Hybridization of Machine Learning Techniques to Optimize Portfolio of Stock Market: Review of Literature from the Period 2005 to 2018

K.S. Mahajan, Ulka Toro, R.V.Kulkarni

ABSTRACT: In finance there has always been the problem of how to combine investments to form a portfolio. Progress on this problem we focus on some of the important applications such as Forecasting, Trading, Portfolio Selection and Management of Stock Market is considered as one of the fundamental building block of developed country. If number of investor's increases then the economy of the country also increases and every investor invests to get good returns. But as stock market is uncertain and complicated the selection of good scripts are considered as one of the challenge in stock market field. So much work has been done in this field, The purpose of the present study is to review research articles from the period 2005 to 2018 and to find research gap for future work.

KEYWORDS: Stock Market, Machine Learning Techniques, Fuzzy, Neural Network, Portfolio, BSE Stock Exchange, NSE Stock Exchange.

I. INTRODUCTION:

Optimization is a process by which the most constructivetransaction between competing interests is determined subject to the constraints faced in any decision making process. Within the context of portfolio management, the competing interests are risk reduction and return enhancement among the other interests. Stock Market Portfolio Optimization is the main foundation for the investment in capital market with huge uncertainty and confusion. So much work has been done related toportfolio selection, prediction and management called as Portfolio Optimization, which helpsin decision making for investors to get better return against their investments and to improveefficiency of portfolio. Towards this study the first research is been conducted by Markowitzin 1952 introduced about the diversification of total amount of the investor using Mean-Variance Model. This work has created new horizons, assumptions and more scope for further research and the Linear programming model has been introduced by Konno-Yamazaki and then Werner has combined both the ideas and developed Fuzzy LinearProgramming Model.

Fuzzy set theory is used in this model which was first introduced by Zadeh is able to handle uncertainty which is more in the behaviour of stock market andto handle inadequate information about returns on investment.

Stock market is considered as one of the most important economic pillar of each countrywhere public companies raise funds by issuing shares to public and Institutions. Furthermore,a future trading is not only popular in developed markets of the world, but is equally popularin emerging markets like India. More than 8000 public companies are listed in Indian stockmarket which is evident from the fact that Indian equity future is ranked in top 5 in the list ofworld stock market from last two decades. Indian Stock Market (both BSE and NSE) offersan average of more than 25,00,00, 000 stocks, This makes an approximate business of morethan 2000 cr. By purchasing these scripts, an investor becomes partial owner of the tradedcompany which creates a portfolio of individual investors. Stocks are exchanged amongbuyer and sellers which generate a huge transaction data and prices keeps on changing as perdemand and supply of stocks. All trading data is captured by stock exchange where stockcompanies are listed. Stock trading data is non-linear, fluctuating and uncertain hence highly time variant. Hugeinformation is hiding therefore extracting and analysing such huge market data will be beneficial toindividual investors to make their portfolio strong. When we speak about portfolio then theinvestor thinks about strong, correct and high return scripts against investment.Accordinglyeach investors has to be practical rather than emotional or sentimental hence study of manyparameters and historical data using some powerful tool is vital to design strong portfolio,Considering above points, rotation of money is also vital in portfolio and to achieve thisbuying and selling both are important. As per the current scenario, the process of buying andselling of equity is called portfolio development and management which helps to minimizerisk, to earn profit and also helps to book profit and loss.Hence to select , predict and to optimize the patterns generated in this Stock Trade over theperiod of time from Indian Stock market is essential, Also rotation of moneyin the portfolio is a key requirement. An application based on Machine Learning Techniquesis the right choice in the current scenario.The research work intends to construct and design correct investors portfolio by developinghybrid model using machine learning techniques such as Data Mining, Statistical computations and soft computingtechniques.

Mrs. Keerti. Mahajan, Ph.D at Bharati Vidyapeeth Institute of Management ,Kolhapur.
Dr. Ulka Toro, Associate Professor in Bharati Vidyapeeth Institute of Management, Kolhapur .
Dr. R.V Kulkarni, Professor and Head of Computer studies in Chh. Shahu Institute of business education and research Kolhapur

Hybridization of Machine Learning Techniques to Optimize Portfolio of Stock Market: Review of Literature from the Period 2005 to 2018

A.   Machine Learning Techniques (ML):

Technological and computational advances and up gradation of hardware and softwareultimately leads to generate floods of data which has led to use machine learning techniquesfor optimization problem in the field of financial stock market. ML is the whole lot on the list.

It is well thought-out a subfield of Artificial Intelligence (AI) and consists of learning models. ML allows the program to make predictions on data. It is more than just a list of instructions which clearly define what the algorithm should do. Moreover, it is linked to Computational Statistics which uses learning models. A learning models allows algorithm to learn the input and output combinations and then make its own decision on new data. This allows machines to perform tasks which are not possible to perform. Such tasks can be as simple as recognizing human handwriting or as difficult as self driving cars.

