A METHODICAL REVIEW OF SECURITY MARKETS USING STATISTICAL AND MACHINE LEARNING TECHNIQUES

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ABSTRACT:
Stock market pattern predictions are considered to be an important and most effective activity. Therefore, stock prices will yield lucrative gains, if they make informed decisions. Stock market-related forecasts are a major challenge for investors due to stagnant and noisy data. Therefore, forecasting the stock market is a big challenge for investors to invest their money for more profit. Stock market predictions use mathematical strategies and learning tools. This study provides a comprehensive overview ofout of 30 research papers recommending methods, including computational methods, machine learning algorithms, performance parameters, and selected publications. Studies are selected based on research questions. Therefore, these selected studies help to find the ML techniques along with their data set for stock market forecasting. Most ANN and NN techniques are used to get accurate stock market forecasts. Although a lot of work has been done, the latest stock market-related prediction methodology has many limitations. In this study, it can be assumed that the stock market forecast is an integrated process and the characteristic parameters for the stock market forecast should be examined more closely.

KEYWORDS: Stock market prediction, Machine learning (ML) Classification, Deep learning, Support vector machine (SVM), Neural networks (NN).

INTRODUCTION

One of the most fascinating inventions of our time is the financial markets. These financial markets have a great influence [1] in many areas such as economics, employment technology. Investors have used two main strategies to make decisions in the stock market to invest money and get more returns with less risk. The development of[2] stock market forecasts has gained great importance among expert analysts and investors. Analysis of stock market movements [3] and price movements is extremely difficult due to the choppy market environment. The stock price complication changes many factors including quarterly earnings announcements and market news. Stock indices[4] are calculated using their market capitalization. Therefore, an accurate stock market forecast[5] is a very difficult task in changing the market world. Market researchers and analysts [6, 7]were interested in developing and testing stock market behavior. Therefore, different types of statistical techniques are applied; including autoregressive integrated moving average and clustering for stock market

forecasts, because this model provides historical evidence and postulatestheories of normality. Extensive research [8, 9]has been conducted in the field of stock market forecasting applications using SVM, NN and Genetic Adversarial Network (GAN) ML techniques. When guessing the stock market price index [10], the data analyzer used anArtificial Neural network (ANN) and Support Vector Regression (SVR) ML algorithms. Every ML algorithm has a way of learning patterns. Some of the authors [11] have proposed a hybrid method and it is a combination of a basis set and anArtificial Neural Network (ANN) used to calculate the Relative Strength Index (RSI). The RSI acts as a gauge oscillator, comparing past price strength to current price. The results show that the proposed hybrid technique could handle large swings in stock market values with high accuracy compared to other ML approaches.

In general, some of the researchers [12] apply a combination of Long- Short Term Memory (LSTM) with a genetic algorithm (GA) to the Korean stock price index for stock market forecasts using available financial data. Many networks [13, 14] use the predicted stock pattern feedback network. The main purpose of this study is to provide an overview of stock market forecasting strategies that are very helpful in predicting the stock market in the future.Therefore, this review looks at various statistical and MLtechniques for stock market forecasting along with their datasets. The analysis should be performed using different methodologies, performance matrices, data setsused and stock market forecasting techniques.Therefore, this study reads as follows:

Section 1: Defines the detailed introduction of the stock market forecast.
Section 2: Describes the need related to stock market forecasting.
Section 3: Describes the research methodology for the selection of the topics.
Section 4: Provides an overview of the findings and discussions.
Section 5: Provides the research findings.

NEED FOR THE STUDY:

In the stock market, the investor shows an interest in making a profit by investing some money in the stock market. The stock market has attracted interest from investors due to advanced applications, where predictions can lead to prosperous market predictions. Predicting the movements [15] of the stock market depends precisely on the expected information. The tools used for stock market forecasting [16,17] can track the market and monitor what can be used to make the right decisions. The stock market has to processpieces of information [18]about industrial stocks, covering the entire financial market.These are adjusted according to the business situation of the investors [19, 21], taking sales and purchases into account. Various factors affecting the position of the market are the estimate of future profits, a press release about profits and changes in management, etc. Therefore, an accurate stock market forecast [22] helps investors to make better decisions. With ML techniques, the high-riskinvestor can make more money. Fig.1 describes the stock exchange process.

