高等院校双语教学适用教材

经济学

Introduction to Econometrics

Brief Edition

James H. Stock
Mark W. Watson

经济计量学精要

〔美〕
詹姆斯·H.斯托克
马克·w.沃特森　　著

王庆石　译注

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Dongbei University of Finance & Economics Press

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出版者的话

当前，在教育部的大力倡导下，财经和管理类专业的双语教学在我国各大高校已经逐步开展起来。一些双语教学开展较早的院校积累了丰富的经验，同时也发现了教学过程中存在的一些问题，尤其对教材提出了更高的要求；一些尚未进入这一领域的院校，也在不断探索适于自身的教学方式和方法以及适用的教材，以期时机成熟时加入双语教学的行列。总之，对各类院校而言，能否找到“适用”的教材都成为双语教学成功与否的关键因素之一。

然而，国外原版教材为国外教学量身定做的一些特点，如普遍篇幅较大、侧重于描述性讲解、辅助材料（如习题、案例、延伸阅读材料等）繁杂，尤其是许多内容针对性太强，与所在国的法律结构和经济、文化背景结合过于紧密等，却显然不适于国内教学采用，并成为制约国内双语教学开展的重要原因。因此，对国外原版教材进行本土化的精简改编，使之变成更加“适用”的双语教材，已然迫在眉睫。

东北财经大学出版社作为国内较早涉足引进版教材的一家专业出版社，秉承自己一贯服务于财经教学的宗旨，总结自身多年的出版经验，同培生教育出版集团和汤姆森学习出版集团等国外著名出版公司通力合作，在国内再次领先推出了会计、工商管理、经济学等专业的“高等院校双语教学适用教材”。这套丛书的出版经过了长时间的酝酿和筛选，编选人员本着“品质优先、首推名作”的选题原则，既考虑了目前我国财经教育的现状，也考虑了我国财经高等教育所具有的学科特点和需求指向，在教材的遴选、改编和出版上突出了以下一些特点：

- 优选权威的最新版本。入选改编的教材是在国际上多次再版的经典之作的最新版本，其中有些教材的以前版本已在国内部分高校中进行了试用，获得了一致的好评。
- 改编后的教材在保持英文原版教材特色的基础上，力求内容精要，逻辑严密，适合中国的双语教学。选择的改编人员既熟悉原版教材内容，又具有本书或本门课程双语教学的经验。
- 改编后的教材配有丰富的辅助教学支持资源，教师可在网上免费获取。
- 改编后的教材篇幅合理，符合国内教学的课时要求，价格相对较低。

本套教材是在双语教学教材出版方面的一次新的尝试。我们在选书、改编及出版的过程中得到了国内许多高校的专家、教师的支持和指导，在此深表谢意，也期待广大读者提出宝贵的意见和建议。

尽管我们在改编的过程中已加以注意，但由于各教材的作者所处的政治、经济和文化背景不同，书中的内容仍可能有不妥之处，望读者在阅读中注意比较和甄别。

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Preface 前 言

Econometrics can be a fun course for both teacher and student. The real world of economics, business, and government is a complicated and messy place, full of competing ideas and questions that demand answers. Is it more effective to tackle drunk driving by passing tough laws or by increasing the tax on alcohol? Can you make money in the stock market by buying when prices are historically low, relative to earnings, or should you just sit tight as the random walk theory of stock prices suggests? Can we improve elementary education by reducing class sizes, or should we simply have our children listen to Mozart for ten minutes a day? Econometrics helps us to sort out sound ideas from crazy ones and to find quantitative answers to important quantitative questions. Econometrics opens a window on our complicated world that lets us see the relationships on which people, businesses, and governments base their decisions.

This textbook is designed for a first course in undergraduate econometrics which includes a substantial amount of statistics review. It is our experience that to make econometrics relevant in an introductory course, interesting applications must motivate the theory and the theory must match the applications. This simple principle represents a significant departure from the older generation of econometrics books, in which theoretical models and assumptions do not match the applications. It is no wonder that some students question the relevance of econometrics after they spend much of their time learning assumptions that they subsequently realize are unrealistic, so that they must then learn "solutions" to "problems" that arise when the applications do not match the assumptions. We believe that it is far better to motivate the need for tools with a concrete application, and then to provide a few simple assumptions that match the application. Because the theory is immediately relevant to the applications, this approach can make econometrics come alive.

