KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 12 October 2023
Accepted 01 December 2023
Published online 20 December 2023

International Journal of Innovation Management and Organizational Behavior

Volume 3, Issue 5 (Special Issue on Finance and Economics), pp 23-28

IJIMOB International Journal of Innovation Management and Organizational Behavior

E-ISSN: 3041-8992

Investment Management with Innovation in Neural Networks and Metaheuristic Algorithms

Mostafa. Sohouli Vahed[1], Mohammad Ali. Aghaei[2]*, Fariborz. Avazzadeh Fath[3], Ali. Pirzad[4]

[1] Ph.D.Candidate Of Accounting ,Department Of Accounting ,Yasuj Branch,Islamic Azad University,Yasuj,Iran
[2] Associate Professor,Department Of Accounting,Tarbiat Modares University,Tehran,Iran
[3] Assistant Professor,Department Of Accounting,Gachsaran Branch ,Islamic Azad University,Gachsaran,Iran
[4] Assistant Professor,Department Of Management,Yasuj Branch,Islamic Azad University,Yasuj,Iran

*** Corresponding author email address**: aghaeim@modares.ac.ir

A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Abbasian, A., Chavoshi, S. K., Fallahshams, M., & Gholami Jamkarani, R. (2023). Investment Management with Innovation in Neural Networks and Metaheuristic Algorithms. *International Journal of Innovation Management and Organizational Behavior, 3*(5), 23-28.
https://doi.org/10.61838/kman.ijimob.3.5.3

© 2023 the authors. Published by KMAN Publication Inc. (KMANPUB), Ontario, Canada. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

A B S T R A C T

Objective: Considering the issue of selecting an optimal and desirable stock portfolio, which all investors, both individual and institutional, face.

Method: The purpose of the current research is to present trading systems with innovation based on neural networks and metaheuristic algorithms grounded in technical analysis. Therefore, the criteria affecting stock selection in technical analysis have been examined. Consequently, from among the companies listed on the Tehran Stock Exchange during the years 2011 to 2021, 135 companies were selected as samples through a systematic elimination method and analyzed using a combination of innovative neural network methods and metaheuristic algorithms.

Findings: The results have shown that such a trading system produces comparable or better results compared to Buy & Hold and other trading systems for a wide range of stocks even over relatively longer periods.

Conclusion: For future work, it is planned to focus on combining more technical parameters and using convolutional neural networks (CNN) or other deep neural network models.

Keywords: *Trading System Management, Neural Network Innovation, Metaheuristic Algorithms, Technical Analysis*

1 Introduction

The capital market and trading on the stock exchange are considered as the closest examples of a perfectly competitive market, deemed efficient and providing a suitable environment for investment. Furthermore, companies listed on the stock exchange can finance themselves with less risk compared to other methods by increasing capital and issuing new shares, and also benefit from tax exemptions. The main and noteworthy point about the stock exchange is that, firstly, it provides investment and profit conditions for most income groups, and secondly, by mobilizing small savings and capitals of the society, it generates significant capitals and turns them into economic opportunities. Participating in the stock exchange is much easier and more regulated than in other markets, hence, this

market has attracted attention in both developed and developing countries (Barzegar Abbaspour et al., 2023; Pakdelan et al., 2023). Statistics show that in developed countries such as the USA and Germany, more than 70% of the population are stockholders in the securities exchange (Pakdelan et al., 2023).

The presence of an active and thriving capital market is always recognized as one of the signs of countries' development on an international level. In developed countries, most investments are made through financial markets. Active participation of people in the stock exchange ensures the vitality of the capital market and the sustainable development of the country. The main issue that investors face in these markets is making decisions to select suitable securities for investment and forming an optimal stock portfolio (Moghadam Nia et al., 2021; Moghadamnia et al., 2020).

The investment process in a cohesive state requires the analysis of the fundamental nature of investment decisions. In this context, activities related to the decision-making process are dissected, and significant factors in the investors' activity environment that affect their decisions are examined (Chang et al., 2009; Cho, 2008; Yousefi Nejad Attari et al., 2022).

