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Stock Price Forecasting Using the Jumping Frog Algorithm between Two types of Stock Market Trader Personality.

Aylin Erdoğdu [1], Farshad Ganji[2*]
Co-author: Department of Finance and Banking, Economics and Administrative Faculty, University of İstanbul Arel, Istanbul, Turkey
Corresponding author: Business-Accounting and Finance Ph.D. (C) The student in the Institute of Social Sciences, University of İstanbul Arel, Istanbul, Turkey

Abstract:- The main mechanism of the stock market is based on the transaction, and buyers and sellers enter into this market with their price offerings, and capital market activists believe that the purpose of creating this platform is to facilitate people's transactions. In general, people active in the capital market can be divided into 2 personality types[1], including investors and traders who have their own special characteristics, and it cannot consider a general recommendation for all who act in this market because each person's personality is unique to him and among two personality types of trader and investor, there are successful people because today, many people are interested in the trading job, and involved in several decisions in various markets on a daily basis, and any suggestion that can improve the accuracy of the decision or reduce the decision-making time is attractive and valuable to them. One of the markets that is booming today, and the advantages of decision support systems are very evident in it, is money and capital markets, including the stock market. The actors of this market buy and sell the shares of companies in that market in which, by accepting the future risk of shares, they bring profit or loss for themselves. In this study, after gathering data from the stock-exchange database, the main characteristics of data were extracted using the wavelet transform method and applied as inputs for prediction to the Multilayer Perceptron Neural Network (MLP-NN) trained by the frog leaping algorithm, and the results were compared with the Basic-Radial Neural Network (BR-NN) trained with frog leaping algorithms.

Keywords*: Frog Leaping Algorithm, Neural Network, Decision Time, personality types, Stock Exchange.*

Introduction

Investing in the shares offered on the stock exchange is one of the profitable options in the capital market. The stock market has a non-linear and chaotic system that is influenced by political, economic, and psychological conditions. Predicting and investigating the price behavior of securities is a category that financial scientists and investors are always looking for to optimize, and in this way, there are methods which are more durable and applicable and have the least amount of error in forecasting. In this way, during recent years, mathematical methods, such as simple average, weighted average, double average, regression, and stuff like that, were the only models that were firmly used, but they also had problems at various times. In today's era, due to the advancement of technology in the field of computer science and its widespread use in various sciences, the fields of using NNs have emerged due to the high speed of processing in computers. These networks learn any changes in the rules hidden in the time series using their learning ability to predict the future. Based on the importance of stock price forecasting, we decided to predict stock prices in the stock market using MLP-NN. Generally, the stock price

[1] https://en.wikipedia.org/wiki/Type_A_and_Type_B_personality_theory(Type A Type B)

forecasting system consists of four stages. After gathering the data from the stock exchange site, feature extraction is done by wavelet transforms, then stock price prediction is done by MLP-NN, and the frog leaping algorithm is used to train NN. One of the important issues in the speed of forecasting systems is the extraction of data dimensions. In this research, we are trying to use the wavelet transform to extract the feature vector. Wavelets were developed in the early 20th century by Haar. Wavelets can be used to extract the feature vector. Wavelets provide more and more accurate information than the decomposition that is done by Fourier transform in the frequency domain and can extract exactly the features that exist in a specific position and accuracy. The output of applying these wavelets is then coded and a compact and straightforward[2] display of data is created[3] .

What are the characteristics of a trading personality in the stock market?

The first question proposed regarding the trading personality in the stock market is what are the points of this personality type, and can all people follow this career? The answer to this question should be found in the characteristics of this personality type, and in general, the trading personality in the stock market and investment should be separated from each other. The main characteristic of a trading personality in the stock market is having a personal strategy, and professional capital market activists believe that without a strategy, one cannot succeed in the financial markets. This topic arranges the minds of traders and facilitates decision-making in sensitive and complex situations. The strategy for each person is specific to him and no one can consider a general version for all activists. Traders' personal strategy can include technical analysis, chart reading, fundamental analysis, etc.

For example, a trader may use fundamental analysis to make his transactions, and based on his/her personal strategy, companies can only be included in the watch list of stocks whose P/E ratio is less than 4 units[4].

1.Personality characteristics of stock market traders:

1.1 Individual discipline:

Another feature of the trading personality in the stock market is individual discipline, and traders are usually regular and precise people. Although in the short term, beginners and irregular people may also make good transactions, it has been shown experimentally that in the long term, successful traders are those who have put self-discipline in their working life. Note that individual discipline should include all aspects of individual trading and strategy. For example, when a person sets a loss limit for his/her transactions, if he/she has personal discipline, he/she exits the trade after the loss limit is activated. But if this person does not have personal discipline, he/she may not respect the loss limit and suffer heavy losses[5].

1.2 Risk-taking :

Risk taking is another characteristic of the trading personality in the stock market, and most traders have a more risk-taking personality compared to long-term[6] investors, and this is the reason why the number of their transactions is greater than that of investors. People who are risk averse usually prefer to trade less and invest their money in fundamental shares or indirectly in the form of investment funds or portfolio companies. Of course, note that traders themselves are divided into different categories, such as daily traders, intermediate traders, etc.

For example, the risk taking of a day trader is definitely different from someone who may only do 2 transactions during a month. Therefore, before you decide to choose a career as a trader in the stock market, be sure to consider your risk-taking.

1.3 Up-to-date news and information:

Another important point regarding the character of trading in the stock market is the up-to-date news and information. In fact, a professional trader must always have a relative mastery over the news and information

[2] Liu , Jie , "Shannon wavelet spectrum analysis on truncated vibration signals for machine incipient fault detection", 2012.
[3] Akansu , A. N. ; Serdijn, W. A. ; Selesnick, I. W. (2010) . "Emerging applications of wavelets:
A review " , 2009.
[4] https://www.investopedia.com/terms/p/price-earningsratio.asp
[5] https://www.merriam-webster.com/dictionary/loss
[6] https://www.investopedia.com/terms/l/longterminvestments.asp

affecting the financial markets[7] due to conducting many transactions, and being away from the news for a long time makes transactions risky because the sensitivity of the stock market to political, military, economic news, etc. is very high and the smallest positive or negative news can change the market trend.For example, Russia's military attack on Ukraine caused severe turbulence in global markets; and this issue can change the profitability of commodity-based companies on the stock exchange and off-exchange, and if a trader does not have sufficient mastery over such news, he/she cannot have good deals and will probably face losses.

