Adaptive Bayesian Changepoint Analysis & Local Outlier Scoring

David S. Matteson [1]; Haoxuan Wu[1]

[1] Cornell University

Abstract:

We introduce global-local shrinkage priors into a Bayesian dynamic linear model to adaptively estimate both changepoints and local outliers in a novel model we call Adaptive Bayesian Changepoints with Outliers (ABCO). We utilize a state-space approach to identify a dynamic signal in the presence of outliers and measurement error with stochastic volatility. We find that global state equation parameters are inadequate for most real applications, and we include local parameters to track noise at each time-step. This setup provides a flexible framework to detect unspecified changepoints in complex series, such as those with large interruptions in local trends, with robustness to outliers and heteroskedastic noise. ABCO may also be used as a robust Bayesian trend filter that can recon- struct interrupted time series. We detail the extension of our approach to time-varying parameter estimation within dynamic regression analysis to identify structural breaks. Finally, we compare our algorithm against several alternatives to demonstrate its efficacy in diverse simulation scenarios and two empirical examples.

Keywords:

Anomaly Detection; Interrupted Time Series; Stochastic Volatility; Structural Change; Trend Filtering