Technical analysis refers to techniques attempting to predict future trends by studying past patterns. Analysts believe changes in supply and demand can be determined and forecasted through changes in price charts (Moghadam Nia et al., 2021; Moghadamnia et al., 2020). The foundation of technical analysis rests on three principles: 1) everything is reflected in prices, 2) prices move in trends, and 3) history repeats itself. The origins of technical analysis are based on the findings and research of Charles Dow, with Dow's theories expanding in the early 1900s and evolving over time. However, technical analysis has several weaknesses, including the often visual nature of techniques, requiring constant monitoring by traders without providing precise pricing. Over time, the proliferation of tools and discussions has introduced more instruments, broadening the scope of techniques and tools to an extent that not all can be practically applied by traders. Most patterns in practice indicate similar outcomes, with some price patterns differing only in nomenclature but essentially conveying the same message. The lack of defined rules for price patterns leads to disagreements among analysts over pattern recognition or violation due to the lack of precise definitions. There's also an over-reliance on static buy and sell strategies, suggesting that the analytical aspect of price chart analysis has given way to the use of rigid technical tools, with some traders becoming so immersed in the world of techniques and tools that they forget the main objective and focus (Barzegari Khanagha & Jamali, 2016).

Contrastingly, fundamental analysis considers stock returns as a function of macroeconomic conditions, industry status, and specific company situations, including performance and financial status presented in financial statements (Saghafi & Sheri, 2004). It's based on the assumption that securities (and the market as a whole) have an intrinsic value that can be estimated by investors. The value of securities is a function of a set of fundamental variables, combining to create an expected return with a specified risk level. Fundamental analysis estimates the intrinsic value of stocks through the evaluation of fundamental variables, based on past and present data with the aim of financial forecasting. It is founded on real events and occurrences, making it more time-consuming and usually involving the collection of information from various sources compared to technical analysis.

The importance of predicting stock returns has led researchers to seek variables and indicators capable of explaining stock returns and to develop models for predicting stock return trends. Following the studies of Ball and Brown (1968) demonstrating the impact of information on stock returns, Ohlson (1993) caused a paradigm shift in accounting (Barzegari Khanagha & Jamali, 2016; Karmi et al., 2008).

Innovations in neural networks and the application of combined predictive models based on chaos theory have been explored. Pavlidis et al. (2003) introduced a combined technique for forecasting financial time series, incorporating chaos theory and neural networks trained by the Differential Evolution (DE) algorithm (Pavlidis et al., 2003). This combination has shown improved accuracy in daily currency exchange rates of yen to dollar and pound to dollar for both DE and Particle Swarm Optimization (PSO) compared to standalone neural networks. Hwang et al. (2010) proposed a combined model that models data using chaos theory and predicts forex rates with support vector regression, finding that this combination performed better in terms of Root Mean Square Error (RMSE), Mean Square Error (MSE), and Mean Absolute Error (MAE) in daily exchange rates of euro to dollar, pound, New Zealand dollar, Australian dollar, Japanese yen, and Russian ruble compared to independent techniques (Huang et al., 2010; Huang, 2008).

The exploration of neural networks in finance reflects a computational approach based on connecting multiple

IJIMOB
E-ISSN: 3041-8992

processing units or neurons, forming networks that map input sets to output sets. Significantly inspired by natural learning systems, these networks comprise complexly interconnected neurons involved in learning processes. Each connection is assigned a numerical value or weight. Neurons receive signals from connected neurons and activate if the sum of input signals exceeds a threshold. Grouped into layers, these networks produce nonlinear predictive models that learn how to adapt to specific patterns without explaining the reasons behind specific outcomes. For instance, neural networks can identify potential comorbidities with diseases (Lakonishok et al., 1994; Lee et al., 2009) and assist in diagnosis, treatment, and drug development through image analysis, ECG interpretations, and other clinical observations (Sermpinis et al., 2015).

The juxtaposition of technical and fundamental analyses with the innovative application of neural networks and chaos theory in forecasting reflects a diverse and evolving landscape in financial market prediction. These methodologies, each with its strengths and limitations, underscore the complexity of financial markets and the continuous quest for more accurate and reliable predictive models.

Therefore, considering the issue of selecting an optimal and desirable stock portfolio, which all investors, both individual and institutional, face, the purpose of the current research is to present trading systems with innovation based on neural networks and metaheuristic algorithms grounded in technical analysis. Hence, the criteria affecting stock selection in technical analysis have been examined.

2 Methods and Materials

This study is based on actual figures and information from the stock market and financial statements of companies active on the Tehran Stock Exchange. In this research, financial information has been obtained from the financial statements and accompanying notes of the companies under study, with the help of compact discs from the Tehran Stock Exchange organization, and finally, data analysis has been conducted using statistical analysis software. This research examines data obtained from the Tehran Stock Exchange market over an 11-year period from 2011 to 2022. Therefore, data from 135 companies have been examined through a systematic elimination method.