1.4 Expert knowledge:

One of the main foundations of a trading personality in the stock market is to have specialized knowledge in various fields, such as technical analysis, fundamental analysis, table reading, market psychology, etc., and a professional trader always updates his/her knowledge and scientific information.For example, a person has a personal trading strategy, high risk-taking[8], personal discipline, etc., but he/she doesn't have enough knowledge of technical analysis, and can't recognize the buying and selling points of companies' shares, well. For this reason, this person cannot be a good trader without having scientific information and expert knowledge.

1.5 Checking the trading board:

When a long-term investor completes his/her purchase, he/she may not check the trading board of the purchased stock for several months or even several years; but due to the high number of purchases and sales, a trader must constantly check the trading board plus the money entering and exiting, carefully, and the capital market actors should consider their personality type; Because many people cannot bear the stress and anxiety induced by the price fluctuations in the stock market, and it is proposed that market actors use the Myers-Briggs Type Indicator(MBTI) test [9]to measure the type of trading personality in the stock market or investment. We got acquainted with the concept of emotional behavior in financial markets, including the stock market. Emotional behaviors are actually one of the investment risks that we can reduce and control to a very good extent by practicing and working on ourselves. In this article, we have stated a number of solutions and tips to prevent the occurrence of emotional behavior, which can be very useful to understand and follow for a successful investment. Therefore, if you want to perform better in your transactions, you should avoid making emotional decisions.

1.6 Greater understanding of the fear of loss:

One of the important aspects of the psychology of losses in financial markets is the fear of loss. Fear of loss in behavioral economics refers to the phenomenon in which an actual or potential loss is perceived by individuals as psychologically or emotionally more severe than an equivalent interest. For example, the pain of losing $100 is often much greater than the joy of finding the same amount. The psychological impacts of experiencing a loss or even facing the possibility of loss may even induce risk-taking behavior which can make actual losses even greater or more severe.No one likes to lose, especially when it comes to money and wealth! The fear of recognizing a loss can paralyze an investor and force him/her to hold on to a losing investment long after he/she should have sold it, or to sell winning or profitable stocks and investments too early; a cognitive bias, which is known as the tendency impact. Beginners often make the mistake and hope that the stock price trend will go up again, even though all the evidence points to the contrary because making a loss leads to stronger emotional reactions than making a profit. Behavioral economists claim that human behavior is very strange when it comes to fear of loss, which is one of the types of cognitive biases identified by them. Some psychological studies indicate that the pain of losing is psychologically twice as strong as the pleasure we experience when we win. However, several studies also question the practical effect or even the existence of loss aversion. However, extreme fear may cause investors to behave irrationally and make poor investment decisions.

The psychology of loss may even be the cause of the asymmetric volatility phenomenon exhibited in the stock markets, where the stock market volatility is greater in the bearish markets than in the bullish markets. According to the "prospect"[10] theory, people strongly prefer to avoid losses rather than seek gains. This fear of loss is so

[7] https://www.investopedia.com/ask/answers/042915/how-do-financial-market-exhibit-asymmetric-information.asp
[8] https://www.merriam-webster.com/dictionary/risk-taking
[9]https://tr.wikipedia.org/wiki/Myers-Briggs_Tip_G%C3%B6stergesi
[10]https://www.investopedia.com/terms/p/prospecttheory.asp#:~:text=The%20prospect%20theory%20says%20that,as%20the%20loss%2Daversion%20theory.

strong that it can lead to a negative bias. In such cases, investors tend to put more weight on bad news than good news, causing bull markets to lose their momentum for fear of reversing course and panic at even small markets dips.

1.7 Minimizing the fear of loss:

One of the ways to avoid psychological traps is to follow an asset allocation strategy. Instead of trying to schedule perfectly and precisely time market sentiments and follow the old adage, investors are advised to periodically rebalance their portfolios based on a rules-based strategy and methodology[11]."Formula" investing is another form of strategic investing[12]. For example, "fixed ratio programs" keep the low-risk and high-risk parts of a portfolio at a fixed ratio. To maintain the target weighting, usually stocks and bonds, the portfolio is periodically rebalanced by selling better-performing assets and buying poorer ones. This is in contrast to "momentum investing", which is cyclical in nature.There are many tried and tested principles for asset allocation and fund management, like learning how to build diverse portfolios and using buying and holding strategies.

1.8 Some of the best psychology of loss:

Behavioral finance provides scientific insights into our cognitive reasoning and investment decisions. On a collective level, it helps us understand why heavy rallies or market panics can occur. Investors need to understand behavioral finance not only to be able to profit from stock and bond market fluctuations, but also to be more informed about their decision-making process.Losses can be worth if you learn from them and look at all things strategically without any biases. Losses are inevitable, which is why "successful investors" [13]include the "psychology of loss" in their investment strategies and use coping strategies. To get rid of the fear of "losing" and overcome cognitive biases, they learn to cope with negative experiences and avoid emotional and panic-driven decisions. Smart investors focus on rational and prudent trading strategies that prevent them from falling into the common traps that occur when psychology and emotion affect their judgments.

1.9 Psychological coping strategies for dealing with losses:

Losing a large amount of money can have a devastating effect on people, especially if the loss affects important life stages such as retirement, paying for a child's education or buying a home. Many people may feel that the financial loss is irreversible, and therefore, take actions that aggravate the situation. Although, unfortunately, time cannot be turned back, it is better to manage this process psychologically than to compensate for losses with risky investments or other drastic measures. Studies have shown that there are positive ways to deal with these losses, as well as identifying harmful methods and how to avoid them.

1.10 Ineffective coping strategies:

Many people use ineffective coping strategies when faced with a loss. For example:

1.10.1 Suppression: Trying to suppress the negative emotions associated with a loss can be difficult and trap you again. Financial problems and unhappiness caused by a loss can easily turn into problems or tensions in marriage or work, and you may end up taking out your unhappiness on your family members, colleagues or friends.

