THE PREDICTION OF SALE TIME SERIES BY ARTIFICIAL NEURAL NETWORK

Abstract: *The article presents one of the methods of prediction of time series with the support of MATLAB program when Neural Network Toolbox is used. There are mentioned the steps of calculation. The setup of parameters plays a key role for correct prediction. The method of calculation can be used for any time series.*

Keywords: *Prediction, time series, calculation, MATLAB, Neural Network Toolbox*

1. Introduction

The article presents the steps of calculation of prediction of sell time series. The Neural Network Toolbox of MATLAB environment is used. The correct prediction is very complicated task because the components of time series in economy and financial are quite often stochastic and random. Therefore the prediction is very difficult and sometimes impossible, when the behaviour of time series is random. This is quite often case of time series on the stock market. A little better situation it is with sale time series. The sale time series include also deterministic components such as periodicity and/or tendency that are easy recognizable. It could be mentioned consumption or sell of some products, for example week periodicity is caused by behaviour of customers during the week, year tendency is caused by physical phenomena, Gompertz curve is caused by saturation of market, etc. These periodicity and tendency enable reasonable prediction. The case study is focussed on consumption of energy.


2. Used Methods

There are hundreds of methods for prediction of time series. The competitions are held where the best prediction is evaluated. The program MATLAB with Neural Network Toolbox is a strong tool for prediction. The steps of predictions are as follows: download of input and output time series, choice of the type of neural network, set up the number of layers, the number of neurons, transfer functions and some other parameters necessary for the calculation. When the neural network is build up, the process of learning and testing is necessary to run. After the calculation it is necessary to evaluate the results of prediction. The parameters of neural network are possible to change in case of bad prediction. The process of learning and testing is possible repeat several times and with changed parameters. When the prediction is correct, it could be used as a support for decision making for the setup of production plan. The results could be exported for graphical visualisation.

3. Case study

This case study presents the prediction of consumption of energy of a town, where the day and week periodicity is recognisable together with season tendency influence. The behaviour of people and weather could be evaluated as a chaotic. The input data are available at *input.csv* and output data for learning at *target.csv* file. The data are downloaded by orders

p=(load('input.csv'))';
t=(load('target.csv'))';
nntool

and the order *nntool* for opening neural network is called. The import of input time series is done by means of menu *Import* p *Input data Import OK* and output data by means of menu *Import* t *Target data Import OK*. See Fig.1.
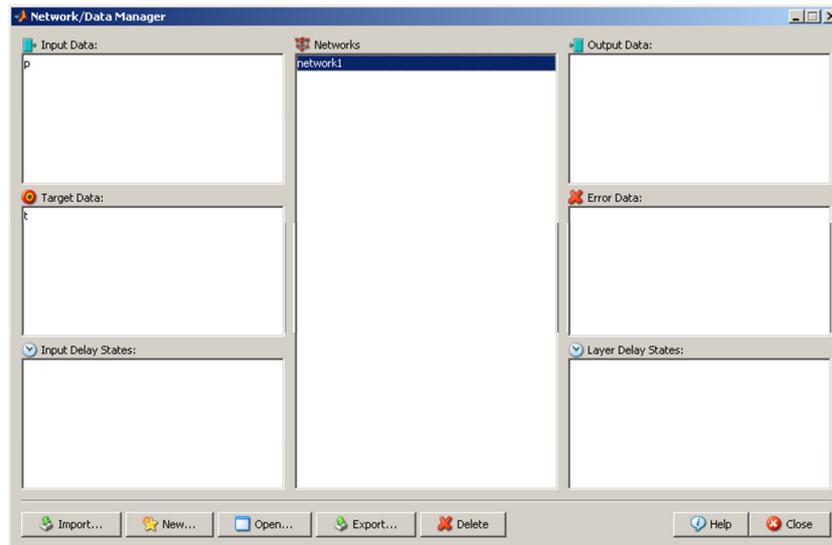
Fig. 1 Import of input and output time series

