Forecasting of Energy Demand in the UK

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Accurate and rigorous electricity demand modelling and forecasting is extremely important for energy suppliers, Independent System Operators (ISOs), financial institutions, and other participants in electric energy generation, transmission, distribution, and markets. Such forecasts are crucial for planning periodical operations and facility expansion in the electricity sector at various levels. For example, models for electric power load forecasting are essential to the operation and planning of a utility company. At this level, load/demand forecasting would help an electric utility to make important decisions including purchasing and generating electric power, load switching, and infrastructure development.

We collected 30 minutely data from the National Gridwatch website[1] ranging from 00:00:00 of 21 December 2013 to 00:00:00 of 21 March 2016. The data relate to energy demand for the entire UK plus import, minus export less un-metered sources, and is disaggregated by energy source including coal, nuclear, combined cycle gas turbines (CCGT hereafter), wind and hydro-power. We work with this data to obtain 30-minute to one-day predictions of the demand for energy as produced from these five energy sources.

We contribute to the literature on energy demand forecasting by detailing a pseudo out-of-sample combination forecast design which uses high frequency time series data to obtain improved short-term forecast (up to 1 day) of the demand for energy produced from five different sources in the UK, averaging from a set of 6 univariate and multivariate models. We produce short-term forecasts of the demand for energy in the UK using a forecasting approach based on model averaging of several popular linear or non-linear, univariate and multivariate forecast models.

In order to overcome certain methodological issues and produce improved forecasts of the demand for energy in the UK, we use a forecasting strategy based on model averaging across several popular linear or non-linear, univariate and multivariate forecast models. Specifically, we first obtain the forecasts from sets of ARMA, Holt-Winters Smoothing (HWS), Non Linear Autoregressive Neural Networks (NLANN), Vector Autoregressions (VAR), Bayesian VAR (BVAR), and Factor Augmented VAR (FAVAR) models. The best models, as selected by each of different information criteria, are then averaged using six different combination weight metrics (including Simple Model Averaging, Granger-Ramanathan Model Averaging, Bayesian Model Averaging, Akaike Model Averaging, Mallows Weights and the Jackknife).

[1] `http://www.gridwatch.templar.co.uk/`

Our results confirm the merits of combination forecasting as a superior forecasting strategy. Among the single forecasting models, NARNN and VAR forecast are superior in terms of lower MSFE whilst HWS perform worst. Unexpectedly, direct multiple steps (DMS)forecasts outperforms those obtained by iterated multi-step (IMS) in terms of accuracy. For all energy sources, the MSFE obtained from the forecasting model selected by AIC and JKC almost never under-perform compared to their counterparts suggested by BIC and MIC. Among the six types of model averaging methods, generally the BMA, MMA are superior to the others. Lastly but most importantly, there always exists a model averaging method which gives a lower MSFE than the best/optimal models within each class however selected.