

NETS:  
NETWORK ESTIMATION FOR TIME SERIES

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**Abstract**

This work proposes novel network analysis techniques for time series. We define the network of a multivariate time series as an undirected graph where nodes denote the components of the process and edges denote nonzero long run partial correlation between two components. Long run partial correlation is a comprehensive measure of cross-sectional conditional dependence for time series capturing contemporaneous as well as lead/lag relations. We then introduce an algorithm called NETS to estimate sparse long run partial correlation networks, a procedure that detects which edges are present in the network from the data. The algorithm is based on a two step LASSO regression of the VAR approximation of the process. The large sample properties of the estimator are analysed and we establish conditions for consistent estimation of the network. The methodology is illustrated with an application to a panel of U.S. bluechips. The risk of monthly equity returns is decomposed in a systematic and an idiosyncratic components and NETS is used to analyse the network structure of the idiosyncratic part. The empirical analysis shows that the idiosyncratic risk network captures a significant portion of the total risk and that it exhibits several of the empirical regularities found in social networks.

**Keywords:** Networks, Multivariate Time Series, Long Run Covariance, LASSO

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The procedures presented in this paper are available in the package `nets` for R.

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