This Brief Edition

This brief edition consists of the first nine chapters of the second edition of Stock and Watson (2007), *Introduction to Econometrics*, plus a new chapter (Chapter 10) on conducting an empirical analysis using economic data. Part I (the first three chapters) provides a review of probability and statistics. Part II (the remaining chapters) covers the core material of regression with cross-sectional data: regression

with a single regressor, multiple regression, nonlinear regression functions, and assessing studies that use regression analysis. This brief edition was developed in response to requests from instructors who do not have enough time to cover more advanced material, such as regression with time series data or instrumental variables regression, which are covered in the full edition of Stock and Watson. This brief edition should prove especially useful for courses in which a considerable amount of class time is spent reviewing statistics and probability. The final chapter on conducting an empirical analysis will support the instructor who wants to round out his or her econometrics course with a substantial empirical project.

Like the full edition of Stock and Watson, this textbook differs from others in three main ways. First, we integrate real-world questions and data into the development of the theory, and we take seriously the substantive findings of the resulting empirical analysis. Second, our choice of topics reflects modern theory and practice. Third, we provide theory and assumptions that match the applications. Our aim is to teach students to become sophisticated consumers of econometrics and to do so at a level of mathematics appropriate for an introductory course.

Real-World Questions and Data

We organize the discussion of methods and theory around important real-world questions that demand specific numerical answers. We teach single-variable regression, multiple regression, and functional form analysis in the context of estimating the effect of school inputs on school outputs. (Do smaller elementary school class sizes produce higher test scores?) We also illustrate statistical and regression methods by estimating the returns to education, an application that is revisited throughout the book. These and other applications in special-interest boxes can all be understood with only a single introductory course in economics. Thus the instructor can focus on teaching econometrics, not microeconomics or macroeconomics.

Through each application, we teach students to explore alternative specifications and thereby to assess whether their substantive findings are robust. The questions asked in the empirical applications are important, and we provide serious and, we think, credible answers. We encourage students and instructors to disagree, however, and invite them to reanalyze the data, which are provided on the textbook's Companion Website (**www.aw-bc.com/stock_watson**).

Contemporary Choice of Topics

Econometrics has come a long way in the past two decades. The topics we cover reflect the best of contemporary applied regression analysis of cross-sectional data.

For many students in the class, this will be their only course in econometrics. With this in mind, what is the most important material for them to learn? What should the students take away from this course for use in a subsequent course in applied economics and thereafter?

This book is shaped around our answers to these questions. From our perspective, the key lasting lessons from a single introductory econometric course concern omitted variable bias, how multiple regression can address omitted variable bias by estimating a partial effect, an understanding of sampling variability and the methods of statistical and econometric inference (estimation, testing, confidence intervals), an understanding of how regression analysis is done in practice, the ability to read and to critique papers in economics that use regression analysis, and an understanding of the conditions under which regression analysis can (and cannot) provide credible estimates of causal effects.

This book reflects this perspective, both in the development in the text and in the multiple general interest boxes. The review of probability and statistics emphasizes sampling variability, sampling distributions, and how sampling uncertainty is handled using the methods of statistical inference. This treatment is continued in parallel in the subsequent chapters on regression methods. The treatment of multiple regression focuses not only on mechanics and tools (a necessary part of any introductory course), but also on how those tools are useful because they address omitted variable bias. This is accompanied by an ongoing treatment of two empirical examples: the effect on test scores of class size reductions and the returns to education. These examples are used as a platform to motivate and to illustrate regression methods, omitted variable bias, the use of control variables in multiple regression, different ways to handle nonlinearities, the presentation of regression results, and, crucially, how systematically to assess the internal and external validity of a regression study.

The decision to focus on these large "take-away" ideas means that some topics found in older books receive less emphasis in this text. For example, while perfect multicollinearity is treated thoroughly, imperfect multicollinearity is treated as a feature of the data that implies that certain questions will not be well answered by a given data set, and we do not go into technical (and rarely used) devices to mitigate imperfect multicollinearity. In modern econometrics, the dummy variable trap is important; ridge regression is not.