1.10.2 Projection: It is not uncommon for those facing a major[14] loss to blame it on someone or something else instead of taking responsibility for their own poor decisions or excessive risk-taking.

10.10.3 Denial and self-deception: These ineffective countermeasures keep people from abandoning their failed investments in the vain hope that "their price will go up again.[15]" If you've bought a broken item, it's almost always best to get rid of it and put whatever money is left over into something safer and sounder.

1.11 Correct coping strategies:

When you have no legitimate claim from the seller for your losses after purchasing a defective item, or you cannot afford a lawsuit, it is required to deal with the situation. Failed investments are such topics. A meaningful way to

[11] https://medium.com/coinmonks/rule-based-trading-strategies-893308035682
[12] https://www.investopedia.com/terms/f/formula_investing.asp
[13] https://www.investopedia.com/world-s-11-greatest-investors-4773356
[14] https://www.youtube.com/watch?v=Gkoy37w8rEc
[15] https://www.forbes.com/advisor/in/investing/cryptocurrency/bitcoin-prediction/

cope is to simply learn from your mistakes and try to compensate for the loss over time by investing well and prudently in the future. It's not a quick or surefire solution, but it certainly makes sense to try.

1.12 Re-evaluation:

If you took too many risks, trusted the wrong people, or were just unlucky, you can be careful and diversify your portfolio in the future. Even if it takes years to recoup some or all of your losses, it's comforting to think that it might happen. Diversifying your portfolio should always be the first step in investing to ensure a balanced portfolio and avoid heavy losses. Keep in mind that some investments based on trusting another person have been wrong from the start. Incompetent and wrong people exist in all fields, and anyone can fall into their trap. That's life and "what doesn't kill you, can make you stronger".

1.13 Learning from mistakes:

Rationalization is useful, but only if it is realistic. It is important to understand what you and others have done and why. For example, have you been tempted by the lure of a big income, or have you been the victim of false promises or even fraud[16]? Getting to the bottom of what really happened in the past is the best way to move toward a better future. But when the rational justification is really self-deluding and involves blaming others for their own mistakes or not facing reality, this process becomes a negative process. Trying to understand why you made an investment decision can help you avoid poor investment decisions in the future. Accordingly, in this study, two intra-organizational factors including management support for internal audit and internal audit independence were examined and thus the effect of the above two factors (as an independent variable) on the effectiveness of internal audit (dependent variable) Was tested. The statistical sample is estimated at 200 managers and auditors according to Krejcie and Morgan table.[17]

1.14 Seek professional help:

In the case of severe losses or even losses that do not threaten a person's financial survival, there are cases where people suffer from depression or even despair. As such, they may resort to those negative coping strategies discussed above, or worse. In such cases, the help of a professional may be needed. Finally, a good investment in the future is worth seeking the help of an independent financial advisor with a good record. $A\ MLP-NN$ is a type of artificial NN that consists of an input layer, at least one hidden layer, and an output layer. The processing components of this network are Trons. Each Tron receives the weighted combination of inputs and after calculating their sum, adds the bias value to the calculated sum and applies it as an input to the activation function. The mentioned process is carried out for all the neurons in different layers until the NN output is determined. In order that NN calculates the output after applying the input, the values of weights and biases of neurons in the network should be determined, so the values of weights and biases of Trons are unknown values in NN. Determining the values of weights and biases in NN is called NN[18] training[19]; the frog leaping algorithm is one of the algorithms inspired by nature. In this algorithm, a group of frogs (a set of answers) is divided into several subsets, each frog has its own culture, and can use cultures with the ideas of other frogs during the evolution process[20];The results of the present study show that the variables of audit competence within the interaction of internal and external auditors have a significant relationship with the effectiveness of internal audit.[21] the frog leaping algorithm is a combination of deterministic and random methods. The deterministic method allows the algorithm to exchange messages efficiently. The random method guarantees the flexibility and resistance of the algorithm. The algorithm starts with the random selection of frog groups. Frog groups are divided into several subgroups. Each of these subgroups can perform local searching independently and in a different way. Frogs in a subgroup can affect other frogs in the same subgroup. In this way, the existing frogs evolve in a subgroup. Subgroup evolution improves the quality of the group of individual frogs and increases the ability to achieve the goal. To achieve a good goal, the weight of good frogs can increase, and the weight of bad frogs can decrease.

[16]https://scholar.google.com/citations?view_op=view_citation&hl=tr&user=_RyCeTEAAAAJ&citation_for_view=_RyCeTEAAAAJ:7PzlFSSx8tAC
[17] Mehmet Hanifi AYBOĞA, & Farshad Ganji. (2021). INVESTIGATE THE SUPPORTIVE ROLE OF MANAGEMENT AND THE INDEPENDENCE OF THE INTERNAL AUDITOR IN THE EFFECTIVENESS OF INTERNAL AUDIT. *PalArch's Journal of Archaeology of Egypt / Egyptology*, *18*(6), 241-251. Retrieved from https://archives.palarch.nl/index.php/jae/article/view/8558
[18] Neural Networks: A Comprehensive Foundation, Simon Haykin, 1986-2012.
[19] Artificial Neural Networks: Architectures and Applications, by Kenji Suzuki, In Tech 2013.
[20] https://frog.gatech.edu/code.html
[21] Mehmet Hanifi Ayboga, Farshad Ganji(Vol. 12 No. 13 (2021)https://www.turcomat.org/index.php/turkbilmat/article/view/11117

After the evolution of some subgroups, the subgroups are combined. Due to the combination, the subgroups are optimized in the global domain and a new frog is created by the combination mechanism of subgroups. The combination increases the quality of subgroups affected by different subgroups. The local and global search continues until the convergence condition is met. The balance between global message exchange and local search allows the algorithm to easily leap from the local minimum to achieve development optimization. One of the characteristics of the frog leaping algorithm is fast convergence[22]. To determine the best values for the weights and NN[23] biases, we intend to use the frog leaping optimization algorithm. In the initial preparation stage, each member of the population includes a vector containing genes and parameters of NN, which is randomly assigned as an input to the objective function. The objective function receives the input vector including the weights and biases and considers it as the weights and biases of NN; then it applies the training inputs to the constructed network and based on the output of NN and the target output, the network error is calculated and reversed.In the reiteration stage, it is done by creating different subgroups and evolving them into the algorithm. The reiteration continues until the termination conditions are met. After completing the training process, the algorithm returns to the member of the population that has the best values of weights and parameters. The member selected by the algorithm is the member whose NN mean square error is less than the rest of the population. Another part of the data is used as test data to check the effectiveness of the trained model.The main purpose of this research is to identify the most effective stock price forecasting model of companies active in the stock exchange market, built with an artificial NN trained with an evolutionary algorithm[24].