In Fig. 1, real-time data is first collected from various sources either websites or legacy datasets such as NASDAQ [23] based on their price index. The price index is a subset of the stock market and allows investors to compare the current price to past market prices to calculate performance. After collecting the data, the collected data is pre-processed[24]to remove noise and other parameters.Then the pre-processed data can be useful for stock market forecasts. Feature selection methods select some features [25] from a large amount of data. Some of the user-friendly applications or data analysis functions divide the data set into two subcategories, namely current and predictions. These details are very helpful to make better trading decisions. After a firm decision, a price index notification [26,27]will be sent to investors.This notification is very useful for investors as this notification [28]reports the profit

or loss status for the price index. If the status generated by the application is[29] profit, then the investor can use the shares for high turnover and if the price index is low [30] then more attention is paid to the development in order to make better decisions.
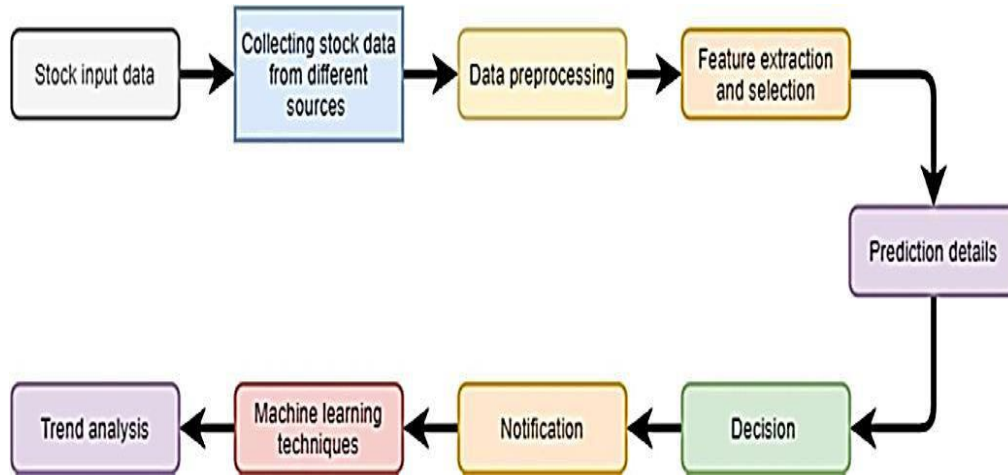

Fig. 1: Process of Predicting Stock Market

APPROACH:

The main goal of our survey is to summarize the empirical evidence for stock market forecasts based on ML models. In this approach, five research questions (RQ1, RQ2, RQ3, RQ4, RQ6) are subject to the narrative synthesis method and one research question (RQ4) is subject to the vote counting method.

The research approach includes the research questions that help extract information. From the selected studies we constructed some research questions listed as follows:

RQ1.: What are the Different Statistical Tools, used in a Stock Market Analysis?

RQ2.: What are the different types of ML algorithms used to predict the stock market?

RQ3:What different types of data sets are used for stock market forecasts?

RQ4.: Has a hybrid ML model approach been used for stock market forecasting or not?

RQ5: What different performance parameters are used in stock market forecasts?

RQ6: Which are the most important magazines for stock market forecasts?

RESULTSANDDISCUSSIONS:

Weareselectingsomeresearcharticlesbasedonresearchquestions.Inthissection,weare reviewingtheresearchquestionwhichisdescribedintheabovesection.Theresearchquestio nsdescribedas:

I. RQ1.: Whatarethevariousstatisticaltoolsareusedinastockmarketanalysis?

After selected studies, we are analyzing and extract the information. For more, we are studied some statistical tools which areusedinstockmarketanalysis.Thevariousstatisticalmethodswereused in the analysis containing basic descriptive for interpretationofthestockmarket.SomeoftheselectedstudiesuseARIMA,Regression, and clustering techniques for stock market forecasting.Eachtechniqueisdescribedas:

a. **ARIMA:** The ARIMA[11]is a statistical tool and used in timeseriestopredictfuturetrendstounderstandthedatasetbetter.

b. **Clustering:** The clustering method [13,14] is used to groupsets of objects that share similar properties. The stocks thatare having high correlations fall into one basket those areless correlated into another. This process is continued untileachstockisplacedineverygroup.

