

*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.*

Exploratory analysis The clearest way to examine a regular time series manually is with a line chart such as the one shown for tuberculosis in the United States, made with a spreadsheet program. The number of cases was standardized to a rate per , and the percent change per year in this rate was calculated. The use of both vertical axes allows the comparison of two time series in one graphic. Autocorrelation analysis to examine serial dependence Spectral analysis to examine cyclic behavior which need not be related to seasonality. For example, sun spot activity varies over 11 year cycles. Separation into components representing trend, seasonality, slow and fast variation, and cyclical irregularity: Curve fitting Curve fitting [5] [6] is the process of constructing a curve , or mathematical function , that has the best fit to a series of data points, [7] possibly subject to constraints. A related topic is regression analysis , [14] [15] which focuses more on questions of statistical inference such as how much uncertainty is present in a curve that is fit to data observed with random errors. Fitted curves can be used as an aid for data visualization, [16] [17] to infer values of a function where no data are available, [18] and to summarize the relationships among two or more variables. The construction of economic time series involves the estimation of some components for some dates by interpolation between values "benchmarks" for earlier and later dates. Interpolation is estimation of an unknown quantity between two known quantities historical data , or drawing conclusions about missing information from the available information "reading between the lines". This is often done by using a related series known for all relevant dates. A different problem which is closely related to interpolation is the approximation of a complicated function by a simple function also called regression. The main difference between regression and interpolation is that polynomial regression gives a single polynomial that models the entire data set. Spline interpolation, however, yield a piecewise continuous function composed of many polynomials to model the data set. Extrapolation is the process of estimating, beyond the original observation range, the value of a variable on the basis of its relationship with another variable. It is similar to interpolation , which produces estimates between known observations, but extrapolation is subject to greater uncertainty and a higher risk of producing meaningless results. Function approximation In general, a function approximation problem asks us to select a function among a well-defined class that closely matches "approximates" a target function in a task-specific way. One can distinguish two major classes of function approximation problems: First, for known target functions approximation theory is the branch of numerical analysis that investigates how certain known functions for example, special functions can be approximated by a specific class of functions for example, polynomials or rational functions that often have desirable properties inexpensive computation, continuity, integral and limit values, etc. Second, the target function, call it  $g$ , may be unknown; instead of an explicit formula, only a set of points a time series of the form  $x, g(x)$  is provided. Depending on the structure of the domain and codomain of  $g$ , several techniques for approximating  $g$  may be applicable. For example, if  $g$  is an operation on the real numbers , techniques of interpolation , extrapolation , regression analysis , and curve fitting can be used. If the codomain range or target set of  $g$  is a finite set, one is dealing with a classification problem instead. A related problem of online time series approximation [24] is to summarize the data in one-pass and construct an approximate representation that can support a variety of time series queries with bounds on worst-case error. To some extent the different problems regression , classification , fitness approximation have received a unified treatment in statistical learning theory , where they are viewed as supervised learning problems. Prediction and forecasting[ edit ] In statistics , prediction is a part of statistical inference. One particular approach to such inference is known as predictive inference , but the prediction can be undertaken within any of the several approaches to statistical inference. Indeed, one description of statistics is that it provides a means of transferring knowledge about a sample of a population to the whole population, and to other related populations, which is not necessarily the same as prediction over time. When information is transferred across time, often to specific points in time, the process is known as forecasting. Fully formed

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statistical models for stochastic simulation purposes, so as to generate alternative versions of the time series, representing what might happen over non-specific time-periods in the future Simple or fully formed statistical models to describe the likely outcome of the time series in the immediate future, given knowledge of the most recent outcomes forecasting. Forecasting on large scale data is done using Spark which has spark-ts as a third party package. Statistical classification Assigning time series pattern to a specific category, for example identify a word based on series of hand movements in sign language.

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