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**APPLICATION OF NEURAL NETWORKS FOR PREDICTION
FINANCIAL TIME SERIES**

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Annotations: The article discusses some aspects and features of the use of neural networks for forecasting financial time series for the purpose of making a profit

Key words: neural networks, technical analysis, trading dynamics (prices and volumes), prices of the financial instrument under study.

Prediction of financial time series is a necessary element of any investment activity. The very idea of investing - investing money now in order to generate income in the future - is based on the idea of predicting the future. Any task involving the manipulation of financial instruments, be it currencies or securities, involves risk and requires careful calculation and forecasting.

The behavior of the market community has many analogies with the behavior of the crowd, which is characterized by special laws of mass psychology. The partial predictability of the market is due to the relatively primitive behavior of the players, who form a single chaotic dynamic system with a small number of internal degrees of freedom.

To successfully trade in the stock market, it is necessary to develop a game system, tested on the past behavior of the time series, and strictly follow this system, without being influenced by emotions.

As you know, there are two main approaches to market analysis: technical and fundamental. The first of them is based on the Dow theory, which is based on the axiom: “Prices take everything into account,” and accordingly the technical analyst uses only asset prices and various indicators (price functions). Fundamental analysis, on the contrary, looks for the relationship between asset prices, external events and data such as macroeconomic indicators and corporate financial statements, etc.

The use of neural networks as a complement provides a unique opportunity to combine these two methods. Such analysis, unlike technical analysis, has no restrictions on the nature of the input information. This can be either indicators of a given time series, or information about the behavior of other market instruments, or external events. Neural networks are actively used in the West by institutional investors (for example, pension funds and insurance companies) working with large portfolios, for which correlations between different markets are especially important [1].

Unlike technical analysis, based on general recommendations and experience of the trader, neural networks are able to build an optimal forecasting model, moreover, a model adaptive and changes with the market, which is especially important for modern highly dynamic financial markets, in particular the Ukrainian one.

The use of neural networks in finance is based on one fundamental assumption - the replacement of forecasting with recognition. The neural network does not predict the future; it “tries to recognize” a previously encountered situation in the current state of the market and reproduce the market reaction as accurately as possible.

For forecasting financial time series, it is possible to use multilayer perceptrons. The use of feedback networks in this case is inappropriate due to the difficulty of training such networks and the irrelevance of the main characteristic of feedback networks – short-term memory. It is necessary to determine what inputs to give to the network and what data to receive as output.

In general, network inputs reflect the dynamics of trading (prices and volumes)

for the instrument under study for some previous period of time. The output of the network is usually the change in the price of the financial instrument being studied in the future. This exit allows the player to make decisions about making transactions in the market.

Formation of neural network inputs. Even though predictions are extrapolations of data, neural networks actually solve the interpolation problem, which significantly increases the reliability of the solution. Prediction of a time series comes down to a typical problem of neuroanalysis - approximation of functions of many variables for a given set of examples using the procedure of immersing the series in multidimensional space.

For dynamic systems, the following Takens theorem has been proven. If the time series is generated by a dynamic system, that is, the values of X_t are arbitrary functions of the state of the system, then there is an immersion depth d (approximately equal to the effective number of degrees of freedom of a given dynamic system) that provides an unambiguous predicting the next value of a time series. Thus, by choosing a sufficiently large d , you can guarantee an unambiguous dependence of the future value of the series on its d previous values:

$$X_t = f(X_{t-d}),$$

that is, time series prediction reduces to the problem of interpolating a function of many variables. The neural network can then be used to restore this unknown function from a set of examples given by the history of the time series [2].

Although the prediction of financial series comes down to the problem of approximating a multidimensional function, it has its own characteristics both in the formation of inputs and in the selection of outputs of a neural network. Quite important is also the issue of assessing the quality of financial predictions to select and build the best strategy for training a neural network.

You should not choose the quote values themselves as inputs and outputs of the neural network (let's denote them C_t). What really matters for predictions are changes in quotes. Since these changes are usually much smaller in amplitude than the quotes themselves, there is a large correlation between successive exchange rate values - the

most probable exchange rate value at the next moment is equal to its previous value:

$$\langle C_{t+1} \rangle = \langle C_t + \Delta C_t \rangle = C_t + \langle \Delta C_t \rangle \approx C_t$$

To improve the quality of learning, one should strive for statistical independence of inputs, that is, the absence of such correlations. Therefore, it is logical to choose the most statistically independent quantities as input variables, for example, changes in quotes ΔC_t or the logarithm of the relative increment:

$$\log \left(\frac{C_t}{C_{t-1}} \right) \approx \frac{\Delta C_t}{C_{t-1}}$$

The use of the logarithm of the relative increment is successful for long time series, when the influence of inflation is already noticeable. In this case, simple differences in different parts of the series will have different amplitudes, since they are actually measured in different units. On the contrary, the ratios of successive quotations do not depend on units of measurement and will be of the same scale despite the inflationary change in units of measurement.

As a result, greater stationarity of the series will make it possible to use a larger history for learning and provide better learning.

