

# VERIFICATION OF DATA FOR THE IMPLEMENTATION OF THE FORECAST OF DOLLAR USING ARTIFICIAL NEURAL NETWORKS.

The moving average method with the 4 samples window width is used to raise the weekly forecast of the US dollar exchange rate accuracy. The non-iterative artificial neural network with the radial basis functions is used for. In the end we got the forecast error less than 1%.

**Keywords:** ANN, prediction, forecasting, moving average, US dollar

## Introduction

In a market economy the problem of forecasting are becoming increasingly important because of its instability. Without reliable forecasting exchange rates, particularly the dollar, stable operation is not possible any enterprises and institutions. Various businesses are often in dire need of obtaining reliable information on future status of exchange rates both in the short and medium term. The most relevant are short-term forecasts of currencies, the results of which can be used to offset changes in the company that is in the mode of "on-line".

The underlying reasons are constant fluctuations in the international currency market. In complex systems by implementing forecasting the dollar are the following problems: a large number of factors that affect exchange rates; no unambiguous analytical dependencies between input and output parameters of models and significant uncertainty between parameters that affect them. This determines considerable complexity problems associated with forecasting the dollar in Ukraine [1,2].

The use of artificial intelligence, including artificial neural networks, greatly improving the accuracy of forecasts of exchange rates. The entry of Ukraine into European structures, and its active participation in the global financial and foreign exchange markets constantly increases the reliability requirements for the forecast. This will greatly enhance the effectiveness of the economists forecasting of certain economic processes.

## Description of the algorithm

The statistical information on the exchange rate is taken from the site of the Ministry of Finance (minfin.com.ua/currency/nbu/usd/) by 2015. Upon learning these statistics were found lost data. Since the dollar lost value are rare mainly on weekends and public holidays and their maximum number in a row is not more than 4, then take them as data with low probability of occurrence. So build a histogram coherent averaging method [3] for the evaluation of the process and the expectation of the location of seats lost data.

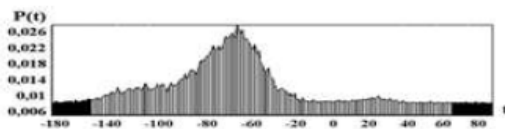


Fig. 1. centered histogram signal (light area - signal of lost data)

To estimate the variance signal  $\overset{\circ}{X}_i$  centered histogram method was used. Estimated variance estimation was made

half-width  $P\left(\overset{\circ}{X}_i\right)$  in the probability density distribution

$$P\left(\overset{\circ}{X}_i\right) = \frac{P(X_m)}{2}$$

point. On the horizontal axis postponed most likely value, and the vertical axis (see. Fig. 1).

Experimentally it was found that the assessment of the probability density distribution of the signal  $\overset{\circ}{X}_i$  is not symmetrical relative  $X_m$ . Therefore defectives considered data  $\overset{\circ}{X}_i \notin [X_m - k_1\hat{\sigma}, X_m + k_2\hat{\sigma}]$ , where  $k_1 = 2$ ,  $k_2 = 3$  which were chosen coefficients experimentally.

For predict the dollar chosen of artificial neural network (ANN) iterative type with radial basic functions developed by Tkachenko R. O. [4]. The main advantage of this neural network is a high speed and high precision studies carried of forecasts. Software implementation of the network is the integrated automated system (AIS) "Forecast" [5, 6]. This program incorporated a large number of statistical and neural networks methods of verification data.

Localize of space necessary to replace the data because there is no value in predicting the result using ANN reduced to a large rms value range error. So try to use different methods for data validation to improve the accuracy of forecasting the dollar per week.

### Results of research

Most banks fix the exchange rate on weekends and public holidays. Will replace your lost data revealed of last existing value and will try to predict the dollar a week.

Table.1

Method	Number of weeks for training	Number of hidden layer neurons	Training		Forecast	
			SQR %	SQR MAX %	SQR %	SQR MAX %
Moving average with replacement and last existing values	20	6	0,01	0,03	0,01	0,03
	19	5	0,01	0,03	0,02	0,03
	18	5	0,01	0,03	0,01	0,03
	17	5	0,01	0,03	0,01	0,03
	16	6	0	0,02	0	0,02
	15	6	0	0,02	0	0,02
	14	6	0	0	0	0
	13	6	0	0,01	0	0,01
	12	5	0	0,01	0	0,02
	11	6	0	0	0	0,02
	10	6	0	0	0	0,02
	9	6	0	0	0	0,02
	8	5	0	0	0,01	0,03
	7	5	0	0	0,02	0,07
	6	5	0	0	0,38	1,01
	5	4	0	0	0,37	0,91
	4	3	0	0	5,15	11,5
3	3	0	0	5,57	11,1	
2	2	0	0	4,8	8,32	

