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# Contents

**Bias Correction for Estimators of the Residual Variance in the ARMA(1,1) Model**


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**ABSTRACT**

We consider the ARMA(1,1) model and deal with the estimation of the residual variance. General results are known for the maximum likelihood (ML) estimators under normality, both for known and unknown mean, in which case the asymptotic biases depend on the number of parameters (including the mean) and on the true residual variance, but not on the values of the remaining parameters. For moment and least squares estimators the situation is different: the asymptotic biases depend on the values of the parameters, besides the true variance. Some simulation results are also presented.

## Prediction of Long-Memory Time Series: An Overview

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### ABSTRACT

Two different approaches, called *Type-I* and *Type-II*, to linear least-squares prediction of a long-memory time series are distinguished. In the former, no new theory is required and a long-memory time series is treated *on par* with a standard short-memory time series and its multi-step predictions are obtained by using the existing modelling approaches to prediction of such time series. The latter, by contrast, seeks to model the long-memory stochastic characteristics of the observed time series by a fractional process such that its $d$-th fractional difference, $0 < d < 0.5$, follows a standard short-memory process. The various approaches to constructing long-memory stochastic models are reviewed, and the associated question of parameter estimation for these models is discussed. Having fitted a long-memory stochastic model to a time series, linear multi-step forecasts of its future values are constructed from the model itself. The question of how to evaluate the multi-step prediction constants is also discussed and a review of the various methods proposed for doing so is given. The predictive efficacy of the *Type-II* approaches relative to the *Type-I* approaches is investigated by a simulation study in which the *Type-I* forecasts are obtained by autoregressive model fitting while the *Type-II* forecasts are constructed by fitting an *ARFIMA*(1,*d*,1) model to each generated time series, but the actual simulated processes follow a variety of *ARFIMA* and *FEXP* models and not necessarily an *ARFIMA*(1,*d*,1) model.

## Seasonal Outliers in Time Series

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### ABSTRACT

The standard procedures for automatic outlier detection and correction consider four types of outliers, namely, the additive, innovational, level shift, and transitory change outliers. In this paper, it is argued that this typification presents serious shortcomings. First, the innovational outlier may display undesirable features; second, it is incomplete because it cannot model breaks in the pattern of the seasonal component. Several specifications for a seasonal outlier are considered and the one denoted Seasonal Level Shift (SLS) is analyzed through simulation and real examples. It is concluded that a

seasonal outlier is a better candidate for automatic outlier detection and correction than the innovative one.

## Outliers and Conditional Autoregressive Heteroscedasticity in Time Series

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### ABSTRACT

This paper reviews the literature on GARCH-type models proposed to represent the dynamic evolution of conditional variances. Effects of level outliers on the diagnostic and estimation of GARCH models are also studied. Both outliers and conditional heteroscedasticity can generate time series with excess kurtosis and autocorrelated squared observations. Consequently, both phenomena can be confused. However, since outliers are generated by unexpected events and the conditional variances are predictable, it is important to identify which one is producing the observed features in the data. We compare two alternative procedures for dealing with the simultaneous presence of outliers and conditional heteroscedasticity in time series. The first one is to clean the series of outliers before fitting a GARCH model. The second is to estimate first the GARCH model and then to clean of outliers by using the residuals adjusted by its conditional variance. It is shown that both approaches may result in different estimated conditional variances. However, our main conclusion is that, apparently, there is no an easy way of distinguishing between outliers and ARCH effects.

## A Study of the Asymmetric and Symmetric Weights of Kernel Smoothers and their Spectral Properties

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### ABSTRACT

The main purpose of this paper is to discuss the smoothing properties of several kernel estimators in the context of time series analysis, with special reference to short-term trend-cycle estimation. The kernel smoothers analysed are the Gaussian, some polynomial kernels following the Beta distribution function, the Box and the Minimum Variance. We study their smoothing properties by means of the frequency response functions corresponding to symmetric (applied to central observations) and asymmetric (applied to end observations) weights. The smoothing effects of each kernel estimator are analysed in two ways: (1) by fixing a constant bandwidth parameter for all the kernels and (2) by fixing the number of nonzero weighted observations. The first condition enables the comparison of the smoothing power of each kernel relative to the

others while the second provides information on the appropriateness of each kernel for short-term trend estimation.

## On-line Monitoring of High Dimensional Physiological Time Series – a Case-Study

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### ABSTRACT

In modern statistical process control, intelligent alarm systems have to be constructed which extract the important information from multivariate time series and detect critical "out-of-control" states of the underlying mechanism quickly and reliably. Regarding high-dimensional time series, statistical methods for dimension reduction can help to compress the data into a few relevant variables before characteristic patterns in the data are searched for. In this paper we apply graphical models as a preliminary step preceding a factor analysis of the vital signs of critically ill patients in intensive care. Then a procedure for the online-detection of change points in univariate time series is applied to the original series and to each of the factors and the results are compared to the judgement of an experienced physician.

## Recent Developments in Multivariate Time Series Analysis: Reduced Rank Autoregressive Models and Cointegration

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### ABSTRACT

Reduced rank regression, when applied to multivariate time series, is not only useful in achieving parsimony but also useful in estimating the long-run equilibrium in non-stationary time series. In this paper recent developments in multivariate time series analysis that employs reduced rank regression are reviewed. Reduced rank regression and its application to time series analysis are first discussed in a general framework. Then specific models that employ reduced rank regression are reviewed. Especially, the nested reduced rank model for stationary time series and the partially nonstationary autoregressive model for nonstationary time series are reviewed extensively. Reduced rank estimation in cointegration analysis under the framework of the partially nonstationary autoregressive model is discussed. The partial nonstationarity is extended to seasonal models with seasonal cointegration. Future research related to reduced-rank models and cointegration with mixed frequency data are proposed.

## Developments in Multivariate Time Series Modeling

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### ABSTRACT

We consider two new modeling procedures for multiple time series, which address the challenge of providing both, a good representation of the structure, and an efficient parameterization. We first review a method, applied to vector autoregressions of low order, which uses conditional independence graphs to identify a sparse structural autoregressive representation. We show by an example how this may be extended to identify a sparse structural form of an ARMA(1,1) model for a series of seven daily US dollar term rates. The identified structure reveals the pivotal role of the series of two year rates, and highlights sources of heteroscedasticity. Vector autoregressions of high order are widely used to provide an empirical approximation to multiple time series structure, but the large number of parameters in these models restricts the possible maximum lag when the series is of moderate length. We present, and illustrate by example, a simple extension of the vector autoregression in which the predictors are smoothed functions of the past variables. This allows information from higher lags to be used in a model of relatively low order, and can improve forecasts at higher lead times.

## Robust Estimation in Vector Autoregressive Models Based on a Robust Scale

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### ABSTRACT

A new class of robust estimates for vector autoregressive processes is proposed. The autoregressive coefficients and the covariance matrix of the innovations are estimated simultaneously by minimizing the determinant of the covariance matrix estimate, subject to a constraint on a robust scale of the Mahalanobis norms of the innovation residuals. By choosing as a robust scale a $\tau$ – estimate, the resulting estimates combine good robustness properties and asymptotic efficiency under Gaussian innovations. These estimates are asymptotically normal and in the case that the innovations have an elliptical distribution, their asymptotic covariance matrix differs only by a scalar factor from the one corresponding to the maximum likelihood estimate.