Robust optimal reconciliation for hierarchical time series forecasting with M-estimation

Abstract

Aggregation constraints, resulting from geographical/sectoral division, often occur in a large collection of time series. Coherent forecasts of these constrained series are expected to accord with their hierarchical structure organized by the aggregation rules. To enhance its resistance to potential irregular series, we investigate the robust reconciliation procedure for hierarchical time series (HTS) forecasting. We incorporate M-estimation to obtain the reconciled forecasts via minimizing a robust loss function of transforming a group of base forecasts subject to the aggregation constraints. Related minimization procedure is developed and implemented through a modified Newton-Raphson algorithm via local quadratic approximation. Extensive numerical experiments are conducted to examine the performance of the proposed method, and the results indicate its feasibility in dealing with many abnormal cases (e.g., series with non-normal errors). The proposed robust reconciliation also shows nice efficiency when no outliers exist in HTS. Finally, we illustrate the practical utility of the proposed method in a real-data study on Australian domestic tourism.

Key Words: Hierarchical time series forecasting; Robust reconciliation; M-estimation; Local quadratic approximation; Australian domestic tourism.