From the analysis of the Table 1, some of the selected topics usestatisticalmethodsusedtopredictthestockmarket.Only18%of thesubjectsarepopularespeciallyinstockmarketpredictionsbutonlyonestudyisusedinth emergerprocess.

Tools	Selected Studies	Percentage
An autoregressive integrated moving average (ARIMA)	S8, S3, S8, S13, S14, S16	18
Clustering	S17	3

Table 1: Statistical techniques used by selected studies

II. RQ2. What are the different types of ML algorithms used topredictthestockmarket?

Most selected subjects use ML or in-depth learning methods topredict the stock market. A few selected studies use the hybridapproach for better prediction accuracy in stock market forecasting. Mostly the stock market prediction approaches are elaboratedinthissection.Themostcommonpredictiontechniquesaredescribedas:

a. **SVM:** SVM is one of the better effective methods for forecasttimeseries.SVMcanbeusedforregressionandclassificationpurposes. SVM consists of plotting [15,16]data as a point inn-dimensional space. Such stock market measurements arecharacterizedandplottedondifferentcoordinateplanes.SVM is the most powerful and predictive tool in the financialmarket.

b. **NN:** It is a sequence of algorithms [17] that identifies thechangingdatasetoveramechanismanddescribesa waythathowthehumanbrainworks.ChungandShin[18]developed an outer break NN approach to stronger stockmarket forecasting. The data is taken in real-time from thelivestock market. The deep LSTM dependent NN was established here for the usage of the embedded layer. The neuralLSTMnetworkencodertopredicttrendsinstock.

c. **Artificialneuralnetwork(ANN):**ANNcapturesthestructuralrelation [19]of stock more specifically output and its determinants than lots of other statistical techniques. Many of theresearchersappliedtheANNmodelbeforepreprocessingthedata. There are so many performance parameters used instockmarketforecastingwhichisdiscussedinRQ5.

d. **Convolutional NN (CNN):** The CNN [20]is feed up the neuralnetwork. In CNN, there is a greater number of hidden layers ascorrelated to traditional neural network techniques. CNN isthenameofacomprehensivelearningalgorithmandusedinstockmarketpredictions.

e. **Recurrent NN (RNN):** RNN [20]in the form of ANN in whichnodes are interconnected in graph shape which is directedalong with their temporal chain. Therefore, it allows showingcomplexdynamicbehavior.

f. **Supportvectorregression(SVR):**TheSVR[5]adoptstheconcepts of SVM but there is only a small difference between anSVM and SVR. The SVR is used in stock market prices forecasting but SVM is used in stock market forecasting accordingtotheirtime-series.

g. **Generative Adversarial Network (GAN):** The GAN [23] is anewframeworkanditistraining two versions like zerofungame.Intheantagonistcycle,thegeneratorcanbecalleda fraud to produce data close to real data while the racisttakes on the role of judges to separate real data from dataprocessing.

h. **Naïve Bayes (NB):** The NB is a classification algorithm [29]that generates the Bayesian networks for a specific Bayesbaseddatasettheorem.Itsupposesthatthespecifieddataset contains a unique function that is unrelated to any otherfunctioninaclass.Itisasimplealgorithmandouterperformforhighlygradingstrate giesforlargedatasets.

Moreover,someoftheselectedstudiesuseeitherMLordeeplearningtechniquesforstock marketforecasting.These algorithms havetakenthereal-timedatasetalongwiththeirfeaturesandevaluatedthroughperformanceparameters.Thed escriptionofeach selected study along with their implementation ML algorithmislistedinTable2.

From the analysis of Table 2, most of the selected studies usetheNNapproachesfrequently.Fig.2showsthepercentageoftechnique.

