

Time series partial causality: Computational and empirical examples

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Abstract

Focusing on the stationary vector autoregressive moving average (VARMA) models, the paper provides a quantitative approach to characterize in the frequency domain the strength of one-way effects and reciprocity between a pair of series in the presence of a third series, and proposes a unified statistical method of estimation and testing for the partial measures of interdependence.

Under the condition that the spectral density matrix which is not derived from a specific VARMA model is decomposable and its canonical factorization is available, Hosoya (2001) proposed partial causal measures, introducing how to eliminate the one-way effect of the third series. The new aspect of the present paper is the introduction of a practically numerical procedure based on the canonical factorization algorithm given by Hosoya and Takimoto (2010) and a revised version of Takimoto and Hosoya (2004)'s three-step Whittle-likelihood maximization for the model parameter estimation. Furthermore, the paper proposes Monte Carlo Wald tests for the purpose of testing and constructing interval-estimates of those measures.

To evaluate finite sample performances of the proposed estimation procedure, numerical simulations are conducted, using trivariate stationary VAR and VARMA settings. The simulation results suggest, on the whole, that the the third-step estimates do not improve notably the second-step estimates in respect of bias and sampling variation for small-sample data. For empirical illustration, the paper examines partial causal relationships between the term spread and the growth of GDP in U.S., comparing the estimation and testing results under a variety of third-series presence as well as with the unconditional simple result. The result is compared with the existing literature.

References

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