Forecast reconciliation

2. The geometry of forecast reconciliation

Rob J Hyndman

MONASH University

Photo by Edvard Alexander Rølvaag on Unsplash

robjhyndman.com/fr2023

Outline

Notation reminder

- Data: $\boldsymbol{y}_t = \boldsymbol{S}\boldsymbol{b}_t$ where $\boldsymbol{S}$ is a summing matrix and $\boldsymbol{b}_t$ is a vector of disaggregated time series
- Base forecasts: $\hat{\boldsymbol{y}}_{T+h|T}$
- Reconciled forecasts: $\tilde{\boldsymbol{y}}_{T+h|T} = \boldsymbol{S}\boldsymbol{G}\hat{\boldsymbol{y}}_{T+h|T}$
- MinT: $\boldsymbol{G} = (\boldsymbol{S}'\boldsymbol{W}_h^{-1}\boldsymbol{S})^{-1}\boldsymbol{S}'\boldsymbol{W}_h^{-1}$ where $\boldsymbol{W}_h$ is covariance matrix of base forecast errors.

Zero-constraint representation

The coherent subspaces

Least squares reconciliation of data

Game theory perspectives

Adding optimization constraints

ML and regularization

Bayesian versions

In-built coherence

References

- Di Fonzo, T and D Girolimetto (2022). Forecast combination-based forecast reconciliation: Insights and extensions. *International Journal of Forecasting* **forthcoming**.
- Eckert, F, RJ Hyndman, and A Panagiotelis (2021). Forecasting Swiss exports using Bayesian forecast reconciliation. *European J Operational Research* **291**(2), 693–710.
- Panagiotelis, A, P Gamakumara, G Athanasopoulos, and RJ Hyndman (2021). Forecast reconciliation: A geometric view with new insights on bias correction. *International J Forecasting* **37**(1), 343–359.
- van Erven, T and J Cugliari (2015). "Game-theoretically optimal reconciliation of contemporaneous hierarchical time series forecasts". In: *Modeling and Stochastic Learning for Forecasting in High Dimension*. Ed. by A Antoniadis, JM Poggi, and X Brossat. Cham: Springer International Publishing, pp.297–317.

References

Wickramasuriya, SL, BA Turlach, and RJ Hyndman (2020). Optimal non-negative forecast reconciliation. *Statistics & Computing* **30**(5), 1167–1182.