

Developing a AI Algorithm for Trading the SiH8 Futures Contract at MoEx on the Basis of Big Data Quantization

N. I. Lomakin

Volgograd State Technical University,
Faculty of Economics and Management
Volgograd, Russia
tel9033176642 @ yahoo.com

S. P. Sazonov

Volgograd State Technical University
Faculty of Economics and Management
Volgograd, Russia
sikaterina@mail.ru

Y. G. Onoprienko

Volgograd State Technical university,
Faculty of Economics and Management
Volgograd, Russia
helenderbet@mail.ru

Abstract— Solving the problem of sustainable regional development by using a neural-network stock trading algorithm is of importance. Analysis has shown many businesses successfully use the stock market mechanisms not only to invest their temporarily disposable assets in securities portfolio, but also for speculation. Research has shown that in the modern world, the ever-larger bulk of stock exchange transactions are done by using mechanical trading systems (trading robots). AI-based systems stand out of mechanical trading systems. Our effort has produced a neural-network trading algorithm for speculative stock transactions with the SiH8 futures contract in USD. The developed neural network is a perception that has an six-parameter input layer, a hidden layer, and a single-parameter output layer that tells the user to either buy (+1) or sell a financial instrument. In the light of transition to digital economy, it is important to use artificial intelligence systems that enable big data processing for pattern-based problem solving.

Keywords— sustainable development, speculative stock transactions, perceptron, neural-network algorithm, digital economy

I. INTRODUCTION

When creating a digital economy in the light of market uncertainty and all kinds of risks being amplified, it is important to broadly use artificial intelligence to solve the problem of sustainable regional development. Today, sustainable regional development can be attained by improving the financial sustainability of selected enterprises of a region as a system. Analysis has shown that successful stock trading may be a factor of obtaining liquidity. Many businesses successfully use the stock market mechanisms not only to invest their temporarily disposable assets in securities portfolio, but also for speculation.

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trading systems (trading robots). AI-based systems stand out of mechanical trading systems.

What makes this study relevant is the ever greater importance of using innovations, including AI-based developments, and big data processing results as an important direction of sustainable regional development in order to stabilize the business profitability, which is what determines the practical importance of this research effort.

Experience has shown that the problem of dynamic sustainable regional development is a complex, multifaceted, and multi-aspectual problem. As is known, the problem of reaching the liquidity of stock transactions is nothing new and carries a great risk. Some authors have researched into some aspects of this problem. N.I. Lomakin viewed stock transactions as a factor of growth in the investment activity of real-economy businesses [1]; he also studied the use of stock trading robots in an information society. [2]

A research team led by S.P. Sazonov has studied some aspects of sustainable regional development from the standpoint of using the opportunities of university-provided financial management. [3] From the standpoint of A.A. Polyanskaya, the competitive advantages of a regional university can be seen as factors supporting the regional development strategy. [4] N.I. Lomakin and Ye.V. Loginova analyzed the prospective use of fuzzy algorithms and artificial intelligence in risk management pertaining to the financial system of the Single Economic Space (SES) [5]. V.A. Ekova, O.N. Maksimova, and N.I. Lomakin proposed a systematic approach to enhancing the toolset that governs sustainable regional development. [6]

The financial sector is the most important aspect of sustainable regional development. However, its main parameter, i.e. the uncertainty factor and financial risk assessment requires further research. Russian scientists, we believe, have achieved the most in this respect. For instance,

V.A. Vasilyev, A.F. Lyotchikov, and V.Ye. Lyalin proposed using real options as risk assessment and hedging tools for businesses in the real sector of economy. [7]

For the purpose of risk assessment and minimization, some non-Russian researchers have proposed using a wide range of tools of financial mathematics, including quantile hedging, minimum deficit risk hedging, as well as optimal quadratic hedging. [8]

Use of the Green City budget optimization NN-based algorithms for attaining sustainable regional development, particularly that of the town of Volzhsky, was covered in papers by V.A. Kabanov and L.N. Medvedeva. [9] It is important to study the dynamics of stock-exchange financial instruments.

The time series of quotes of the SiH8 futures contract in USD features is moderately volatile on a 15-minute time frame at MoEx, see Figure 1.



Figure 1. The time series of quotes of the SiH8 futures contract in USD on a 15-minute timeframe.

Application of predictive modelling to assess the investment attractiveness of regions based on data quantization was studied by A.F. Moskvovtsev, A.F. Kopylov, I.A. Samorodova, and S.P. Sazonov. [10] K.S. Dontsova and Yu.A. Chebotareva developed a neural-network model to plan the budget revenue of an urban district. [11]

External factors including the value of the dollar to the ruble do affect the company's financial results. It seems useful to identify patterns by means of big data quantization, i.e. the time-series parameters of the price of the SiH8 futures contract, so as to generate a set of input factors for the neural network.

