# Hierarchical Summary Forecasting

Christoph Bergmeir

University of Granada, Spain
https://www.cbergmeir.com

# Hierarchical forecasting

- In hierarchical forecasting, we usually assume that we can aggregate the actual, past data within a hierarchy.
- The problem then comes when we forecast, as the forecasts do not necessarily add up.
- However, in practice it is often not that simple.

# Motivating example

- Let's assume we have a peak demand energy tariff, where we pay according to our maximum consumption over a 30-minute window, per month
- Let's assume we want to forecast this series 18 months out.
- Should we use the 30-minutely time series for forecasting, or the time series of monthly maxima? Do we want to forecast a 30-minutely time series 18 months out?

# Motivating example (2)

- What happens if this is one household and we now want to build the usual hierarchy across households, regions, etc.
- The historical series of monthly peaks will not add up in a meaningful way across households.
- We can solve the problem by going back to the original 30-minute granularity, to get all monthly series on all levels. Still the monthly series will not add up.
- How to forecast? How to reconcile?
- What if we do not have the high-frequent data or it doesn't even exist?

# More problems from the energy sector

- Disclaimer: I don't consider myself an expert in this...
- Wind turbines work internally with 22Hz, but their SCADA systems oftentimes historize only 1-second data. Min, max, mean per second.
- Energy markets work on 4-second or 1-second granularity presumably also already aggregated over time in some way.
- The assumption is that over, e.g., 4 seconds or 1 second, the power (or frequency, voltage (?)) will be constant (or smooth) over this short time window.
- If the value is constant, minimum, maximum, mean, median, are all the same, and everything adds up correctly.

# Problems in other sectors

- This is not a problem limited to the energy sector, in capacity planning and supply chain similar problems exist.
- Often, the series are not only daily minima and maxima, but quantiles (e.g., 0.05, 0.95), which makes the problem even more difficult.

# Way forward

We have some initial ideas how to tackle parts of the problem, but I would be very happy to discuss with anybody interested

# Thank You

https://www.cbergmeir.com

bergmeir@ugr.es