III. RQ3: What are the distinct types of datasets used for stockmarketforecasting?
A selected study uses various types of a dataset in stock marketforecasting. According to selected studies some datasets are publicly available.Most selected subjects have used public datasetsto predict the stock market. These data sets are used for classificationorpredictivepurposes.Table3showsvarioustypesofdatasetsusedbyvariou sselectedstudiesaredescribedas:

The above table shows most of the selected studies used theNASDAQdatasetinstockmarketprediction/forecasting.

IV. RQ4.: Is any hybrid approach of ML model has been used forstockmarketforecastingornot?
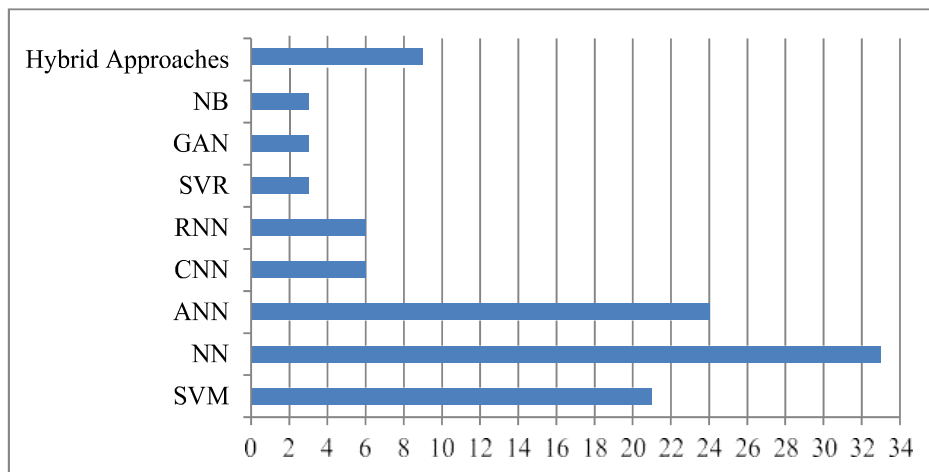

Fig. 2: Frequently used ML Techniques

The Fig. 2 shows that only three of the selected studies use thehybrid approach for stock market forecasting. Selected study S3proposed a hybrid method that is an ANN compound with a roughapproach and S8 proposed a hybrid method that combines ANNwith GA to improve GA performance in stock market forecasts.AnotherstudyS13combinedthestatisticaltechniquediscretewavelet transform with ML algorithm ANN (DWT-ANN) for stockmarketprediction.

V. RQ5: What are the different performance parameters used inthestockmarketforecasting?

Studies	Techniques	Percentage(%)
S2,S3,S4,S9,S12,S15,S22	SVM	21
S1,S2,S10,S12,S17,S18,S21,S24,S25,S27,S29	NN	33
S5,S6,S11,S14,S16,S20,S28,S30	ANN	24
S24,S26	CNN	6
S24,S26	RNN	6
S5	SVR	3
S23	GAN	3
S29	NB	3
S7,S8,S13	Hybrid Approaches	9

Table2: Percentageofeachtechniqueusedbyselectedstudies.

Study	Year	Target	Dataset Values (Days/Source)
S1	2007	Dow Jones Industrial Average Index	1024
S2	2016	Stock Market	500
S3	2019	Stock Market	NASDAQ
S4	2019	Stock Market	1659/www.moneycontrol.com
S5	2014	Stock Market	www.nseindia.com
S6	2019	Stock Market	NASDAQ
S7	2012	Dhaka Stock Exchange	www.dse.com.hd
S8	2014	Stock Market	OGDCL Pakistan
S9	2002	Stock Market	104/FASM
S10	2016	Stock Market	TFIDM
S11	2003	Stock Market	100/Instabul Stock Ex.
S12	2005	Stock Market Forecasting	MCcardy cd Mahen
S13	2016	Stock Market	1414/TataSteel/Cisco
S14	2013	Stock Market Forecasting	734/Godman Sach Inc.