2. Theoretical research foundations:

2.1 Stock market:

The stock market is a market where the share price of investment companies and other tradable securities is determined by supply and demand competition between buyers and sellers. Any legal or natural person can receive the transaction code for any amount; this market will buy or sell: every active member of this market will decide to buy or sell company shares based on the results of his/her research and investigations, and thus assigns his/her profit or loss. Genetic Algorithm (GA): GA [25]is a learning method based on biological evolution introduced in 1970 by John Holland. A GA produces a very large set of possible solutions to solve a problem. Each of the solutions is evaluated using a fitness function, and a number of the best ones become candidates for producing new solutions in a process called evolution. Thus, the search space evolves in a direction that leads to a desired solution. Particle Swarm Optimization (PSO) algorithm[26]: PSO Algorithm is a population-based algorithm. This algorithm is inspired by the collective movement of natural populations such as birds and fishes, which do not behave intelligently individually, but their collective behavior is intelligent. The meaning of the particle in this algorithm is the same as the position of the candidate for the answer to the problem. The Imperialist Competitive Algorithm (ICA): ICA [27]is a mathematical modeling of social evolution. Most evolutionary optimization algorithms are simulations of natural processes, such as genetics, simulated refrigeration. Human evolution has other aspects other than biological evolution, such as social, intellectual, and socio-political aspects; the evolution of this aspect is the inspiration for the proposal of ICA[28]. ICA follows a path different from other algorithms[29] from the same starting point. Frog leaping algorithm: this algorithm is a very simple algorithm which is utilized for direct search, child generation, and evolution of these very complex subsets. This strategy is employed in the path of evolution by using the information that exists in these complex subsets. examining the hypotheses, it was found that the basis of national accounting standards by independent auditors to comment in the financial

[22] https://www.sciencedirect.com/science/article/pii/S2352484720317145
[23] https://towardsdatascience.com/whats-the-role-of-weights-and-bias-in-a-neural-network-4cf7e9888a0f
[24] https://towardsdatascience.com/gradient-descent-algorithm-and-its-variants-10f652806a3
[25] J. S. Goetti, A. W. Brugh, B. A. Julstrom, "Arranging the Keyboard with a Permutaion-Coded Genetic Algorithm," in Proc. of the 2005 SCM Symposium on Applied Computing, 2005.
[26] https://machinelearningmastery.com/a-gentle-introduction-to-particle-swarm-optimization/
[27] Atashpaz-Gargari, E. , Lucas, C. , "Imperialist competitive algorithm: an algorithm for optimization inspired by imperialistic competition," in IEEE 2007, 2007.
[28] https://www.mathworks.com/matlabcentral/fileexchange/22046-imperialist-competitive-algorithm-ica
[29] https://www.academia.edu/5954963/A_Geometric_Algorithm_for_Overcomplete_Linear_ICA

statements, reduce the clause in the audit report, the use of national accounting standards by auditors, leads to consistency and uniformity of audit reports. application of national accounting standards by auditors reduce audit time.[30]

3 . Research methodology:

To implement this study, some small limitations due to limited research time and limited resources have led to constraints on the scope of the problem and research. The following are the factors limiting the scope of this research: The sample under investigation is 16 shares out of more than 450 shares on the Istanbul Stock Exchange market. According to the theoretical and statistical calculations, more samples than 450 existing shares are needed to reach a 90% confidence level, but considering the huge variation in the behavior of different stock prices in one industry and the number of 35 active industries on the stock exchange, the number of 16 shares is 95% assured as an acceptable sample. The computing power of the software used in this research, MATLAB software[31], is another thing of interest. This very powerful software for performing calculations has limited power compared to some existing software such as R in terms of calculation efficiency and required space. This case has not created an effect on the calculations and results of this research. However, the possibility of simultaneous calculations of larger samples is limited. In the modeling stage, dividing the data into training and testing data sets is conducted. In this research, randomly, 80% of the data will be the education basis and the rest will be evaluated based on quality of education. The model used to predict is the forward artificial NN model, which will be trained with the help of evolutionary algorithms. In other words, instead of using the forward-propagation training algorithm, each of the shuffled frog-leaping algorithms (SFLA), GA, ICA, PSO will be used to train the artificial NN. For this purpose, MATLAB software is used for programming. In this research, the model was evaluated with the help of the Mean Squared Error (MSE)[32] evaluation index. The quality of the model will be judged by predicting the share price and the status of this index in its different execution. At this stage of the research, the structure of the artificial NN model along with the calculated weights and biases are extracted to implement the model. Table 1 Summary table of meta-heuristic algorithm of frog jump:

Table 1 Summary table of meta-heuristic algorithm of frog jump:

Shuffled Frog Leaping (SFLA)	The name of the algorithm
Population based	Population-based or point-based
It is the exchange of information between groups, based on which, after each local search in the groups, the information obtained between the groups is compared.	Focus
The search technique is local, based on which the frogs in each group improve their position relative to food (the best answer) by exchanging information.	Variety
The balance between global message exchange and local search allows the algorithm to easily jump from local minima and evolve to reach optimization.	Escape from local optima
The new position of the worst solution is placed along the best and worst solution, which slows down the convergence speed	How to move
It guarantees the flexibility and power of the search algorithm	How to make accidents

