

Seminário

Grupo de Probabilidades e Estatística

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Sala 11.2.21

Parameter estimation in state-space models – strategies for handling outliers

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Abstract

Time series analysis and modeling play a crucial role in predicting future observations. Most time series data exhibit certain components, such as trend or seasonality and the presence of outliers, which make analysis challenging, as well as the selection of the most suitable model. On the one hand, state-space models (SSM) are very flexible, since it is possible to incorporate these components in several ways. On the other hand, the presence of outliers can impact parameter estimation, forecasts and inferential results, and can lead to erroneous conclusions [1,2]. Therefore, detection and treatment of outliers are important steps in time series analysis [3].

In general, the SSM is not specified and the parameters need to be estimated. The maximum likelihood (ML) method is the most widely used due to its asymptotic properties, versatility and good properties for constructing confidence intervals and hypothesis tests. Since the ML function is not easy to maximize, optimization algorithms are typically employed. The Newton-Raphson method is a widely used iterative algorithm for parameter estimation. This method applied in the context of the SSM considers the score vector and the information matrix. However, in the presence of outliers, this method may not be robust for two main reasons; firstly, it can generate

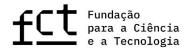
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high gradients and lead to local convergence; secondly, the information matrix is obtained approximately from the first-order partial derivatives and expressed as the sum of two parcels, one of which is simplified by dropping the expected value operator. [4]. This simplification can affect convergence in the numerical method and also lead to confidence intervals that may not accurately reflect reality.

In this seminar, we will present and discuss some alternatives to address this situation. One of these alternatives involves bootstrapping the standardized innovations to obtain an asymptotic information matrix that considers the mean value and/or robust measures when dealing with data containing outliers.

References:

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