2. Literature Review

2.1 Introduction

“A literature review uses as its database reports of primary or original scholarship, and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second a literature review seeks to describe summaries, evaluate, clarify and/or integrate the content of primary reports” (Cooper, 1988).¹

“The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background to and justification for the research undertaken” (Bruce, 1994).²

Bruce, who has published widely on the topic of the literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report (Bruce, 1994).³

The review of literature provides in-depth understanding and explanation on how your findings are similar to or novel from previous research work. It also reveals the techniques and statistical procedures used and what that have not been attempted by others also.

2.2 Significance of Literature Review

A literature review is an evaluative report of the literature relating to a particular research area or topic. There is some very important reason for spending valuable time and hard work on review of different literature before embarking on a research project. To identify the gaps in the literature to avoid reinventing the wheel to save the time in an effective manner to avoid mistakes. It gives a basic idea of existing knowledge and work upon the relevant topic. It helps to identify the other research working in the same field, different views, relevant information, and relevant methods to researcher project (Bourner, 1996).

It always provides theoretical background to the study or field of interest. It also helps to justify how the findings are related to the body of knowledge in relevant area of research. The major significance is lined up as follows:

i. Improve research methodology whether the methods other researchers used worked for them and what are the problems they faced. It could strategize well to select a methodology that researcher feel will suit research work better.

ii. The main focus will on research problem because the process helps to understand the subject area better to help to conceptualize research problem clearly and precisely.

iii. Gather knowledge base for relevant research area to find the gap for the study.

iv. Contextualising Research Findings

v. Ensure novelty in research work means that wasting efforts on trying to rediscover something that is already known or published. Therefore, literature review ensures the novelty and new contribution in the research work.

2.3 A review of existing literature is given as follows:

Blume et al., (1994). “Investigated the informational role of volume and its applicability for technical analysis. They developed a new equilibrium model in which aggregate supply is

\[\text{volume} \times \text{technical analysis} = \text{aggregate supply}\]

---


fixed and traders receive signals with differing quality. They found that how a technical analysis can be valuable to the investors in an economy which the only uncertain arises from the underlying information structure. It is valuable because the current market statistics may be sufficient to reveal some information, but not all. They focused on quality, or precision of information suggested value of particular market statistics may vary depending upon characteristic of the information structure.”

Sedeque (1996)\(^7\), examined what are the quantitative techniques, how they are used, whether it is related to traditional techniques or not and they are useful for the investment. The result shows that diverse and interesting nature of quantitative investment techniques.

Dalang et al., (1999)\(^8\), compared the quantitative investing with passive investing in global market and found that mathematical model fulfilled the theories of market efficiency and take the advantage of US market and in the global market minimum variance strategy achieved both higher return and lower volatility than the benchmark while passive strategies shown underperformance because of no replication of indices.

diBartolomeo of Northfield information services Inc (1999)\(^9\), examined the cause of failure of quantitative model on implementation while it produced excellent results in back-tests and simulations. He found that back-tests and simulations are of limited usefulness in prediction of future investment outcomes. Many of the limitation are conceptual and only apply irrespective of the level of statistical and experimental rigor. Subjective analysis of the professional and sociological context found the problem of quantitative investment analysis. Most of the models fail the final test of implementation as it was a theoretical model for the paper.

---

\(^7\) Imam-sadeque, F. (1996). Quantitative investment techniques. AIMA.


A study conducted by Intertek Partners (2003) 10. “Dealt with the use of financial modeling at European asset management firms to evaluate model performance following the fall of the markets from their peak in March 2000, and explores changes that have occurred since then. 61 managers at European asset management firms in the Benelux countries, France, Germany, Italy, Scandinavia, Switzerland, and the U.K. were interviewed. The major findings show that quantitative methods in the investment decision play a vital role. Almost 75% of the firms interviewed reported this to be the case, while roughly 15% reported that the role of models had remained stable. The remaining 10% noted that their processes were already essentially quantitative. The role of models had also grown in another sense; a higher percentage of assets were being managed by funds run quantitatively.” One firm reported that over the past two years assets in funds managed quantitatively grew by 50%.

