

# INED-STOCK PREDICTION USING MACHINE LEARNING

M Devi Aswin Shanker

*Dept.of Computer Science and Engineering  
St.Joseph's College of Engineering and Technology  
Palai,Kottayam,Kerala*

Nithin Mani

*Dept.of Computer Science and Engineering  
St.Joseph's College of Engineering and Technology  
Palai,Kottayam,Kerala*

Rithin Soney

*Dept.of Computer Science and Engineering  
St.Joseph's College of Engineering and Technology  
Palai,Kottayam,Kerala*

Kassinath V N

*Dept.of Computer Science and Engineering  
St.Joseph's College of Engineering and Technology  
Palai,Kottayam,Kerala*

Praseetha V M

*Dept.of Computer Science and Engineering  
St.Joseph's College of Engineering and Technology  
Palai,Kottayam,Kerala*

**Abstract**—Stock market prediction is considered an important activity that can lead to lucrative profits through sound decisionmaking. Analyzing the sentiments of the news and opinions surrounding a stock is also a part of predicting the stock's value. The newest trend in stock market prediction involves using machine learning, which makes predictions based on the values of current stock market values by training on their previous values. Machine learning uses different models to make predictions more accurate and reliable. The project focuses on the use of machine learning to predict stock values. The data which is collected for stock prediction includes the open, close, low, high, and volume of a stock, that is, the historical prices of a stock. The project also allows the users to manage their portfolios and find the total value of stocks currently held by them.

**Index Terms**—logistics, dynamic route allocation, transaction logging

## I. INTRODUCTION

A stock, also known as equity, represents the ownership of a part of the issuing corporation. The Stock Market is where shares of publicly listed companies are bought and sold. Companies initially offer their shares to the public in the primary market through an IPO to raise capital. Once these new securities are sold, they are traded in the secondary market, where investors can buy shares from other investors at the prevailing market price or a mutually agreed-upon price. The secondary market, also known as stock exchanges, is regulated by a regulatory authority. In India, the Securities and Exchange Board of India (SEBI) governs both the primary and secondary markets. Stock exchanges provide a platform for stockbrokers to facilitate the trading of company stocks and other securities. Stocks must be listed on an exchange to be bought or sold, and they form a fundamental part of many individual investors' portfolios. Therefore, stock exchanges serve as a meeting place for buyers and sellers of stocks. Stock

market prediction involves attempting to forecast the future value of a company's stock or other financial instruments traded on an exchange. Successful predictions can lead to significant profits. The efficient-market hypothesis suggests that stock prices reflect all currently available information and any price changes that are not based on newly revealed information and thus are inherently unpredictable. Others disagree and those with this viewpoint possess myriad methods and technologies which purportedly allow them to gain future price information.

## II. OBJECTIVE AND SCOPE

The main objective of this stock prediction website is to predict stock market indices with precision and accuracy. What our website does is make long-term predictions about the future of stocks. Our website also educates the public with the help of an in-depth list of instructions, which is available in the former. Our system intends to make use of external factors which enables people to analyze stock market movements. It also aims to enable the users to manage their portfolios, thereby calculating the total stock value held by them. This feature would also allow users to evaluate their overall profit and loss in a single location. This will help them to learn more about market patterns and enable them to make better choices or decisions in the future. The system is to be developed using a machine learning algorithm, which can provide a better accuracy rate for long-term stock prediction.