Table 1 presents the results of research on the verification of input data by replacing the existing values from last database in the dollar Ukraine Ministry of Finance website. To assess the accuracy of prediction adjusted to take rms value range error learning (SQR training) and its maximum value for all the outputs of ANN (SQR MAX training) expressed as a percentage. Also brought to the rms value range prediction error (SQR forecast) and its maximum value for all the outputs of ANN (SQR MAX forecast) expressed as a percentage. The accuracy of prediction is satisfactory (SQR forecast = 0.01% ÷ 0.37%, SQR MAX forecast = 0% ÷ 0.91%), but revealed the need for a significant amount of statistical data, namely 5 weeks. ANN is also particularly sensitive to sharp changes in the dollar.

Table2

Method	Number of weeks for training	Number of hidden layer neurons	Training		Forecast	
			SQR %	SQR MAX %	SQR %	SQR MAX %
Moving average of three points	19	6	0,02	0,08	0,02	0,08
	18	6	0,02	0,09	0,02	0,09
	17	6	0,02	0,08	0,02	0,09
	16	6	0,02	0,06	0,02	0,06
	15	6	0,02	0,06	0,02	0,06
	14	6	0,01	0,03	0,01	0,03
	13	6	0,01	0,04	0,01	0,04
	12	6	0,01	0,02	0,01	0,02
	11	6	0,01	0,03	0,01	0,03
	10	6	0	0,02	0,01	0,05
	9	6	0	0	0,02	0,06
	8	4	0,03	0,07	0,07	0,22
	7	4	0,04	0,08	0,08	0,22
	6	4	0	0	0,09	0,25
	5	3	0	0	0,12	0,31
	4	3	0	0	0,76	1,71
3	3	0	0	1,62	3,24	
2	2	0	0	10,1	17,5	

In Table 2 presents the results of research by smoothing the input of method moving average on three points. The accuracy of prediction is satisfactory (SQR forecast = 0.01% ÷ 0.76%, SQR MAX forecast = 0.2% ÷ 1.71%) and reduced the need for a significant amount of statistical data. Sufficient for the accuracy of the forecast 2% only 4-week training set. ANN also become less sensitive to abrupt changes in the dollar.

Table.3

Method	Number of weeks for training	Number of hidden layer neurons	Training		Forecast	
			SQR %	SQR MAX %	SQR %	SQR MAX %
Moving average by four points	20	6	0,04	0,1	0,04	0,1
	19	6	0,03	0,07	0,03	0,07
	18	6	0,02	0,07	0,02	0,07
	17	6	0,02	0,07	0,02	0,07
	16	4	0,17	0,45	0,16	0,45
	15	6	0,03	0,09	0,03	0,09
	14	6	0,03	0,1	0,03	0,1
	13	6	0,02	0,05	0,03	0,06
	12	6	0,01	0,03	0,02	0,09
	11	6	0,01	0,04	0,03	0,09
	10	6	0,01	0,02	0,02	0,07
	9	6	0	0,01	0,02	0,07
	8	5	0	0,01	0,04	0,13
	7	5	0	0	0,04	0,13
	6	5	0	0	0,03	0,09
	5	4	0	0	0,06	0,16
4	5	0	0	0,38	0,87	
3	3	0	0	1,21	2,43	
2	2	0	0	9,26	16	

In Table 3 presents the results of research by smoothing the input method moving average by four points. Increased forecast accuracy (SQRprohn = 0.02% ÷ 0.38%, SQR MAXprohn = 0.13% ÷ 0.87%), the need for a significant amount of statistics remained same as for previous studies. Sufficient for the accuracy of the forecast only 1% 4-week training set. Also ANN even less sensitive to abrupt changes in the dollar.