Goyal A., (2004)11 studies to find out the link between population age structure and net outflows in stock market and stock market return in an overlapping generations framework. “He used OLG model to analyze the effect of changing demographic structure on the investment flows in and out of the asset markets, and on asset prices. He found that outflows are positively correlated with changes in the fraction old people and negatively correlated with the changes in the fraction of middle aged people. He also found that outflow over the next 50 years are not expected to rise to levels that cause retirement concern for baby boomers. Demographic changes have some power in explaining international capital flows.”

Baker, M., & Wurgler, J (2006)12, explained top down approach to behavioral finance and the stock market to identify the result of investors sentiments for their investment decision. “They show that it is quite possible to compute investor sentiment, and that waves of sentiment have clearly discernible, important, and regular effects on individual firms and on the stock market as a whole. Stocks that are tricky to arbitrage or to value are most affected by sentiment. He is found that the investor sentiment approach faces a number of challenges: characterizing and measuring uninformed demand or investor sentiment; understanding the foundations and variation in investor sentiment over time; and determining which particular stocks attract speculators or have limited arbitrage potential.”

---

Sonnenreich et al., (2006)\textsuperscript{13}, explored a number of techniques that can be used to calculate security within a business. “It proposes a new benchmarking methodology that produces results that are of strategic significance to both decision makers and technology implementers. Researcher analyzes the problem of shaping a meaningful Return on Security Investment for security expenditures. They presented a model for calculating ROSI, and then showed how the various factors could be obtained. Some unique approaches to measuring Risk Exposure and Risk Mitigation were explored, specifically those that focused on lost productivity as a critical factor. The aptness of using Net Present Value in this context was explored.”

Yang et al., (2006)\textsuperscript{14}, proposed a quantitative approach that requires no knowledge of internal mechanisms of the algorithm. “The approach focuses on performance attribution using historical data and provides parameters that help forecast the potential performance of the algorithm.”

A study conducted by Intertek Partners (2006)\textsuperscript{15}, was on based on survey responses and conversations with industry representatives in 2006. “The findings of the 2006 study suggested that the skepticism relative to the future of quantitative management at the end of the 1990s had given way by 2006 and quantitative methods were playing a large role in equity portfolio management. Of the 38 survey participants, 11 (29\%) reported that more than 75\% of their equity assets were being managed quantitatively. This includes a wide spectrum of firms, with from $6.5 billion to over $650 billion in equity assets under management. Another 22 firms (58\%) reported that they have some equities under quantitative management, though for 15 of these 22 firms the percentage of equities under quantitative management was less than 25\% often fewer than 5\% of total equities under management. Five of the 38 participants in the survey (13\%) reported no equities under quantitative management. This report focused that the amount of equities under quantitative management was reported to have grown at most firms participating in the survey (84\%). One reason given by respondents to explain the growth in equity assets under quantitative management was the flows into existing quantitative funds. According to survey respondents, the most important factor contributing to a wider use of quantitative methods in equity portfolio management was the positive result obtained with these methods. Half of the participant stated positive results as the single most important factor contributing to the widespread use of quantitative methods. Other factors contributing to a wider use of quantitative methods in equity portfolio management were, in order of importance attributed to them by participants, (1) the

computational power now available on the desk top, (2) more and better data, and (3) the availability of third-party analytical software and visualization tools.”

