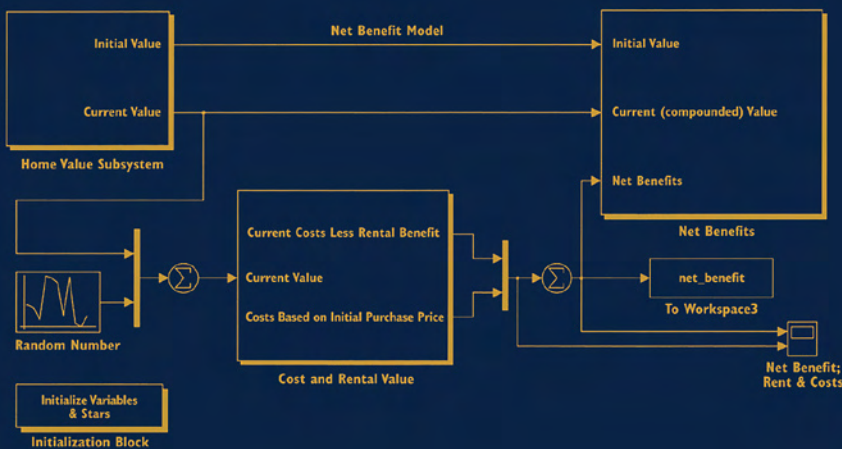


# Business Economics and Finance with MATLAB®, GIS, and Simulation Models



Patrick L. Anderson



**Also available as a printed book  
see title verso for ISBN details**

---

# Business Economics and Finance with MATLAB<sup>®</sup>, GIS, and Simulation Models



---

# Business Economics and Finance with MATLAB<sup>®</sup>, GIS, and Simulation Models

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



CHAPMAN & HALL/CRC  
A CRC Press Company  
Boca Raton London New York Washington, D.C.

---

This edition published in the Taylor & Francis e-Library, 2005.

“To purchase your own copy of this or any of Taylor & Francis or Routledge’s collection of thousands of eBooks please go to <http://www.ebookstore.tandf.co.uk/>.”

**Library of Congress Cataloging-in-Publication Data**

Anderson, Patrick L. Business economics and finance with MATLAB, GIS and simulation models/Patrick L. Anderson. p. cm. Includes index. ISBN 1-58488-348-0 (alk. paper) 1.

Managerial economics—Mathematical models. I. Title.

HD30.22.A53 2004 338.5'01'13—dc22 2003069765

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming, and recording, or by any information storage or retrieval system, without prior permission in writing from the publisher. The consent of CRC Press LLC does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from CRC Press LLC for such copying.

Direct all inquiries to CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.

**Trademark Notice:** Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

**Visit the CRC Press Web site at [www.crcpress.com](http://www.crcpress.com)**

© 2005 by Chapman & Hall/CRC Press LLC

No claim to original U.S. Government works

ISBN 0-203-49465-2 Master e-book ISBN

ISBN 0-203-59406-1 (Adobe e-Reader Format)

International Standard Book Number 1-58488-348-0 (Print Edition)

Library of Congress Card Number 2003069765

---

## *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.



---

## *Acknowledgements*

This book would not have been completed without the assistance of the following people:

David Littman, who mentored me for three critical years early in my career, and whom I consider the dean of American business economists.

Ian Clemens, who first introduced me to MATLAB and who helped develop some of the routines for gravity models, sprawl, and diversification presented here.

Ilhan Geckil and Chris Cotton, who worked with me on a number of projects excerpted here, including fiscal and economic model analyses of retail sales.

Christine LeNet, who both reviewed the content in the business, tax policy, and other chapters, and formatted figures and document files for publication.

Arianna Pieper and Megan Boone, who formatted, corrected, adjusted the figures, and checked the manuscript—and provided an occasional polite recommendation that I rephrase a few things.

Vlad Hlasny, Dan Li, Kevin Dick, Michael Robbins, Raymond Neveu, Jay Abrams, and Ralph Sandler, who provide invaluable review comments on earlier manuscripts.

Bob Stern of CRC Press, who was supportive, encouraging, and politely insistent on getting this project done.

Finally, my wife, Madhu, and our children Neal, Sean, and Mohra endured many evenings, late nights, and long days without me while I labored on the text, especially the past year. It has been a long journey, but not a lonely one for an author much blessed with a wonderful family.