The order *New Create* displays the screen that enables to choose the type of neural network, the number of layers, the number of neurons, transfer functions and some other parameters necessary for the calculation. The process of build-up of neural network is done by order *Create*. See Fig.2.
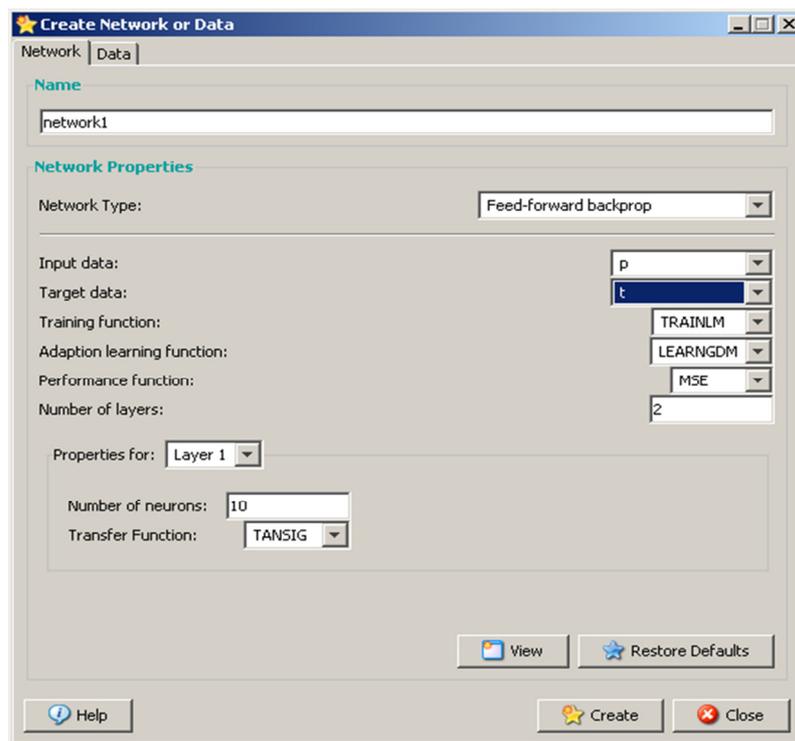
Fig. 2 The build-up of neural network

The neural network named *network1* must be trained. The procedure starts by order *Train-Train Network*. The process of training is presented in the window. After the process of training it is possible to use options for display graphs to evaluate the performance. See Fig. 3.
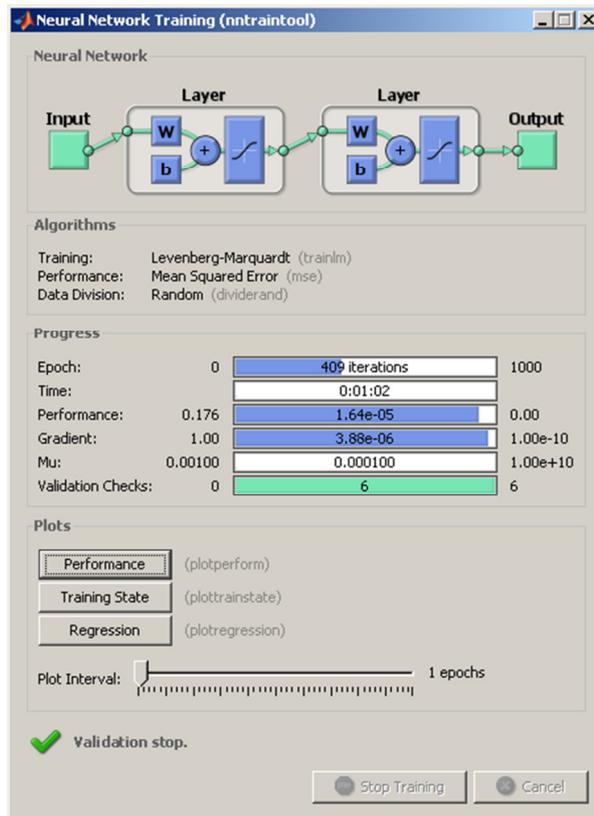
**Fig. 3** Displaying the process of training of neural network