A study conducted by Intertek Partners (2007) 16. “It was based on conversations with asset managers, investment consultants, and fund-rating agencies as well as survey responses from 31 asset managers in the United States and Europe. In total, 12 asset managers and eight consultants and fund-rating agencies were interviewed and 31 managers with a total of $2.2 trillion in equities under management participated in the survey.” Half of the participating firms were based in the United States; half of the participating firms were among the largest asset managers in their countries. Survey participants included chief investment officers of equities and heads of quantitative management and/or quantitative research. “The 2007 survey participants were asked how they managed the model building and back-testing process. One-fourth of the participants said that their firms admitted several processes. For example, at 65% of the sources, quantitative models are built and back-tested by the asset manager him/herself; at 39% quantitative models are built and back-tested by the firm’s central research center. More rarely, at 23% models might also be built by the corporate research center to the specifications of the asset manager, while at 16% models might also be built by the asset manager but are back-tested by the research center. The main finding was the need to continuously update models was identified by sources as one of the major challenges to a quantitative investment process. According to survey respondents, three main objectives were behind the decision to adopt (at least partially) a quantitative-based equity investment process: tighter risk control, more stable returns, and better overall performance. Other major objectives reported behind the decision to implement a quantitative equity investment process include diversification in general. Among survey participants, the desires to stabilize costs, revenues, and performance or to improve the cost/revenues ratio were rated relatively low as motivating factors to introduce quantitative processes.”

Nuttall (Feb, 2007) 17, focused on the quantitative investing based on the technique of machine learning. “He describes the basic structure of general approach to equity return prediction. The result shows that a more sophisticated form of machine learning can improve predicted return. In practice the highest (and lowest) predicted returns will come from regions of predictor space with a low density of samples, and it is important in the present application that the predicted return is well approximated in these regions. On the other hand, a method such as neural networks is completely global because all samples affect the predicted return at all points. Thus, a global method will be dominated by high density regions.”

Griffo et al. (2007)\(^{18}\), focused on power of algorithmic execution tools usage to improve trading performance of commodity trading advisors (CTA). “It was used for black box trading, automated trading, systemic trading and enhanced execution but the most important benefit is improved trading performance and the reduction of market impact and reduced slippage.”

Zwick et al. (2007)\(^{19}\), discussed the impact of algorithmic trading in US financial firms and found that it needs more nourishment and trading innovations.

Rao (2007)\(^{20}\), found that algorithmic trading one of the fast moving bandwagons in the stock market. “It also reduced transaction cost and investors are the controller of their own trading processes. More sophisticated algorithms allow buy-side firms to fine-tune the trading parameters in terms of start time, end time, and aggressiveness. In today’s hyper-competitive, cost-conscious trading environment, being the first to innovate can give a broker a significant advantage over the competition both in capturing the order flow of early adopters and building a reputation as a thought leader.”

Muehlberg et al. (2008)\(^{21}\). “The article examined the different ways by which individual stock traders can take advantage of how an algorithmic trading moves money from one market to another. It used automation to take advantage of the best opportunities. Algorithmic trading was a defined quantity into a quant model that automatically generates the timing and size of orders.”

---


Muehlberg et al., (2008)²², offered information about algo trading and procedure for solving a mathematical problem. “The main purpose was to create a balance between buyers and sellers, between productions, supply, demand and distribution so that if market got crashed an investor should at least protect him from the downturn. It provided a complete embrace of algo trading which require a different perspective on the market.”

Avellaneda et al., (2008)²³, studied the optimal submission strategies of bid and ask orders in such a limit order book. “The two most often addressed sources of risk facing the dealer are (i) the inventory risk arising from uncertainty in the asset’s value and (ii) the asymmetric information risk arising from informed traders. This study focused on the inventory effect. This inventory effect was found to be significant in an empirical study of AMEX Options. It is found that the optimal bid and ask quotes are derived in an intuitive two-step procedure. First, the dealer computes a personal indifference valuation for the stock, given his current inventory. Second, he calibrates his bid and asks quotes to the limit order book, by considering the probability with which his quotes will be executed as a function of their distance from the mid-price. In the balancing act between the dealer’s personal risk considerations and the market environment lays the essence of our solution.”

