the use of Microsoft Excel as an environment for easily collecting, importing, and reporting data. Three appendices to this chapter discuss XML and structured data, creating and using custom data structures, and also importing files of various formats. Most readers will again benefit from these chapters, although those with some familiarity with the MATLAB environment will skim portions of them.
5. The fifth chapter discusses certain building blocks of economic analysis used in economics and then provides custom-programmed functions and models which implement these tools. These tools form the basis of the economics toolbox created for readers of this book. The chapter also discusses creating and using a library of such functions. This chapter introduces material not available in any other form and will be essential reading for those who wish to implement the models described later in the book.

<sup>1</sup> MATLAB® and Simulink® are trademarks of The Mathworks, Inc., 3 Apple Hill Drive, Natick, MA 01760.

6. The chapters that follow describe specific fields of application:

- a. Economic and fiscal impact models as well as tax policy and forecasting tax revenue are covered in Chapter 6, Chapter 7, and Chapter 8. These chapters provide practitioners in these fields with advanced tools that enable more accurate, reliable analysis. The first sections of the chapter on economic impact models identify the severe weaknesses in many common economic impact reports, adding in some examples of particularly absurd gross exaggeration in published reports. These sections close with a plea for ethics in that subfield. As much of our work has been in public policy, we use these tools on a regular basis and hope that the analytical tools will help improve the level of analysis and that our admonitions about ethics in using them will not fall on deaf ears.
- b. Regional economics is discussed in Chapter 9, particularly the proper analysis of economic diversification for states or regions and a rigorous discussion of urban sprawl. In the first sections, we present techniques that have been recently developed and provide a much better concept of risk and return in regional economies than naive diversification analyses that are not grounded in a rigorous theory of economic growth and variation among industries. In the second section, a numerical sprawl index is presented for the first time in print.
- c. Chapter 10, Chapter 11, and Chapter 12 cover the economics of a firm. Chapter 10 describes modeling a firm, focusing on the crucial question of how a firm makes money. An iterative method of matching market value and expenses based on value is introduced. Chapter 11 discusses business valuation, noting the various methods used to estimate the value of a business and the various definitions of value. The chapter differs from most other references in this field in two ways: first, we concentrate on what we consider the most important consideration in the market value of a company, namely its prospects for future earnings; and, second, we utilize the greater analytical power of quantitative models that the MATLAB environment provides.
- d. Retail sales are discussed in Chapter 13. Much of the material presented here, including the derivation of the distance-sales relationship from microeconomic foundations, is unique to this book. Other portions provide craft knowledge of this interesting field that is rarely described in print.
- e. Chapter 14 briefly covers statistical process control techniques in manufacturing—a topic that is less well known than it should be among business economists and managers, given its importance.
- f. Fuzzy logic models are introduced in Chapter 15. Fuzzy logic is actually quite rigorous, though the name it has been given may be inhibiting its adoption as a powerful tool for incorporating various types of information, including vaguely defined or subjective information, into a rigorous inference system.
- g. Chapter 16 deals with using MATLAB and Simulink with the Internet and includes suggestions on analytical applications on the Web, sharing and displaying information, and the use of the MATLAB Web server. This is optional reading for many readers, but it contains unique material for those who wish to advance to the state of the art for analytics and data transfer on the Web.
- h. The last chapter contains extensive information on the proper use of graphics to communicate data and specific MATLAB code to generate and customize a

number of charts. The chapter starts with a review of the classic rules for graphical excellence and descriptions of the all-too-common graphical errors such as “chartjunk” and distortion due to improper use of 3-D graphics. There are very few texts in the social sciences which offer guidance in the proper use of graphics, and we intend this to be one.

7. Each of these chapters describes briefly the theory behind the models and then outlines an approach. These chapters can be read, skimmed, or skipped, depending on the interest at hand. A reader dealing with a finance problem, or one interested in fuzzy logic applications, could jump right to this chapter (after, of course, reviewing the initial chapters) without necessarily reading up on economic or fiscal impact models. Numerous cross-references indicate where similar or extended material appears elsewhere in the book.
8. The appendices contain troubleshooting suggestions that could save you a lot of time and trouble.

### **Intended Audience**

This text is primarily designed for two audiences:

1. Economists, finance and valuation professionals, market researchers, public policy analysts, and other practitioners whose occupation demands the ability to model market behavior under a variety of real-world conditions
2. Teachers or students in graduate-level classes in applied economics, particularly those who cover topics such as fiscal and economic impact analysis, fuzzy logic applications, retail sales analysis, and the integration of geographic information systems, as this is one of the very few books to rigorously cover these subjects

The book may also be used by those interested in specialized topics rarely covered in economics texts, such as those listed above, and by those who have extensive background in mathematical or simulation models (such as MATLAB and Simulink) and wish to extend their knowledge.

### **Prerequisite Knowledge**

We presume the reader has the following knowledge:

1. A good grounding in the laws of microeconomics and a familiarity with their application. Most practitioners and graduate students in economics, finance, public policy, and related disciplines should either be able to acquire this or should have already done so. Most undergraduates will need additional training.
2. A working understanding of mathematics, including (for some chapters) an understanding of the calculus used in comparative statistics. The completion of a graduate course in math for economists would be helpful, but is not mandatory.
3. For many of the chapters, a familiarity with (but not necessarily expertise in) the MATLAB software environment. Most of the applications presented here could be

accomplished in other software environments, but we provide examples of applications in MATLAB. See “References on MATLAB and Applied Economics” on page 9.

4. For some chapters, an awareness (but not necessarily a working knowledge) of geographical information systems.

We suggest some resources on these topics under “References on MATLAB and Applied Economics” on page 9.

### **Suggested Reading Plans**

The organization of this book allows you to read those portions most relevant to the work you are doing at present, in particular:

- Regardless of whether you are new to business economics or a veteran, read the brief “Maxims of Business Economics” on page 15.
- If you are new to the use of simulation models, it is best to start at the beginning. Go through the chapters that explain the MATLAB and Simulink environment, how to get your data, and creating and using library functions. Then jump to the most interesting application chapters.
- If you are focused on one type of application and have a working familiarity with MATLAB or Simulink, finish this chapter and then jump straight to the application chapters. Be prepared to review information in the earlier chapters or in the appendices.
- If you are currently using MATLAB or Simulink and are looking for suggested approaches or troubleshooting information, scan the chapters on troubleshooting in the appendices, any relevant application chapters, and the early chapters on design guidelines, getting your data, and library functions.
- If you want to learn about using MATLAB and Simulink on the Internet, jump to that chapter but be prepared to refer to other areas.

### **Typographic Conventions**

We have adopted certain typographic conventions that will assist the reader in understanding the text, such as:

- The main text of the book is written in a normal font, like this.
- Text that is part of a computer program or is a command you type in a software environment is in a keystroke font.
- Program commands for software that uses menus are sometimes summarized by listing the menu selections that execute them with the piping separator (“|”) between the menu selections. For example, to use the MATLAB menu command to open a new Simulink model, you would execute the following menu items:

1. First, hit the File menu with your mouse or with a keyboard command (such as Alt-F).



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