[30] Mehmet Hanifi AYBOĞA, & Farshad Ganji. (2021). INVESTIGATING THE IMPACT OF USING NATIONAL STANDARDS ON THE QUALITY OF AUDITING AND THE UNIFORMITY OF FINANCIAL STATEMENTS. *PalArch's Journal of Archaeology of Egypt / Egyptology*, *18*(6), 214-224. Retrieved from https://archives.palarch.nl/index.php/jae/article/view/8556
[31] https://tr.wikipedia.org/wiki/MATLAB
[32] https://en.wikipedia.org/wiki/Mean_squared_error

The stopping criterion of the algorithm can be based on the stability of changes in the fitness of the best answer or Repeating the algorithm until a certain number is selected	• Stopping conditions • Discussion on parameters
• Production of the primary population • sort • Local search	A summary of the steps of the frog algorithm

Optimization algorithms[33](algorithm of frog jump)

3.1 Part of the algorithm Shuffled Frog Leaping Algorithm (SFLA):

```
@@ -1,21 +1,21 @@
%
% Copyright (c) 2015, Mostapha Kalami Heris & Yarpiz (www.yarpiz.com)
% All rights reserved. Please read the "LICENSE" file for license terms.
%
% Project Code: YPEA109
% Project Title: Implementation of Shuffled Frog Leaping Algorithm (SFLA)
% Publisher: Yarpiz (www.yarpiz.com)
%
% Developer: Mostapha Kalami Heris (Member of Yarpiz Team)
%
% Cite as:
% Mostapha Kalami Heris, Shuffled Frog Leaping Algorithm in MATLAB (URL: https://yarpiz.com
                /71/ypea109-shuffled-frog-leaping-algorithm), Yarpiz, 2015.
%
% Contact Info: sm.kalami@gmail.com, info@yarpiz.com
%
function b = IsInRange(x, VarMin, VarMax)
  b = all(x >= VarMin) && all(x <= VarMax);
  b = all(x >= VarMin) && all(x <= VarMax);
end
@@ -27,7 +27,7 @@
VarSize = [1 nVar];    % Unknown Variables Matrix Size
VarMin = -10;          % Lower Bound of Unknown Variables
VarMax = 10;           % Upper Bound of Unknown Variables
VarMax = 10;           % Upper Bound of Unknown Variables
%% SFLA Parameters
MaxIt = 1000;      % Maximum Number of Iterations
nPopMemeplex = 10;                 % Memeplex Size
nPopMemeplex = max(nPopMemeplex, nVar + 1);  % Nelder - Mead Standard
nMemeplex = 5;             % Number of Memeplexes
nPop = nMemeplex * nPopMemeplex; % Population Size
```

[33] https://www.seldon.io/algorithm-optimisation-for-machine-learning#:~:text=Algorithm%20optimisation%20is%20the%20process,predicted%20value%20of%20output%20data.

$I = reshape(1{:}nPop, nMemeplex, []);$
$\%\ FLA\ Parameters$
$fla\_params.q = max(round(0.3 * nPopMemeplex), 2);\ \ \%\ Number\ of\ Parents$
$fla\_params.alpha = 3;\ \ \%\ Number\ of\ Offsprings$
$fla\_params.beta = 5;\ \ \%\ Maximum\ Number\ of\ Iterations$
$fla\_params.sigma = 2;\ \ \%\ Step\ Size$
$fla\_params.CostFunction = CostFunction;$
$fla\_params.VarMin = VarMin;$
$fla\_params.VarMax = VarMax;$

4. Research findings:

The data set of 16 companies from 10 non-identical industries were selected for this research as described in Table 2 taken into account[34].

Table 2. Symbol of the selected shares:

Row	Company Name	Trading symbol in the stock exchange	Industry or activity attachment
1	AFYON CIMENTO	AFYON	Construction Industry
2	ADESE.TE TEMERRUT	ADESE	Construction Industry
3	AZTEK TEKNOLOJI	AZTEK	Technology
4	ATAC INSAAT	ATAC	Construction Industry
5	PINAR ET VE UN SANAYI AS	PETUN	Food and catering industry
6	PAMEL ELEKTRIK	PAMEL	Construction Industry
7	SONMEZ FILAMENT	SONME	Clothing industry raw materials
8	TEK ART INSAAT TICARET TURIZM AS	TEKTU	Construction Industry
9	VAKKO TEKSTIL VE HAZIR GIYIM AS	VAKKO	Construction Industry
10	YATAS YATAK	YATAS	Bedding and Household Goods
11	YAPRAK SUT VE BESI CIFT SAN TIC	YAPRAK	Food and catering industry
12	TURKCELL ILETISIM HIZMETLERI AS	TCELL	Communication
13	YAYLA ENERJI URETIM TURIZM AS	YAYLA	Construction industry and tourism
14	YUKSELEN CELIK	YUKS	Construction industry
15	YUNSA	YUNSA	Clothing industry raw materials
16	UNLU YATIRIM HOLDING	UNLU	Research & Development
17	Overall Index	-	-

[34] https://www.yf.com.tr/piyasa-analizi/hisse-senedi-analizi/UNLU

1 The index of the average error of the second degree is $(Mean\ Squarred\ Error)$, which is with the formula $\frac{1}{n}\sum_{i}^{n} = 1(\hat{x}i - x_i)^2$ in which n the number of data $\hat{x}i$ is the predicted data x_i the base data .

The data resulting from daily transactions on the Istanbul Stock Exchange is stored and maintained on the information servers of that organization and is available to those interested in two forms of web service or downloadable/storable. The downloadable file has been given in Excel format, and includes the information fields of symbol title, Gregorian calendar, first price, highest price, lowest price, closing price, transaction volume, transaction value, number of transactions, yesterday's price, company code, Latin name, name, solar calendar, and last price. In order to download and store the daily trading price data of 16 selected shares as well as the total index information, the aforementioned outputs were received through the website of the Stock Exchange Organization.

