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Electricity demand load forecasting of the Hellenic power system using an ARMA model

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ABSTRACT

Effective modeling and forecasting requires the efficient use of the information contained in the available data so that essential data properties can be extracted and projected into the future. As far as electricity demand load forecasting is concerned time series analysis has the advantage of being statistically adaptive to data characteristics compared to econometric methods which quite often are subject to errors and uncertainties in model specification and knowledge of causal variables. This paper presents a new method for electricity demand load forecasting using the multi-model partitioning theory and compares its performance with three other well established time series analysis techniques namely Corrected Akaike Information Criterion (AICC), Akaike's Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC). The suitability of the proposed method is illustrated through an application to actual electricity demand load of the Hellenic power system, proving the reliability and the effectiveness of the method and making clear its usefulness in the studies that concern electricity consumption and electricity prices forecasts.

1. Introduction

Load forecasting plays an important role in power system planning and operation. Basic operation functions such as unit commitment, economic dispatch, fuel scheduling and unit maintenance can be performed efficiently with an accurate forecast. Forecasting of electricity demand load is a recurrent, however not a routine, requirement in the management of utilities. Various degrees of sophistication exist in the available methods of forecasting, ranging from simple data extrapolation [1,2] and artificial intelligence techniques [3,4] to complex econometric models [5]. Recently new techniques for short-term load forecasting have been developed. In [6] a new algorithm for successful short-term forecasting is introduced by using a sample bispectrum in order to test whether the load data is Gaussian or not. In [7] a method for successful short-term load forecasting based on periodic time series analysis is proposed. Additionally the stationary properties of the estimated models are used in order to identify typical daily customer profiles of residential, business and industrial customers. The choice of a specific approach depends upon considerations such as the required quality of forecasts, availability of input information, ease of application and cost of adoption. Usually difficulties in forecasting occur due to multiple seasonality (corresponding to weekly and yearly seasonality), calendar effect (such as weekends and holidays), high volatility, etc.

This study addresses the problem of modeling and forecasting the electricity demand loads of the Hellenic power system. Firstly an appropriate deseasonalization of the provided electricity demand load data covering the period from January 1st 2004 to December 31st 2005 is conducted. Then an AutoRegressive Moving Average (ARMA) model is fitted (off-line) on this data using the Corrected Akaike Information Criterion (AICC). The developed model is shown to fit the data in a successful manner.

This model is used by four different estimation methods, a new method namely multi-model partitioning theory (MMPF), which is extensively presented in this paper, Corrected Akaike Information Criterion (AICC) [8], Akaike's Information Criterion (AIC) [9] and Schwarz's Bayesian Information Criterion (BIC) [10], in order to predict the electricity demand load for the period from January 1st 2006 to December 31st 2006. For every day in the test period an adaptive day-ahead prediction is adopted, meaning that instead of using a single model for the whole sample, for everyday in the

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