

Preface

Most 21st century students are familiar with microcomputers. They are adept in visually-oriented learning and playing, whether through video games, music videos, DVDs, iPod, or the internet. This book appeals to the computer skills of modern day undergraduate and graduate students through innovative uses of spreadsheets, including built-in spreadsheets, equations, and formulas.

This computer skill-intensive book covers major topics in both economic and business analysis. Students will learn how to build complex spreadsheet layouts and perform high-level calculation and analysis using the popular spreadsheet program Microsoft Excel. The exposition of the basic concepts, models, and interpretations are presented intuitively and graphically without compromising the rigor of analysis. We study Economics, Business, Mathematics, and Statistics systematically and with hands-on practice while learning Excel.

To encourage students' active learning and critical thinking, they will be given hands-on experiences by creating tables and graphs presented in the text and practice questions. They will be able to change parameters within spreadsheets and see the effects of change instantly. At the same time, by acquainting themselves with Microsoft Excel, students will directly acquire practical and advanced job skills.

The book is intended for third or fourth year (upper-level undergraduate) economics or business majors in colleges and universities, and first-year graduate students in MA programs in economics and business. The book is a stand-alone full textbook for one semester, but, depending on the pace of instruction (if Excel commands have to be covered extensively), it can be extended to two semesters. It can also serve as a supplement to textbooks on principles of economics, intermediate economics, and introductory statistics.

The Features, Tools, Structure, and Advantages of this Book

There are many unique and innovative features in this book, which have been developed by the author over the past twenty five years through teaching a course using the manuscript of this textbook and from his research on computer assisted learning (CAL). Our new systematic approach of unifying economics, business, mathematics, statistics, and spreadsheet programs is probably the first of its kind in the area of quantitative methods. The following is a summary and explanation of the unique features, tools, structure, and advantages of our approach.

A. The features of this book

(1) The book contains major topics **in economics**, such as the derivation of the demand and supply curves and utility and production optimization models in microeconomics, national income models, economic policy analysis, and dynamic models in macroeconomics. These topics are also shared by managerial economics. On the other hand, the book also covers some of the major topics in **business economics**, including future and present value problems with or without annuity, probability, statistics, regression analysis, flow charts, and PowerPoint slide presentations. Due to recent emphasis on integrated and interdisciplinary studies, more and more economics majors are also interested in these business topics, and more business majors are also interested in microeconomics and macroeconomics.

(2) For both students and instructors, instead of spending time in programming, using software like C+, we feel that it is much easier to spend time on **spreadsheet construction** and learn economic modeling first-hand, using spreadsheet commands directly. If the proprietary software programs are used in teaching, the students download the program as add-ins, they will miss hands-on practice opportunities. This is a black box we would like to avoid. While it is true that proprietary software programs may be more powerful and may introduce more advanced or sophisticated methods or topics, we submit that such advanced or sophisticated methods or topics may not be appropriate at the undergraduate level.

(3) We emphasize the economic interpretation and **policy implications** of the models and computer output results, and the **applicability** of the models to real world issues in economics and business. For example, in teaching linear policy models, we systematically present the effects of fiscal, monetary, and consumption policies on equilibrium income and consumption, by simply changing the parameters in the model. We present it as the prototype of the more sophisticated federal government's economic policy, and all analyses are carried out easily by finding an inverse matrix. If a model does not make economic sense, we ask students to change the model (like parameter values) so that the model is plausible.

(4) The book combines major concepts and tools in **economics and related topics in statistics, mathematics, and spreadsheet programs**. As an upper level undergraduate textbook, it can also serve as a review of the materials for students who have previously studied introductory economics and business courses, and give students a different, unified perspective on previous courses. For example, we emphasize the similarity of demand and supply relations in microeconomic market models and in the aggregate demand/supply macroeconomic income determination models, the relationships between static and dynamic microeconomic and macroeconomic models, the relationship between numerical demand and supply equations, the method of estimating these equations, and other topics.