Similarly, our least squares assumptions do not include homoskedasticity, so the first standard error formula for the ordinary least squares (OLS) estimator is what econometricians will recognize as the heteroskedasticity-robust formula, even though the terms heteroskedasticity and homoskedasticity have not yet been introduced. This constitutes a substantial departure from other treatments, which

introduce homoskedasticity as an assumption, give the homoskedasticity-only variance and standard error formulas, state that homoskedasticity often does not hold, then "solve" the "problem" of falsely assuming homoskedasticity by using either heteroskedasticity-robust standard errors or weighted least squares. In the approach of this book, there is no problem to begin with, and our experience is that students have no difficulty with this method. After all, the standard formula for the differences-in-means t-statistic is heteroskedasticity-robust—typically the pooled variance formula is presented as the homoskedasticity-only special case—and neither instructors nor students balk at this treatment. In addition to reducing student frustration, a payoff of our approach is that instructors can devote the week that is usually spent "solving the problem" of heteroskedasticity to other more important topics, such as interaction effects, critiquing regression studies, having the students do an empirical study, and so forth. This said, some instructors find it useful to teach the formulas for the variance of the OLS estimator under homoskedasticity, the Gauss-Markov theorem, and the t- and F-distributions arising from the homoskedastic normal regression model. For this reason, the additional assumption of homoskedasticity (and, for the t- and F-distributions, normality of the errors) is introduced toward the end of the basic treatment of regression, prior to the optional sections on the Gauss-Markov theorem and the classical normal regression model (including the t- and F-distribution).

Theory That Matches Applications

Although econometric tools are best motivated by empirical applications, students need to learn enough econometric theory to understand the strengths and limitations of those tools. We provide a modern treatment in which the fit between theory and applications is as tight as possible, while keeping the mathematics at a level that requires only algebra.

Modern empirical applications share some common characteristics: the data sets typically are large (hundreds of observations, often more); regressors are not fixed over repeated samples but rather are collected by random sampling (or some other mechanism that makes them random); the data are not normally distributed; and there is no *a priori* reason to think that the errors are homoskedastic (although often there are reasons to think that they are heteroskedastic).

These observations lead to important differences between the theoretical development in this textbook and other textbooks.

- ***Large-sample approach.*** Because data sets are large, from the outset we use large-sample normal approximations to sampling distributions for hypothesis testing and confidence intervals. Our experience is that it takes less time

to teach the rudiments of large-sample approximations than to teach the Student t and exact F distributions, degrees-of-freedom corrections, and so forth. This large-sample approach also saves students the frustration of discovering that, because of nonnormal errors, the exact distribution theory they just mastered is irrelevant. Once taught in the context of the sample mean, the large-sample approach to hypothesis testing and confidence intervals carries directly through differences of means and regression with a single or multiple regressors.

- ***Random sampling.*** Because regressors are rarely fixed in econometric applications, from the outset we treat data on all variables (dependent and independent) as the result of random sampling. This assumption matches our applications to cross-sectional data; it extends readily to panel and time series data; and because of our large-sample approach, it poses no additional conceptual or mathematical difficulties.

- ***Heteroskedasticity.*** Applied econometricians routinely use heteroskedasticity-robust standard errors to eliminate worries about whether heteroskedasticity is present or not. In this book, we allow for heteroskedasticity from the outset and simply use heteroskedasticity-robust standard errors.

Skilled Producers, Sophisticated Consumers

We hope that students using this book will become sophisticated consumers of empirical analysis. To do so, they must learn not only how to use the tools of regression analysis, but also how to assess the validity of empirical analyses presented to them.

Our approach to teaching how to assess an empirical study is threefold. First, after introducing the main tools of regression analysis, we devote Chapter 9 to the threats to internal and external validity of an empirical study. This chapter discusses data problems and issues of generalizing findings to other settings. It also examines the main threats to regression analysis, including omitted variables, functional form misspecification, errors-in-variables, selection, and simultaneity—and ways to recognize these threats in practice.

Second, we apply these methods for assessing empirical studies to the ongoing examples in the book. We do so by considering alternative specifications and by systematically addressing the various threats to the validity of the analyses.

Third, to become sophisticated consumers, students need firsthand experience as producers. Active learning beats passive learning, and econometrics is an ideal course for active learning. For this reason, the textbook Web site features data sets, software, and suggestions for empirical exercises of differing scopes.

Mathematical Prerequisites and Level of Rigor

The mathematical prerequisites for this book are Algebra II and an introductory course in statistics at the high school AP Statistics level. Part I of this book provides a thorough review of probability and statistics, and if the statistical background of students coming into the course is sketchy the instructor using this book might choose to spend several weeks going through Part I; however the material in Part I is not intended to be a student's first introduction to probability and statistics.

This book has fewer equations, and more applications, than many introductory econometrics books. But more equations do not imply a more sophisticated treatment, and a more mathematical treatment does not lead to a deeper understanding for most students. On the contrary, it is our experience that a deeper understanding is achieved through repeated treatment of serious empirical applications, both in class and in homework exercises. For this reason, this book (supported by the student resources on the book's Web site) includes many empirical exercises. Like the empirical analysis in the text, the data sets in the empirical exercises are revisited in multiple chapters, in each case using the methods introduced in the chapter to take a closer look at the empirical issue under study. The key formulas and derivations of regression analysis are provided in chapter appendices, so that this material is available to students with a stronger mathematical background but does not get in the way of learning for students who are less prepared mathematically.