There are many key industries where ML is making a huge impact, these industries are Stock market ,other Financial Industries, Health Care, Education System, Marketing and Sales etc. Recently after reviewing many research papers authors learned that traders in stock market started using Machine Learning techniques because, to make use and advantages of different ML techniques, such as Supervised and Unsupervised, Reinforcement and Deep learning is efficient to generate rules for programs and has more heuristic approach, which has many techniques such as Natural Language Processing, Robotics, SVM, Genetic algorithm, ANN, Baysian learning, Rule induction, Decision tree, Clustering etc used for prediction ,classification, categorizing, planning, selection, analysis and optimization.

II.   PRIOR WORK

Researcher has thrown some light on theliterature review related to the studies of Capital Market, Stock Market and Stock Exchange. In this section previous work done in the field of stock market, portfolio selection,prediction and optimization using machine learning techniques such Data Miningalgorithms, soft computing approach and statistical methods using different tools suitable such as R, Python ,and MatLabto the problem defined, are reviewed from the period 2005 to 2018 in a few words.

Ralph E. Steueret al(September 2005) they compared standard investors with one objective and a non standard investors with multiple objectives such as short selling, dividends, social liability, liquidity etc. these multi objectives are considered using Stochastic programming and deterministic formulations to select and optimize portfolio. Authors' suggests that there is a huge scope to explore algorithms to compute well organized and non-dominated sets of EDP with more linear objectives.

Nirbhey Singh Pahwa, Neeha Khalfay et al. (2017) conducted a survey to predict stock market with reference to BSE Stock Exchange using machine learning techniques. Based on the prior work, authors proposed a system to extract knowledge from the collected information and recommended to use supervised learning method of ML which has many different methods, among them they have suggested to use linear regression and logistic regression for prediction and analyses of the data collected from BSE

SENSEX of Indian Stock Market. And they have also recommended Support Vector Machine Algorithm to optimize accurate results. Towards this study the first research is been conducted by **Markowitz (1952)** introduced about the diversification of total amount of the investor using Mean-Variance Model. This work has created new horizons, assumptions and more scope for further research and the Linear programming model has been introduced by **Konno-Yamazaki** and then **Werner** has combined both the ideas and developed Fuzzy Linear Programming Model.

The author **Fatih Konak et al. (2016)** has used the same base of Fuzzy Linear Programming to develop model for decision making using investors experience and knowledge and past performance of stocks in different sectors which are selected from FTSE 100 stocks listed in the Turkey Index. In this model the Linear Programming is divided into three main parts such as purpose functions, fuzzy restricts and decision variables. In the proposed model purpose functions and purpose function coefficient together is taken as fuzzy target and both fuzzy target and fuzzy restricts are used to make fuzzy decisions. Authors suggested this model when the problem have fuzzy parameters and can be modelled by using linear function which allows investors to create portfolio according to their behaviours from FTSE-100 shares. Initially authors made decision about fuzzy parameters and techniques and then membership functions are created to describe the structure of the purpose function. After this a linear function is applied to develop a model. This method helps to analyse portfolio using financial indicators such as Price/ Earning per ratio and collection distribution index by adding constraints. Authors concluded that the British American Tobacco and Hikma Pharmaceuticals stocks should be included in the portfolio with 0.7% return and 9.6% risk.

Mehdi Alinezhad Sarokolaei et al. (2013) has conducted research on Fuzzy Optimization on listed stocks of Tehran Stock Market Portfolio based on portfolio value at risk using mean absolute deviation method. They have developed hybrid intelligent algorithms such as genetic with fuzzy logic to optimize portfolio at the confidence levels of 95% and 99% with the use of parametric method. They used genetic single-stage Roulette Wheel technique and generated 2000 generations with 20 populations each using MATLAB tool. In their research 15 stocks with 7 years of time period has been considered to calculate value at risk by taking 6 criteria's such as Asymmetric and Symmetric Value at Risk, Interval Value at risk with (5% to 95%) and (10% to 90%) interval, Normal Value at Risk and Value at Risk based on the Mean Absolute Deviation **[1]** are considered as fuzzy variables **[4].** They concluded in their research is that the calculated probability ratio using Kupiec statistic method based on six criteria's for fuzzy optimization model is more larger than critical value obtained from chi-square distribution at the confidence level of 95% and it also indicate that the model at risk based on mean absolute deviation function gives more accurate result.

Therefore according to the authors fuzzy variables are more suitable to handle asymmetric uncertainties in financial domains **[4].**

P. Divya and P. Ramesh Kumar (2012) states that the traditional method and new method of asset selection and optimization of investor's portfolio.

To select a profitable asset which makes a better portfolio and to optimize this portfolio, they have considered fuzzy – genetic algorithm. To optimize non linear data and to handle uncertainty present in the stock market they had considered four financial indicators of some listed companies such as price/earnings ratio (P/E ratio), return on capital employed (ROCE), Earning per share (EPS) and Liquidity ratio are taken as input variables to find the quality of each listed companies for investment according to the score given to rate these companies. And the output variable is investment ranking as per the annual price return (APR). The researchers have concluded that with the use of Fuzzy logic and Genetic Algorithm optimization, the section of scripts for investments are ranked as per the fundamental financial information and price return on investment. This model helps investors to select the top investments to construct efficient portfolio which is able to manage uncertainty and risk**.**

Masafumi Nakano et al. (2017) has developed a new Knowledge based system called as Expert System using Fuzzy logic with particle filtering and anomalies detection to select different scripts with fine risk-return profiles from the number of listed scripts by combining multilateral performance measures. They have developed ES considering three criteria's such as Estimation, Portfolio construction and selection with a Fuzzy logic system **[6].** They have considered Exponential moving average (EMA) model for different smoothing factors to prevent anomalies such as expected return and volatility which is estimated using many time series models such as by particle filtering with anomaly detectors, and then calculates Mean-Variance optimal portfolio weights.