Sougiannis (2008)²⁴, in his research shaded the light on how Greek companies make capital investment. “He found that 57% and 33% use rate for the NPV and IRR methods, 23% of Greek firms use the weighted cost of capital, 7% of Greek firms use synchronous methods for estimation of the of portfolio risk such as simulation, CAPM, sensitivity analysis, etc. He also recommended Greek Universities to teach beyond the simple capital budgeting in Financial Management and strengthen the ties between the university and the business community. Eric P. Leve focus to gain an understanding of who quants are and what they do, to highlight the goals of quantitative equity management and to emphasize the attributes of a solid quantitative process specifically as applied to management of international equities. The

---


result shows that quantitative equity management is a very useful tool to build an investment process around insight, theory and market knowledge utilizing large amount of data. Doing quant right can be a great benefit to a strategy’s investors.”

Gsell (2008) assessed the impact of algorithmic trading models can be conducted by comparing different simulation runs including and excluding a trader constituting an algorithmic trading model in its trading behavior. “It is found that large volumes to execute by the algorithmic trader have an increasing impact on market prices. This study showed that the implemented Algorithmic Trading concepts have an impact on market outcome in terms of market prices and market volatility. On the one hand, low latency showed the potential to significantly lower market volatility. On the other hand, large volumes to execute had a negative impact on both market prices. However, as up to now only simple algorithmic trading strategies have been implemented within the simulation environment, it is not valid to conclude that algorithms in general are not capable of handling large order volumes appropriately. Further extensive simulations will have to be conducted to confirm these results and to identify further impacts on the markets itself that might arise from the increasing usage of such automated execution concepts”

A study conducted by Yong et al., (2009) “They created a model with the help of FA (financial analysis) and TA (Technical analysis) in order to understand that how stock price prediction works in stock market. They combine the AI and DM for their hybrid model specifically in the knowledge based sub-system for the better analysis of historical data.”

Schumaker et al., (2009) “Examined the problem of distinct stock price forecast using a synthesis of linguistic, financial and statistical techniques to create the Arizona Financial Text System (AZFinText). Researcher has checked the feasibility of a textual-based processing system that can route large amounts of financial news articles and make discrete predictions from them (AZFinText). It si found that Sector-based training had the better performance of the models tested. Sector had the best Directional Accuracy at 71.18% and Simulated Trading of 8.50% return on investment. When comparing the Sector-based approach to trading professionals, we found that AZFinText had a Directional Accuracy of

---


71.18%, which was second-best to DayTraders.com’s 81.82%.” He suggested that, it would be interesting to discover other machine learning techniques which can take advantage of the historical probabilities associated with stock prices.

A study by Lent (2009) found that tactical equity allocation model (T.E.A.M) can be used for the more effectively invest in the individual stock and broad market indices like NASDAQ and S&P500. “Further they found that it goes long at market open on any day when a stock falls a certain percentage (C) under its short-term moving average but is still a certain percentage (D) above its longer-term moving average. And it exits the trade at market open on Monday if the stock has fallen below the longer-term moving average + D on Friday. The strategy is tested on large cap stocks and two indexes. There are also similar rules for going short. The strategy seems to do well based on its Sharpe ratio.”

A study by Ansio (2010), found that validity of contextual framework for strategic investment decision making proved good and it also indicate that risk analysis and innovativeness increases.

Abrams et al., (2010), used four key design principles: market-regime-switching, non symmetrical trading algorithms, volatility adaptive metrics, and robustness to regime whipsaws. “An extensive analysis of out-of-sample ETFs and managed futures demonstrates the robust performance of the system over ten years. This study described a quantitative method for trading equity indexes (ETFs and futures) that can increase return and reduce volatility when used in a diversified portfolio. The system is designed to be adaptive to changes in market volatility over the short-term, and also deploys techniques aligned to the dominant market regime. The system is based on four core principles: (1) a market-regime-switching method to exploit different characteristics of markets by using short-term mean-reversion in the bear regime, and deploy swing trading in the bull regime. Next, it uses (2) non symmetrical trading algorithms for entries, exits and the regime specific trading algorithms. Every system component is based on (3) volatility adaptive metrics that it can handle changes in volatility over a long time span.” Finally, since no regime switching model will be able to eliminate all false signals, each core system

component exhibits (4) robustness to regime whipsaws. This demonstrated that investors will benefit by including a portion of their funds to a non-correlated systematic approach to smooth and protect their portfolio performance.

