International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 4 Issue: 4 27 - 30

Price Forecasting using Artificial Neural Network

Roneda Mucaj
Department of Computer Science
University of Vlora "Ismail Qemali"
Vlore, Albania

Valentina Sinaj
Department of Applied Mathematics
University of Tirana
Tirana, Albania

Abstract— Artificial Intelligence, the oldest and best known research area which has the goal of creating intelligent systems, is revolutionizing every field. It is the key technology in many of today's applications. There are a lot of intelligent techniques which have different functions in real life. One of the main functions of these techniques is prediction. In this paper we see some of the artificial intelligence based methods which are adequate for prediction. One of them is neural network. It can be used for prediction with various levels of success. It is able to predict various types of data based on automatic learning of dependencies only from measured data without any further information. It is important to know how and when they are well suited for the problem. So we will take a look to this concept and we will concretize it with a real-life application. This application consists in a neural network used to predict prices of a market in our city. It shows one possible approach how one of the intelligent technique can be used for this kind of prediction.

Keywords—*prediction; intelligence methods; neural network; price series data*.

*****

I. INTRODUCTION

Intelligence systems are used to discover knowledge from data in an independent way, without human intervention. Based in their training process, they create data models. This system is able to generate its rules, modeling the data.

Intelligent systems need to develop successful intelligent behavior as successful traders who use market analysis combined with their knowledge and skills. Artificial intelligence can overcome some of the limitations of the human, such as a low coefficient of performance and low efficiency. The technique, which has been identified as the most dominant due to its high efficiency in the field of financial forecasting is artificial neural network. As part of the problem of forecasting financial market, price prediction can find solutions satisfactory enough trained through this intelligent system.

ANN are intelligent systems, able to adapt, to recognize patterns, to generalize and classify data. They are used to advise the financial markets in order to increase profits. It is necessary to learn structure of data to recognize patterns of data. Learning is achieved by providing set of entrance and exit links. Each link has a weight. ANN learns by adjusting the weights in order that the application of inputs produces the desired outcomes.

Using ANN in forecasting the price has a big impact on profit growth, if it is successful. Therefore, its use can be able to predict prices and are much more efficient than other systems. For this reason, we decide to use ANN to solve our problem.

Backpropagation neural network is the most widely used in financial time series forecasting. The Backpropagation algorithm was created using the learning rule, which updates and generates network weights in the opposite direction with performance function. Performance function is measured by the "mean square error" (MSE) - the average quadratic error between the network outputs and target outputs. This network can be used to approximate a general function and we can predict the future value based on that model.

II. STEPS OF DESIGNING A NEURAL NETWORK FORECASTING MODEL

A. Selection of variables

It is very important to understand the problem you need to solve. Raw data variables are more than necessary. Selection of key variables for predicting the market is very important. Frequency of data selection depends on the goals of the researcher.

B. Data collection

In data collection we should be considered their quality and cost. There are four issues that must be considered in this process: the method of calculation, the data that can not be modified, delays of the data and to make sure that the source will continue to give us data in the future.

C. *Preliminary data process*

Preliminary processing of the data is the process that helps the neural network in learning data models. Input and output variables, rarely, are placed raw on network. Preliminary processing of data is carried out to minimize noise, to highlight important relations to eradicate and destroy variable distributions, as well as to detect their trend. Raw data usually scaled in value from 0 to 1 or from -1 to 1,

so that their processing performs in accordance with the type of transfer function.

D. *Training, testing and evaluation data*

In general, the process performs the separation of incoming time series data into three groups called: training set, testing set and evaluation set. Training set is the largest set. It is used by neural network to train and learn the patterns of the data. Testing set is used to test network models so that the researcher can choose the model, which has the best performance. Testing set can be selected randomly by training set or it can be a set of data that follows immediately the training set. Evaluation set is used to make a final check on the performance of the trained network. It should be selected from the most recent data observations.

E. *Architecture of neural networks*

There are many ways to build a neural network. We have to determine the number of input neurons, hidden neurons, output neurons and transfer functions. Commercial ANN may contain three or four layers including one or two hidden layers. Each layer can have 10 to 1000 neurons. Experimental neural networks can have 5 or 6 layers including 3 or 4 hidden layers and containing millions of neurons, but most practical applications only use 3 layers, because each additional layer increases the number of calculations exponentially. Transfer function is to equilibrate results by not allowing them to get large value which can then disable the network. Most models use the sigmoid, tangential or linear function. Sigmoid function is usually used in time series data of financial markets, which are not linear and constantly changing.