---

## *Table of Contents*

Table of Contents	ix
List of Tables	xi
List of Figures	xiii
List of Code Fragments	xvii
<b>1 How to Use This Book</b>	<b>1</b>
<b>2 Mathematical and Simulation Models in Business Economics</b>	<b>16</b>
<b>3 MATLAB and Simulink Design Guidelines</b>	<b>26</b>
<b>4 Importing and Reporting Your Data</b>	<b>53</b>
<b>5 Library Functions for Business Economics</b>	<b>83</b>
<b>6 Economic Impact Models</b>	<b>110</b>
<b>7 Fiscal Impact Models</b>	<b>137</b>
<b>8 Tax Revenue and Tax Policy</b>	<b>149</b>
<b>9 Regional Economics</b>	<b>164</b>
<b>10 Applications for Business</b>	<b>182</b>
<b>11 Business Valuation and Damages Estimation</b>	<b>211</b>
<b>12 Applications for Finance</b>	<b>262</b>
<b>13 Modeling Location and Retail Sales</b>	<b>286</b>
<b>14 Applications for Manufacturing</b>	<b>331</b>
<b>15 Fuzzy Logic Business Applications</b>	<b>341</b>
<b>16 Bringing Analytic Power to the Internet</b>	<b>360</b>
<b>17 Graphics and Other Topics</b>	<b>376</b>

---

<b>Appendix A : Troubleshooting</b>	400
<b>Appendix B : Excel Link Debugging</b>	405
<b>Index</b>	408

---

## *List of Tables*

Theoretical vs. Applied Economics	17
When to Use Simulation Models	24
Major Style Elements for Simulink Models	36
Styles for Specific Blocks	38
Key Simulation Parameters	42
Sample Excel Sheet for Inputting Data	62
Economic Impact of the Fantasy Game	117
Gross and Net Costs of a 25% Michigan State EITC	158
Standard Measures of Diversification	179
Concepts of Value in Accounting and Economics	215
Cost of Capital Estimates for Small Beer Distributors, 2003	242
Input Sheets for Individual Distributors	243
Questions for Audit Predictor	347
Waves of Internet Functionality	361
Actual and Visual Impression of Data	381



---

## *List of Figures*

Simulink Model Example: House Net Benefits	32
Costs and Rental Value Subsystem	33
Simulink Model Example: Cost Shares Subsystem	34
Simulink Model Example: Cost Subsystem	35
Top-level view of Simulink Model	37
Initialization Block in a Simulink Model	41
Linear Demand Function	91
Supply Schedule	92
Elasticity of Supply Schedule	93
Demand and Supply Graph	95
Elastic Impact Block	99
Example Business Economics Model	101
Base Income Subsystem	102
Policy Change Subsystem	102
Income and Sales Subsystem	103
Sales Projection with Policy Change	103
Fiscal and Economic Impact Model	132
Population Migration Subsystem	133

---

Tax Revenue Subsystem	133
Municipal Costs	143
Cost and benefit	144
Fiscal Model Schematic-I	145
Fiscal Model Schematic-II	145
Fiscal Model Schematic-III	146
Effective Tax Rates, Selected Income, and Payroll Taxes	155
Total Tax Rates on Wage Income	156
Fiscal Estimation Model	157
Gross and net costs of Michigan EITC by year	158
Selected Diversification Measures	166
Employment Risk and Reward	170
Frontier of Risk and Return	173
Sprawl Indices for Various Cities	176
Trend Projection Graphic	184
Income Statement	201
Earnings Subsystem	201
Depreciation and Amortization	201
Iterative Model: Overview	203
Iterative Model: Operating Expenses	204
Iterative Model: Tax Subsystem	204

---

Iterative Model: Convergence of Tax and Value Variables	205
Plausible Values from Valuation Command	249
Mortgage Analysis	265
Auto Depreciation: Double Declining Balance	267
Auto Depreciation: Half-Year Convention, Modified Accelerated Cost Recovery System (MACRS)	268
Auto Depreciation: Long-lived Vehicles	269
Return & Volatility Percent Analysis	271
Comparison of Price Changes	272
Drive-Time Analysis	300
Equal-Distance Rings	301
Sales Patterns and Distance	302
Sales Patterns and Distance: Alternative Perspective	303
Market Penetration Rate	304
Daylight Areas	305
Underlying Sales-Distance Relationship: Gravity Model	313
Estimated Sales-Distance Relationship	314
Distance-Sales Relationships for Automobile Dealers	315
Gravity vs. Polynomial Specifications	318
Xbar Chart	334
S Chart	354