Due to the extensive volume of the statistical population and the existence of some inconsistencies among the members of the population, the following conditions have been set for selecting the statistical sample:

The companies' stocks have been traded on the stock exchange board during each year of the research period.

The fiscal year-end of the companies is the end of March, and companies that have changed their fiscal year have been excluded from the sample.

These companies have not suspended operations or changed their fiscal period during the review period.

The companies under review are not investment companies.

3 Findings and Results

The purpose of this process is to examine the proposed stock market simulation model for long-term stock index forecasting. The performance of three selected models for three identified impulses has been compared. Statistical parameters for pairwise comparisons between different model pairs have been shown, and the model with the best performance has been selected: Initially, predictions were made with each of the independent variables. For prediction using the perceptron neural network, the hyperbolic tangent activation function was used in the input layer, and the identity activation function was used in the output layer. Subsequently, the predicted data were compared with actual data. The T-test was used to compare the differences between predicted and actual data. The results of the research have shown that there is no significant difference between the actual data predicted by the perceptron neural network. Also, the Pearson correlation test was used to examine the relationship between research variables and test hypotheses, which showed that the relationship between liquidity ratio and return was positive and significant, and the relationship between return and debt ratio was negative and significant. The relationship between return and interest ratio was also positive and significant. Furthermore, the F-test was used to test the significance of the relationship between independent variables and return. The results of this test have shown that the computational F for all three explanatory variables was greater than the critical value of F. Therefore, the effect of each of the explanatory variables, including liquidity ratio, debt ratio, and interest ratio on the dependent variable, i.e., return, during the period under review, was statistically significant.

IJIMOB
E-ISSN: 3041-8992

Table 1

Pairwise Comparison of Performances

AMRules_DB03_(Nt+2) _FIL	*PER_DB03_(t+2) _CTC*	*PER_DB01_(t+2) _CTC*	Dataset	Set
-0.06	-0.12	0.00	*PER_DB01_(t+2)_CTC*	*Drift_01*
0.06	0.00	0.12	*PER_DB03_(t+2)_CTC*	
0.00	-0.06	0.06	*AMRules_DB03_(Nt+2)_FIL*	
-0.02	-0.08	0.04	*PER_DB01_(Nt+2)_CTC*	
-0.02	-0.08	0.04	*PER_DB01_(Nt+2) _WRP*	
-0.06	-0.06	0.00	*PER_DB01_(t+2) _CTC*	*Drift_02*
-0.01	0.00	0.06	*PER_DB03_(t+2) _CTC*	
0.00	0.00	0.06	*AMRules_DB03_(Nt+2) _FIL*	
0.01	0.01	0.07	*PER_DB01_(Nt+2) _CTC*	
0.02	0.02	0.08	*PER_DB01_(Nt+2) _WRP*	
-0.03	-0.10	0.00	*PER_DB01_(t+2) _CTC*	*Drift_03*
0.06	0.00	0.10	*PER_DB03_(t+2) _CTC*	
0.00	-0.06	0.03	*AMRules_DB03_(Nt+2) _FIL*	
0.06	0.02	0.10	*PER_DB01_(Nt+2) _CTC*	
0.01	0.03	0.05	*PER_DB01_(Nt+2) _WRP*	

4 Discussion and Conclusion

In developed countries, most investments are made through financial markets. Active participation of individuals in the stock market ensures the vitality of the capital market and the sustainable development of the country. The main issue that investors face in these markets is making decisions to select suitable securities for investment and forming an optimal stock portfolio. The investment process, in a cohesive state, requires the analysis of the fundamental nature of investment decisions (Moghadam Nia et al., 2021; Moghadamnia et al., 2020; Pradeepkumar & Ravi, 2017; Ravi et al., 2017; Yousefi Nejad Attari et al., 2022). In this case, activities related to the decision-making process are dissected, and significant factors in the investors' activity environment affecting their decisions are examined. Every day, extensive efforts are made to improve methods of examining and analyzing stocks in the world's financial markets. Efforts to improve stock analysis methods, especially in markets with a high number of stocks, have led to the emergence of new methods that, along with past methods, seek to answer the desire to maximize individual profit in financial markets. However, these methods have not been able to adapt themselves to the capital market conditions in Iran and have a significant impact on investors' choices. On the other hand, the transparency actions taken in recent years in the Tehran Stock Exchange have led to access to a large volume of specialized information. Proper use of this information is not possible for ordinary people and requires the use of financial experts' opinions. The abundance of information and other influential factors have made individual decision-making for selecting an appropriate stock portfolio a challenging issue, to the extent that most people have reduced their criteria for decision-making to the volume of buy and sell queues, news and rumors heard in the market, and similar issues. Managing this vast amount of information and effectively using it to improve decision-making is a controversial topic. Therefore, this research aims to propose a model that can dissect, analyze, and summarize the vast amount of information related to different companies and assist in decision-making in selecting suitable stocks for most investors.

