A Hawkes Model Approach to Modeling Price Spikes in the Japanese Electricity Market.

Name Bikeri Adline Kerubo
Laboratory's name Mathematical Informatics
Supervisor's name Prof. Kazushi Ikeda

Abstract

The Japanese Electric Power Exchange (JEPX) provides a platform for trading of electric energy in a manner similar to more traditional financial markets. As the number of market agents increase, there is an increasing need for effective price forecasting models. Electricity price data is observed to exhibit periods of relatively stable i.e., low-magnitude, low-variance prices interspersed by periods of higher prices accompanied by larger uncertainty. The price data time series therefore, exhibits a temporal non-stationarity characteristic that is difficult to capture with typical time-series modeling frameworks. This thesis focuses on models for the occurrence of price spikes where we define spikes as observing prices above a pre-defined threshold. For the purpose of modelling and analysis, the price spikes threshold in the JEPX is set at 25 yen/kWh. The price spikes time series is observed to be a set of rare events that occur in clusters.

This work therefore proposes to model the data as a Hawkes process whereby the occurrence of a spike event increases the probability of observing more spikes in the period immediately following a price spike event. Apart from the classical Hawke's model formulation, this work proposes two variations for modelling the price spikes time series in the JEPX. The first variation models the change in the magnitude of the underlying intensity as a function of the magnitude of the price spike while the second variation models the change in the decay rate of the underlying intensity as a function of the magnitude of the price spike.

An analysis on the forecasting performance of the original Hawkes model, the proposed variations compared to a baseline persistence model shows that the variable magnitude variation of the Hawkes model best captures the underlying characteristics of the process generating the price spike events. The model also performs best in forecasting the occurrence of price spike events.