Implementation of artificial NN

For time series, the NN architecture involves determining the number of layers and consequently that of hidden layers, that of inputs, that of outputs, and the transfer (activation) function. The number of neurons in the first layer, or in other words, that of input neurons, depends on the purpose of research and the nature of data obtained from the environment and external information resources. In this research, 8 items were selected due to the parameters affecting the stock price. The number of input neurons in the artificial NN architecture of this problem is considered. Also, it has been proven in theory and practice that increasing the number of hidden layers is a very risky decision in artificial NN architecture and generally leads to network overfitting, in addition to increasing the volume of calculations. In this architecture, a hidden layer is considered for NN. According to the nature of the problem and the purpose of predicting the share price on one day in the future, the number of one output and, therefore, only one output neuron is considered. This forecast output will be the result of seven effective future input parameters. In artificial NNs with a hidden layer, it is proposed that the number of neurons in the hidden layer is at least greater than the square root of the number of input ones and output ones. This theory suggests the number of two neurons in the hidden layer. Past research also shows that, in general, the number of five neurons in the hidden layer has been considered. Considering these two suggestions, the number of five neurons was considered for the hidden layer. In order to implement the mentioned data input model to the artificial NN in $MATLAB$, a $n * 8$ matrix is formed. In other words, the share price data is transferred from the environment of the input matrix resulting from the time series with dimensions $8 * n$ to another matrix environment with dimensions $1 * n$.

Implementation of artificial NN training:

With evolutionary algorithms, the training of NNs is actually a problem in which the optimal weights of the NN effect are determined. Various methods have been researched to solve this problem, but better results have been obtained using evolutionary algorithms.

GA was coded in $MATLAB$ in order to train the artificial NN with the help of GA and required functions. The structure of the files created to implement this algorithm in the artificial NN training is described in Table 3.

Table 3. The implementation structure of neural network training with genetic algorithm:

Row	File title	Description of file function
1	The main program	It includes the code of the artificial neural network structure and access to the data, and by referring to the training function of the artificial neural network, it creates the desired genetic algorithm output.
2	Data normalization function	Performs normalization of the input data to the artificial neural network.
3	Artificial neural network training	It trains the artificial neural network with the help of selection, combination, network structuring and cost functions.

	function with genetic algorithm	
4	Selection function	By using the cost function, it selects the chromosomes in each step.
5	Combination function	By selecting the parent chromosome, it creates two child chromosomes.
6	Artificial neural network structure function	At each stage of artificial neural network training, it reconstructs the network.
7	Cost dependent	It calculates the cost of each step for each chromosome.

The PSO algorithm was coded in order to train the artificial NN with the help of PSO, program, and required functions in $MATLAB$. The structure of files created to implement this algorithm in artificial NN training is described in Table 4.

Table 4. Implementation structure of neural network training with particle swarm algorithm:

Row	File title	Description of file function
1	The main program	It includes the code of the artificial network structure and access to the data, and by referring to the training function of the artificial neural network, it creates the desired output particle swarm optimization algorithm.
2	Data normalization function	It normalizes the input data to the artificial neural network.
3	Artificial neural network training function with particle swarm algorithm	It trains the artificial neural network with the help of two network structuring and cost functions.
4	Artificial neural network structuring function	At each stage of training, the artificial neural network reconstructs the network.
5	Cost dependent	It calculates the cost of each step for each particle.

ICA was coded in $MATLAB$ with the help of ICA and required functions to train the artificial NN. The structure of files created to implement this algorithm in the artificial NN training is described in Table 5.

Table 5. Implementation structure of neural network training with colonial competition algorithm:

Row	File title	Description of file function
1	The main program	It includes the code of the artificial network structure and access to the data, and by referring to the training function of the artificial neural network, it creates the desired output particle swarm optimization algorithm.
2	Data normalization function	It normalizes the input data to the artificial neural network.
3	Artificial neural network training function with	It trains the artificial neural network with the help of two network structuring and cost functions.

Row	File title	Description of file function
	particle swarm algorithm	
4	Artificial neural network structuring function	At each stage of training, the artificial neural network reconstructs the network.
5	Cost dependent	It calculates the cost of each step for each particle.
6	Subject to colonial competition	By creating competition, it identifies weaker colonies.
7	Early empire building function	Creates an early empire.
8	Function to create a new country	It creates new countries and colonies.
9	Subject to the unification of empires	Empires with the same cost are united and the cost of all empires is updated.
10	Merger function of colonies	It deals with combining and summarizing colonies into empires.
11	Colony change function	Re-determines the position of the colonies.
12	Show empires function	It shows the graphic representation of the empire.
13	Subject to the unification	It performs the process of revolution and positioning of the colonies at each stage
14	Subject to having an empire	By comparing the costs, it performs the process of revolution and positioning of the colonies at each stage.

Frog Leaping Algorithm:

Frog Leaping Algorithm was coded in order to train artificial NN with the help of Frog Leaping Algorithm and the required functions in $MATLAB$. The structure of files created in order to implement this algorithm in artificial NN training is described in Table 6.

Table 6. Implementation structure of neural network training with frog jump algorithm:

Row	File title	Description of file function
1	The main program	It includes the code of the artificial neural network structure and data access, and it creates the desired output by referring to the artificial neural network training function with the frog jump algorithm.
2	Data normalization function	It normalizes the input data to the artificial neural network.

3	Artificial neural network training function with particle swarm algorithm	It trains the artificial neural network with the help of two network structuring functions and cost.
4	Artificial neural network structuring function	At each stage of training, the artificial neural network reconstructs the network.
5	Cost dependent	It calculates the cost of both stages for each population.

Application of artificial *NN* trained by evolutionary algorithms:

The main artificial NN training program was implemented with each selected evolutionary algorithm based on the following two ways for total index and each of the 16 selected shares: first method; the algorithms were implemented for the number of fixed steps: Algorithms were implemented for the number of steps to correct the results limited to 1000 steps. The second method: the algorithms were implemented for a limited time: algorithms were implemented for limited and specific time over an hour. In Tables (7,11) the results of NN training with each evolutionary algorithm, including the execution time, the error square of the training data, the error square of the testing data, and separately from 2 implementation methods, are given. Table 7 shows the results of artificial NN training with an error forward-propagation algorithm.

