MODELING NEURAL NETWORK FOR STOCK PRICE FORECASTING

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Numerous observations of financial markets have shown the inconsistency of assumptions about the rationality of investors and the information efficiency of markets to the real conditions that exist in some cases. In this regard, the construction of new models for forecasting the development of financial markets, systematization and selection of key features of the dynamics of real capital markets becomes relevant.

Artificial neural networks are a computer system with a huge number of parallel simple processors with many connections.

Areas of application of neural networks are quite diverse - it's text and speech recognition, semantic search, expert systems and decision support systems, stock prediction, security systems, text analysis.

One of the most complex and in-demand capabilities of neural networks is forecasting. After all, it is the most important element of modern information technology decision-making in management. The effectiveness of a management decision is assessed in relation to events that occur after its adoption. Therefore, forecasting uncontrolled aspects of such events before making a decision allows you to make the best choice, which, without forecasting, could not be so successful [1].

Possible forecast values for such systems are profitability and price indicators: weighted average price, closing and opening prices, maximum and minimum prices. In addition, it is possible to forecast both the indicators defined for the whole group of instruments or a certain market as a whole, and the indicators defined for only one instrument of the financial market.

Determining for a given market or instrument a predicted value and a set of influencing factors (and data directly stored in a database may not always be used, some data transformations often need to be made: for example, relative changes in values are often used as such factors).

They are actively used where conventional algorithmic solutions are ineffective or impossible. The practice of using neural networks has shown their applicability in such areas as forecasting, dependency detection, situational management. All this can be applied in financial markets [2].

There are many types of neural networks that differ in the number and location of neurons and synaptic connections. For the purpose of making predictions for the financial market it is important for the network to be able to sift thru time series of data with possibility of serious lags between important events, because of the that, the network type that was chosen was long short-term memory (LSTM).

LSTM type neuron models could mathematically be described like this [3]:

$$f_t = \sigma_g\left(W_f x_t + U_f h_{t-1} + b_f\right) \quad (1)$$

$$i_t = \sigma_g(W_i x_t + U_i h_{t-1} + b_i) \quad (2)$$

$$o_t = \sigma_g(W_o x_t + U_o h_{t-1} + b_o) \quad (3)$$

$$\tilde{c}_t = \sigma_c\left(W_f x_t + U_f h_{t-1} + b_f\right) \quad (4)$$

$$c_t = f_t \circ c_{t-1} + i_t \circ \tilde{c}_t \quad (5)$$

$$h_t = o_t \circ \sigma_h(c_t) \quad (6)$$

Where W – are weights

U – are recurrent connections where the subscript $_q$ can either be input gate $_i$, output gate $_o$, the forget gate f or the memory cell $_c$.

x_t – input vector

f_t – forget vector

i_t – input/update gate vector

h_t – LSTM output vector

c_t – cell state vector

σ_g – sigmoid activation function

σ_c – hyperbolic tangent activation function

σ_h – hyperbolic tangent activation function or in the peephole design $\sigma_h(x)=x$

The practical application of LSTM network to predict important indicators of stock market – stock price itself – can be carried out by analyzing time series of Apple stock for the September of 2021[4]

It is known that for input and output parameters of the neural network, you should not choose the values of quotes themselves.

Their changes are really significant for forecasting.The network was built utilizing 7 input neurons, 100 hidden (including memory cells) and 1 output neuron.

The input neurons are fed closing prices in chronological order. The rarefication of coefficient characterizing change of weights of neurons during network training is equal to 15. For this time series (Apple stock), 700 data on quotes were selected so that the accuracy of artificial neural network was within acceptable range. Obtained forecast results are shown on the Fig.1

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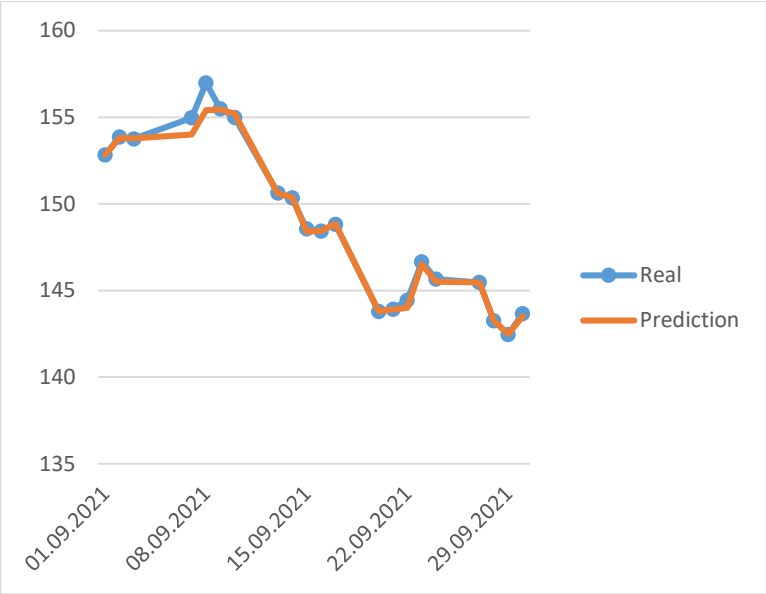

Figure 1 Actual and forecasted values for the Apple stock prices September 2021

that neural networks can be used with the same if not more success as traditional market prediction methods.

In general, the forecast accuracy in this experiment is high enough for making decisions however, the result still can be improved further by careful preparation of input data, incorporation of additional factors as input data and more meaningful economic indicators.

References

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Анотація

Розглянуто можливість використання штучної нейронної мережі для прогнозування ціни акції. Було побудовано та обучено штучну нейронну мережу типу LSTM. Прогноз нейромережі типу LSTM ціни акції Apple було порівняно з фактичними значеннями ціни.

Ключові слова: нейронні мережі, фондовий ринок, акції, LSTM.

Аннотация

Рассмотрена возможность использования искусственной нейронной сети для прогнозирования цены акции. Была построена и обучена искусственная нейронная сеть типа LSTM. Прогноз нейросети типа LSTM цены акции Apple был сравнен с фактическими значениями цены.

Ключевые слова: нейронные сети, фондовый рынок, акции, LSTM.

Abstract

The possibility of using an artificial neural network to predict the share price is considered. An artificial neural network of the LSTM type was built and trained. The forecast of the LSTM network of Apple's share price was compared with the actual price values.

Key words: neural networks, stock market, stocks, LSTM.