Finally taking historical data of each script based on Fuzzy logic system by integrating different investment criteria's such as compound return (CR), standard deviation (SD), downside deviation (DD), maximum drawdown (MDD), Sharpe ratio (ShR), Sortino ratio (SoR) and Stering ratio (StR), which enable multilat- eral assessment to select best portfolio. This numerical experiment has confirmed that the Expert system generates reasonable investment record helps to construct efficient portfolio.

Oguzhan Ece et al.(2017) in their research paper titled " Applicability of Fuzzy TOPSIS Method in Optimal Portfolio Selection and an Application in BIST" discussed about to find out the availability of alternative method to determine the best script with the combination of managing risk and return perspective of investors who would like to evaluate their investments in capital market. And to achieve these, authors has used FUZZY TOPSIS method mainly used for multi-criteria decision making to get optimal portfolio. Researchers has considered a list of stocks suggested by different trade houses for investors of Johnson and Sharp Indexes, and then common stocks among them are selected and sorted using Fuzzy TOPSIS method, then the ranking is applied according to the performance of individual scripts,

they compared with the performance of the portfolio constructed using Markowitz traditional portfolio theory. They found that fuzzy TOPSIS method works better based on risk return, performance and other results. Researchers suggests that the Fuzzy TOPSIS method uses linguistic evaluation of the experts called as decision makers, there is more possibilities to improve efficiency of the portfolio according to the knowledge of the experts**.**

Novriana Sumarti,Patricia Nadya (2016), In the research paper titled "A Dynamic Portfolio of American Option Using Fuzzy Binomial Method" has discussed about the new fuzzy model using Binomial CRR for computing the optimal stock price of American Option prices. They considered three types of price movements of stocks such as bearish, bullish and sideways. According to the researchers fuzzy binomial CRR model helps investors to adjust their portfolio according to the price movement. They considered simplified trading market to get return of 8.998% for 5 trading days. This model helps to take decision about to buy or sell the stocks based on membership degree of fuzzy**.** Researchers suggest that other variables in binomial option pricing model can be used to fuzzify to get better results.

bolfazl Kazemi et al. (2017) discussed about Goal Programming using fuzzy logic with probabilistic constraints to get efficient portfolio. In their research they believed that return of risky stocks were random variables and objectives such as risk, return taken from Markowitz (Markowitz 1952) and dividend yields attainability had fuzziness. They found that two main objectives such as risk and return had normal distributions therefore added divided yield as third objective which have discrete distribution to maximize return, divided and minimize risk. In Markowitz's model risk is based on mean-variance of return whereas using goal programming risk is calculated considering two patterns of sharp coefficient and variance of return using the result of the model. They concluded that divided yield in the fuzzy goal programming model is better than Markowitz's constraint model**.** Researchers recommend stochastic programming with fuzzy concept. And to consider more objectives and develop a decision support system for selecting portfolio, to recognize indices that have more impact on the risk and return of portfolio.

EddieChi Man Hui et al. (2009) had focused on fuzzy concept with linear programming to get best portfolio of real estate investment. He has considered Hong Kong portfolio for local people, they had taken data from Hang Seng Composite Industry Index(HSCII) , Hong Kong Dollar Bond Index and Private Domestic Price Index with the historical data and collected experts judgement. An author suggests that real estate helps to hedge uncertainties such inflation and interest rate volatilities which helps to change the investment behaviour. To achieve this researcher applied fuzzy tactical asset allocation flexible programming model helps to construct portfolio more efficiently than traditional method. Authors said that this model fails to minimize risk and to select high risk scripts into the portfolio. They suggest that investors should study carefully and look into its disadvantages of each script before investment.

They also suggest focusing on the development of membership functions for determination approach. This model is not suitable for optimization if there are too many constrains are present. This model is not suitable for optimization and this model is difficult for laymen to implement.

Mualla Gonca et al.(2012) has discussed in their thesis about the Fuzzy Rule based Expert System to support portfolio managers to make decisions about middle term evaluation of stocks and construction of portfolio and also the system handles uncertainty exists in the relationship between fundamental and technical criterion. In this study, for portfolio construction they have used mixed integer linear programming model which helps to select high rated scripts in the portfolio. In the theses the expert system is validated from 2002 to 2010, they have considered 61 equity scripts which are listed in Istanbul Stock Exchange (ISE) i. e National-100 Index (XU100). The performance of expert system is evaluated by comparing with benchmark index (XU030), and proved the performance of ES is better than the benchmark index. Also the ES is better in case of risk averse investor profile and middle term investment period.

In their study the author comprised macroeconomic factors such as GDP, inflation rate etc which highly affects stock market of any country. Author suggested that by considering these macroeconomic parameters, the proposed ES can be used in international investment case and helps to reduce risk level of the portfolio. It is further suggested that while gaining knowledge, we can apply group decision making approach. They have also mentioned some more approaches to handle uncertainty other than Fuzzy model, such as Bayesian algorithm, Demster and Shafer's belief functions.

