

NETWORK MODELING AND ANALYSIS OF SPATIO-TEMPORAL CORRELATIONS IN MULTIVARIATE TIME SERIES

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Zoom Link: <https://binghamton.zoom.us/my/hirokisayama>

Abstract: We propose a method of analyzing multivariate time series data that investigates lead-lag relationships among economic indicators during the COVID-19 era with a weighted directed network of lagged variables. Three complex networks are created with these variables and several lags of each as the network nodes. Network edges are weighted based on three relationship metrics: correlation, mutual information, and transfer entropy. In each network, nodes are merged, and edges are aggregated to simplify the weighted directed graph. Pagerank is used to determine the most influential and the most influenced node over the time period. Results were reasonably robust within each network, but they were heavily dependent on the choice of metric. We then propose an extension of the method for lead-lag analysis of multivariate time series to include the analysis of spatial correlations. We applied the extended spatial and temporal method to CIRIGHTS, a large global human rights dataset, to determine the most influential and most influenced indicators of human rights, freedoms, and atrocities over time. We consider four target countries. The lead-lag method is extended to the spatial multivariate time series by investigating geographical correlations between each target country and its surrounding region to determine which variables best represent activity between the target country and the surrounding region. The nodes in this undirected network are variables in the target country and variables in the surrounding region, with edges weighted by mutual information. Eigenvector centrality is used to determine which variables best represent activity between the target country and the surrounding region. Key findings indicate that occupational and worker rights are the most influential and most influenced in the target countries over time and by region, and laws tend to influence future activity. The lead-lag and spatial network models are then combined to create a network model to investigate spatial lead-lag effects in the CIRIGHTS dataset. Directed network edges between nodes of the target country and nodes of the surrounding region over time are weighted by transfer entropy. Pagerank is used to determine variables in the target country that most influence those in the surrounding region and variables in the surrounding region that most influence those in the target country. We also determine variables in the target country that are most influenced by those in the surrounding region and vice versa. Key findings indicate that occupational and worker rights tend to be influential and influenced from the target country to the surrounding region and vice versa, justice rights are influential, and physical integrity rights are most influenced in all target countries except Germany, where empowerment rights and freedoms are influential in the surrounding region.