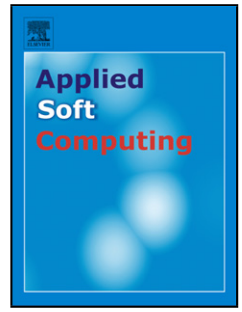
Accepted Manuscript



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PII: S1568-4946(16)30572-5
DOI: http://dx.doi.org/doi:10.1016/j.asoc.2016.11.003
Reference: ASOC 3893

To appear in: *Applied Soft Computing*

Received date: 15-2-2016
Revised date: 16-10-2016
Accepted date: 5-11-2016

Please cite this article as: J.G. Carvalho<ce:suffix>Jr.</ce:suffix>, C.T. Costa<ce:suffix>Jr.</ce:suffix>, Identification method for fuzzy forecasting models of time series, *<![CDATA[Applied Soft Computing Journal]]>* (2016), http://dx.doi.org/10.1016/j.asoc.2016.11.003

Identification method for fuzzy forecasting models of time series

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Abstract

In this paper, we propose a fuzzy forecasting methodology of time series, which is tested on two series: the price of electricity in New South Wales, Australia; and on the futures market index of Taiwan. The method uses a triangular membership function in a fuzzification process, including an α-cut, and applies the extended autocorrelation function. The identification algorithm enables optimization of the number of fuzzy sets to be used, to determine the optimal order for the fuzzy prediction model and estimate its parameters with greater accuracy. The fuzzy prediction models of time series found in the scientific literature are compared using mainly trivalent membership functions (0, 0.5 and 1 as membership values), and the proposed method shows more accurate results.

Keywords: `Electrical energy price, futures market index, autoregressive seasonal fuzzy model,` α`-cut, fuzzy prediction`

1. Introduction

In the real world, the variability in data collected is one of the fundamental characteristics in any statistical modeling process, and needs to be evaluated efficiently, especially when a predictive model is required for noisy data. The fuzzy set theory developed by [48], combined with statistical analysis of time series proposed by [39], has emerged as a practical and efficient alternative among known forecasting tools. This created a hybrid modeling structure, which is capable of significantly reducing the inherent variability of the series of the modeled data.

To optimize prediction methods for fuzzy time series, some authors included prediction techniques of artificial intelligence, such as genetic algorithms [7], fuzzy C-means clustering [10], artificial neural networks [12] and particle swarm optimization [21], in their algorithms. Some fuzzy prediction models can be found in scientific literature, where the models are applied to solar activity [1], rice production [5], the Chinese market index [13], electrical energy loads [19], oil demand [37] and enrollment data [43], among other examples.

In this paper, in addition to evaluating the inherent variability of time series data, other terms present in the identification process of prediction models are analyzed. The main structural parameters used in the proposed fuzzy prediction algorithm are as follows: the triangular shape of the membership function, the number of adequate fuzzy sets into which the series is partitioned, the definition of the α-cut established a priori to activate fuzzy sets, an extended autocorrelation function to determine the order of the prediction model, a criterion of prediction errors to assess the accuracy of the estimated model, and significant sta-

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