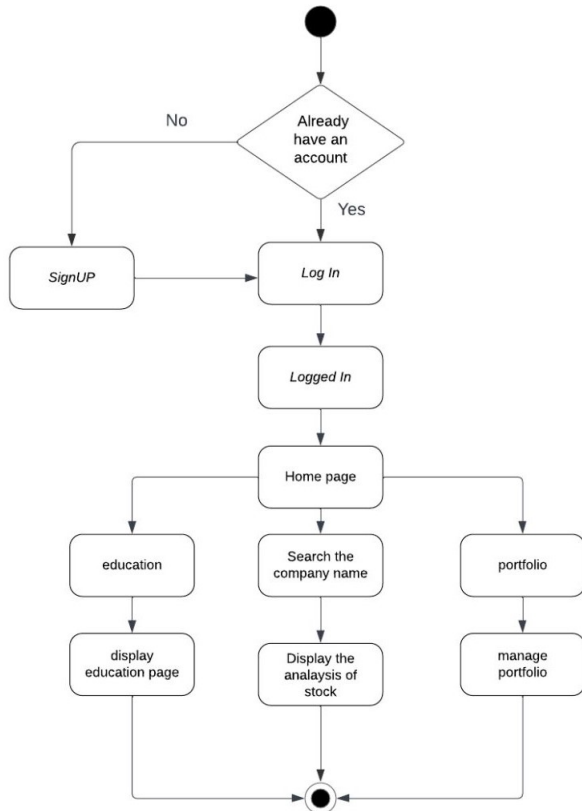


Fig. 1. Activity diagram of proposed system

### III. LITERATURE SURVEY

#### A. Stock Prediction

Stock price analysis has been a critical area of research and is one of the top applications of machine learning. A stock market is a public market where people can buy and sell shares for publicly listed companies. The stocks, also known as equities, represent ownership in the company. The stock exchange is the mediator that allows the buying and selling of shares. Stock Price Prediction using machine learning helps people discover the future value of company stock and other financial assets traded on an exchange. The entire idea of predicting stock prices is to gain significant profits. Predicting the performance of the stock market is a hard task to do. There are other factors involved in the prediction, such as physical and psychological factors, and so on. All these factors combine to make share prices dynamic and volatile. This makes it very difficult to predict stock prices with good accuracy.

##### 1) Importance of Stock Market:

- Stock markets help companies to raise capital.
- It helps generate personal wealth.

- Stock markets serve as an indicator of the state of the economy.
- It is a widely used source for people to invest money in companies with high growth potential.

2) *Importance of Stock Market Prediction:* Stock market prediction is the act of trying to determine the future value of company stock or other financial instruments traded on an exchange. The successful prediction of a stock's future price could yield significant profit. The efficient-market hypothesis suggests that stock prices reflect all currently available information and any price changes that are not based on newly revealed information and thus are inherently unpredictable.

3) *Prediction Methods:* Prediction methodologies fall into three broad categories. They are fundamental analysis, technical analysis (charting), and technological methods.

a) : Fundamental analysts are concerned with the company that underlies the stock itself. They evaluate a company's past performance as well as the credibility of its accounts. Many performance ratios are created that aid the fundamental analyst in assessing the validity of a stock, such as the P/E ratio. What fundamental analysis in the stock market is trying to achieve is finding out the true value of a stock, which then can be compared with the value it is being traded with on stock markets and therefore finding out whether the stock on the market is undervalued or not.

b) : Technical analysts or chartists are not concerned with any of the company's fundamentals. They seek to determine the future price of a stock based solely on the trends of the past price (a form of time series analysis). Numerous patterns are employed such as the head and shoulders or cup and saucer. Alongside the patterns, techniques are used such as the exponential moving average (EMA), oscillators, support and resistance levels, or momentum and volume indicators.

c) : With the advent of the digital computer, stock market prediction has since moved into the technological realm. The most prominent technique involves the use of artificial neural networks (ANNs) and Genetic Algorithms(GA).

#### B. Existing solutions

The following research papers were reviewed which contain the various existing solutions for predicting the movement of the stock market.

1) *Predicting Stock Market Trends Using Machine Learning and Deep Learning Algorithms Via Continuous and Binary Data; a Comparative Analysis:* For experimental evaluations, four groups of stocks from the Tehran Stock Exchange are selected, namely diversified financials, petroleum, non-metallic

minerals, and basic metals. This study compares nine machine learning models (Decision Tree, Random Forest, Adaptive Boosting, eXtreme Gradient Boosting, Support Vector Classifier, Naïve Bayes, K-Nearest Neighbors (KNN), Logistic Regression, and Artificial Neural Network) and two powerful deep learning methods (Recurrent Neural Network (RNN) and Long short-term memory (LSTM))[1]. The advantage is that LSTM and RNN are more accurate than the other algorithms. The disadvantage is that running time is more for deep learning algorithms.