Optimal selection for investment is every investor's goal. In the past, investors used their experiences to achieve the expected return. With advancements in financial management, investors' choices became systematic, and they were able to make optimal selections by applying various models and integrating the results with their experiences. The diversity of investment methods and the complexity of decision-making have significantly expanded in recent decades, creating the need for comprehensive and integrated models. To meet this need, financial modeling emerged from the merger of financial approaches and mathematical planning. Extensive research has been conducted on stock selection criteria and specific industries, both in the Tehran Stock Exchange and globally. The research in this specific area has focused on risk criteria specific to emerging metrics in financial literature, such as downside risk and value at risk, and their significant explanation in pricing theories like CAPM and arbitrage; using optimal technical analysis

IJIMOB
E-ISSN: 3041-8992

parameter values as input features for the neural network stock trading system management is the basis of the proposed model. Genetic algorithm innovations were used to optimize RSI parameters for bullish and bearish market conditions. Then, those optimized feature values were used as buy and sell points for the deep neural network dataset. The results show that such a trading system produces comparable or better results compared to Buy & Hold and other trading systems for a wide range of stocks even over relatively longer periods. For future work, it is planned to focus on combining more technical parameters and using convolutional neural networks (CNN) or other deep neural network models.

This study, while comprehensive in its approach to analyzing stock market data through neural networks and genetic algorithms, encounters several limitations that must be acknowledged. Firstly, the reliance on historical data from the Tehran Stock Exchange limits the generalizability of the findings to other markets with different volatility patterns and regulatory environments. Additionally, the study's focus on specific financial ratios and technical indicators may omit other potentially influential variables, such as macroeconomic factors or industry-specific trends, which could impact investment decisions. The complexity of the models used also raises questions about their applicability by individual investors without sophisticated analytical tools or financial expertise.

Future research should aim to address the limitations noted in the current study by expanding the analysis to include diverse markets and additional predictive variables. Investigating the impact of macroeconomic indicators, such as inflation rates and GDP growth, alongside the financial ratios and technical indicators used here, could provide a more holistic view of the factors influencing stock market performance. Furthermore, exploring simpler, more accessible models that can be utilized by individual investors without requiring advanced computational resources would significantly contribute to the field. The integration of artificial intelligence and machine learning techniques, beyond neural networks and genetic algorithms, offers another promising avenue for enhancing predictive accuracy and investment strategy formulation.

The findings of this study have practical implications for investors, financial analysts, and policy-makers. For investors, especially those operating in the Tehran Stock Exchange, this research underscores the importance of incorporating both financial ratios and technical indicators into their decision-making processes. Financial analysts can leverage the proposed model to refine their investment strategies and recommendations, potentially improving portfolio performance for their clients. On a broader scale, policy-makers and regulatory bodies could use insights from this study to develop educational programs aimed at enhancing the financial literacy of individual investors, focusing on the application of advanced analytical methods in investment decision-making. Such initiatives could democratize access to sophisticated investment strategies, leveling the playing field for investors of all backgrounds.

Acknowledgments

The cooperation of all participants in the research is thanked and appreciated.

Declaration of Interest

The authors of this article declared no conflict of interest.

Authors Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Ethics principles

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

References

Barzegar Abbaspour, K., Eslami Mofid Abadi, H., & Ebrahimi Shaghaghi, M. (2023). The Effect of the Auditor Attributes and Board of Directors Structure on the Possibility of Fraudulent Financial Statements of Commercial Companies. *Judgment and Decision Making in Accounting and Auditing*, *2*(7), 115-145. https://doi.org/10.30495/jdaa.2023.705530

Barzegari Khanagha, J., & Jamali, Z. (2016). Predicting Stock Returns with Financial Ratios; An Exploration in Recent Researches. *Journal of Accounting and Social Interests*, *6*(2), 71-92. https://doi.org/10.22051/ijar.2016.2432

Chang, J.-F., Chang, C.-W., & Tzeng, W.-Y. (2009). Forecasting exchange rates using integration of particle swarm optimization and neural networks. 2009 Fourth International Conference on Innovative Computing, Information and Control (ICICIC),