---

Capability Chart	336
Graphical Display of Audit Predictor	350
Income Membership Functions	351
Audit Flag Membership Function	352
Surface of Rules	353
Ruleviewer for Audit Risk FIS	353
Credit Risk Simulation Model	356
3-D Graphic of Sales and Income Data	379
Proper Display of Underlying Data	380
Line Graph	384
Pie Chart	385
Bar Chart	387
Time Series Analysis	389
Growth Chart	390

---

## *List of Code Fragments*

A Simple Startup File	6
Display command in masked subsystem	39
Help information in masked subsystem	40
Setting parameters for blocks	40
Self-describing variable for blocks	41
Setting the Source Workspace	43
Setting Time Parameters	43
Setting Options and Simulating Model	44
Messages in a Callback	46
Character Arrays	46
Character and Cell Array Displays	47
Library Blocks	48
Master Simulation Callback	49
URLREAD for Direct Internet Data Access	60
Entering String and Numeric Data Arrays	64
Cell Arrays	65
Structure Syntax	66
Creating, Packing and Unpacking a Structure	67

---

Saving Structures to a .mat File	69
The Info.xml File for the Economics Toolbox	74
Creating a Valuation Data Structure	76
Simple Linear Demand Function	104
Supply Function	105
Declaring An Economics Block Library	108
Fiscal Impact Callback	146
Social Security Tax	159
Federal Income Tax Calculator	160
EITC Master M-file Code	162
Trend Projection Function	205
Trend Projection Output	206
Ito Process Projection	207
Projecting Jump Processes	208
Simulation Callback for Iterative Tax Model	208
Input List for Valuation Function	241
Valuation Session for Beer Distributors	257
Valuation of Beer Distributors Function	258
Mortgage Calculator	274
Auto Depreciation	276
Get Stocks Function	279

---

Test Gravity Model Output	313
An SPC Demonstration Routine	339
Audit Predictor Rules	348
Read FIS Command	357
Fuzzy Logic Audit Risk	358
Using XML to Generate Help Files	372
Info.xml file for Economics Toolbox	373
Testplot: Line Chart	390
Testplot Function	391
Testplot: Adjusting Axes	392
Testplot: Pie Chart	394
Testplot: Bar Graph	396
Testplot: Sub-Plots	398

---

# 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).



- [The Art of Dahlov Ipcar book](#)
- [read online Destined \(House of Night, Book 9\) pdf](#)
- [Sneaky Science Tricks: Perform Sneaky Mind-Over-Matter, Levitate Your Favorite Photos, Use Water to Detect Your Elevation pdf, azw \(kindle\), epub, doc, mobi](#)
- [The Everything Guide to Nutrition: All you need to keep you, and your family, healthy pdf, azw \(kindle\)](#)
- [download online On the Camera Arts and Consecutive Matters: The Writings of Hollis Frampton pdf](#)
- [Nature's Blueprint: Supersymmetry and the Search for a Unified Theory of Matter and Force pdf](#)
  
- <http://omarnajmi.com/library/A-Companion-to-Gender-History--Wiley-Blackwell-Companions-to-World-History-.pdf>
- <http://honareavalmusic.com/?books/A-Life-in-Stitches--Knitting-My-Way-Through-Love--Loss--and-Laughter.pdf>
- <http://thewun.org/?library/A-Mess-of-Greens--Southern-Gender-and-Southern-Food.pdf>
- <http://drmurphreesnewsletters.com/library/The-Everything-Guide-to-Nutrition--All-you-need-to-keep-you--and-your-family--healthy.pdf>
- <http://sidenoter.com/?ebooks/Big-City-Girl.pdf>
- <http://toko-gumilar.com/books/4-Steps-to-Financial-Security-for-Lesbian-and-Gay-Couples--Expert-Advice-for-Reducing-Your-Tax-Burden--Increasing>