Gupta et al., (2010)\textsuperscript{31}, examined the algorithm trading process flow and found that high speed trading tools such as algorithmic trading are significant contributors to trading volumes in the developed markets. “These tools minimize impact cost and increase the speed of executing large trades, thereby improving systematic efficiency. It suggested that ATS is associated with greater liquidity in market.”

Bansal et al., (2010)\textsuperscript{32}, proposed a framework for intelligent interaction of these trading algorithms with the user which maintains required user adaptability, modeling and knowledge sharing in the coming future. “They discussed about the various trading algorithms, their areas of concern and its likely impact on the market presently and in coming future. They found that the algorithmic trading software should be able to understand the requirements of the small investors. There should be a proper graphical user interface so that the investor can input all its requirements in the form so that algorithm works accordingly to the input data. This GUI should also be available in the regional language to ease the users in terms of input of the requirements. This feature will make the algorithm more users friendly and acceptable for the smaller investors.”

Nair et al., (2010)\textsuperscript{33}, proposed system is a genetic algorithm optimized decision tree-support vector machine (SVM) hybrid, which can predict one-day-ahead trends in stock markets. “The uniqueness of the proposed system lies in the use of the hybrid system which can adapt itself to the changing market conditions and in the fact that while most of the attempts at stock market trend prediction have approached it as a regression problem, present study converts the trend prediction task into a classification problem, thus improving the prediction accuracy.” significantly. “Performance of the proposed hybrid system is validated on the historical time series data from the Bombay stock exchange sensitive index (BSE-Sensex). The system performance is then compared to that of an artificial neural network (ANN) based

system and a naïve Bayes based system. It is found that the trend prediction accuracy is highest for the hybrid system and the genetic algorithm optimized decision tree-SVM hybrid system outperforms both the artificial neural network and the naïve bayes based trend prediction systems.”

Yong Liu (2010)\textsuperscript{34}, focused on trading strategy to leverage the current market trend and then on risk control but to perform well in automated trading, new functionality needs to be added constantly. Through constant testing and evaluation of trading strategies secure winning element in time to time.

Clark et al., (2010)\textsuperscript{35}, discussed the HFT algorithmic trading system by financial institution in US. It was said that HFAT depends on computerized quant model that determine which type of instrument investors should buy or sell while HFAT helps to lessen latency, filling and confirming or cancelling orders.

Kannan et al., (2010)\textsuperscript{36}, examined an algorithm to predict the closing price for the stock. It was found that algorithm is only useful for the trading analysis only and performed well on half of the stock only. It meant that only 50\% chance to win the situation.

Kapoor et al., (2011)\textsuperscript{37}, tried to find GA (genetic algorithms) be used to improve the performance of a particular trading rule by optimizing its parameters, and how changes in the design of the GA itself can affect the solution quality obtained in context of technical trading system. “It was found that experiments based on real time series data demonstrate that the optimized rule obtained using the GA can increase the profit generated significantly as compare to traditional moving average lengths trading rules taken from financial literature.


This study was introduce ideas of representing investment strategies as rules, when to buy and when to sell which is put together into conditional statements involving difference of moving averages. It showed that GA’s helps in finding global optimal solutions and found that solution quality (maximum fitness) increases as population size increases. Within impounded limited data set experiments with all population sizes, shows similar results i.e high overall rate of return. Finally, they conclude with a proposition of GA robustness remains reasonable for tuning of parameters of technical trading system.”