2) *Stock Trend Prediction Using Candlestick Charting and Ensemble Machine Learning Techniques With a Novelty Feature Engineering Scheme*: An ensemble machine learning approach is created for daily stock pattern prediction by combining traditional candlestick charting with artificial intelligence methods. The approach utilizes an eight-trigram feature engineering scheme for inter-day candlestick patterns. Various machine learning techniques, including logistic regression, support vector machine (SVM), k-nearest neighbors (KNN), random forest, gradient boosting decision tree, and long short-term memory (LSTM), are employed to predict the direction of the closing price based on stock data. Deep learning algorithms, such as LSTM, are shown to be good for making predictions[2]. However, one limitation is that certain patterns may not be effectively utilized for profit due to the stop-trading rules in the Chinese market.

3) *Stock Ranking Prediction Using List-Wise Approach and Node Embedding Technique*: This study uses an approach that utilizes a graph for stock ranking prediction by using stock relation information as input for the machine learning model. A novel measure called Normalized Rank Biased Overlap for top-k (NRBO@k) stocks is introduced for stock ranking prediction. The method incorporates LSTM, an optimal loss function, NRBO@k, and Node2Vec. A significant advantage of this approach is that the use of a list-wise loss function greatly enhances the stock ranking performance within a graph-based framework. Additionally, Node2Vec reduces the training time for graph-based stock ranking prediction methods[3]. However, a disadvantage is observed when the stock relation graph is dense, such as the New York Stock Exchange with Industry graph, as the performance of Node2Vec slightly degrades compared to the baseline model. .

4) *Decision Fusion for Stock Market Prediction: A Systematic Review*: The aim of this study was to conduct a systematic review of research concerning decision fusion in the context of stock market prediction. The review focused on examining the characteristics of base learners and decision fusion methods utilized in the literature. Specifically, the research trend on this topic, which has shifted over the past two decades, is discussed. This review also presents future directions in applying decision fusion to stock market prediction, such as the fusion of forecasts with different data types, using

new algorithms as base learners, and integrating sentiment analysis with decision fusion techniques[4]. The advantage is that better prediction is often achieved by combining forecasts from multiple models rather than using a single model in isolation. The disadvantage is that a forecasting model that applies decision fusion can consist of only homogeneous base learners, such as ANN, decision trees, SVM, and LSTM, or heterogeneous base learners employing various algorithms.

5) *Which Artificial Intelligence Algorithm Better Predicts the Chinese Stock Market?*: This review uses high-frequency data to examine the ability to make predictions of deep learning algorithms, and also three traditional ANNs: 1) the Back Propagation (BP) neural network; 2) the Extreme Learning Machine (EML); and 3) the Radial Basis Function (RBF) neural network are compared. It was found that the deep learning method of predicting stock index futures had better predictive power than the BP neural network, EML and RBF neural network in its fitting degree and directional predictive accuracy[5]. The advantage is that the predictive power of deep learning is superior to that of BP neural network, EML and additionally RBF neural network has high accuracy too. The disadvantage is that although RBF neural network is very accurate, it requires so much more running time and this advantage is obviated.

6) *Optimizing LSTM for time series production in Indian stock market*: Long Short-Term Memory (LSTM) is among the most popular deep learning models used today. It is also being applied to time series prediction which is a particularly hard problem to solve due to the presence of long-term trends, seasonal and cyclical fluctuations, and random noise. The performance of LSTM is highly dependent on the choice of several hyper-parameters which need to be chosen very carefully, in order to get good results. In this paper, this research gap was addressed. A dataset was created from the Indian stock market and an LSTM model was developed for it. It was then optimized by comparing stateless and stateful models and by tuning for the number of hidden layers[6]. The advantage is that stateless LSTM is more stable compared to stateful LSTM. It can be concluded that for time series prediction problems, a stateless LSTM model is preferable due to its higher stability. The disadvantage is that the present work is limited to tuning the basic LSTM architecture.

