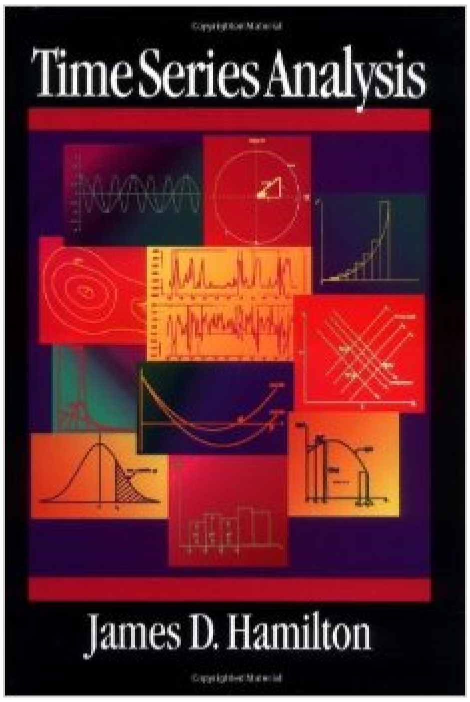
Time Series Analysis



Synopsis

The last decade has brought dramatic changes in the way that researchers analyze economic and financial time series. This book synthesizes these recent advances and makes them accessible to first-year graduate students. James Hamilton provides the first adequate text-book treatments of important innovations such as vector autoregressions, generalized method of moments, the economic and statistical consequences of unit roots, time-varying variances, and nonlinear time series models. In addition, he presents basic tools for analyzing dynamic systems (including linear representations, autocovariance generating functions, spectral analysis, and the Kalman filter) in a way that integrates economic theory with the practical difficulties of analyzing and interpreting real-world data. Time Series Analysis fills an important need for a textbook that integrates economic theory, econometrics, and new results.The book is intended to provide students and researchers with a self-contained survey of time series analysis. It starts from first principles and should be readily accessible to any beginning graduate student, while it is also intended to serve as a reference book for researchers.

Book Information

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Customer Reviews

This book is a comprehensive overview of the theory and techniques for analyzing time series. The author has done a fine job, and the book will no doubt continue to be a good source of information for researchers and statisticians, and also to students, since exercises appear at the end of some of chapters. Proofs of the important mathematical results are put in the appendices to each chapter. Chapter 1 introduces both first order and pth order difference equations and outlines some methods of solution, such as recursive substitution. Dynamic multipliers are discussed, along with long-run and present-value calculations. Readers familiar with linear ordinary differential equations will see the similarity in solution techniques. The next chapter introduces time series for the first time, and gives examples, both deterministic and probabilistic. Time series operators are discussed, with specific emphasis on the lag operator. The role of initial conditions for solving difference equations is outlined in detail. After discussing the concepts of stochastic processes, stationarity, ergodicity, and white noise, in Chapter 3 the author discusses moving average processes and autoregressive processes, along with the invertibility of these processes. A few realizations of AR(1) processes are plotted explicitly. The forecasting of time series is the topic of Chapter 4, with techniques based on conditional expectation, triangular and Cholesky factorization, and the Box and Jenkins method. An elementary example of sample and sample partial autocorrelations for US quarterly GNP growth is plotted. The technique of maximum likelihood estimation is discussed in the next chapter, wherein the author shows how to calculate the likelihood function for various Gaussian ARMAs, along with optimization techniques. The discussion on grid searching is one of the best I have seen in the literature. The all-important spectral analysis techniques are covered in Chapter 6 and the author does an excellent job of explaining how taking the spectrum will illustrate the contributions of periodic cycles to the variance of the data. An example of spectral analysis dealing with manufacturing data is given. The next chapter on asymptotic distribution theory is a little bit more demanding mathematically, but the author does manage to explain the details of this theory very well. The reader can see explicitly how the central limit theorem comes into play in time series analysis. After a review of ordinary least squares, the author gives a very rigorous discussion of linear regression models in Chapter 8. The author shows the role that heteroskedasticity plays in these techniques. Departures from the ideal regression model are discussed further in Chapter 9, wherein the author illustrates the impact of simultaneous equations bias in contributing to the correlation of the error term with the explanatory variables. A supply and demand model from econometrics is used effectively to illustrate this contribution. Chapters 10 and 11 discuss vector time series, with multivariate dynamical systems and vector autoregressions both treated in detail. The population coherence between two vector processes is given, along with the Newey-West, the Granger-Causality tests, and spectral-based estimators. "Green’s function" techniques, via the impulse-response function , are also discussed. Bayesian techniques, which take advantage of prior information on the sample, are discussed in Chapter 12 from both an analytical and numerical point of view. The role of Monte Carlo techniques in estimating posterior moments is unfortunately only discussed briefly. The representation of a dynamical system in terms of state-space via the Kalman filter is treated in the next chapter. The author discusses the use of the Kalman filter in forecasting , maximum likelihood estimation, smoothing, and statistical inference. All of these tools are important in applications, and the author does a fine job of explaining them in this chapter. The Hansen technique of generalized moments is considered in Chapter 14, with the most interesting discussion being the one on the estimation of rational expectation models. The author also shows how to use the method when nonstationary data is present. Chapter 15 begins the study of nonstationary time series, with trend-stationary and unit root processes compared and analyzed throughout the chapter in terms of their forecast errors and their dynamic multipliers. Two other approaches to the study of nonstationary time series are also discussed in the chapter, namely, the fractionally integrated process and processes with discrete shifts in the time trend. Processes with deterministic time trends are the subject of Chapter 16, wherein the author outlines the methods for calculating the asymptotic distributions of the coefficient estimates.The most interesting discussion in the next chapter on univariate processes is on the Brownian walk, for it permits a more general formulation of the central limit theorem. A very detailed discussion of the Dickey-Fuller tests is given with an example of quarterly real US GNP. The Dickey-Fuller test has been widely accepted as a standard test for nonstationarity in time series. Other approaches to finding the unit roots, such as the Phillips-Perron tests are also given. The results here are generalized to the multivariate case in the next chapter.Vector unit root processes called cointegrated processes are the subject of Chapters 19 and 20. These special time series, with each component series being I(1), are treated with respect to the implications they have on moving average, Philips triangular, common trends, and error-correction representations. An interesting application is given to exchange rate data.Time series with variances that change over time, or heteroskedastic processes, are discussed in Chapter 21. The infamous ARCH models are fully detailed, along with their generalizations, the GARCH models.Drastic changes in the behavior of time series is the subject of the last chapter of the book, wherein Markov chains are employed to model these kinds of time series. An application of the these models to U.S real GNP is given.Some omissions in the book include approaches for testing covariance stationarity, such as the postsample prediction test, the CUSUM test, and the modified scaled range test.