Sassoon et al., (2011) 38. “Focused on the advantage of HF algo trading in US where trading approach had been programmed to recognize known trading strategies like pure auction volume, volume-weighted average price, and price destination with time horizon to target the opportunity for a larger advance.”

Ramesh et al., (2011) 39 found that each investor has its own perception about the market. He also presented a model which is better in predicting the financial asset price over the conventional methods.

A mercer advisors research report (2011) 40, focused on the advantages of quantitative investing. “They compared the quantitative investing techniques with actively managed strategies and index strategies for higher return. Actively managed strategies use research that covers both the.” company and its market to identify emerging companies but at the end they rely heavily on their personal experience while on the other hand Index strategies avoid the risk and instead solely aim to match the return of an index. “The result shows that Quantitative Investing and Institutional funds provide their investors with multi-dimensional methods to increase market returns and generate returns beyond the market. After looking at different investing strategies and management techniques, they have found that returns cannot be maximized using Actively Managed or Index funds available to the retail investor. World-class returns require the sophistication of Quantitative Investing.”


A study conducted by Mitra et al., (2011) 41. “They tried to explore that how an automated analysis of anticipated and non-anticipated extraordinary news events impact both automated and manual trading activities. Automated algorithmic trading and news analytics both are recently developed technologies in India. The inter-actions of these are still uncharted and basically rely upon, information, communication technologies, artificial intelligence and behavioral finance.”

Dzikevičius, A., & Šaranda, S. (2011) 42, examined whether a proper technical analysis rule such as Exponential Moving Average (EMA) has a predictive power on stock markets in the Baltic States. “The method is applied to OMX Baltic Benchmark Index and industrial indexes as they are more or less sensitive to the main index fluctuations. The results were compared using systematic error (mean square error, the mean absolute deviation, mean forecast error, the mean absolute percentage error) and tracking signal evaluation, CAPM method and appropriate period of EMA finding for each market forecast. It was found that EMA method is relevant to forecast stock market fluctuations of OMX index in the Baltic States.”

Yang et al., (2011) 43, proposed to characterize traders’ behavior in terms of the reward functions most likely to have given rise to the observed trading actions. “The approach is based on machine learning technique known as Inverse Reinforcement Learning (IRL). The reward function is of interest by itself in characterizing agent’s behavior regardless of its circumstances. Researcher focused attention on the former problem to identify trader’s behavior using reward functions. He found the results using a linear programming method for solving IRL with simulated E-Mini S&P 500 futures market data, and attain a high identification accuracy ranging between 95% and 100% for the targeted trading strategy class, namely High Frequency Trading from Market Making and Opportunistic strategies. It also showed that the algorithm can accurately (between 92% and 95%) identify a particular type of HFT spoofing strategy from other HFT strategies.”


Sharma (2012), discussed the various popular trading algorithms, the trends, area of concern and impact of algorithmic trading. “Algorithm innovation continues to offer returns for firms with the scale to absorb the costs and to reap the benefits. This study found that Algorithmic trading has had a profound impact on the way trading is done. It has led to globalization of markets and reduced transaction costs per stock. This has also resulted in increased trading volumes. There are tremendous growth opportunities in this form of trading but a few areas of concern need to be addressed before it becomes more widely accepted amongst the investing community.”

Shen et al., (2012), proposed a new prediction algorithm that exploits the temporal correlation among global stock markets and various financial products to predict the next-day stock trend with the aid of SVM(support vector machine). “The numerical results indicate a prediction accuracy of 74.4% in NASDAQ, 76% in S&P500 and 77.6% in DJIA. The same algorithm is also applied with different regression algorithms to trace the actual increment in the markets. Researcher found that strong interconnection between the US stock index and global markets that close right before or at the very beginning of US trading time. Various machine learning based models are proposed for predicting daily trend of US stocks.” And numerical results suggest high accuracy. A practical trading model is built upon our well trained predictor. The model generates higher profit compared to selected benchmarks.