To use stock market, data base for better perceptive, there is a requirement to discover unsupervised learning and deep learning which include both data mining and soft computing techniques along with some statistical techniques that amalgamates the data with theoretical developments to benefit the users.

M Gunasekaran et al. (2012) proposed Neuro-Fuzzy model to optimize portfolio considering Indian Stock Market. They had taken BSE INDEX considered both price and volume data to forecast stock market by applying hybridization of Neuro–Fuzzy model based on Fuzzy logic theory and fuzzy set and integrated with Fuzzy Inference System (FIS) and adaptive neural network system. Using this hybrid model neural network learning algorithm is implemented and proved that this model gives higher returns than other model.

Kranthi Sai Reddy (2018) explained about the prediction of a stock market using machine learning techniques such as Support Vector Machine by Radial Basis Function Kernel to predict price movement of stocks for large and small caps from global financial market, and considered daily and up-to-the minute frequencies. In this study researchers proposed python programming tool to implement machine learning approach that will be trained from collected daily stock prices and extract intelligence to predict the market. This study has concluded with high returns as compare to other model.

Ronald Baganzi et al. (2017) states that R tool is more suitable for statistical computing to analyse portfolio optimization models including Markowitz's Mean-Varience model, the VaR model, Konno and Yamazaki's Mean-Absolute Deviation model. They have analysed multi asset's historical data collected from the top most indexes in the world of 16 constituent scripts listed in USE i.e Uganda Securities Exchange for the time period of 6 years. They found results of the model and discussed about most dominating bond was GREXP on world market, because analysis result has shown 60% of the Maximum Diversified Portfolio. They have used different risk measures such as Sharpe Ratio, Expected Shortfalls, Volatility, Risk Parity to evaluate stock performance for Uganda Stock Exchange to identify more dominating scripts. Finally it is concluded that UMEME, EBL, KCB, CENT etc were the more dominating and better performing scripts by using R tool, and this model helped Uganda investors to make decisions about which stocks to be included in their portfolio.[2]

Osman Hegazy et al.(2013) discussed about machine learning model with the integration of supervised learning algorithms such as Particle Swarm Optimization and LS-SVM to forecast stock price using technical indicators such as moving average, convergence and divergence, stochastic oscillator, money flow index, relative strength index etc. They have explored that Particle Swarm Optimization (PSO) is implemented iteratively as global optimization algorithm to optimize LS_SVM for price prediction, and is used in the selection of LS-SVM parameters such as kernel, cost penalty and other parameters. And this model is called as LS-SVM-PSO model which is capable to overcome the over-fitting problem found in ANN. Also PSO-LS-SVM algorithm parameters can be tuned easily. The above model was tested for all sectors of S&P 500 stock market. These sectors are Information Technology (Adobe, Hp, and Oracle), Financials (American Express and Bank of New York), Health Care (Life Technologies, and Hospera), Energy (Exxon-Mobile and Duck energy), Communications (AT&T), Materials (FMC Corporation); Industrials (Honey Well). It is proved that this model performs and gives better results than ANN using back propagation model.

Jigar Patel et al.(2015) had developed two stage fusion approach using Support Vector Regression (SVR) at first stage and ANN, Random Forest (RF) at second stage. By combining both by using hybridization technique SVR-ANN and SVR-RF and SVR-SVR models were developed. This model is implemented on two indices namely CNX Nifty and S&P Bombay Stock Exchange of Indian Stock Market for experimental evaluation. They had considered 10 years of historical data of both indices and technical indicators are used as input to each of the model. The predictions are made for 1–10, 15 and 30 days in advance. The result of prediction using these hybrid models were compared with single stage scenarios such as ANN, SVR and RF and concluded that hybrid models perform better than single handed models.

Samer Obeidat et al.(2018) in their research paper authors has proposed a very recent machine learning technique such as Deep learning used to automate portfolio management and to improve risk adjusted returns.

36

Authors have considered Long Short –Term Memory (LSTM) approach to adaptive asset allocation to recommend personalized portfolio. In this study historical price data is collected and calculated based on macroeconomic data and used other market indicators using principal component analysis to develop Neural Network using Deep Learning method.

This model is implemented to estimate the expected return, volatility level and to find correlation between selected scripts in the portfolio. Then the output of this action is optimized using Mean-Variance statistical technique and further improved to use forward looking rolling window technique. This was implemented and tested on collected data explored that a long short term memory model can generate better risk adjusted returns compared to strategic passive portfolio management.

S.R. Nanda et al. (2010) in their research paper titled Clustering Indian Stock Market Data for Portfolio Management. In this study researcher has presented integration of Data Mining clustering techniques such as K-means, SOM and Fuzzy C-Means to classify huge number of stocks into clusters for portfolio management. This hybrid model of clustering techniques is build to get efficient portfolios. Authors have collected data of stock returns at various times with their valuation ratios from the stocks of BSE sensex of the year 2007-2008. Hybrid model of clustering is tested on this data and analyzed. After analysis, it is concluded that K-Means cluster technique is more efficient than compared to SOM and Fuzzy C Means clustering algorithms.