A negative feature of immersion in the lag space is the limited “outlook” of the network, while technical analysis does not fix a window in the past and uses rather distant values of the series. For example, it is argued that the maximum and minimum values of the series, even in the relatively distant past, have a fairly strong impact on players' psychology and should therefore be predictive. An insufficiently wide window of immersion into the lag space is not capable of providing such information, which naturally reduces the effectiveness of prediction. On the other hand, expanding the window to such values when distant extreme values of the series are captured increases the dimension of the network, which in turn leads to a decrease in the accuracy of neural network prediction due to the increase in the size of the network [2].

An alternative way of encoding the past behavior of a series solves this problem. It is intuitively clear that the further into the past the history of a series goes, the less details of its behavior affect the result of predictions. This is justified by the

psychology of the subjective perception of the past by bidders, who actually shape the future. Consequently, the representation of the dynamics of the series must have selective accuracy - the further into the past, the fewer details - while maintaining the general appearance of the curve.

One of the alternative ways to encode a time series is to use as input data the values of technical analysis indicators over a relatively distant period of time and the values of exchange rate fluctuations in the current period.

Wavelet decomposition may also be a rather promising tool here. It is equivalent in information content to lagged immersion, but more easily allows for information compression that describes the past with selective accuracy.

Neural network training. When training neural networks intended for forecasting financial time series, a standard approach is used. The available examples are divided into three samples: training, validation and test. The training sample is designed to adjust the synaptic coefficients of the trained neural networks in order to minimize the error at the network output. The validation set is used to select the best of several trained networks and/or to determine when to stop training. The test sample, which was not used during the training process, serves to control the quality of prediction.

Error Function Selection. To train a neural network, it is not enough to create training sets of inputs and outputs. It is also necessary to determine the network's prediction error. The root mean square error does not make much "financial sense" for market series. For example, for choosing a market position, a reliable determination of the sign of the exchange rate is more important than reducing the standard deviation. Although these metrics are related, networks optimized for one of them will make worse predictions for the other.

The network error is represented as a function of synaptic coefficients and is minimized by one of the gradient methods. Traditionally, the root mean square error is used (the summation is performed over all outputs)

$$E = \frac{1}{2} \sum (y_i - d_i)^2,$$

where y is the output of the neural network;

d – desired output value.

The purpose of forecasting financial series is to obtain and maximize profits. Therefore, in forecasting financial series, what is important is not the proximity of the forecast to the true value (which is ensured by minimizing the root-mean-square error function), but the same directionality of the forecast and the true value. The function has this property

$$E = -\ln[1 + yd].$$

The error E is averaged over all examples of the training set, and the resulting value is used to adjust the synaptic coefficients [2].

Using the Neural Networks Committee. The use of different network architectures, the randomness of the choice of initial synaptic coefficients, as well as the use of other parameters that distinguish networks - all this leads to the fact that the predictions of different neural networks trained on the same examples vary, sometimes quite significantly.

Clearly “unsuccessful” network options are eliminated at the validation and testing stage. And more or less “successful” networks can be used together by organizing a so-called network committee, using the output values of all networks included in the committee to make decisions [2].

$$\left(\frac{1}{L} \sum_{i=1}^L \varepsilon_i \right)^2 \leq \frac{1}{L} \sum_{i=1}^L \varepsilon_i^2$$

where ε_i is the error of the i -th network in the committee;

L – number of networks in the committee.

Thus, it is preferable to use the average value of the outputs of the neural network committee to make a decision. Moreover, you can use not the average value of the outputs, but the weighted average.

The weights are chosen adaptively, maximizing the performance of the committee's predictions on the training set. As a result, the best networks will contribute the most, while the predictions of the networks that produce the worst results will contribute less and will not spoil the predictions.

Conclusion. The use of neural networks to analyze financial information is a promising alternative (or complement) to traditional research methods. Due to their adaptability, the same neural networks can be used to analyze several instruments and markets, while the patterns found by a player for a specific instrument using technical analysis methods may work worse or not work at all for other instruments.

The specificity of the research object imposes some features on the use of neural networks for data analysis. This feature is the choice of a neural network error function that is different from the traditional root mean square one. It should be noted that one of the important components of data analysis using neural networks is data preprocessing, aimed at reducing the dimensionality of network inputs, increasing the joint entropy of input variables and normalizing input and output data.

REFERENCES

1. Holland J.H. Adaptation in Natural and Artificial Systems. J.H. Holland, ed. University of Michigan Press, 1975.
2. Rafik A. Aliev, Bijan Fazlollahi, Rashad R. Aliev Soft computing and its applications in business and economics English. - Springer, Berlin, 2004.
3. Sharifa Rajab, Vinod Sharma Neuro-fuzzy approach in business applications: a decade survey //International Journal of Business Information Systems Vol. 26, No. 4 Copyright, 2017 Inderscience Enterprises Ltd.
4. Nick Bostrom. SuperIntelligence: Paths, Dangers, Strategies. Oxford University Press, 2014.
5. Ramon Lawrence. Using Neural Networks to Forecast Stock Market Prices / Ramon Lawrence. – Department of Computer Science : University of Manitoba.