DSO 522: APPLIED TIME SERIES ANALYSIS FOR FORECASTING

PROJECT PROPOSAL FOR ELECTRICITY LOAD AND PRICE FORECASTING FOR DAY-AHEAD ENERGY MARKETS

GROUP 11

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BACKGROUND

Electricity demand and price forecasting are pivotal not only for the energy companies but also for regulators and electricity markets. Energy companies utilize these forecasts to balance supply and demand on their grid. Load forecasts are crucial for ensuring that energy companies meet the demand of their customers and that customers are paying the lowest prices for electricity. Moreover, electricity price forecasts drive crucial decision-making at the corporate level and are imperative for various business aspects such as planning of operations, optimal scheduling of hydro-energy production and formulating bidding strategies for trading. The rise in competition in energy markets and the complex nature of load and price forecasting have bolstered the evolution of various price forecasting techniques and researches over the last two decades.

We collaborated with one of our alums for this course project who works for Southern California Edison (SCE) and acquired electricity prices and load data available in hourly intervals. SCE is one of the largest power utilities that serves 15 million Californians. It participates in the California deregulated energy market (CAISO) and buys and sells everyday energy in the market in order to meet the demand of its customers. Having the right load and price forecast is imperative to ensure lowest prices for its customers. By buying too much unused energy, SCE must endure loss of revenue and face potential penalties by state regulators. On the other hand, by not buying enough, they risk having to buy energy in 'real-time' at a higher price. Most of the forecasted load is bought 16 hours before the start of the 'flow date' in the 'day-ahead' energy market. The flow date is defined as the day the energy is consumed by the customers. The rest of the load is bought in the real-time energy market in order to capture the real-time fluxes of demand.

OBJECTIVE

We aim to explore various forecasting techniques so as to be able to produce accurate forecasts for the electricity price and demand series. We also aim to explore the relationship between the two series. We can also incorporate external factors such as weather forecasts, alternative energy sources and others in our model to check whether it improves the accuracy. The objective is to build upon a holistic forecasting method which is both interpretable and accurate.

Forecast Horizon: SCE forecasts on multiple horizons, namely, 90-day forecast, 7-day forecast, 16-hour forecast and same day forecast. In terms of importance, the accuracy of the 16-hour forecast is the most crucial because that is when they buy most of their energy. The 16-hour forecast is 16 hours before the start of the day they buy energy. SCE participates in the day-ahead market every day and must run this forecast every morning. We can explore other forecast horizons as well.

Peak Hours: Peak hours are defined as the hours of the day with the highest load, and these can change by season. Forecasts for peak hours are very important because it's crucial for SCE to meet the demand during these peak hours. We will particularly focus on improving the accuracy of the forecasts during peak hours.

Through our analysis, we expect to understand the dynamics of electricity supply and demand and how it affects both prices and load. We also want to accurately forecast these series and find additional factors which would help us in our endeavour so as to be able to share our analysis with the company.

DATA

We have the following data available from SCE:

Historical Load Series: The historical load data is available in hourly intervals for each day starting from 2014 till the present time. The load is measured in MWhs.

Historical Price Series: The historical price data is available in hourly intervals for each day starting from 2015 till the present time and is measured in USD.

Actual Temperature Data: We have actual temperature data available from 2014 that SCE tracks for its 5 sub regions, namely, CQT, RIV, LAX, TRM, WJF. There are both the highs and lows of those sub regions. SCE primarily looks at the forecast within the SCE territory.

Other External Data: We can also incorporate other external factors from publicly available sources such as those related to weather such as wind speed, humidity etc. We can also explore data of alternative energy sources such as solar energy or wind energy to check whether they provide extra information which is useful for forecasting.

Constructing Additional KPIs: We would explore additional KPIs such as the effect of temperature change (in either direction) on electricity demand and prices because usually electricity consumption is high at both extremes, i.e., when the temperature is high or low. We would like to explore the data for these patterns and create transformed variables based on our observations which we would further use in our forecasting method.