7) *Prediction of Stock price direction using a hybrid GA-XG Boost algorithm with a three-stage feature engineering process*: This study proposes a hybrid GA-XGBoost prediction system with an enhanced feature engineering process consisting of feature set expansion, data preparation, and optimal feature set selection using the hybrid GA-XGBoost algorithm. This study experimentally verifies the importance of the feature engineering process in stock price direction prediction by comparing obtained feature sets to the original dataset as well as improving prediction performance to out-

perform benchmark models. Specifically, the most significant accuracy increment comes from feature expansion that adds 67 technical indicators to the original historical stock price data. This study also produces a parsimonious optimal feature set using the GA-XGBoost algorithm that can achieve the desired performance with substantially fewer features[7]. The advantage is that the proposed prediction model achieves better performances with more flexibility as the prediction period can be changed arbitrarily. The disadvantage is that the experiment used only a predefined number of technical indicators.

8) *Predicting the direction of US stock prices using effective Transfer Entropy and ML techniques:* This work integrates time-varying efficient transfer entropy with multiple machine learning algorithms to predict the direction of US stock prices. At first, it was explored that the effective transfer entropy based on 3 and 6 months moving windows can be regarded as the market explanatory variable by analyzing the association between the financial crises and Granger-causal relationships among the stocks. Then, it was discovered that the prediction performance on the stock price direction can be improved when the effective transfer entropy-driven variable is integrated as a new feature in the logistic regression, multilayer perceptron, Random Forest (RF), eXtreme Gradient Boosting, and LSTM network[8]. The advantage is that the utilization of effective transfer entropy network indicators as new features improves the prediction of the stock price direction for all cases of the Logistics Regression, Multilayer perceptron, RF, eXtreme Gradient Boosting, and LSTM. The limitation of this research is the computation time to obtain the time-varying effective transfer entropy.

9) *Stock market prediction using machine learning:* The goal of stock market prediction is to forecast the value of a company's financial stocks in the future. The application of machine learning, a recent development in stock market prediction technology, produces forecasts based on the values present indices of the stock market by training on their historical values. Multiple models are used by machine learning to facilitate and authenticate prediction. The paper concentrates on LSTM-based machine learning and regression for stock value prediction. Open, close, low, high, and volume are all the factors considered[9]. The advantage is that two techniques have been utilized in this paper:

LSTM and Regression, on the Yahoo finance dataset. Positive outcomes have been achieved by both strategies due to an increase in forecast accuracy. The disadvantage is that LSTM is time-consuming to train.

10) *Stock closing price prediction based on sentiment analysis and LSTM" in Neural Computing and Applications:* The proposed method is to gradually decompose the complex sequence of stock prices by adopting empirical modal decomposition, which yields better prediction accuracy. Also,

LSTM is adopted due to its advantages of analyzing relationships among time-series data through its memory function. Experiment results show that the revised LSTM model can not only improve prediction accuracy but also reduce time delay. It is confirmed that investors' emotional tendency is effective to improve the predicted results; the introduction of empirical modal decomposition can improve the predictability of inventory sequences; and the attention mechanism can help LSTM to efficiently extract specific information and current mission objectives from the information ocean[10]. The advantage is that the input values fed to the network not only go through several LSTM layers but also propagate through time within one LSTM cell. The disadvantage is that LSTMs take longer to train, LSTMs require more memory to train and LSTMs are easy to overfit.