(5) The book appeals to the **intuitive and visual understanding** of complex economics, business, statistics, and mathematics topics, such as unconstrained and constrained optimization problems, through the use of spreadsheets. In fact, our method of using 3D

and 2D contour maps makes it easy for students to visualize optimization problems on spreadsheets, before going through the first and second order conditions or LaGrange function method for optimization using calculus.

(6) “**Computer assisted teaching**” also enables the students to take the “**computer assisted testing**”. Unlike traditional written tests, this book allows students to use computers to perform complicated calculations, such as accurate comparative static analysis (Chapter 4), estimating multiple regression coefficients, hypothesis testing (Chapter 7), finding the solution to a large system of simultaneous equations (Chapter 10), and giving economic interpretations to the results during the examinations. This eliminates the need for take-home examinations.

(7) Since the calculations are performed by computer, the instructor has more time to concentrate on teaching the procedures of computing, economic and business concepts, and interpretation or explanation of results. Our basic philosophy is reflected in the questions presented in the **homework assignments** for each chapter. They are mostly collections of past mid-term or final examinations that the author has used in this course. Note that few homework questions are purely mathematical or statistical; yet, due to the complete integration with microcomputer techniques, the level of these homework questions is quite advanced and challenging, and at least comparable to, if not exceeding, the difficulty of course materials in intermediate microeconomics or macroeconomics.

(8) More importantly, the tables and charts in the book are not only used to illustrate explanation of definitions, theories, and applications of topics, as in most textbooks, but are also presented to that students can **reproduce or reconstruct the tables and charts** using Microsoft Excel, to gain better understanding of the topics and deeper insight into the concepts and methods.

(9) The textbook is **self-contained**. Through innovative uses of spreadsheets and built-in spreadsheet equations and formulas, we are able to present all these topics in one book. We do not use homemade add-in spreadsheet macro programs, proprietary software programs, or additional data sets by attaching a CD to the book. We emphasize **hands-on practice**; all models are built with the students, step-by-step, on site in the classroom. All data sets, except in Chapter 14, where students practice how to download on-line data, are also generated by the students in the classroom through the use of a random number generator.

In general, unlike the practice of workbooks or study guides of other textbooks, the basic concepts are explained concisely and rigorously in each chapter. We provide key terms in economics and business and key terms in Excel commands at the end of each chapter for review, and the basic topics are illustrated by a flowchart at the end of chapters.

B. On analytical tools

(1) **We use only algebraic operations. Calculus is not required.** The exposition of the basic concepts, models, and interpretations are presented intuitively and graphically without compromising the rigor of analysis. We study Economics, Business, Mathematics,

and Statistics systematically and with hands-on practice while learning Excel. To maintain rigor and clarity of exposition, we introduce the concept of difference to explain the change of variables, which is then used extensively in the last chapter on difference equations.

(2) We place emphasis on teaching the class to understand **intermediate and some advanced concepts in economics and business** without being inhibited by the technicalities of mathematics and computer programming. For example, we introduce and illustrate the income and substitution effects of price change in demand, total factor productivity, and the golden rule of capital accumulation without getting into complicated mathematics or computer programming.

(3) In this book, learning spreadsheet commands advances with the progress of each chapter, along with improvement in statistical and mathematical modeling skills. From statics to comparative statics, from dynamics to comparative dynamics, the sequence of commands builds up naturally, and the **spreadsheet commands are a joy for students to learn and instructors to teach**. For example, when we study comparative statics in Chapter 4, we introduce the naming method and picture copy command, so that students will know immediately the uses and advantages of these commands. Thus, the spreadsheet commands are introduced in the context of economic and business applications. These commands are also used in other chapters, and students have opportunities to reinforce their previous learning.

(4) In addition to simulation methods and constructing data sets in the classroom setting, we also introduce how and where to **download government and international data sources**, and we practice the **research methods** of extracting useful information through Excel's data analysis tools: sorting, subtotaling, auto-filtering, and pivotal tables and graphs.

C. Structure of the book

(1) Each chapter has **six parts**: chapter outline, objectives, basics (theoretical background), programming (on how to use Excel to learn, verify, and understand the basic theories), appendices (explanation of the text and additional Excel techniques), and homework. These are integral parts of systematic learning.