Biyan, k. (2012), identified the role of Stock Exchange market to economic growth in Tanzania and the factors which hinder the swift growth of Dar es Salaam Stock Exchange Market. He also suggested measures to be taken by DSE to promote economic development in Tanzania. Researcher found that investors need to expand their ownership structure and move from family business structure to the universally accepted model – operated by quoted companies, government should make the environment conducive for business and regulators and operators need to improve operational efficiency of the market for running their business transparently and efficiently in accordance to stipulated guidelines.

---

A study conducted by Baker et al., (2012)⁴⁷, Low Risk Stocks Outperform within All Observable Markets of the World provided comprehensive additional evidence to support the notion that bearing relative risk in the equity markets of the world yields an expected negative reward in all developed countries and emerging markets and also provide a rationale based in the theory of agency, which explains the remarkable anomaly, and provide empirical evidence to support this contention. They covered the stocks in 21 developed countries and 12 emerging markets over the time period 1990 to 2011. It is found that the basic pillar of finance, that greater risk can be expected to produce a greater reward, has fallen.

Soe (2012)⁴⁸, examined the low-volatility effect: a comprehensive look through S&P DOW JONES INDICES and found that both principal approaches to constructing low-volatility strategies are equally effective in their ability to reduce realized volatility relative to market cap-weighted portfolios over an intermediate to long term investment horizon. The analysis showed low-Volatility strategies possesses superior risk-adjusted performance over a benchmark portfolio.

A study conducted by Prof. Narawade et al., (2012)⁴⁹. “They proposed a system for analyzing the stock market database which is user friendly and statistically analyzed the pattern of stock to recommend the investors with the help of expertise of trading experts. To increase user-friendliness we have used simpler software for developing it. The GUI was also kept very simple so as to improve user involvement while doing transactions with the end site. They have implemented a Module called InnoBroker which uses Statistical Analysis to analyze the stock patterns. As the commodity, bond and stock markets were interlinked; such effects will spread with spillovers into the bond and stock markets.”


Bhattacharyya et al., (2012)\textsuperscript{50}, developed mean-variance-skewness portfolio selection models in uncertain environment. “The model in uncertain environment is formulated as a non-linear programming model based on uncertain programming approaches. Researcher verified the feasibility and effectiveness of the proposed method is by numerical example extracted from Bombay Stock Exchange (BSE). They found that the efficiency of the portfolios is evaluated by looking for risk contraction on one hand and expected return and skewness augmentation on the other hand. They found that goal programming approach meta-heuristic algorithms such as genetic algorithm, tabu search, simulated annealing, ant-colony optimization, and particle swarm optimization may be employed to solve the non-linear programming problem.”

Othman, A. (2012)\textsuperscript{51}, constructed a principled theoretical framework for market making along with applications of that framework to different contexts. He synthesized of two concepts—automated market making from the artificial intelligence literature and risk measures from the finance literature—that were developed independently. “Researcher used Gates Hillman Prediction Market (GHPM), a fielded large-scale test of automated market making that successfully predicted the opening date of the new computer science buildings at CMU to find some uncovered practical flaws of automated market makers. He tried to rectify those flaws to facilitate better trades in internet prediction market to focus on profit optimization.”

Andersen, A. C. (2012)\textsuperscript{52}, implemented an automated trading system able to outperform the benchmark uniform buy-and-hold strategy. “Performance is measured in term of multiple risk and return measures. He found many of the trading systems are heavily influenced by machine learning methods, with a special focus on time series prediction. Support vector machines (SVM), artificial neural networks (ANN), and regression are the primary methods applied for low level machine learning. In addition to machine learning methods, classical portfolio optimization methods using modern portfolio theory are applied, some in combination with machine learning methods. Support Vector Machines are identified to be the best time series


predictors among the machine learning techniques used. Evolution is found to be a powerful tool in identifying and training trading systems.”