II. SIH8 FUTURES PURCHASE/SALE DECISION PERCEPTION

A. Creating the AI

It is hypothesized that artificial intelligence could be used to generate an algorithm to decide whether to purchase or sell the SiH8 futures contract in USD on a 15-minute time frame, which algorithm could ensure a yield above that of risk-free instruments like Federal Bonds (FB). The yield to the maturity of 2nd-issue FBs offered in September 2017 is 8.48% per annum.

We use Deductor to find certain patterns on the basis of processing big data by quantization of the time-series parameters of SiH8 in USD; these patterns were used in the neural-network model, see Figure 2.

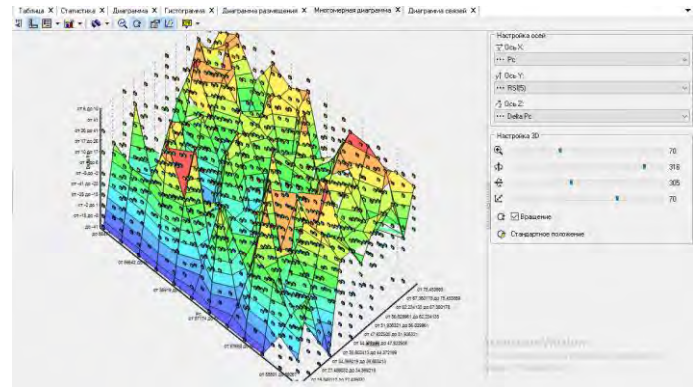


Figure 2. SiH8 USD futures contract data quantization results

The data thus obtained indicated there existed certain correlations of the analyzed factors, such as the closing price I_c , the trading volume V , the upper Bollinger band value $SIG(h)$, the lower BB value $SIG(l)$, the relative strength index on 5 intervals $RSI(5)$ and ΔPc

Bollinger bands are a tool for technical analysis of the financial markets; it indicates the current deviations in the price of a share, a commodity, or a currency. The indicator is based on the standard deviation σ from the simple moving average. It can be displayed both on top of the price curve or below it.

The input parameters of the model are shown below in Figure 3.

	Pc	V	SIG(h)	SIG(l)	RSI(5)	Delta Pc		
01/07/17 09:00	57785	48945	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 09:00
01/07/17 09:15	57785	35740	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 09:15
01/07/17 09:30	57785	34266	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 09:30
01/07/17 09:45	57785	129880	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 09:45
01/07/17 10:00	57785	92362	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 10:00
01/07/17 10:15	57785	38229	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 10:15
01/07/17 10:30	57785	37738	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 10:30
01/07/17 10:45	57785	25097	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 10:45
01/07/17 11:00	57785	55209	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 11:00
01/07/17 11:15	57785	51405	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 11:15
01/07/17 11:30	57785	104142	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 11:30
01/07/17 11:45	57785	62698	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 11:45
01/07/17 12:00	57785	51540	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 12:00
01/07/17 12:15	57785	46632	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 12:15
01/07/17 12:30	57785	46599	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 12:30
01/07/17 12:45	57785	68617	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 12:45
01/07/17 13:00	57785	62954	57315.29324	57584.43682	57048.54342	57410.84269	75.453668	01/07/17 13:00
01/07/17 13:15	57785	77591	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 13:15
01/07/17 13:30	57785	68221	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 13:30
01/07/17 13:45	57785	76385	57584.43682	57785.97371	57048.54342	57410.84269	75.453668	01/07/17 13:45

Figure 3. Data quantization-based parameters group snippet

RSI is the technical indicator capable of detecting the weak zones in the current price flux. The relative strength index is an oscillator. The relative of this strength is reflected by the RSI via the rate and amplitude, at which the price movement alters itself. Such rate and amplitude may also be referred to as the momentum.

The ultimate goal is to predict the trend in the closing price (Pc) curve after it alters the direction at the moments when the market is "oversold" or "overbought". Thus, if the RSI line is above 70%, it means the price has been growing, the asset has been being actively purchased, and price entered the overbought zone, and the market reversal is nigh. The RSI indicates that this long position must be closed, —*short* (a short position must be opened). It is exactly a vice-versa transaction that must be done when the market is oversold, as the RSI falls below 30%.

Based on the analysis of parametric dynamics, we generate the “rules” of a simple neural network and create a neural-network model, a perceptron, see Figure 4.

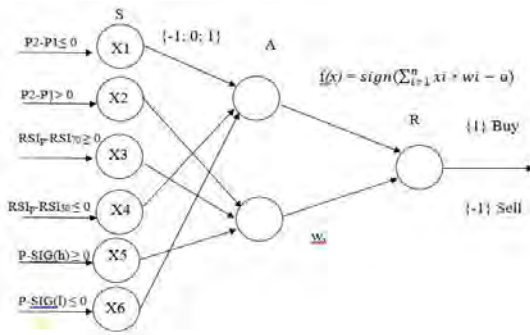


Figure 4. Perceptron graph

The structure contains an input layer that has such parameters as: P2-P1 ≤ 0; P2-P1 > 0; RSI_p-RSI₇₀ ≥ 0; RSI_p-RSI₃₀ ≤ 0; P-SIG(h) ≥ 0; P-SIG(l) ≤ 0. The output layer has one parameter, the order 1 Buy / -1 Sell.