(2) At the end of each chapter we include a **summary**, list of **key economic concepts**, a list of **new spreadsheet commands**, a **review of mathematical and statistical formulas, problems, and applications**. Problems and applications are covered extensively in each chapter of the book.

(3) **Homework** includes a collection of the past mid-term and final examination questions from my upper level undergraduate course, *Microcomputer Applications in Economics*. It presents useful practical problems and is an integral part of learning. Some homework problems are taken from various existing textbooks on mathematical economics or economic statistics, to show the linkages between our approach (using spreadsheets) and the traditional approach (without using spreadsheets).

(4) We emphasize the **link between basic theories and hands-on programming**. Students learn abstract basic theories and then verify or understand the theory by hands-on programming through Excel. They also learn the meanings and sources of formulas and equations through hands-on programming. Unlike some textbooks or workbooks in mathematical economics or statistics, this book tries to present theory and practice as two sides of one coin.

D. Advantages of using spreadsheets

(1) By using the **random number generating device** in the Microsoft Excel program and what we call the “naming method”, students can generate their own simulated and yet realistic data sets, and change the parameters to find out how they change the economic solutions and the graphic images by their hands-on practice. The ease of generating a data set, as compared to entering external data by typing or downloading the data from a website, encourages students to engage in active learning that they initiate themselves. In addition, the random numbers are “live” and students really enjoy “**dancing**” **numbers and curves** by simply pressing the recalc (F9) key.

(2) We have devised a powerful and versatile “naming method” to prepare sensitivity tables to illustrate the functional relations in **three-dimensional graphs** instantly. For example, this method can illustrate easily any two-independent-variable function $z = f(x, y)$. Our method avoids the problems of relative and absolute references in copying a formulas or the need for either prepacked commercial or homemade add-in programs. We have also solved the classroom problem of quickly implementing a complicated equation into tables without importing add-ins.

(3) We apply the “**naming method**” and the “**picture copy command (PCC)**” to illustrate and learn comparative statics and comparative dynamics in economics. Many current computer-assisted instruction (CAI) programs do not use the naming method or the picture copy command, making teaching and learning comparative statics and comparative dynamics quite tedious and time consuming, as the students have to change formulas and equations each time, instead of just changing the parameters.

(4) The naming method, the picture copy command, and the range copy command (RCC) used extensively in this book enable students to reproduce different **comparative statics graphs** and arrange them in one sheet in the same workbook beautifully. All the above RCC and PCC can be performed within 15 minutes or less, even during course examinations. In this sense, we submit that our methods “revolutionize” the presentation of economics in Excel, and can be applied in many other fields in business and sciences.

(5) By combining the **built-in Excel Solver** for the optimization program and the graphic methods, students can find and illustrate solutions to optimization problems as accurately as possible. By changing the parameters, they can experiment with the impacts on solutions as many times as they like. They even can invent their own optimization problems.

(6) We emphasize the one-to-one **correspondence between data table and chart**. Students are not only able to draw the charts, they are required to find the correspondence between lines and curves in charts and numbers in the table. For example, they must find the equilibrium price and quantity of the demand and supply curves in the chart as well as in the table. They also will be asked to change the parameters of the model and trace out how the correspondence has been changed.

(7) Since the charts can show different widths for horizontal and vertical grid lines, using them is the same as using plotting paper in the pre-computer era several decades ago. Instead of the students drawing charts manually, the computer can **draw the charts** accurately and neatly. Students can change the scales of drawings, zoom in and zoom out, and get a feeling for the charts.

(8) Since charts and tables can be colored or boxed, we encourage students to present the tables and charts in **as colorful and pleasant forms** as they can. For example, students enter the formula of the CES function themselves and set up the three-dimensional surface. Then we encourage them to color the table and charts in presenting their results. They learn and have a lot of fun painting. This experience will not be possible in traditional economics, business, and quantitative textbooks.