Table 7. Results of training and testing of neural network trained with error pre-propagation algorithm:

Row	share name	Run for an hour			Run 1000 steps		
		MSE		Execution time	MSE		Execution time
		Education	Test		Education	Test	
1	AFYON	0.031784	0.036818	27.3652	0.053072	0.059154	13.481
2	ADESE	0.039515	0.036199	22.2498	0.041975	0.048293	5.8803
3	AZTEK	0.043935	0.040835	24.0726	0.069084	0.075948	5.7551
4	ATAC	0.031375	0.030699	25.6356	0.023989	0.022861	6.0938
5	PETUN	0.032453	0.035497	26.074	0.042916	0.045159	22.5627
6	PAMEL	0.051424	0.062285	26.199	0.060057	0.052058	6.6252
7	SONME	0.057746	0.052927	32.6003	0.07152	0.088246	6.015
8	TEKTU	0.079423	0.039397	29.924	0.049033	0.064954	17.7937
9	VAKKO	0.050522	0.045605	29.0955	0.054215	0.056112	5.9511
10	YATAS	0.034737	0.024567	90.2902	0.062181	0.079354	5.9066
11	YAPRAK	0.045774	0.037387	40.1052	0.10756	0.15433	22.6892
12	TCELL	0.036768	0.033856	24.8444	0.053605	0.046282	6.1395
13	YAYLA	0.112	0.14024	19.3259	0.11012	0.21306	18.9563
14	YUKS	0.074716	0.16373	19.9133	0.15067	0.17787	4.918
15	YUNSA	0.013046	0.014063	19.9234	0.01694	0.017951	13.9228
16	UNLU	0.013096	0.014635	19.9234	0.01698	0.017959	14.0228
17	Overall Index	0.013046	0.014063	14638.89	0.01699	0.017969	14.0396

Researcher's findings

Table (8) shows the results of artificial neural network training with genetic algorithm.

Table 8: Training and test results of neural network trained with genetic algorithm:

Row	share name	Run for an hour			Run 1000 steps		
		MSE		Execution time	MSE		Execution time
		Education	Test		Education	Test	
1	AFYON	0.050528	0.044942	3608.426	0.055596	0.044444	1776.485
2	ADESE	0.048335	0.041989	3607.231	0.049605	0.050601	1761.464
3	AZTEK	0.051702	0.054505	3607.384	0.056015	0.048285	1768.445
4	ATAC	0.03768	0.040591	3607.548	0.035103	0.035845	1775.06
5	PETUN	0.052307	0.056473	3607.459	0.040303	0.038922	1802.495
6	PAMEL	0.068453	0.074761	3608.581	0.072477	0.051787	1853.784
7	SONME	0.059584	0.049666	3607.928	0.055819	0.058969	1880.044
8	TEKTU	0.033962	0.045656	3607.781	0.03913	0.036823	1810.705
9	VAKKO	0.052045	0.073527	3606.205	0.067166	0.06842	1838.765
10	YATAS	0.059749	0.070549	3611.381	0.059561	0.047677	1837.739
11	YAPRAK	0.048481	0.044567	3608.62	0.05174	0.052376	1791.967
12	TCELL	0.051459	0.049531	3606.197	0.062032	0.069315	1784.049
13	YAYLA	0.1272	0.049979	3606.395	0.10177	0.13326	1735.051
14	YUKS	0.11406	0.088356	3605.567	0.11301	0.14861	1748.013
15	YUNSA	0.068453	0.074761	3608.581	0.072477	0.051787	1853.784
16	UNLU	0.052045	0.073527	3606.205	0.067166	0.06842	1838.765
17	Overall Index	0.014434	0.013007	3608.059	0.014955	0.012689	1754.226

Researcher's findings

Table 9 shows the results of artificial neural network training with particle swarm base algorithm.

Table 9: Training and testing results of neural network trained with particle swarm optimization algorithm:

Row	share name	Run for an hour			Run 1000 steps		
		MSE		Execution time	MSE		Execution time
		Education	Test		Education	Test	
1	AFYON	0.029486	0.022984	52458.74	0.020586	0.019205	2381.402
2	ADESE	0.052307	0.056473	3607.459	0.040303	0.038922	1802.495
3	AZTEK	0.068453	0.074761	3608.581	0.072477	0.051787	1853.784
4	ATAC	0.059584	0.049666	3607.928	0.055819	0.058969	1880.044
5	PETUN	0.033962	0.045656	3607.781	0.03913	0.036823	1810.705
6	PAMEL	0.03768	0.040591	3607.548	0.035103	0.035845	1775.06
7	SONME	0.052307	0.056473	3607.459	0.040303	0.038922	1802.495
8	TEKTU	0.068453	0.074761	3608.581	0.072477	0.051787	1853.784
9	VAKKO	0.034737	0.024567	90.2902	0.062181	0.079354	5.9066
10	YATAS	0.045774	0.037387	40.1052	0.10756	0.15433	22.6892
11	YAPRAK	0.036768	0.033856	24.8444	0.053605	0.046282	6.1395
12	TCELL	0.112	0.14024	19.3259	0.11012	0.21306	18.9563
13	YAYLA	0.074716	0.16373	19.9133	0.15067	0.17787	4.918
14	YUKS	0.013046	0.014063	19.9234	0.01694	0.017951	13.9228

15	YUNSA	0.013096	0.014635	19.9234	0.01698	0.017959	14.0228
16	UNLU	0.013096	0.014635	19.9234	0.01698	0.017959	14.0228
17	Overall Index	0.004807	0.006145	3610.705	0.004841	0.004368	2371.571

Researcher's findings

Table (10) shows the results of artificial neural network training with colonial competition algorithm.