This is a large text in time series analysis that is designed for graduate students as the author acknowledges in his preface. It deals primarily with the theory and the tools rather than providing practical applications. It does not require a Ph.D. but does require a fair amount of mathematical sophistication that comes from advanced courses in probability and statistics. There are many good books at this level. This one has some unique features. It covers the traditional ARIMA models that can be found in most texts and uses the operator notation that Box and Jenkins introduced. It adds vector autoregressions which is fairly recent material. Spectral analysis (the frequency domain approach)is also covered and asymptotic theory is presented. Linear systems (more common to econometric time series than in the standard statistical books) is covered. Topics not commonly covered in competitor texts include nonstationary cases (both univariate and multivariate)with unit roots to the characteristic equation, Bayesian approaches, heteroscedastic models including the ARCH models and the topic of cointegration originally developed by Clive Granger. The book is loaded with references to the literature and is slanted towards methods useful in econometrics. Other good books at this level include Brockwell and Davis (1987), Fuller (1976), Anderson (1971), Harvey (1981) and Shumway and Stoffer (2000). Good texts solely in the frequency domain include Bloomfeld (1976), Priestley (1981), Koopmans (1974) and Brillinger (1981). Box, Jenkins and Reinsel (1994) provides practical applications using the Box-Jenkins time domain approach.

I bought this book when i studied econometrics in grad school. now i work at an investment bank, and i use the book practically every day. the derivations (which rely solely on calculus and linear algebra) are always clear, and most of the subjects are covered thoroughly but concisely. using this book, for example, i learned gmm in one day and implemented it on the next day. moreover, most of the chapters are self-contained (if you already know a bit about regression analysis), so you won't have to read a bunch of preliminary stuff before you get to what you need to learn.btw, the author seems like a nice guy, too. one time, i had a question about his treatment of the kalman filter, and he actually responded to my email.

As an economist,before taking PhD lectures, I used to think that this book was too complicated. It is not for undergraduate students. Once you acquire some level in mathematics, this book becomes the best reference for time series econometricians. It covers a wide array of themes, the text is clear and understandable, even if, from time to time, you get lost in the mathematical explanations (but it's not the usual). I particularly liked the non-stationary chapters. The spectral analysis is a little bit confusing and there is no non-parametric section. I think this is one of the best books in the field. Mathematicians will find it extremely clear and graduate economists understandable. "Time series Analysis" it's an unavoidable book for those seeking to understand specialised papers.

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