We have thus created a mathematical model capable of generating instrument purchase / sale orders. The tested yield is positive. Figure 5 shows the distribution of transactions over time.

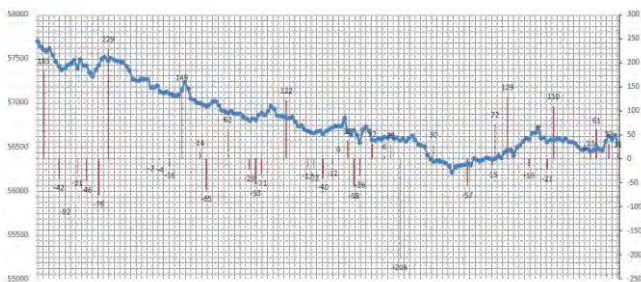


Figure 5. Testing the yield of the neural network on February 7, 2018.

The perceptron output is shown in Table 1.

TABLE I. PERCEPTRON OUTPUT FOR 07.02.2018

N p/p	Long/Sho rt	P(b)	P(s)	Profit	r
1.	Long	57414	57597	183	0.003187376
2.	Short	57414	57372	42	0.000730664
3.	Long	57482	57390	92	0.001600501
4.	Long	57422	57391	31	0.053986277
5.	Short	57376	57422	46	0.000801729
6.	Long	57498	57422	76	0.001321785
7.	Long	57246	57475	229	0.004000279
8.	Long	57169	57167	-2	-0.000000001
9.	Long	57127	57123	-4	-0.000000001
10.	Short	57085	57101	16	0.000280284
11.	Long	56997	57146	149	0.002614173
12.	Long	56979	56993	14	0.000245705
13.	Short	56896	56961	65	0.001142435
14.	Long	56961	56896	62	0.001091165
15.	Long	56822	56799	23	0.000404773
16.	Long	56861	56808	53	0.000932098
17.	Short	56880	56849	31	0.000545007
18.	Long	56696	56818	122	0.002151827
19.	Short	56681	56664	17	0.000299924

N p/p	Long/Sho rt	P(b)	P(s)	Profit	r
20.	Long	56679	56657	22	0.000388151
21.	Long	56680	56640	40	0.000705716
Total	K=3450			199	0.057681159

To trade a single SiH8 futures contract, one needs a minimum sum on their broker account, the so-called collateral, or “the capital” K = 3,450 rubles. When testing the algorithm on retrospective data for February 7, 2018 we attained a positive margin, a yield of 199 rubles. The return on capital amounted to 5,768% = 199/3450*100*.

III. RESULTS AND DISCUSSION

The neural network model, or perceptron we created attained a good yield of 5.768% for February 7, 2018. Research showed that over three days, the algorithm traded with a positive yield of 0.28103% per day on average, see Table 2.

TABLE 2. ACTUAL AND PREDICTED VALUES

Date	Profit	K(Collateral)	r
07/02/18	142	3450	0.04115942
08/02/18	199	3450	0.057681159
09/02/18	628	3448	0.182134571
Total	969	3448	0.281032483
On average	323	3449	0.281032483

The neural network model used appropriate weights that had a certain effect on the output of the created AI system representing the authors’ know-how.

Based on this study, we identified that the obtained results could be improved by adding intermediate layers to introduce additional rules to the model, which would increase the yield.

It must be noted that AI is finding ever greater use in many applied tasks, e.g. there is an AI model to predict the stock-exchange price of a financial instrument [12], an AI for predicting the completion of regional investment projects [13], a neural network to ensure business profitability [14], an AI system for analyzing the foreign trade turnover of Russia and Vietnam by means of big data quantization [15], AI as a tool for efficient banking operations [16], neural networks to predict the Bitcoin value [17], big data quantization of regional investment business projects [18], etc.

Of merit are studies that have produced Rospatent-patented programs, such as the neural network for market depth analysis [19], the neural network for business bankruptcy risk assessment [20], the neural network for global-economy big data quantization [21], the neural network for correlation analysis of big enterprise data in a global economic context [22].

A. Output of the NN-model (perceptron)

- The generated NN model is a simple model, in which weights are adjusted initially.
- Analysis has shown that the average daily yield of this algorithm is 28.1%.
- We have therefore validated our hypothesis that AI could be used to reach a yield above that of risk-free assets (government bonds).
- The concept of sustainable business development is to some extent derivative of successful speculative stock trading using AI-based algorithms.

CONCLUSION

Therefore, when analyzing the concept of sustainable business development, we may conclude that it to some extent might be derivative of successful AI-based stock trading. In the today's competition, the winner is the one that has a better AI.

Experience shows that AI systems are innovative tools that bring great financial results in the context of market uncertainty.

We may therefore conclude that dynamic sustainable development of an enterprise is impossible without AI. Of importance is to set the innovative vector, i.e. AI-based sustainable regional development.

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