PREPARING AND ANALYSIS OF ELECTRICITY CONSUMPTION DATA FOR SHORT TERM PREDICTION

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ABSTRACT

This paper deals with analysis of power consumption values of The Czech Republic. This analysis is necessary to predict the future development. Electricity consumption depends on several factors and here are shown the most important of them. Another aim of this paper is to demonstrate possibilities of time-series analysis.

KEYWORDS

Prediction, time series, electricity consumption, ČEPS

1. INTRODUCTION

Electricity is a special commodity which is difficult to store. Production and consumption have to be equal every time. For these reasons, is necessary to know the quantity of electricity (consumption and production charts). For example: TSO buys major part of ancillary services for the year ahead. For purchase the required amount is important to know relatively precisely how much electricity will be produced and consumed. Basically all players in the electricity market have to know past and future development of consumption and production.

There are several prediction methods. Most of them work with data from previous periods and use the principle that history repeats itself. Analysis of this data is used to create a suitable model to understand the conditions and relationships which affect the development of these values. With this model we can predict the future development with certain accuracy.

2. DATA PREPARING

The transmission system operator CEPS publishes on its web sites "The Operation of the Transmission System", which includes instantaneous hourly values of production and consumption of the Czech Republic. Those data are available since 2006 and downloadable as Microsoft Excel tables. Electricity consumption depends on many factors. For this reason was the data set extended by the day type (work / weekends / holidays) and by the average monthly temperature for whole country. These temperatures were obtained from the website www.chmi.cz.

For the simple collection of necessary data was whole the data set imported into the database.

The analysis was implemented in MATLAB software and the necessary data were loaded in through database queries.

3. ANALYSIS OF CONSUMPTION

Hourly consumption values are time series. These can be analysed in several ways:
1. Decomposition of Time Series

2. Box-Jenkins methodology
3. Linear dynamic models
4. Spectral analysis of time series

This article focuses on identifying trends and dependencies in the data set. On the basis of that can be designed simple predictive model.

4. TRENDS IDENTIFICATION

4.1. Temperature dependence

To find the temperature trend we can approximate the power consumption progress with suitable curve. In the charts below you can see consumption and temperature curves for the year 2007 which was smoothed by bi-quadratic polynomial.

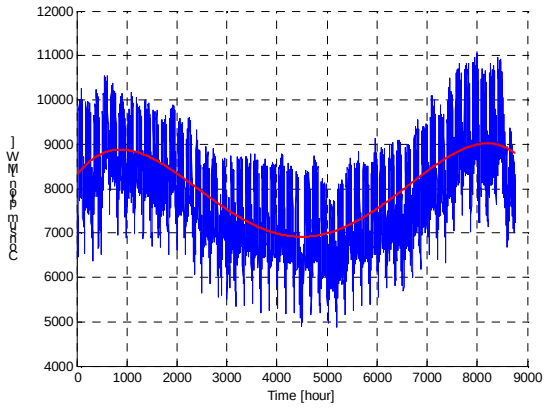

Figure 1 – Electricity consumption in 2007

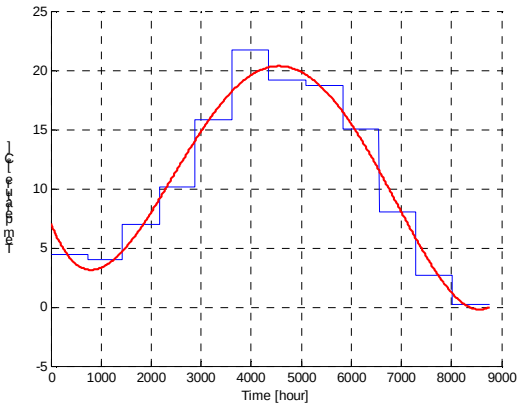

Figure 2 – Average monthly temperature in 2007

We can generally say that the electricity consumption is inversely proportional to the temperature. This situation is illustrated in the following charts. Electricity consumption is lowest in summer, which is caused not only by temperature, but also by holiday season (companies consume less electricity). Dependence of consumption on temperature is in this season relatively little in comparison with the winter months (heating period).

