Robust Singular Spectrum Analysis

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Keywords. *Time Series; Singular Spectrum Analysis; Outlier; L_1norm.*

The Singular Spectrum Analysis (SSA) method is a powerful tool for analysis and forecasting time series data. This technique combines elements of classical time series analysis, multivariate statistics, multivariate geometry, dynamical systems and signal processing. The last decade has seen an exponential increase in the application of SSA to forecasting in various fields ranging from meteorology, biomedical science and finance, to economics.

The aim of SSA is to make a decomposition of the original series into the sum of a small number of interpretable components such as a slowly varying trend, oscillatory components and a structureless noise. Neither a parametric model nor stationarity conditions have to be assumed for the time series. This makes SSA a model-free or nonparametric method and hence enables SSA to have a very wide range of applicability.

A thorough description of the theoretical and practical foundations of the SSA technique (with several examples) can be found [Golyandina et al. , 2001] and [Golyandina & Zhigljavsky , 2013]. An elementary introduction to the subject can be found in [Elsner & Tsonis , 1996].

The most common version of SSA is called *Basic SSA*. This version of SSA is based on the *Frobenius* norm (or L_2 norm), which is very sensitive to the presence of outliers. Therefore the outliers have a significant impact on SSA reconstruction and forecasts Hassani et al. [2014].

The main object of this paper is to introduce a rubustification version of SSA which is based on the L_1 norm. The theoretical and empirical results confirm that L_1-SSA outperforms the basic SSA in reconstruction and forecasts when faced with time series which are contaminated by outliers. The performance of this approach will be investigated by simulation studies.

References

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