11) *Transformer-based attention network for stock market prediction :* Stock movement forecasting is a crucial area of research that can aid market participants in improving their trading choices. This makes use of the Transformer Encoder-based Attention Network architecture, which is built on the exact description provided by small-sample feature engineering. It uses a small sample of 5 calendar days to capture the temporal dependence of financial data. To extract features and effectively analyze financial data for precise prediction, this deep learning system also employs the transform model and various attention methods. [11].

The advantage is that this technique uses sentiment analysis along with price-based prediction to increase accuracy.

The disadvantage is that a fundamental analysis of the stock is not done which can result in misprediction.

12) *Enhancing stock movement prediction with market index and curriculum learning:* Directly predicting stock price movement using historical trading data presents two challenges: Due to two factors: (1) the stock market's time variability, which causes a mismatch between training and test data and poor generalization performance; and (2) the market's noise, which makes it challenging to detect price movements. It suggests a technique for improving stock movement forecasting using market indices and curricular learning. Utilize autoencoder and mixture density network separately based on these two hypotheses to produce trading mode deviation and price prediction Inaccuracy of samples [12]. The benefit is that these methods can be applied to determine how uncertain price movement is. The downside is that long-term movement cannot be accurately predicted by Trading Mode Deviation and Price Prediction Uncertainty.

13) *Stock market prediction using LSTM Recurrent Neural Network :* The abnormality of the financial market does not allow simple models to predict future asset values with higher accuracy. It aims to build a model using Recurrent Neural

Networks and especially Long-Short Term Memory model (LSTM) to predict future stock market values[13].

The advantage is that LSTM is considered as most accurate in predicting movement. The disadvantage is that less amount of datasets is used to come to a decision.

14) *Stock market prediction using ML* : Accurate prediction of stock prices plays an increasingly prominent role in the stock market where returns and risks fluctuate wildly. It introduces the theoretical knowledge of the time series model and LSTM neural network and selects real stocks in the stock market, performs modeling analysis and predicts stock prices, and then uses the root mean square error to compare the prediction results of several models.[14]

The advantage is that combination of two methods helps in increasing the accuracy. The disadvantage is that longer training time is required.

15) *Performance attribution of machine learning methods for stock returns prediction*: Analyzing the performance of investable portfolios built using predicted stock returns from machine learning methods and attributing their performance to linear, marginal non-linear, and interaction effects. Light Gradient-Boosting Machine(LightGBM) method is used to predict the future of stock[15]. The advantage is that LightGBM requires less training time. The disadvantage is that LightGBM is less accurate when a higher amount of data is used.

16) *LSTM-based deep learning model for stock prediction and predictive optimization model*: It proposes a novel method of regression for stock price prediction. The regression model has been implemented on LSTM deep neural network. The predictions once obtained are used to construct an investment portfolio using a new portfolio optimization model[16]. The advantage is that

A predicted portfolio model is proposed making it unique as compared to other works in a similar area. It is also observed that the performance of LSTM is far superior as compared to multilayer perception. The disadvantage is that the limitation of the model is the access time required to calculate predictions; the process may further slow down due to the non-stationary behavior of data.

17) *Predicting Stock market index using LSTM*: This study uses a long short-term memory (LSTM), a particular neural network architecture, to predict the next-day closing price of the SP 500(The Standard and Poor's 500 index). A well-balanced combination of nine predictors is carefully constructed under the umbrella of the fundamental market data, macroeconomic data, and technical indicators to capture the behavior of the stock market in a broader sense[17]. The

advantage is that Single layer LSTM model provides a superior fit and high prediction accuracy compared to multilayer LSTM models. The disadvantage is that it does not incorporate unstructured textual information in the model such as investor sentiment from social media, the most recent policy-related news, as well as market experts' research studies.

18) *Stock closing price prediction using ML* : Due to the financial stock markets' volatility and non-linearity, accurately predicting stock market returns is an extremely difficult undertaking. The stock's open, high, low, and close prices are used to create new variables that are used as model inputs. By use of standardized strategic indicators, the models are assessed: Root-mean-square deviation

and mean absolute percentage error[18]. The advantage is that the Random forest algorithm has been termed as one of the easiest to use and most flexible machine learning algorithm, it gives good accuracy in the prediction. The disadvantage is that

The historical dataset available on the company's website consists of only a few features like the high, low, open, close, adjacent close value of stock prices, etc., which are not sufficient enough to predict stock accurately.