According to the authors **MelekAcar Boyacioglu et al.(2010)** focused on to predict stock market price movement and stock market return. They used monthly six macroeconomic variables and three Indices such as DAX, BOVESPA, DJI and ISE National 100 return. Researchers have collected data from Central Bank of the Republic of Turkey electronic data delivery system and Metrics Information Delivery System Inc. Researchers have collected 228 observations and divided into training and testing data.The experimental results that the model effectively predicts monthly return of ISE National 100 Index with an accuracy of 98.3%.

Kuang YuHuang et al. (2009) as per the researchers a Moving average autoregressive exogenous(ARX) model is more suitable for prediction which is combined with grey system theory and rough set(RS) theory and applied to Taiwan Market to generate automatic selection and prediction mechanism. In this approach, data is collected automatically every quarter and are used to input to an ARX prediction model which predicts future trends for next quarter. This predicted data size is reduced using GM (1, N) model, and clustered using K-Means algorithm. These clusters are applied to Rough Set classification model to select correct stock by applying set of rules. Then using grey

relational analysis technique each selected stock is weighted which helps to maximize rate of return of each portfolio. They had validated the proposed work using E Stock data maintained by Taiwan Economic Journal. And this model is compared with GM (1, 1) prediction method. And proved that hybrid model has greater forecasting accuracy than GM (1, 1) model.

Pankaj Gupta et al (2012) have proposed an integrated approach to develop model to select portfolio for multi criterion decision making. In this paper they have used Support Vector Machines which is a machine learning technique which uses statistical learning methods for asset classification purpose and then it was blended with Real Coded Genetic Algorithm to each class found by SVM algorithm to build optimal portfolio which are based on short term return, long term return and liquidity.

Ms. Anju bala(2013) reviewed about Indian Stock Market written about different authors and concluded that the overall Stock Market is the alleviation of risk by investing in multiple scripts. Author has discussed about the history of different stock exchanges present in India such as Bombay Stock Exchange, National Stock Exchange and Calcutta Stock Exchange. She found that these Indices did not follow random walk and its movements are largely based on GDP, Inflation, FII, Macro economical factors and political stability etc.

Ms. Keerti Mahajan et al (2015) authors has well thought-out the financial indicators of Indian Stock Market (Nifty-50) as a input to the fusion of Neuro-Fuzzy system and collected data of historical quarter results to train and predict to select scripts.This ANFIS model helps to make decisions about whether to Buy, Hold or Sell scripts.Authors suggested that considering more number of Financial Indicators and Technical Indicators more accurate prediction can be done and also they suggest to use Machine Learning techniques to predict Stock Market.

Hossein Dastkhan et al(2011) worked on Fuzzy Weighted Min-Max model using Konno's(2003) Mean –Absolute deviation for Portfolio Selection problem with multi objective and real features. The real features considered are transaction lots, variable transaction costs and cardinality and bounds on holding constrains. And for the resulted model researchers applied a Hybrid Genetic Algorithm. The model was based on empirical study and considered 75 assets of New York stock exchange as sample. The fuzzy portfolios model was compared with the performance of crisp portfolios and S&P 500 index and found that proposed model perform more efficiently.To achieve objective two non-linear logistic membership functions are used such as fuzzy weighted additive model and logistic membership functions.

The Table 1 shows efforts made for the successful implementation of Machine Learning Techniques, Data Mining, Soft Computing and Statistics to Stock Market different countries from the period 2005-2018

Hybridization of Machine Learning Techniques to Optimize Portfolio of Stock Market: Review of Literature from the Period 2005 to 2018

Table 1: Summary of Stock Market Research in different Countries

Author	Title	Technology	Index
Ralph E. Steuer ,et al(September 2005)	Multiple Objectives in Portfolio Selection"	Stochastic Programming and deterministic formulation	Germany
Eddie Chi Man Hui , Otto Muk Fai Lau & Kak Keung Lo,(2009)	A fuzzy decision-making approach for portfolio management with direct real estate investment	fuzzy concept with linear programming to get best portfolio of real estate investment.	Hang Seng Composite Industry Index(HSCII)
Kuang YuHuang,Chuen-JiuanJane Apr-09	A hybrid model for stock market forecasting and portfolio selection based on ARX, grey system and RS theories	Moving average autoregressive exogenous(ARX) model with grey system and RS theories	Taiwan Stock Market
S.R. Nanda, B. Mahanty, M.K. Tiwari(2010)	Clustering Indian stock market data for portfolio management",	Data Mining techniques such as K-means, SOM and Fuzzy C-Means	BSE sensex
Melek Acar Boyacioglu et al.(2010)	An Adaptive Network-Based Fuzzy Inference System (ANFIS) for the prediction of stock market return: The case of the Istanbul Stock Exchange",	Adaptive Neuro –Fuzzy iInference System	Applied to three Indices such as DAX, BOVESPA, DJI and ISE National 100 return (Istanbul Stock Market)
Hossein Dastkhan, Naser Shams Gharneh, HamidReza Golmakani(2011)	A linguistic-based portfolio selection model using weighted max–min operator and hybrid genetic algorithm", Expert Systems with Applications	Fuzzy weighted max–min operator and hybrid genetic algorithm	NYSE ,S&P 500
P.Divya, P. Ramesh Kumar(2012)	The Investment Portfolio Selection Using Fuzzy Logic And Genetic Algorithm	Soft computing techniques such as Fuzzy Logic and Genetic Algorithm	Indian Stock Market
Mualla Gonca YUNUSOĞLU,(2012)	A Fuzzy Rule Based Expert System For Stock Evaluation And Portfolio Construction: An Application To Istanbul Stock Exchange",	Fuzzy Rule Based Expert System	Istanbul Stock Exchange
M. Gunasekaran, K.S. Ramaswami(2012)	Portfolio Optimization Using Neuro Fuzzy System In Indian Stock Market",	Hybridization of Neuro–Fuzzy model based on Fuzzy logic theory and fuzzy set and integrated with Fuzzy Inference System (FIS) and adaptive neural network system	BSE Index(Indian Stock Market)