(9) We have devised a method of **constructing a sample with large data set instantly**, such as randomly generated uniform, normal, or student-t distributions, or large sets of records with many fields (like region, month, year, gender, political affiliation, etc.), using random numbers and the **IF function**, for practice in the classroom. This cannot be done in traditional textbooks.

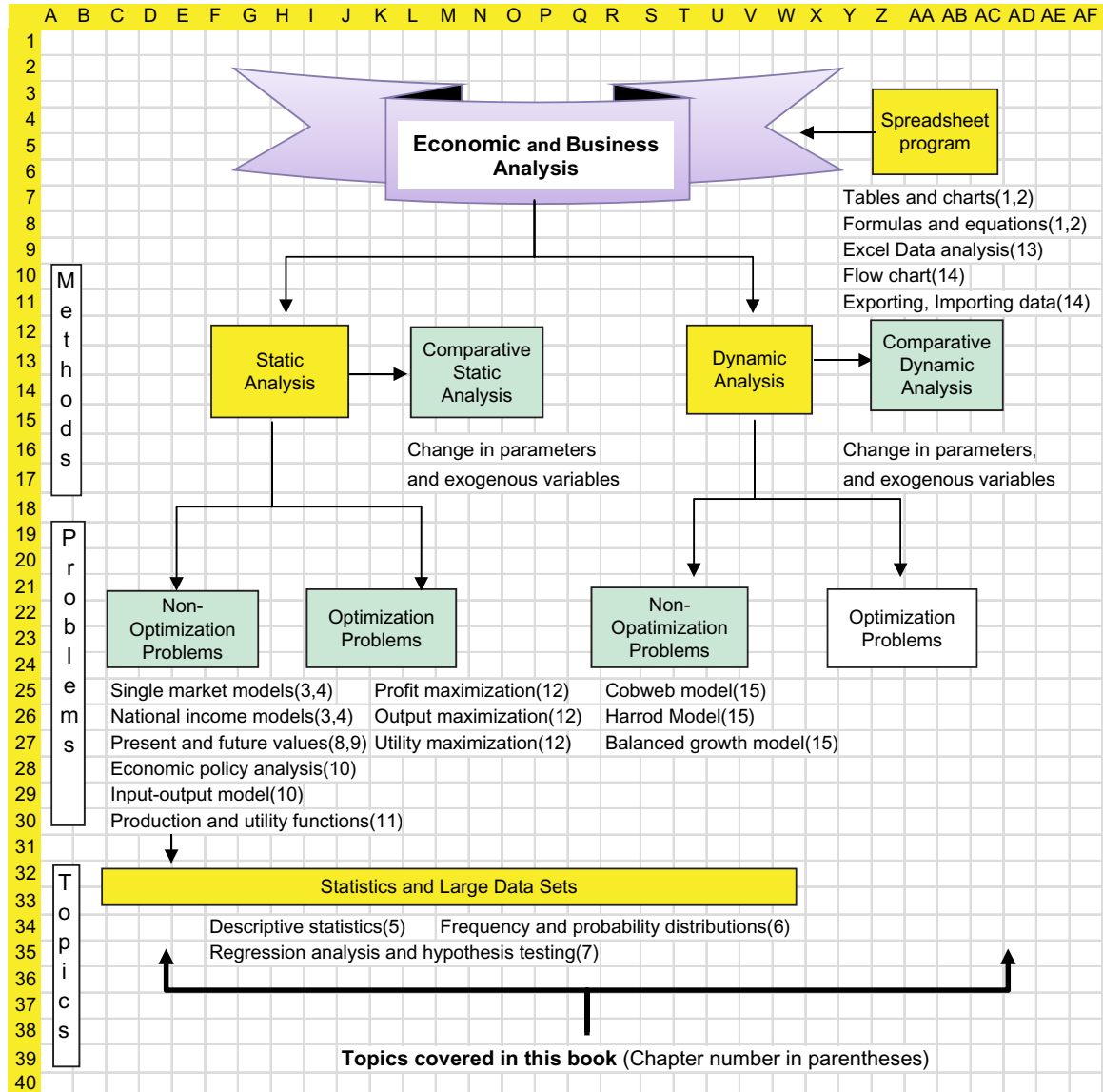
E. Preparing computer skill for job markets

(1) This is a **skill intensive book** in which students learn the skills of using spreadsheets for research and presentations on the job after they graduate. For example, we include the methods of constructing flow charts and presentations by Microsoft PowerPoint. We also include some aspects of business mathematics, like future and present value problems, with and without annuity calculations, which are then tied to the exponential functions and logarithmic functions used in the theory of economic growth. We also build loan amortization tables and methods of constructing index numbers. Students as well as the general readers may use the techniques to work on their personal financial planning.