Table 10: Training and test results of neural network trained with colonial competition algorithm:

Row	share name	Run for an hour			Run 1000 steps		
		MSE		Execution time	MSE		Execution time
		Education	Test		Education	Test	
1	AFYON	0.021248	0.027256	3609.651	0.027237	0.017801	2013.062
2	ADESE	0.02583	0.025045	3606.172	0.027852	0.023872	2003.317
3	AZTEK	0.019488	0.022181	3608.849	0.021826	0.026462	2009.651
4	ATAC	0.016569	0.020863	3609.458	0.018385	0.017456	2022.321
5	PETUN	0.015081	0.015338	3606.697	0.016802	0.011924	2039.39
6	PAMEL	0.0264	0.018554	3607.782	0.026409	0.022844	2050.074
7	SONME	0.022824	0.028315	3607.746	0.024959	0.02849	2076.607
8	TEKTU	0.019378	0.017706	3607.808	0.017369	0.042209	2112.778
9	VAKKO	0.027258	0.03095	3609.129	0.024609	0.022294	2099.476
10	YATAS	0.022824	0.028315	3607.746	0.024959	0.02859	2076.689
11	YAPRAK	0.019378	0.017706	3607.808	0.017369	0.042209	2112.796
12	TCELL	0.027258	0.03095	3609.129	0.024609	0.022294	2096.476
13	YAYLA	0.015081	0.015338	3606.697	0.016802	0.011924	2039.39
14	YUKS	0.0264	0.018554	3607.782	0.026409	0.022844	2050.074
15	YUNSA	0.022824	0.028315	3607.746	0.024959	0.02849	2076.607
16	UNLU	0.019378	0.017706	3607.808	0.017369	0.042209	2112.778
17	Overall Index	0.005167	0.005347	3608.258	0.005196	0.00801	2003.011

Researcher's findings

Table (11) shows the results of artificial neural network training with the Josh-Frog algorithm.

Table 11: Training and testing results of the neural network trained with the frog jump algorithm:

Row	share name	Run for an hour			Run 1000 steps		
		MSE		Execution time	MSE		Execution time
		Education	Test		Education	Test	
1	AFYON	0.056477	0.053847	3118.71	0.056979	0.053082	619.0911
2	ADESE	0.046895	0.055769	3082.867	0.056572	0.046074	617.9399
3	AZTEK	0.056641	0.0645	3089.354	0.063123	0.066618	618.8013
4	ATAC	0.03831	0.034857	3097.529	0.044493	0.052473	621.6213
5	PETUN	0.052476	0.052047	3087.811	0.062871	0.069223	626.505
6	PAMEL	0.074037	0.083719	3331.235	0.064542	0.072345	662.3683
7	SONME	0.060857	0.05851	3075.609	0.05217	0.084067	655.6308

8	TEKTU	0.049076	0.036007	3122.628	0.041346	0.040225	657.9207
9	VAKKO	0.063937	0.065654	3073.605	0.065368	0.090674	648.2437
10	YATAS	0.075861	0.072455	3074.823	0.071286	0.074635	646.3822
11	YAPRAK	0.054289	0.050942	3154.745	0.058199	0.061733	626.2442
12	TCELL	0.063675	0.059632	3139.661	0.075323	0.058825	623.1889
13	YAYLA	0.10621	0.24299	3016.412	0.11386	0.17213	608.6045
14	YUKS	0.10034	0.2389	3022.03	0.11177	0.093456	609.7408
15	YUNSA	0.056477	0.053847	3118.71	0.056979	0.053082	619.0911
16	UNLU	0.046895	0.055769	3082.867	0.056572	0.046074	617.9399
17	Overall Index	0.027822	0.021978	3006.936	0.020565	0.02734	619.0665

Researcher's findings

In order to easily compare the amount of MSE based on the training process for each of the different algorithm, the trend curves of MSEs, in different stages of repeating the algorithm, as well as the comparative curve of the actual situation of the share price of the research subject and the amount predicted by the algorithm, are given for 2 mentioned execution modes.

Conclusion:

In this research, the involvement of emotions in financial matters, including investment, is impartible, but understanding how to minimize this impact is a matter that all investors should work on. There are various theories and articles about the impact of people's emotions on investing. For example, the cycle of investors' emotions and behavioral finance are such cases that were discussed in detail here. Behavioral finance is a field of study that focuses on how psychological influences affect market outcomes. In order to predict the stock prices, artificial NN with a forward propagation algorithm, GA, capital market actors can be divided into 2 categories of investors and the traders, who each have their own characteristics, and experience has shown that both types of traders and investors can bring good returns. In general, the personality of a trader in the stock market has different characteristics, type A personality and type B personality are both investors and sellers, such as risk-taking, use of personal strategy, being up to date in news and information, mastering over the expert knowledge of financial markets, constant checking the trading boards, etc. It should be noted that not all people can be good traders and, based on the things that have been said, they should measure their personality and choose the best option for investment or trading. The PSO algorithm, ICA, and the frog leaping algorithm were trained on daily data and the total index as well as 16 daily prices chosen by the Istanbul Stock Exchange. The purpose of this study is to determine the most suitable common evolutionary algorithm used in share price forecasting algorithms with artificial NN, along with acceptability and reliability of the calculated accuracy. Based on the information received from the network training results, the average MSE for training and testing data and their standard deviation is based on Table 11: after checking the execution time of each algorithm where the iteration steps are limited to 1000 steps, we reach the result that time has an inverse relationship with the accuracy, and it is not possible to find an algorithm that, while having the appropriate accuracy, also has the appropriate speed. Some algorithms perform a simple optimization procedure in each execution, others in each execution; and in order to achieve stronger results, they obtain more optimal options with division and combination procedures. Therefore, a suitable time analysis cannot be presented, and it should be noted that the algorithms perform weaker in the same number of times of execution, they can, perhaps, at the same time, provide a more efficient result.

In summary, it should be said that many studies have proven that markets are not perfectly efficient, and the study of behavioral finance is necessary to understand market irregularities and predict future trends. By investigating the psychological biases of investors, behavioral finance provides a model for market movements and promotes effective decision making.

Suggestion for the future:

Success is a relative concept in financial markets, and each person has a different definition of success according to their goals and strategy. But in general, several factors are effective in the success of a trader, among which the following can be mentioned:

- Have a clear strategy for dealing and proceed only based on your strategy, regardless of the news, Just like a robot.
- Focus on the market you intend to invest in and enter with a thorough analysis of your target market.
- Accept your mistakes and learn from them.
- Avoid pride and greed in your dealings.
- Avoid emotional and imitative behaviors.
- Accept the responsibility of your transaction and know that all profit or loss is the result of your own analysis and action. So, avoid taking signals from others.
- Avoid unreasonable optimism and pessimism about a market.
- Be sure to observe capital management.

The outcome of your transactions should be profitable. Don't lose your spirit with just one loss and be patient.

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