Pankaj Gupta et al (2012)	Asset portfolio optimization using support vector machines and real-coded genetic algorithm",	Support Vector Machines blended with real coded Genetic algorithm	Indian Stock Market
Ms. Anju bala(2013)	INDIAN STOCK MARKET - REVIEW OF LITERATURE"	Review	Indian Stock Markets
Mehdi Alinezhad Sarokolaei et al. (2013)	A Fuzzy Model for Fuzzy Portfolio Optimization with the Mean Absolute Deviation Risk function	Mean absolute deviation, hybrid intelligent algorithms such as genetic with fuzzy logic	Tehran Stock Market
Osman Hegazy et al. -2013	A Machine Learning Model for Stock Market Prediction	supervised learning algorithms such as Particle Swarm Optimization and LS-SVM	S&P 500 stock market
Jigar Patel et al.(2015)	Predicting stock market index using fusion of machine learning techniques	Two stage fusion approach using Support Vector Regression (SVR) at first stage and ANN, Random Forest (RF)	CNX Nifty and S&P Bombay Stock Exchange
Keerti. S.Mahajan et al.(2015)	Portfolio Investment Model Using Neuro Fuzzy System	ANFIS	Indian Stock Market
Fatih Konak et al. (2016)	Fuzzy Linear Programming on Portfolio Optimization: Empirical evidence from FTSE 100 Index	Fuzzy Linear Programming	Turkey Stock Market
Novriana Sumarti,Patricia Nadya (2016),	A Dynamic Portfolio of American Option Using Fuzzy Binomial Method	Fuzzy Model using Binomial CRR	American Stock Market
Nirbhey Singh Pahwa, Neeha Khalfay et al. (2017)	Stock Prediction using Machine Learning a Review Paper	Support Vector Machine Algorithm	BSE Stock Exchange
Masafumi Nakano et al. (2017)	Fuzzy logic-based portfolio selection with particle filtering and anomaly detection	Fuzzy Logic	Tokyo Stock Exchange
Oguzhan Ece et al.(2017)	Applicability of Fuzzy TOPSIS Method in Optimal Portfolio Selection and an Application in BIST	Fuzzy TOPSIS	Johnson and Sharp Indexes

Ronald Baganzi et al. (2017)	Portfolio Optimization Modelling with R for Enhancing Decision Making and Prediction in Case of Uganda Securities Exchange	Mean Absolute Deviation Model	Uganda Stock Exchange
Abolfazl Kazemi et al. (2017)	A Fuzzy Goal Programming Model for Efficient Portfolio Selection	Goal Programming with Fuzzy Logic	Iran Stock EMarket
Samer Obeidat et al.(2018)	Adaptive Portfolio Asset Allocation Optimization with Deep Learning"	Deep Learning(Machine Learning)	S&P 500 US Stock Market
Kranthi Sai Reddy (2018)	Market Prediction Using Machine Learning	Support Vector Machine by Radial Basis Function Kernel	Indian Stock Market

III. FINDINGS:

From the above symposium, authors found that, the current work reviewed the Stock Market, its different parameters such as Financial Indicators, Technical Indicators, Macro economic factors etc since the year 2005 to 2018. The research work indicates that the decade from 1952 to 2018 has contributed towards the development in the performance of Stock Market using various techniques. The researchers in this decade have investigated different routes that will lead to form the Stock Market with Optimum risk and return. And later most of the papers reviewed focused mainly on Prediction, Forecasting and Optimization using Soft Computing techniques,Machine Learning techniques considering multi objectives which shown the improvised and clear results.

➢ Initially researcher (Markowitz 1952) involved in the mean-variance analysis for Portfolio selection (PS).. which focused only on risk adjustment with little return.. And no effort been taken on other factors to select optimum portfolio. Therefore it is found that using this mean-variance technique portfolio analysis is done assuming that the investors are interested only with returns attached to specific levels of risk during selection of portfolio.

➢ It is also found that institutional investors typically use mean-variance optimization in portfolio selection because; it needs only the knowledge of expected returns, standard deviation and correlations of portfolio's mechanism.