F. *Evaluation of network*

Evaluation of neural network or performance measurement is performed based on the sum of squared errors. Selection of time series by eliminating many small changes in prices can grow the benefits. It is observed that neural networks can be more useful if the time series behave differently from traditional models of predictive methods.

G. *Training of neural network*

Neural network training process uses a training algorithm that adjusts weights to achieve a global error as small as possible. The process requires a number of examples with inputs and desired outputs. During training, the network weights fit to reduce network performance function. Training process stops when it has committed a specified number of epochs, or after a random number of cycles when it can not train anymore the neural network because of the overlapping. Overlapping occurs when it has been able to reduce the error excessively, but with the advent of a new value it grows.

The use of intelligent systems to predict financial markets also combines many other types of techniques to develop successful behavior, for example, different algorithms and network structures. There is no way to make a hundred percent accurate predictions, so management risk analysis based on expert knowledge is also required.

III. TIME SERIES PREDICTION

We present, in this section, a model designed to handle and predict time series with chaotic data. The presented model is responsible for the abstraction of the time variable generating patterns, statistically independent between them.

A time series is a sequence of scalars which depend on time t. This concept is heavily used in scientific fields like statistics and signal processing, but also in the context of financial analysis. Forecasting time series data is important component because it is the basis of decision models. Time series analysis is able to select a model which will be used to forecast future events. Time series models assume that observations vary according to some probability distribution of a function of time.

Neural networks have been applied to time-series prediction for many years. It is not the only way to use the time series analysis to obtain forecasts. It is often the expert judgment used to predict long-term changes.

Causal regression models try to predict dependent variables as a function of other correlated observable independent variables.

All forms of time series prediction are fundamentally the same. Given the data x=x(t) which varies as a function of time t, it should be possible to learn the function that maps x(t+1)=x(t). Let consider a date which varies in time. One approach is to sample x at regular time intervals to create a series of dates x(t-2), x(t-1), x(t) …. So we take these dates and present them as input for the network. The target value is x(t+1). Going through the time axis, the training set is formed. It means that if we give the last three samples we take the next value. After we have trained the network, we should present a new vector and predict the next value of it. Another way is to use the predicted value as part of the next input vector. This approach tends to diverge rapidly from the true pattern due to the accumulation of errors.

IV. APPLICATION

To illustrate the use of neural networks in prediction we used Neuroph framework. Neuroph is a Java Framework for the development of neural networks. Neuroph consists of Java library and a GUI editor called Neuroph Studio. We can do experiments with different architectures of neural network in Neuroph Studio and then use Neuroph library in Java to use these neural networks in Java programs

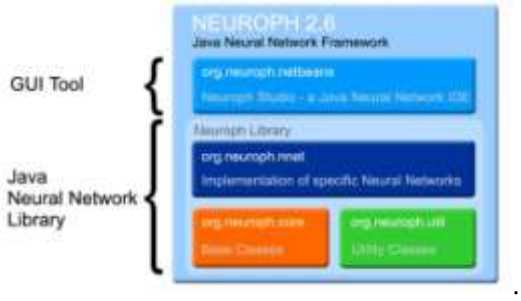

Fig 1. Framework diagram

Neuroph framework provides all the components of neural networks. Neural networks are used to predict the data, playing a key role in the economy. Pricing rates, as well as the consumption of different items, can be predicted in order to help the business in taking appropriate decisions. Our example shows how the neural networks are used to predict whether a market should buy or not different items.

We will train the network with the price data for some years (from June 2013 until February 2016) to predict the price for the month of March 2016. The strategy is: obtaining the sequence with observations data of 5 months to predict the sixth month. In the training set the sixth value is the supervised value.

The next step is the preliminary data process of the training data in area 0 to 1 or -1 to 1. For this process is needed to find the maximum and minimum value of prices: datamax, datamin. These values will be multiplied with 1.2 and 0.8 accordantly, to avoid small (0.0...) and big values (0.99...).

Further the topology of network is defined: what type of network, how many layers and how many neurons per layer are used. Actually, there is no rule for this, and usually it is determined experimentally. However the common type of network used for prediction is a MLP. A recommendation is to have 2n+1 nodes for hidden-layer, where n is the number of the input nodes. The output layer has only one node in this case.

Now we are ready to train the network and then to test it. As a test it is prepared data set in which the price data are given from the October 2015 to February 2016 in order to predict the value at March 2016.

The test results vary from one calculation to another, because the initial state of network is generated with random values of weights. After a certain number of epochs it manages to give a successful prediction.

