Nonparametric Changepoint Analysis of Multiple Time Series

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Abstract:
Analysis of level shifts among multiple time series through characterization of common components helps identify the shared behavior of the data generating process with some known perturbation-causing events. Changes in the error structure variance led to model misspecification and serious violations of other assumptions which facilitate model estimation. Volatility models are used to incorporate variance structure into the mean model but suffer from overparameterization commonly observed in multiple time series data. A model for structural change in the variance component is estimated through the backfitting algorithm, which is then used as a reference for a nonparametric sieve bootstrap-based test to detect changes in the variance structure of multiple time series. Simulation studies show that the proposed test performed well in terms of size and power in almost all scenarios. The size of the proposed test is consistently less than the nominal level of significance and has higher power for larger common autocorrelation, especially in cases where the number of time series in the system is not the same as the length of the time series. The proposed test gains power whenever the change occurred in the middle of the series and performs best if the individual random effects exhibit homogeneity. When applied to nearly nonstationary multiple time series, the proposed test has the potential to detect changes in error variance if it occurred near the end of the series and the series exhibited small variability in its random effects.

Keywords:
changepoint analysis, multiple time series, backfitting algorithm, sieve bootstrap