➢ While the other type of investors prefer to use full scale optimization. This will be considered as an alternative to mean-variance optimization. Since computational advances now allow us to perform such full scale optimization under this approach

➢ Later according to Konno and Yamazaki shown that the use of mean-absolute deviation model can handle the analysis of portfolio problem in a more realistic approach considering multiple objective instead of one, such as transaction cost, transaction lot and minimal transaction unit in an efficient manner using branch and bound algorithm. Later many researchers applied Fuzzy Min-Max weighted algorithm with mean-absolute deviation model to get more optimized result.

➢ From the above review it is also found that if we consider more factors of stock market which includes liquidity, asset class,asset region, micro economics,macro economics and market dynamics, then we can get more optimized result.

➢ In recent papers it is found that within the context of portfolio management, the competing interests are risk reduction and return enhancement and a rise in overall personal satisfaction.

And then found that a significant advance have taken place in recent years in the field of Machine Learning. This is considered as a higher level of computerized automation of the solution and modelling process.

The use of Machine Learning for stock Market is a key activity that allows the machine to go through hundreds of Technical Indicators, more number of Financial Indicators and other Macro Economic Factors and Investors sentiments instead of a few old preferred indicators and let the machine learn and decide which indicators perform better in Prediction, Forecast and to Optimize the correct market trend.

IV. CONCLUSION

Initially manual traders have an understanding of the markets with simple trading strategies. These strategies use a few technical indicators to predict market trend. After reviewing above research papers authors learned that traders in stock market started using Machine Learning techniques because, to make use and advantages of different ML techniques, such as Supervised and Unsupervised, Reinforcement and Deep learning is efficient to generate rules for programs and has more heuristic approach, which has many techniques such as Natural Language Processing, Robotics, SVM, Genetic algorithm, ANN, Baysian learning, Rule induction, Decision tree, Clustering etc used for prediction ,classification, categorizing, planning, selection, analysis and optimization. ML allows the machine to go through hundreds of Technical Indicators, more number of Financial Indicators and other Macro Economic Factors and Investors sentiments instead of a few old preferred indicators.

According to authors an application based on Machine Learning Techniques is the right choice in the current scenario. And also found that the traders who has done quantitative research ,backtesting and optimization has higher chances of performing in live markets. Therefore the research work intends to construct strong and design correct investors portfolio by developing hybrid model using machine learning techniques.