Table.4

Method	Number of weeks for training	Number of hidden layer neurons	Training		Forecast	
			SQR %	SQR MAX %	SQR %	SQR MAX %
Moving average by five points	19	6	0,06	0,12	0,06	0,12
	18	6	0,04	0,08	0,03	0,08
	17	6	0,04	0,08	0,03	0,08
	16	6	0,03	0,06	0,02	0,06
	15	6	0,02	0,06	0,02	0,06
	14	6	0,03	0,07	0,02	0,07
	13	6	0,01	0,03	0,01	0,03
	12	6	0,01	0,03	0,01	0,03
	11	6	0,01	0,03	0,01	0,03
	10	6	0,01	0,03	0,01	0,03
	9	6	0	0	0	0,01
	8	6	0	0	0	0,01
	7	6	0	0	0,01	0,05
	6	6	0	0	0,11	0,29
	5	3	0	0	0,07	0,18
	4	3	0	0	0,26	0,6
3	3	0	0	1,66	3,32	
2	2	0	0	1,3	2,26	

In Table 4 presents the results of research moving average of five points. Increased forecast accuracy (SQR forecast = 0% ÷ 0.26%, SQR MAXprohn = 0.01% ÷ 0.6%), the need for a significant amount of statistics remained same as for previous studies. Sufficient for the accuracy of the forecast to just 0.6% 4-week training set. Also ANN even less sensitive to abrupt changes in the dollar, but more sensitive to the length of the training set.

Therefore, the optimum length of the window for data validation method moving average for the further use of neural prediction is four points. To forecast applied IAS "Weather". The results of the forecast of the dollar IAS "forecast" for all Monday to verified data shown in Figure 2.

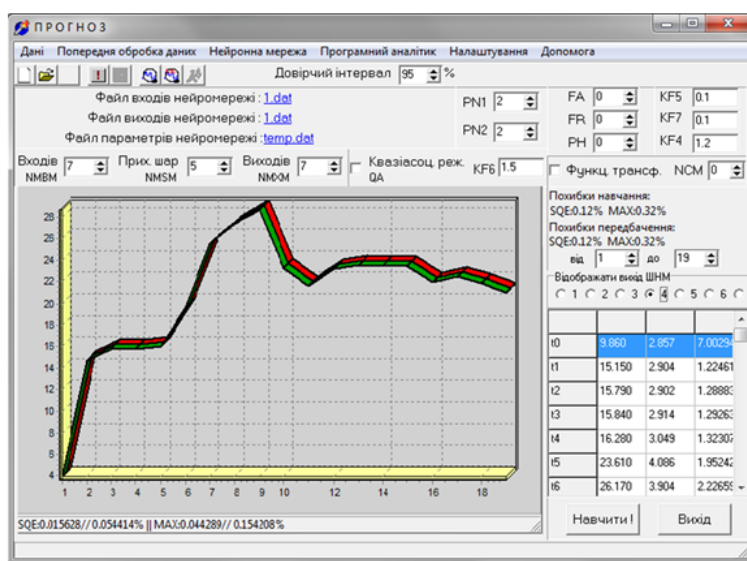


Fig. 2 The results of the forecast of the dollar IAS "forecast" for all Monday to verified data by method of moving average by four points

Result of forecast of dollar per week for verified data shown at Figure 3.

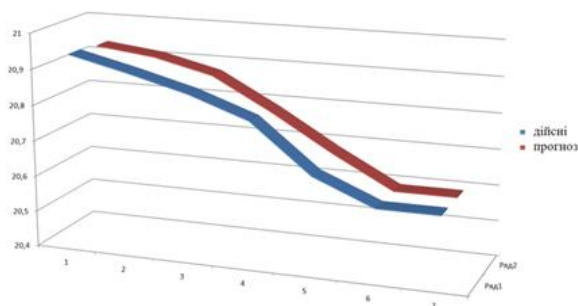


Fig. 3 Result of forecast of dollar per week for verified data.

### Conclusion

An attempt was made macroeconomic forecasting of exchange rate in Ukraine. The exchange rate is the price at which the currency of one country in the currency expressed in units of other countries. Forecasting the exchange rate - a complex of multi task. It is difficult and sometimes impossible to determine a clear dependence parameters. A large number of parameters affecting prognosis has a high degree of uncertainty.

Fixing the exchange rate are making or guaranteed under the gold content of the national currency, or international agreement. In the classical gold standard, that is with the free convertibility of currencies into gold at the central bank, the exchange rate determined in proportion to their gold content. For currencies, including the dollar, based on the exchange rate is parity. Since, exchange rates almost never coincide with their currency parties. To build a clear and accurate mathematical model for predicting the dollar is very complicated task. Using ANN apparatus is justified for this type of problems as they can keep track of complex dependencies parameters, to clustering of data and reduces the dimension of space data.

The accuracy of prediction is carried out using ANN great influence with of reliable statistics. As in the existing database statistics are missing dollar value, so it is necessary to carry out verification. To make accurate from short-term forecast with satisfactory accuracy necessary to use the method of moving average width of the window in four points. This method gave accurate forecast of the dollar in one week with a maximum, when the neural network reduced to the range of mean values of error less than 1%.

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