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Modeling and forecasting electricity prices with input/output hidden Markov models

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Abstract— In competitive electricity markets, in addition to the uncertainty of exogenous variables such as energy demand, water inflows, and availability of generation units and fuel costs, participants are faced with the uncertainty of their competitors’ behavior.
The analysis of electricity price time series reflects a switching nature, related to discrete changes in competitors’ strategies, which can be represented by a set of dynamic models sequenced together by a Markov chain. In this paper, an Input–Output Hidden Markov Model (IOHMM) is proposed for analyzing and forecasting electricity spot prices. The model provides both good predictions in terms of accuracy as well as dynamic information about the market. In this way, different market states are identified and characterized by their more relevant explanatory variables.
Moreover, a conditional probability transition matrix governs the probabilities of remaining in the same state, or changing to another, whenever a new market session is opened. The model has been successfully applied to real clearing prices in the Spanish electricity market.

Index Terms— Artificial neural networks, electricity markets, hidden Markov models, modeling competitors’ behavior, price forecasting.

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