19) *A stock price prediction method based on meta-learning and variational mode decomposition* : The prediction accuracy and obtain better prediction results, a new stock price prediction model called Variational Mode Learning(VML) is proposed in this paper. First, the VML model slices the stock price series to obtain multiple window series, then uses variational mode decomposition to decompose the window series to obtain multiple subseries. Unlike existing decomposition-based methods, VML decomposes the window series to solve the data leakage problem. Next, a model-agnostic meta-learning algorithm and long short-term memory (LSTM) network are applied to predict the subseries.[19]The advantage is that

VML model merges the prediction results of the subseries to obtain the final predicted stock price. This method improves the accuracy of the prediction. The disadvantage is that it does not predict long-term stock prices and does not have any portfolio management system for the users.

20) *Stock market index prediction using Deep transformer model* : From Convolutional Neural Networks(CNN) to Recurrent Neural Networks(RNN), Deep learning approaches do well at predicting stock market indexes because of their improved capacity to grasp the non-linear aspects of stock markets. In this study, we use Transformer, the most recent deep learning framework, to forecast the stock market index. LSTM stands out among prediction models utilizing CNN, RNN, and LSTM due to its remarkable ability to retain long-term memory in stock sequences. The advantage lies in the

superior performance of the Transformer model compared to traditional deep learning models, as well as the buy and hold strategy when considering prediction accuracy and net value analysis. [20].

The disadvantage is that as the Transformer model is still a recent invention and it has so few implementations for financial time series, future research should be conducted.

#### IV. CONCLUSION

Currently people follow copy trading pattern which means that a single person makes a trade and people follow the same pattern. The existing solutions can be used to predict the movement of the stock market but these systems do not provide additional financial knowledge to the users.

Since the stock market is volatile there is a need to estimate the values of stocks and to predict the movement of the stock market. It is important to study the market and its components so as to correctly analyze the market situation and to make good, long-term decisions. We use both external and internal market conditions to predict the movement of the stock. The website provides the necessary tools to predict the movement of the stocks and it also provides guidance to the users in the form of in-depth instructions.