The code of training:

```
TrainingSet<SupervisedTrainingElement> trainingSet = new TrainingSet<SupervisedTrainingElement>(4,1);
for (int i = 0; i < data.length - 5; i++) {

trainingSet.addElement(new SupervisedTrainingElement(new double[]{(data[i] - datamin) / datamax, (data[i + 1] - datamin) / datamax, (data[i + 2] - datamin) / datamax, (data[i + 3] - datamin) / datamax}, new double[]{(data[i + 4] - datamin) / datamax}));

 }
```

```
run:

77.77 76.85 77.25 79.15->81.23
76.85 77.25 79.15 81.23->82.04
77.25 79.15 81.23 82.04->83.46
79.15 81.23 82.04 83.46->85.71
81.23 82.04 83.46 85.71->88.25
82.04 83.46 85.71 88.25->88.42
83.46 85.71 88.25 88.42->88.4
85.71 88.25 88.42 88.4->87.54
88.25 88.42 88.4 87.54->87.02
88.42 88.4 87.54 87.02->87.25
88.4 87.54 87.02 87.25->86.7
87.54 87.02 87.25 86.7->85.73
87.02 87.25 86.7 85.73->85.38
87.25 86.7 85.73 85.38->86.96
86.7 85.73 85.38 86.96->88.17
85.73 85.38 86.96 88.17->88.56
85.38 86.96 88.17 88.56->86.77
86.96 88.17 88.56 86.77->82.85
Programi eshte duke trajnuar rrjetin, ju lutem prisni...    ->84.55
```

Fig 2. The forecasting process

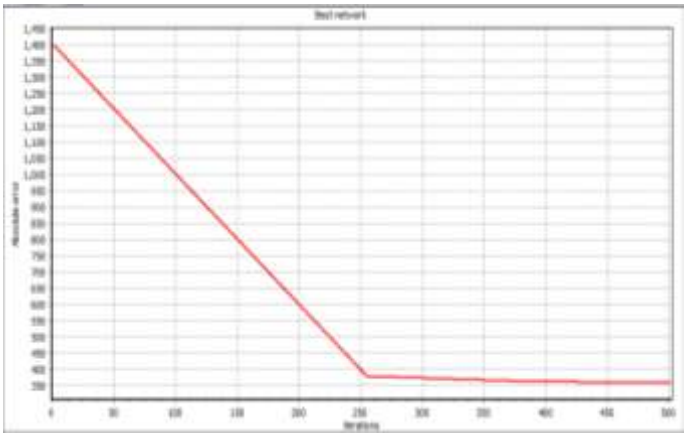

Fig 3. The performance of the error

CONCLUSIONS

Thanks to the increasing power of computers, new methods have replacing massive work of traditional statistical methods, taking a result equally or even better, but in a very short time. Artificial neural network are the most used intelligent systems in forecasting. Advantages of the use of neural networks in prediction model are: their ability to adapt to unfamiliar situations; autonomous learning and generalization; fault tolerant because of redundancies of network. Neural network offer several potential advantages rather than alternative methods, mainly ARIMA time series models, dealing with problems concerning nonlinear data which do not follow a normal distribution. The price data of our product in the short term shows high volatility making it difficult to predict its future value, but with this model significant improvement in the forecasting are achieved. The key element in the processing is the selection of input data and careful pre-processing. The input factors chosen for the price forecasting are the past price and demand data. We conclude for our price series data that the error is almost equal to zero in the test phase. These give a qualitative support to the non-linear ANN as a modeling method for price data.

REFERENCES

[1] A. Gupta, P. Chawla, S.Chawla, "Short Term Electricity Price Forecasting Using ANN and Fuzzy Logic under Deregulated Environment", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

[2] Rune Aamodt, "Using Artificial Neural Networks To Forecast Financial Time Series"

[3] Iebeling kaastra, Milton Boyd, "Designing a Neural Network for forecasting financial and economic time series"

[4] R. Mucaj, V. Sinaj, "Forecasting The Total Fertility Rate In Albania Using Neural Networks". Special Bulletin of Faculty of Natural Sciences. 2016

[5] R. Mucaj, A. Hyso, "ANN in financial prediction". International Conference on Business Technology and Innovation. 2013

[6] http://neuroph.sourceforge.net/Time%20Series%20prediction%20with%20Feed-Forward%20Neural%20Networks.pdf

[7] http://www.me.utexas.edu/~jensen/ORMM/supplements/units/time_series/time_series.pdf

[8] http://www.cs.cmu.edu/afs/cs/academic/class/15782-f06/slides/timeseries.pdf

[9] http://ruyramos.net/~ltorgo/AIFTSA/Proceedings/MM.pdf