REFERNCES

1. Fatih Konak et al,(2016)" Fuzzy Linear Programming on Portfolio Optimization: Empirical evidence from FTSE 100 Index", Global Journal of Management and Business Research: C Finance Volume 16 Issue 2 Version 1.0.
2. Mehdi Alinezhad Sarokolaei, Heydar Mohammadzadeh Salteh, Azadeh Edalat(2013)," Presenting a Fuzzy Model for Fuzzy Portfolio Optimization with the Mean Absolute Deviation Risk function",Europeon online journal of Natural and Social Science,Vol 2., No 3(s),pp 1793-1799, ISSN 1805-3602 .
3. P.Divya, P. Ramesh Kumar(2012),"The Investment Portfolio Selection Using Fuzzy Logic And Genetic Algorithm", International Journal of Engineering Research and Applications , Vol. 2, Issue 5, pp.2100-2105 , ISSN: 2248-9622,79
4. Masafumi Nakano,AkihikoTakahashi,Soichiro Takahashi(2017),"Fuzzy logic-based portfolio selection with particle filtering and anomaly detection", Knowledge-Based Systems,Elsevier 1–12,
5. Oguzhan Ece &Ahmet Serhat Uludag,(2017)," Applicability of Fuzzy TOPSIS Method in Optimal Portfolio Selection and an Application in BIST", International Journal of Economics and Finance; Vol. 9, No. 10; ISSN 1916-971X E-ISSN 1916-9728.
6. Novriana Sumarti,Patricia Nadya,(2016)"A Dynamic Portfolio of American Option Using Fuzzy Binomial Method", Journal of Innovative Technology and Education, Vol. 3 , no. 1, 85 – 92.
7. Abolfazl Kazemi, Ali Shakourloo, Alireza Alinezhad(2017)," A Fuzzy Goal Programming Model for Efficient Portfolio Selection",Journal of Optimization in Industrial Engineering 22, 61-71.
8. Eddie Chi Man Hui , Otto Muk Fai Lau & Kak Keung Lo,(2009)" A fuzzy decision-making approach for portfolio management with direct real estate investment", International Journal of Strategic Property Management ISSN: 1648-715, 1648-9179.
9. Mualla Gonca YUNUSOĞLU,(2012)" A Fuzzy Rule Based Expert System For Stock Evaluation And Portfolio Construction: An Application To Istanbul Stock Exchange", Thesis, Graduate School of Natural and Applied Sciences of Dokuz Eylül University.
10. Keerti. S.Mahajan, Shruti. S. Jamsandekar, Dr. R .V. Kulkarni,(2015)" Portfolio Investment Model Using Neuro Fuzzy System", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (2) ,1819-1823.
11. Nirbhey Singh Pahwa, Neeha Khalfay,et al.(April 2017), " Stock Prediction using Machine Learning a Review Paper", International Journal of Computer Applications (0975 – 8887) Volume 163 – No 5.
12. Shruti S. Jamsandekar, "Data Mining: A Soft Computing Approach"(2016),PhD thesis, Department Of Computer Science Shivaji University, Kolhapur-416004 Maharashtra (India)
13. Osman Hegazy , Omar S. Soliman and Mustafa Abdul Salam(December 2013)," A Machine Learning Model for Stock Market Prediction", International Journal of Computer Science and Telecommunications [Volume 4, Issue 12,].
14. Ronald Baganzi, Byung-Gyoo Kim, Geon-Cheol Shin(2017)," Portfolio Optimization Modelling with R for Enhancing Decision Making and Prediction in Case of Uganda Securities Exchange", Journal of Financial Risk Management, 6, 325-351.
15. Ralph E. Steuer, Yue Qi, Markus Hirschberger(September 2005)," Multiple Objectives in Portfolio Selection", journal of financial decison making Volume 1, Number 1.
16. S.R. Nanda, B. Mahanty, M.K. Tiwari(2010)," Clustering Indian stock market data for portfolio management", Expert Systems with Applications 37 , 8793–87.
17. Ms.Nishamalik,mr. Chand Prakash Saini(2013), "Research Paper on Portfolio Mangement",international journal in multidisciplinary and academic research (ssijmar) vol. 2 no.5 (issn 2278 – 5973).
18. Selvan Simon and Arun Raoot,(May 2012)," Accuracy Driven Artificial Neural Networks In Stock Market Prediction", International Journal on Soft Computing (IJSC) Vol.3, No.2.
19. Sze Sing Lam,Kai Pui Lam,Hoi Shing Ng(2002)," Genetic Fuzzy Expert Trading System For Nasdaq Stock Market Timing", Genetic Algorithms And Genetic Programming In Computational Finance Pp 197-217.
20. Kuang YuHuang,Chuen-JiuanJane(April 2009)," A hybrid model for stock market forecasting and portfolio selection based on ARX, grey system and RS theories", Expert Systems with Applications Volume 36, Issue 3, Part 1, Pages 5387-5392.
21. Pankaj Gupta, Mukesh Kumar Mehlawat, Garima Mittal(June 2012)," Asset portfolio optimization using support vector machines and real-coded genetic algorithm", Journal of Global Optimization, Volume 53, Issue 2, pp 297–315.*
22. V Kranthi Sai Reddy(2018)," Stock Market Prediction Using Machine Learning", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 10.
23. Melek Acar Boyacioglu , Derya Avci(2010)," An Adaptive Network-Based Fuzzy Inference System (ANFIS) for the prediction of stock market return: The case of the Istanbul Stock Exchange",Elsevier, Expert Systems with Applications 37, 7908–7912.
24. M. Gunasekaran, K.S. Ramaswami(2012)," Portfolio Optimization Using Neuro Fuzzy System In Indian Stock Market", Journal of Global Research in Computer Science,Volume 3, No. 4.
25. Jigar Patel, Sahil Shah, Priyank Thakkar , K Kotecha," Predicting stock market index using fusion of machine learning techniques", Expert Systems with Applications 42 , 2162–2172.
26. Ms. Anju bala,"INDIAN STOCK MARKET - REVIEW OF LITERATURE", TRANS Asian Journal of Marketing & Management Research Vol.2 Issue 7, ISSN 2279-0667, July 2013
27. Samer Obeidat, Daniel Shapiro, Mathieu Lemay(2018)," Adaptive Portfolio Asset Allocation Optimization with D Learning", International Journal on Advances in Intelligent Systems, vol 11 no 1 & 2.
28. Hossein Dastkhan, Naser Shams Gharneh, HamidReza Golmakani(2011)," A linguistic-based portfolio selection model using weighted max–min operator and hybrid genetic algorithm", Expert Systems with Applications 38 ,11735–11743,Elsevier

AUTHORS PROFILE

Mrs. Keerti. Mahajan is working as visiting faculty at DYP Engineering College Kolhapur. She has total 9 years of experience in teaching postgraduate and undergraduate level.She ha completed Diploma in E&TC,BCA,MCA,Mphil and pursuing Ph.D at Bharati Vidyapeeth Institute of Management ,Kolhapur. She has published more than 10 papers at national and International Journals. She has attended many conferences ,workshops and seminars. Her area of interest is Machine Learning, Data Mining and Artificial Intelligence.

Dr. Ulka Toro is working as an Associate Professor in Bharati Vidyapeeth Institute of Management, Kolhapur . She has total 21 years experience at postgraduate and undergraduate level. She has completed B.E.(Elc.), M.C.A., M.B.A., M.Phil , Ph.D. form Shivaji University, Kolhapur. She has published more than 35 research papers in national and International journal. She has attended and presented papers in Conferences, workshops and seminars. Her area of interest is Artificial Intelligence, Data Mining and Machine Learning. She is working as a Ph.D. guide in Bharati Vidyapeeth(Deemed to Be University), Pune

Dr. R.V Kulkarni is working as an Professor and Head of Computer studies in Chh.Shahu Institute of business education and research Kolhapur. He has total of 33 years of experience at postgraduate and in Research. He has awarded Ph.D in Statistics from Shivaji University Kolhapur.He has published more than 100 research articles in national and International journals and published more than 10 books.He is recognized Ph.D guide , Consultant and member of many renowned universities of Karnataka and Maharashtra. His area of intrest is Datamining ,Artificial Intelligence, Statistics

41