Advances in Spatial Integer-Valued Time Series Modeling

Cathy W.S. Chen[1], Chun-Shu Chen[2], Hsiao-Hsuan Liao[1]

[1]*Department of Statistics, Feng Chia University, Taichung, Taiwan*

[2]*Graduate Institute of Statistics, National Central University, Taoyuan, Taiwan*

ABSTRACT

This study compares spatial hurdle and spatial zero-inflated generalized Poisson (ZIGP) INGARCH models for analyzing weekly dengue fever counts. Both models extend the INGARCH framework to accommodate spatio-temporal dependence and excess zeros. To enhance epidemiological relevance, we incorporate seasonal components into the log-intensity equations, comparing two approaches: one using periodic harmonic terms based on Fourier series, and the other using meteorological covariates. Model inference is conducted within a Bayesian framework. The spatial hurdle model is further improved using an empirical Bayes approach. Model performance is evaluated using the Deviance Information Criterion (DIC), Bayes factors, and predictive accuracy metrics, including mean squared error (MSE), mean absolute error (MAE), and mean absolute scaled error (MASE). The results highlight the distinct roles of seasonal and environmental covariates in dengue transmission dynamics. Modeling periodic effects with Fourier terms proves effective, especially when explicit meteorological data are unavailable or incomplete. The empirical Bayes approach enhances parsimony and stability over traditional hurdle INGARCH models.

Keywords: Bayesian inference; Fourier series; INGARCH models; Spatio-temporal modelling; Zero-inflated count data

Granger Causality Tests for High-Dimensional VAR Processes

Wei Biao Wu[1], Wentao Hu[1], **Ying-Chao Hung**[2]

[1]*Department of Statistics, University of Chicago*

[2]*Institute of Industrial Engineering, National Taiwan University*

ABSTRACT

Granger causality is a classical and widely used tool for assessing the predictive influence of one group of time series on another within a vector autoregressive (VAR) framework. Traditional Granger causality tests are typically based on Wald-type statistics, but their implementation can be problematic in high-dimensional VAR models due to (i) inflation of the test statistic caused by singular or nearly singular covariance matrices, and (ii) infeasibility or high computational cost associated with tuning parameter selection. In this talk, we introduce an alternative testing procedure for Granger causality that is built on non-pivotal statistics. The proposed method has a solid theoretical foundation and, importantly, does not require any tuning parameter calibration. We further extend the procedure to more general VAR processes with a potentially infinite number of variables, and we establish the corresponding asymptotic theory when the dimensionality of the process increases with the sample size.

Keywords: Vector Autoregression; High-Dimensional Granger Causality; Wald-Type Tests; Non-pivotal Statistics; Gaussian Approximation

Autotune: Fast, Efficient, and Automatic Tuning Parameter Selection for LASSO

Sumanta Basu, Tathagata Sadhukhan

Department of Statistics and Data Science, Cornell University

ABSTRACT

Least absolute shrinkage and selection operator (LASSO) is a popular method for high-dimensional regression, with applications in the analysis of large-scale dependent data such as vector autoregressive (VAR) models in time series. Despite the availability of fast software, interpretability, and asymptotic theory, some practical concerns remain around its tuning parameter selection. Cross-validation (CV), the most common choice in practice, is computationally expensive and comes at the cost of efficiency loss, an issue that is exacerbated for time series cross-validations (TS-CV). Information criteria based tuning is also known to suffer in high-dimensional scenarios. We propose autotune, a procedure that alternately optimizes a penalized log-likelihood over regression coefficients and the error standard deviation, resulting in a LASSO that automatically tunes itself. The premise of autotune is that under exact or approximate sparsity conditions, the error standard deviation may be estimated more easily than the high-dimensional regression parameter. We achieve this algorithmically by leveraging the partial residuals (PR) that are already computed when finding a LASSO solution using coordinate descent. Using extensive simulation experiments on regression and VAR estimation, we show that autotune is faster, and provides superior estimation, variable selection, and prediction performance than existing tuning strategies for LASSO as well as alternatives such as the scaled LASSO. As a by product, autotune provides a new estimator or σ that can be used for high-dimensional inference. Using the partial residuals, we also propose a new visual diagnostic procedure for checking the sparsity assumption. Finally, we demonstrate the utility of autotune on a real-world financial data set. An R package based on C++ is also available on Github.

Keywords: LASSO; Vector Autoregression (VAR); Tuning parameter selection; Cross-validation

Back to Sessions List