When the neural network is trained and successfully validated, the data could be exported by the order *Export – network1 – Export OK – Close* for drawing of real and predicted values of time series. The graph is plotted by orders
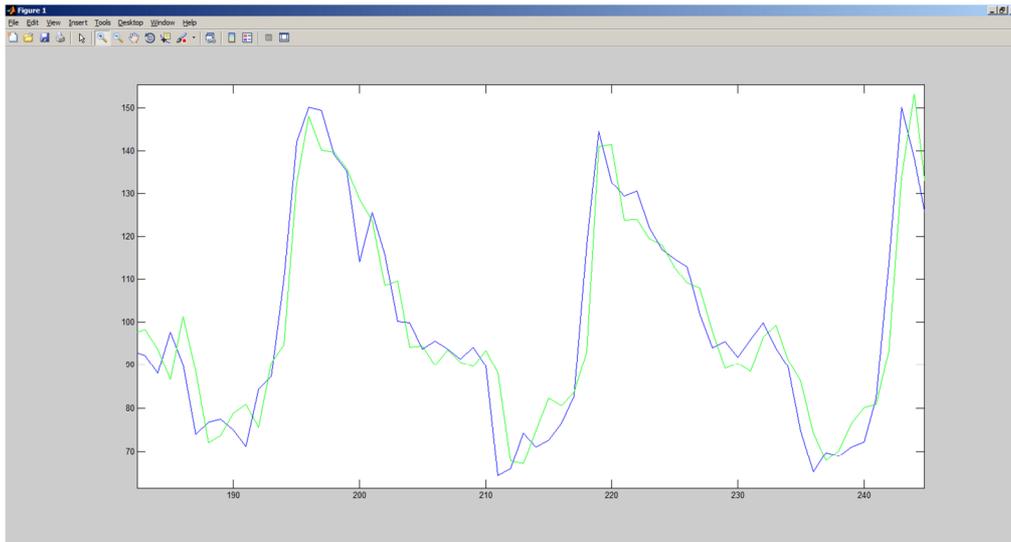
sim(network1,p);
plot(t)
hold on
plot(ans,'g').

The graph is presented at Fig.4. The graph presents a history of 350 samples and the next 50 samples of prediction. The fig.5 presents zoomed graph of prediction.
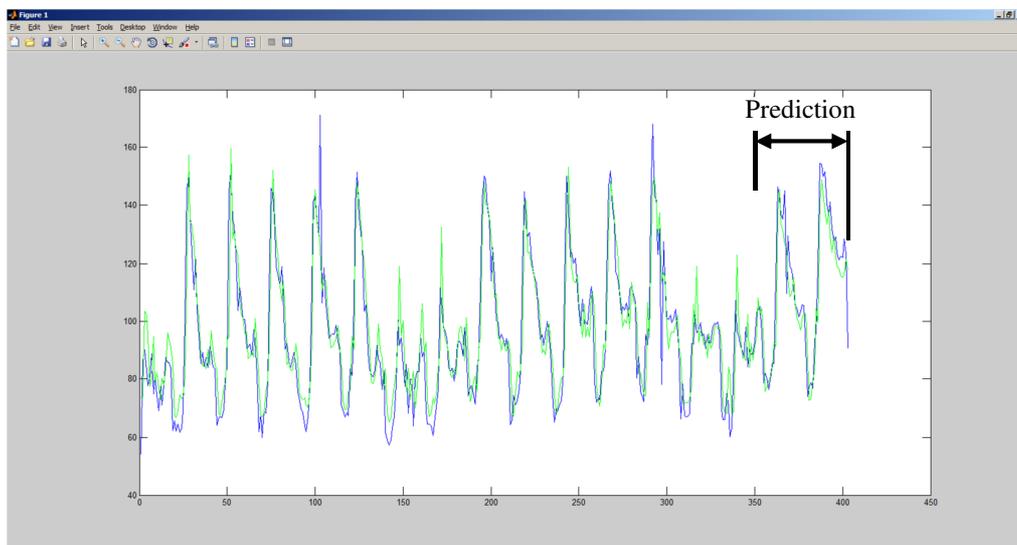
Fig. 4 Historical and predicted data of time series

Fig. 5 Zoomed graph of time series

5. Conclusion

The sale time series usually contains recognizable tendency and periodicity trends, therefore the predictions gives quite often useful information. The prediction supports right decision when production plan is prepared.