Contents and Organization

There are two parts to the textbook. Part I reviews probability and statistics, and Part II covers the core material of regression analysis.

Part I

Chapter 1 introduces econometrics and stresses the importance of providing quantitative answers to quantitative questions. It discusses the concept of causality in statistical studies and surveys the different types of data encountered in econometrics. Material from probability and statistics is reviewed in Chapters 2 and 3, respectively.

Part II

Chapter 4 introduces regression with a single regressor and OLS estimation, and Chapter 5 discusses hypothesis tests and confidence intervals in the regression model with a single regressor. In Chapter 6, students learn how they can address

omitted variable bias using multiple regression, thereby estimating the effect of one independent variable while holding other independent variables constant. Chapter 7 covers hypothesis tests, including *F*-tests, and confidence intervals in multiple regression. In Chapter 8, the linear regression model is extended to models with nonlinear population regression functions, with a focus on regression functions that are linear in the parameters (so that the parameters can be estimated by OLS). In Chapter 9, students step back and learn how to identify the strengths and limitations of regression studies, seeing in the process how to apply the concepts of internal and external validity.

This brief edition concludes with Chapter 10, which is new and does not appear in the full edition, on conducting a regression study using economic data. Many of the steps involved in doing a regression study have been illustrated in the previous chapters via the ongoing treatment of the empirical examples. This final chapter summarizes these steps and includes additional suggestions for identifying a topic, finding a data set, and writing up the results.

Pedagogical Features

The textbook has a variety of pedagogical features aimed at helping students to understand, to retain, and to apply the essential ideas. *Chapter introductions* provide a real-world grounding and motivation, as well as a brief road map highlighting the sequence of the discussion. *Key terms* are boldfaced and defined in context throughout each chapter, and *Key Concept boxes* at regular intervals recap the central ideas. *General interest boxes* provide interesting excursions into related topics and highlight real-world studies that use the methods or concepts being discussed in the text. A numbered *Summary* concluding each chapter serves as a helpful framework for reviewing the main points of coverage. The questions in the *Review the Concepts* section check students' understanding of the core content, *Exercises* give more intensive practice working with the concepts and techniques introduced in the chapter, and *Empirical Exercises* allow the students to apply what they have learned to answer real-world empirical questions. At the end of the textbook, the *References* section lists sources for further reading, the *Appendix* provides statistical tables, and a *Glossary* conveniently defines all the key terms in the book.

Supplements to Accompany the Textbook

The online supplements accompanying *Introduction to Econometrics, Brief Edition* include the Solutions Manual, Test Bank (by Manfred W. Keil of Claremont McKenna College), and Lecture Notes (in both Microsoft Word and PowerPoint formats) with text figures, tables, and Key Concepts. The Solutions Manual includes

solutions to all the end-of-chapter exercises, while the Test Bank, offered in Test Generator Software (TestGen with QuizMaster), provides a rich supply of easily edited test problems and questions of various types to meet specific course needs. These resources are available for download from the Instructor's Resource Center at **www.aw-bc.com/irc.** If instructors prefer their supplements on a CD-ROM, our Instructor's Resource Disk, compatible with both Windows and Macintosh, contains the Lecture Notes, the Test Bank, and the Solutions Manual.

In addition, the Companion Website, found at **www.aw-bc.com/stock_watson**, provides a wide range of additional resources for students. These include data sets for all the text examples, replication files for empirical results reported in the text, data sets for the end-of-chapter *Empirical Exercises*, and EViews and STATA tutorials for students.

Acknowledgments

A great many people contributed to the full edition of this book, and their advice, efforts, and support are detailed in the preface to the second edition of Stock and Watson, *Introduction to Econometrics*. Here, we would like to thank those who specifically helped to make this brief edition a reality. We are grateful to the many instructors who appreciated the treatment in the full edition but pushed us to consider a shorter book that would be more suitable for their course. We are particularly grateful to the panel of reviewers who provided specific advice about what to include in the brief edition:

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Finally, we thank Addison-Wesley, and Adrienne D'Ambrosio in particular, for helping us bring out this version of Stock and Watson that will, we hope, meet the needs of many instructors whose courses do not use the more advanced material appearing in the full edition.

简明目录

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