NUS National University of Singapore | Department of Mathematics Faculty of Science

Research Highlight: Modeling seasonality and serial dependence of electricity price curves with warping functional autoregressive dynamics

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Electricity price forecasting is of fundamental importance for a stable energy supply. Electricity prices are high dimensional, serially dependent and have seasonal variations. We propose a Warping Functional AutoRegressive (WFAR) model that simultaneously accounts for the cross time-dependence and seasonal variations of the large dimensional data. In particular, electricity price curves are obtained by smoothing over the 24 discrete hourly prices on each day. In the functional domain, seasonal phase variations are separated from level amplitude changes in a warping process with the Fisher–Rao distance metric, and the aligned (season-adjusted) electricity price curves are modelled in the functional autoregression framework. In a real application, the WFAR model provides superior out-of-sample forecast accuracy in both a normal functioning market, Nord Pool, and an extreme situation, the California market. The forecast performance as well as the relative accuracy improvement are stable for different markets and different time periods.

Reference:

Chen, Y., Marron, J. S., & Zhang, J. (2019). Modeling seasonality and serial dependence of electricity price curves with warping functional autoregressive dynamics. The Annals of Applied Statistics, 13(3), 1590-1616.