

Time Series Methods for Forecasting Electricity Market Pricing

Zoran Obradovic Kevin Tomsovic
PO Box 642752
School of Electrical Engineering and Computer Science
Washington State University
Pullman, WA 99164-2752

The objective of this work is to gain understanding of interactions between the predictability of electricity price under new market regulations and the engineering aspects of large scale electric power systems. There are numerous practical difficulties in allowing financial mechanisms to direct investments and operations for the generation and distribution of electricity. The electric commodity must be generated, distributed and consumed in real-time under strict physical laws and extremely high reliability requirements. This process is far more exacting and complex than the distribution of traditional commodities, such as, oil or agricultural products. Clearly, assessing the effectiveness of deregulated markets is of extreme importance.

Both traditional engineering as well as the economics viewpoint fail to capture the behaviour of trades and various financial instruments which reflect the health of a market. Of particular relevance are the existence of predictable patterns of trades and price movements which may reflect a market inefficiency. Market inefficiencies constitute conditions either where some data is not available to all market players or where all data is public but the patterns or information contained in this data requires a nontrivial, i.e., non-linear, analysis. This presentation discusses techniques to analyze the deregulated electricity market in order to determine if there exist inefficiencies which represent conditions of concern for proper operation of the power system.

The traditional scheduling problem has been to minimize the cost of operation of the generator units in a utility while meeting the specified demand and reserve requirements at each time step (say, an hour) of the study horizon. The demands are based on load forecasts projected from historical data and accounting for temporal variables such as weather, day of the week and so on. Typically, the problem is broken down into a component of unit commitment (determining which units are on-line or committed) and dispatch (determining the generation level for each unit). Since most plants and units are also subject to a number of operational constraints (e.g. crew constraints, ramping, minimum up and down times), finding the least cost feasible solution can be challenging and has been the focus of numerous research efforts. It is this optimal scheduling problem which will be greatly impacted by the opening of electricity markets.

Financial markets in general are extremely efficient, meaning that at any given point in time the market does a very good job reflecting the actual value of the underlying stocks or commodities. The efficient market hypothesis states that the adjustment of prices to new information is so rapid that any new information which affects this value is accounted for by the market before the general public can make trades based on it. This concept is widely tested by attempting to capture relationships between present and past share prices using simple stochastic linear time series models. Still might be non-linear relationships between market information and the value of stocks that so far have not been identified and therefore are not reflected in stock prices. These

relationships are called market inefficiencies. It is important to note that if inefficiencies do exist, once their existence (and the means for identifying them) becomes public knowledge, traders will have a better understanding of the relationship between information and commodity values, which results in a more efficient market and the elimination of these nonlinear relationships. The long term results then will not be higher returns, but a more efficient market. In general, new markets, such as the deregulated electricity market, are less efficient.

In this presentation, we review methods for time series forecasting where the data of interest is prices for the electric supply and associated ancillary services. These methods include exploratory analysis for identifying statistically sound attributes, non-linear forecasting methods using neural networks and non-stationarity tests. In addition, we will present some recent results addressing a complementary problem on how one can effectively build library models specialized for modeling characteristic regimes in a nonstationary time series. The proposed algorithm is based on the notion of functional similarity between neighboring time series samples meaning that it is more likely that neighboring samples stem from the same regime rather than form different regimes.