Cho, W. N. (2008). *Robust portfolio optimization using conditional value at risk final report*. https://scholar.google.com/scholar?lookup=0&q=Robust+Portfolio+Optimization+Using+Conditional+Value+At+Risk&hl=en&as_sdt=0,5

Huang, S.-C., Chuang, P.-J., Wu, C.-F., & Lai, H.-J. (2010). Chaos-based support vector regressions for exchange rate forecasting. *Expert Systems with Applications*, *37*(12), 8590-8598. https://doi.org/10.1016/j.eswa.2010.06.001

Huang, X. (2008). Portfolio selection with a new definition of risk. *European Journal of Operational Research*, *186*(1), 351-357. https://www.sciencedirect.com/science/article/pii/S0377221707001464

Karmi, G., Moradi, M., & Mahmoudian, O. (2008). An analytical study of the role of financial ratios in explaining stock returns, Strategic. *Management Research Quarterly*, *16*(42), 75-88. https://www.magiran.com/paper/725677

Lakonishok, J., Shleifer, A., & Vishny, R. W. (1994). Contrarian Investment, Extrapolation, and Risk. *The Journal of Finance*, *49*(5), 1541-1578. https://doi.org/10.1111/j.1540-6261.1994.tb04772.x

Lee, W.-S., Tzeng, G.-H., Guan, J.-L., Chien, K.-T., & Huang, J.-M. (2009). Combined MCDM techniques for exploring stock selection based on Gordon model. *Expert Systems with Applications*, *36*(3, Part 2), 6421-6430. https://doi.org/10.1016/j.eswa.2008.07.084

Moghadam Nia, E., Toloei Ashlaghi, A., & Afshar Kazemi, M. A. (2021). Designing a change model for developing human resource training in technology transfer in learning organizations using a metaheuristic framework. *Educational Development of Judishapur*, *12*(2), 657-665. https://edj.ajums.ac.ir/article_136104.html?lang=en

Moghadamnia, E., TOLOEI, A. A., & AFSHAR, K. M. A. (2020). Analysing The Role Of Technology Transfer In The Professional Ethics Of Employees. https://scholar.google.com/scholar?lookup=0&q=Analysing+The+Role+Of+Technology+Transfer+In+The+Professional+Ethics+Of+Employees&hl=en&as_sdt=0,5

Pakdelan, S., Azarberahman, A., & Rafiee, S. (2023). Examining the relationship between the characteristics and expertise of the board of directors and sustainability performance in companies listed on the Tehran stock exchange. *Advances in Finance and Investment*, *4*(1), 54-29. https://doi.org/10.30495/afi.2023.1971292.1165

Pavlidis, N. G., Tasoulis, D. K., & Vrahatis, M. N. (2003). Financial forecasting through unsupervised clustering and evolutionary trained neural networks. The 2003 Congress on Evolutionary Computation, 2003. CEC'03.,

Pradeepkumar, D., & Ravi, V. (2017, 2017//). FOREX Rate Prediction: A Hybrid Approach Using Chaos Theory and Multivariate Adaptive Regression Splines. Proceedings of the 5th International Conference on Frontiers in Intelligent Computing: Theory and Applications, Singapore.

Ravi, V., Pradeepkumar, D., & Deb, K. (2017). Financial time series prediction using hybrids of chaos theory, multi-layer perceptron and multi-objective evolutionary algorithms. *Swarm and Evolutionary Computation*, *36*, 136-149. https://doi.org/10.1016/j.swevo.2017.05.003

Saghafi, A., & Sheri, S. (2004). Role of Fundamental Accounting Information in Predicting Stock Return. *Empirical Studies in Financial Accounting*, *2*(8), 87-120. https://qjma.atu.ac.ir/article_4091.html

Sermpinis, G., Stasinakis, C., Theofilatos, K., & Karathanasopoulos, A. (2015). Modeling, forecasting and trading the EUR exchange rates with hybrid rolling genetic algorithms—Support vector regression forecast combinations. *European Journal of Operational Research*, *247*(3), 831-846. https://doi.org/10.1016/j.ejor.2015.06.052

Yousefi Nejad Attari, M., Ahmadi, M., Ala, A., & Moghadamnia, E. (2022). RSDM-AHSnet: Designing a robust stochastic dynamic model to allocating health service network under disturbance situations with limited capacity using algorithms NSGA-II and PSO. *Computers in Biology and Medicine*, *147*, 105649. https://doi.org/10.1016/j.compbiomed.2022.105649

E-ISSN: 3041-8992