#### REFERENCES

- [1] M. Nabipour, P. Nayyeri, H. Jabani, S. S. and A. Mosavi, "Predicting Stock Market Trends Using Machine Learning and Deep Learning Algorithms Via Continuous and Binary Data; a Comparative Analysis," in IEEE Access, vol. 8, pp. 150199-150212, 2020, doi: 10.1109/ACCESS.2020.3015966.
- [2] Y. Lin, S. Liu, H. Yang and H. Wu, "Stock Trend Prediction Using Candlestick Charting and Ensemble Machine Learning Techniques With a Novelty Feature Engineering Scheme," in IEEE Access, vol. 9, pp. 101433-101446, 2021, doi: 10.1109/ACCESS.2021.3096825.
- [3] S. Saha, J. Gao and R. Gerlach, "Stock Ranking Prediction Using List-Wise Approach and Node Embedding Technique," in IEEE Access, vol. 9, pp. 88981-88996, 2021, doi: 10.1109/ACCESS.2021.3090834.
- [4] C. Zhang, N. N. A. Sjarif and R. B. Ibrahim, "Decision Fusion for Stock Market Prediction: A Systematic Review," in IEEE Access, vol. 10, pp. 81364-81379, 2022, doi: 10.1109/ACCESS.2022.3195942.
- [5] L. Chen, Z. Qiao, M. Wang, C. Wang, R. Du and H. E. Stanley, "Which Artificial Intelligence Algorithm Better Predicts the Chinese Stock Market?," in IEEE Access, vol. 6, pp. 48625-48633, 2018, doi: 10.1109/ACCESS.2018.2859809.
- [6] Anita Yadava, C K Jhaa, Aditi Sharan "Optimizing LSTM for time series production in indian stock market" in Procedia Computer Science 167 (2020) 2091–2100
- [7] Kyung Keun Yun,Sang Won Yoon,Daehan Won "Prediction of Stock price direction using a hybrid GA-XG Boost algorithm with a three stage feature engineering process" in Expert Systems with Applications 186 (2021)115716
- [8] Sondo Kim , Seungmo Ku , Woojin Chang, and Jae Wook Song "Predicting the direction of US stock prices using effective Transfer Entropy and ML techniques" in Digital Object Identifier 10.1109/ACCESS.2020.3002174
- [9] Ishita Parmar, Navanshu Agarwal, Sheirsh Saxena, Ridam Arora, Shikhin Gupta, Himanshu Dhiman, Lokesh Chouhan "Stock market prediction using machine learning" in Conference Paper,December 2018 DOI: 10.1109/ICSCCC.2018.8703332
- [10] Jin, Zhigang Yang, Yang Liu, Yuhong. (2020)."Stock closing price prediction based on sentiment analysis and LSTM" in Neural Computing and Applications. 32. 10.1007/s00521-019-04504-2.
- [11] Qiuyue Zhang, Chao Qin, Yunfeng Zhang, Fangxun Bao, Caiming Zhang, Peide Liu,"Transformer-based attention network for stock movement prediction,Expert Systems with Applications",Volume 202,2022,117239,ISSN 0957-4174,https://doi.org/10.1016/j.eswa.2022.117239.
- [12] Jiahao Yang, Wenkai Zhang, Xuejun Zhang, Jun Zhou, Pengyuan Zhang,"Enhancing stock movement prediction with market index and curriculum learning,Expert Systems with Applications",Volume 213, Part A,2023,118800,ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2022.118800
- [13] Adil Moghar, Mhamed Hamiche,"Stock Market Prediction Using LSTM Recurrent Neural Network",Procedia Computer Science,Volume 170,2020,Pages 1168-1173,ISSN 1877-0509,https://doi.org/10.1016/j.procs.2020.03.049.
- [14] Subasi, Abdulhamit Amir, Faria Bagedo, Kholoud Shams, Asmaa SARIRETE, Akila. (2021). "Stock Market Prediction Using Machine Learning. Procedia Computer Science". 194. 173-179. 10.1016/j.procs.2021.10.071.
- [15] Stéphane Daul, Thibault Jaisson, Alexandra Nagy,"Performance attribution of machine learning methods for stock returns prediction,The Journal of Finance and Data Science",Volume 8,2022,Pages 86-104,ISSN 2405-9188,https://doi.org/10.1016/j.jfds.2022.04.002.
- [16] Akhter Mohiuddin Rather "LSTM based deep learning model for stock prediction and predictive optimization model" in EURO Journal on Decision Processes,Volume 9, 2021, 100001
- [17] Hum NathBhandari, Binod Rimal, Nawa Raj Pokhrel, Ramchandra Rimal, Keshab R.Dahale Rajendra K.C.Khatri "Predicting Stock market index using LSTM" in Machine Learning with Applications,Volume 9, 15 September 2022, 100320
- [18] Mehar Vijha , Deeksha Chandolab, Vinay Anand Tikkiwalb, Arun Kumar c "Stock closing price prediction using ML" in Procedia Computer Science 167 (2020) 599–606
- [19] Tengeng Liu,Xiang Ma,Shuo Li,Xuemei Li,Caiming Zhang "A stock price prediction method based on meta learning and variational mode decomposition " in Knowledge-Based Systems,Volume 252, 27 September 2022, 109324
- [20] Chaojie Wang,Yuanyuan Chen,Shuqi Zhang,Qiuhui Zhang "Stock market index prediction using Deep transformer model" in Expert Systems with Applications,Volume 208, 1 December 2022, 118128