Deep Cascaded Prediction Model for Picture Fuzzy Time Series

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Abstract

Fuzzy sets and some derivatives, such as intuitionistic and picture fuzzy sets, have been used in the prediction literature. A time series whose observations are sets of fuzzy pictures creates a picture fuzzy-time series. This study presents a deep cascaded prediction model for picture fuzzy time series. In the time series prediction process, model construction is the transaction of estimating a function as a prediction tool. Such a predictor can be either an equation consisting of a linear regression or time series prediction model or an artificial neural network with a complex and non-linear structure. A linear predictor ignores non-linear relationships, while a non-linear predictor ignores linear relationships. However, almost all-time series contain both linear and non-linear relationships. From this point of view, in this study, a deep structured cascade forward neural network with multiple hidden layers is designed as a prediction tool and estimated in ways that produce superior predictions. The distinguishing characteristic of a cascade forward neural network is that each layer is connected to all previous layers. In addition, the use of sigmoid and linear activation functions in the hidden layers and the output layer, respectively, makes it superior to other neural networks. It can model linear and non-linear relationships between inputs and outputs together and simultaneously, thanks to this feature.

The predictive ability of the estimated deep cascaded model has been discussed over out-of-sample data sets for widely used time series in related literature via different error metrics and some illustrations. All findings obtained from analyses prove the outstanding performance of the proposed deep cascaded prediction model by comparison with state-of-the-art models.

Keywords

Picture fuzzy time series, Deep cascaded model, Cascade forward neural network, Prediction.

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