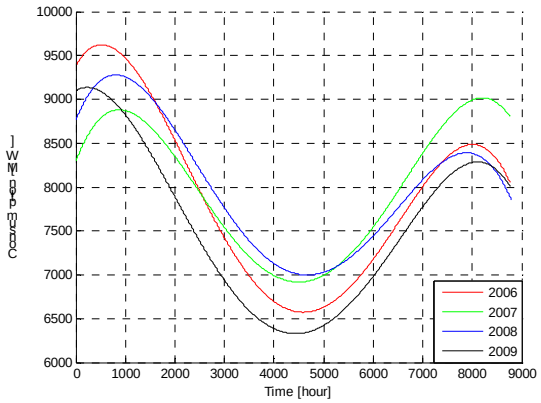

Figure 3 – Electricity consumption in 2006 – 2009

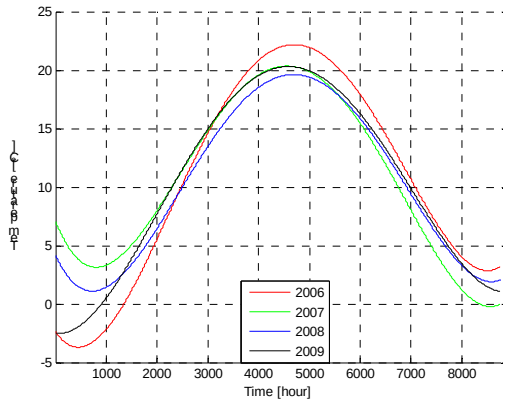

Figure 4 – Average monthly temperatures in 2006 – 2009

4.2. Dependence on the type of day

Basis for further analysis is to split the values according to the type of day. Subsequently, the average values of hourly consumption were calculated for all working and non-working days separately. Electricity consumption is strongly dependent on the type of day (working day / public holiday / weekend). These dependences are illustrated in Figure 6.

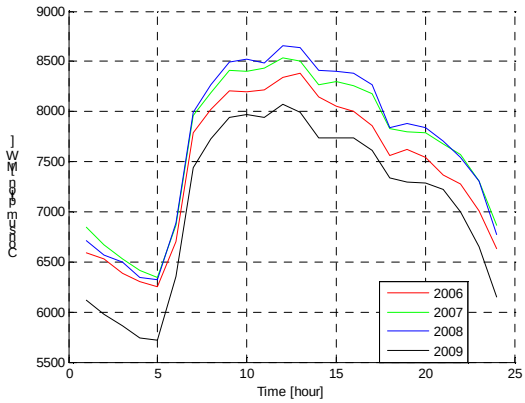

Figure 5 – Average hourly consumption for working June days in 2006 – 2009

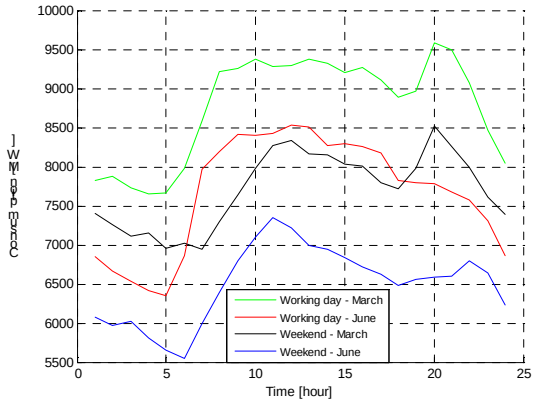

Figure 6 – Comparison of average hourly consumption for working day and public holiday in 2007

As you can see in figure 6 the difference between working day and weekend is more than 1000 MW. The consumption is also changing during the day. There is the first consumption peek around lunchtime and the second peak around 20 hours at the weekend. In summer, the second peak moves further into the evening hours because the sun shines longer.

5. PREPARING DATA FOR SHORT TERM PREDICTION

After subtraction of average hourly consumption from the monthly values we get stationary series for which we can find the autocorrelation function. Stationary series is shown in Figure 8.

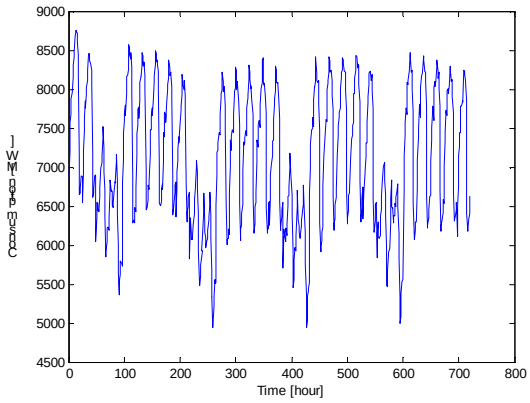

Figure 7 – Monthly electricity consumption in June 2006

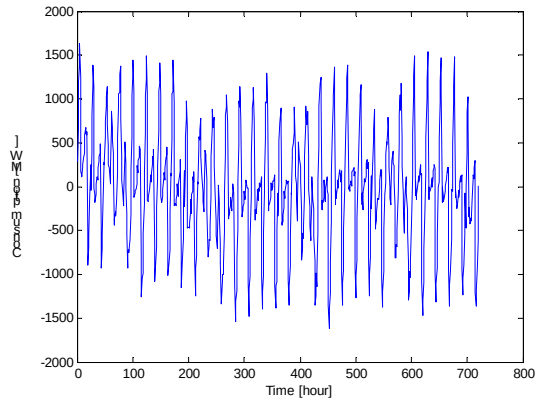

Figure 8 – Stationary series for whole month June 2006

6. CONCLUSIONS

This paper shows the preparation of appropriate data to predict future development. The issue of prediction is very extensive. Good quality of analysis and prediction requires good input data set. We have used hourly values of consumption and average monthly temperatures for the whole country in this paper. Sampling data was relatively raw; nevertheless we were able to identify trends and dependencies in this data set.

Electricity consumption is strongly dependent on weather changes, it would be suitable to extend the data set by accurate hour temperature values and time of cloudless during the day.

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