(2) One of the difficulties in using Excel is that it requires students to learn “idiosyncratic” spreadsheet commands. In this book, **the spreadsheet commands are introduced systematically from simple to complex commands in a natural way as we cover more chapters**. In recent years, most students already have used or are even familiar with some Excel commands before taking the class, and thus learning Excel commands is not a big problem. They can quickly get into economics and business applications in this book. Furthermore, the spreadsheet skills and applications learned in this book are useful when the students graduate and take jobs in banks, business, or government,

or international organizations. In fact, the spreadsheet skills they learn from this book may be among the **most useful tools** that they learn in their college years.

As an example of what we are going to present in this book, a summary chart of the book is shown below. The readers can see immediately the relations among various methods of analysis contained in the book through the flowchart; at the same time, in Chapter 14, they also learn the skill and fun of constructing such a chart (see Fig. 14.2).



Some Suggested Uses of This Book

The contents of this book can cover more than one semester. Thus, the instructor has flexibility in choosing the topics of the chapters or sections. A common ground might include Part I and Part II. Part I includes the first four chapters, which are introduction to basic Excel spreadsheet commands as well as basic economic and business analysis (microeconomics and macroeconomics). The subsequent three chapters (Chapters 5 to 7 in Part II) cover the basic statistics, which are also common topics for both economic and business majors.

After finishing the first seven chapters, students in economics major may go on to Chapter 10 on economic policy, Chapters 11 and 12 on optimization, and Chapter 15 on dynamic analysis. Business majors may go on to Chapters 8 and 9 on future and present value problems, Chapters 11 and 12 on optimization, and Chapters 13 and 14 on large data sets and slide presentations.

We have tried to build up Excel commands and mathematical techniques gradually as the chapter proceeds. Hence, if some chapters are skipped, the readers may want to review the commands and techniques explained in the skipped chapters. The key terms in economics and business, along with Excel commands and terms, listed at the end of each chapter, will help them locate the missed commands or techniques.

Acknowledgments

When personal computers became popular in the 1980s, I was fascinated by their usefulness in Computer Assisted Teaching (CAT) and Learning (CAL). I created ECON 4838: *Microcomputer Applications in Economics* in 1985 with a new course development grant from the University of Colorado at Boulder. I then published 13 academic papers on computer assisted learning in the late 1980s, and a book on *Game Theory Step by Step Using Spreadsheets* in Japanese in 1997 with Yoshisuke Umehara.

The original course name for this book was *Microcomputer Applications in Economics*. It can be *Economic (and/or Business) Analysis — Quantitative Methods using Spreadsheets*. In our department, since the late 1990s, this course has been one of any three quantitative courses that economics majors are required to take for the BA degree. The three courses are this course, namely, *Micro computer Applications in Economics*, *Introduction to Mathematical Economics*, and *Introduction to Econometrics*. This class has been very popular among Economics majors.

Numerous students and colleagues, in and out of the University of Colorado at Boulder, have contributed to this book project over the past two decades. I have benefited from the comments and suggestions of (in alphabetical order) Professors Changmo Ahn, Nam T. Hoang, Hong-Van Thi Hoang, Mei-Chu W. Hsiao, Xiaodong Liu, William Mertens, Keun Yeob Oh, Changsuh Park, Katsuhiko Saito, Myles Wallace, Yongkul Won, Akio Yamashita. They helped me read part of the manuscript. In addition to the artist Ms. Corinne Wang, many students also helped me. Henry Yen Heng Chen, Robert Howard,

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