S15	2017	Stock Market	108
S16	2015	Stock Market	1024
S17	2011	Stock Market	360
S18	2018	Stock Market	4203/Korea Stock Index Price
S19	2014	Stock Market	www.finet.hk
S20	2017	Stock Market	38/KospiMarket
S21	2018	Stock Market	2691
S22	2016	Stock Market	Crawler
S23	2019	Stock Market	5000/NYSE
S24	2017	Stock Market	1721
S25	2017	Stock Market	NASDAQ
S26	2017	Stock Market	600
S27	2018	Stock Market	500
S28	2016	Stock Market	Dhaka Stock Exchange
S29	2017	Stock Market	CS1300
S30	2011	Stock Market	NASDAQ

Table 3: Datasetusedbyselectedstudies.

Different performance parameters are used to test ML's abilitytobetterpredictstockmarkets/exchanges/forecasts.Theseperformanceparameter sareevaluatingtheparticularalgorithmbasedon their technique and dataset. Various performance parametersusedbytheselectedstudiestomeasuretheirperformanceisdescribedas:

a. **Accuracy:** Accuracy [21]is one metric used toassess themodel classification. Informal accuracy is part of the predictionthatourmodeliscorrect.

b. **Root mean square error (RMSE):** The RMSE is used at thelevelusedtocalculate[22]thedifferencebetweentheexpectedmodelvaluesandtheret ainedvalues.RMSEisveryclosetothetrainingandassessmentdatabase.

c. **Mean absolute error (MAE):** MAE [24, 25] is used in regression values. In this case, error prediction is the sum of thedifferencesbetweentheexpectedandactualvariables,divided by the number of data points above all data points.MAEreferstocalculatingthedifferencebetweentwocontinuousvariables.

d. **Meansquarederror(MSE):**MSEissquareaverageerrorused[26, 27]asalossfunctionforcalculatingtheminimumsquareregression.Also,itisthesumofth edifferencesbetween the expected and actual variables, divided by thenumberofdatapointsabovealldatapoints.

e. **Meanabsolutepercentageerror(MAPE):**MAPEismostwidelyusedinKPI[28]forcal culatingthestockmarketfore-casting. It is the sum [30]of absolute individual errors separatedbythedemand. Itisapercentageerroraverage.

Besides, selected subjects have used these performance parameters and their database to predict the stock market. Stock marketexchangeratesincrease/decreasemonthlyorannually.

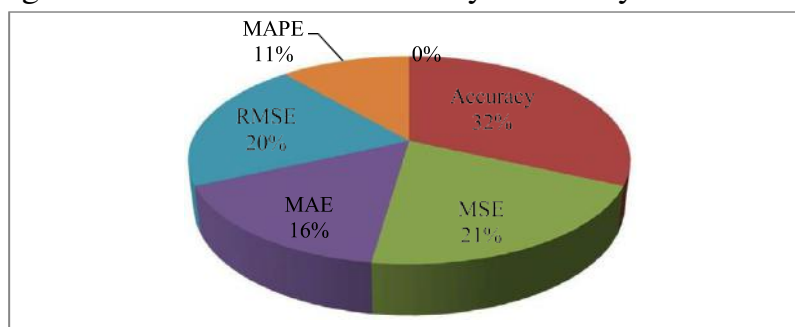Fig. 3: Performance parameters used by selected studies

VI. RQ6: Whatarethemostdominantjournalsforstockmarketforecasting?
Topredictthestockmarket,theauthorsselectedsubjectsbasedon research questions.
These   research   questions   are   extracting
theinformationfromparticularselectedstudies.Butsomeoftheselected studies have
been published in conferences as well as injournals. So, the authors have selected the
selected studies to formdominantjournalsandconferenceswhicharelistedas:

Study	Conference/Journal	Percentage	Publisher
S1	Applied Intelligence	3	Springer
S2	InternationalConferenceonComputerandInformation Sciences	3	IEEE
S3	InternationalJournalofFinancialStudies	3	MDPI
S4	ComputationalIntelligenceinDataMining	3	Springer
S5,S14,S20,S30	ExpertSystemswithApplications	12	Science Direct
S6	InternationalConferenceonInformation Technology and Systems	3	Springer
S7	InternationalConferenceonComputerandInformation Technology	3	IEEEScopus
S8	InternationalJournalofComputerScience andInformation Security	3	Springer
S9	InternationalConferenceonIntelligentData Engineering and Automated Learning	3	IEEE
S10	InternationalConferenceonICTInBusiness Industry and Government	3	Scopus
S11	NeuralComputingandApplications	3	IEEE
S12	PakistanMultitopicConference	3	Scopus
S13	IndianJournalofScienceandTechnology	3	IEEE
S15	InternationalConferenceofElectronics, Communication and Aerospace Technology	3	Scopus
S16	InternationalResearchJournalof Engineering and Technology	3	Science Direct
S17,S22,S23	ProcediaComputerScience	9	MDPI
S18	Sustainability	3	Springer
S19	NeuralComputingandApplications	3	Springer
S21	International Conference on Advances in Computing and Communication	3	Springer
S25	MultimediaToolsandApplications	3	Springer
S26	InternationalConferenceonComputational IntelligenceandVirtualEnvironmentsfor Measurement Systems and Applications	3	IEEE
S28	ConferenceonElectrical, Computer&Telecommunication Engineering	3	IEEE
S29	InternationalConferenceonServiceSystems and Service Management	3	IEEE

Table 4: Most dominant journals/conferences.

Table 4 shows most of the journals/conferences by the selectedstudies.Fig.4showsthemostdominantpublisherfrequently.Mostoftheexpertsystems&applicationsandProcediacomputersciencearethedominantjournals.
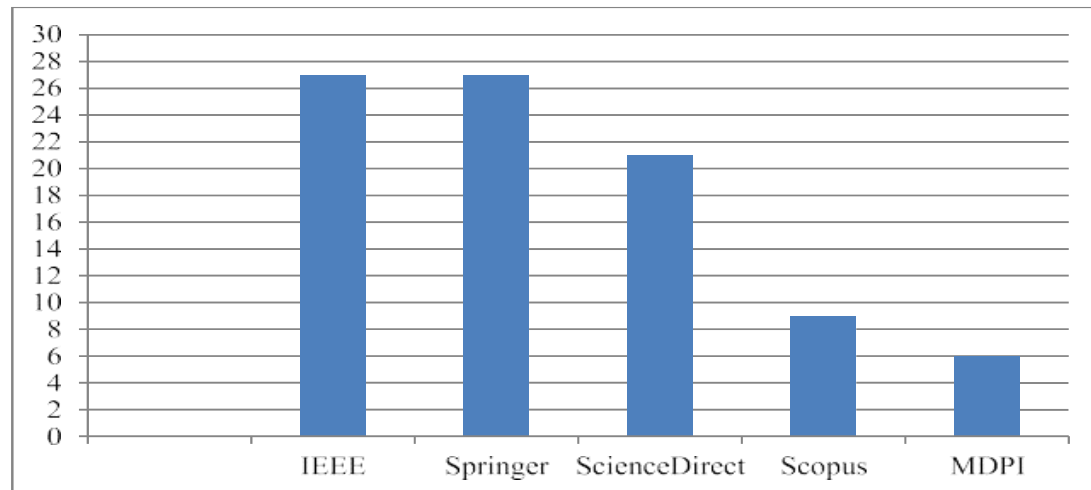

Fig. 4: Most frequently journals

CONCLUSION:

This paper offers an examination of the different strategies used in stock market splits, divided into mathematical strategies and ML strategies. The purpose of this survey is to rank current techniques in terms of adapted methodologies, different datasets used, performance matrices and application techniques. The main journals use 30 research articles. The techniques used in stock market prediction are categorized into different ML algorithms. In order to improve the accuracy of the prediction, some of the selected studies use the hybrid approaches in the stock market. The ANN and NN techniques are a widely used approach to achieve successful stock market predictions. These techniques can be developed for monitoring and monitoring the entire stock market. The great challenge to stock market forecasting is that most current techniques cannot be identified using historical stock data. Therefore, stock markets are influenced by other factors such as B. Government policy decisions and consumer sentiment. In the future, we will strive to improve the system to create a reliable exchange system that is more reliable and accurate.

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