Fletcher, T. (2012)\(^5\), investigated the usage of machine learning techniques for the prediction of financial time series. “Both discriminative and generative methods are used and compared to more standard financial prediction techniques. He found that Support Vector Machines (SVM), Relevance Vector Machines and Neural Networks performed well when incorporating sophisticated exogenous financial information in order to predict daily FX carry basket returns. Hidden Markov and changepoint models are found to be unsuccessful at predicting daily price for a wide range of asset class. He suggested further research involve comparing each of the techniques investigated in his research against more sophisticated financial forecasting techniques than the simple trend-following methods used by him.”

Michalak et al., (2013)\(^5\), proposed an approach to analysis of usage patterns of trading rules in stock market trading strategies. “Analyzed strategies generate trading decisions based on signals produced by trading rules. A novel approach to trading rule pattern discovery, inspired by association rule mining methods, was proposed. Researcher found patterns consisting of up to 5 trading rules were discovered which appear in no less than 50% of trading experts optimized by evolutionary algorithm.”

Rosillo et al., (2013)\(^5\), analyze the different outcomes using support vector machines (SVM) to forecast the weekly change movement of the different simulated markets. “The SVM system helps to investors in the quantitative decision making to get the weekly forecast whether bullish or bearish and analyze the market situation to get the best results. They found that SVM configuration for his trading strategy achieve better results in high and low volatility market than the trend markets.’

---

Hendershott et al., (2013)\textsuperscript{56}. “Examined the role of algorithmic traders in liquidity supply and demand in the 30 Deutscher Aktien Index stocks on the Deutsche Boerse. The main finding was ATs consume liquidity when it is cheap and provide liquidity when it is expensive, likely reducing the volatility of liquidity. ATs closely monitor the market and respond more quickly to changes in market conditions. The increase in ATs has important implications for both regulators and designers of trading platforms. ATs react more quickly to events and even more so when spreads was wide.”

A.S (2013)\textsuperscript{57}, examined the performance of securities and fundamental analysis of the investment. “Fundamental analysis examined the economic environment, industry performance and company performance before making an investment decision. Investment is generally distinguished from speculation in terms of three factors, namely risk, capital gains and time period. It was found that some investors are risk averse, while some may have an affinity to risk.” Each investor tries to maximise his welfare by choosing the optimum combination of risk and return in accordance with his preference and capacity. “A person with higher income is assumed to have a higher risk bearing capacity. Each investor tried to maximise his welfare by choosing the optimum combination of risk and return in accordance with his preference and capacity. It was highly essential for the investor to do both fundamental and technical analysis for deciding the suitable stock.”

Mallick (2013)\textsuperscript{58}, developed the genetic algorithm to achieve sales volume which achieves optimal growth rates and preserves the dynamic capital stock at the golden rule level (genetic). “They developed the econophysics of intertemporal stock markets. They derived a sequence of 5 steps to characterize the technology to achieve the desired stock market sales volume.”

Othman et al. (2013)\(^{59}\) presented a market maker that is both sensitive to liquidity and can run at a profit. “Researcher also provides guidance as to how our market maker can be implemented over very large event spaces through a novel cost-function-based sampling method. He found that if we want sensitivity to liquidity and path independence, then we must relax the arbitrage condition that constrains prices of disjoint and exhaustive assets to sum to exactly one dollar. He also shows that for a broad range of terminal market states, our market maker actually makes a profit regardless of the event that gets realized.”

Premachandra, M., & Reid, M. D. (2013)\(^{60}\). “Showed that the prices generated in sequentially traded prediction markets are stochastic approximations to the price given by an equilibrium analysis. Researcher tried to prove several properties of scheme called mini-trading and show that it can improve the stability of prices in sequentially traded prediction markets.” He explored the convergence of instantaneous prices in sequential markets to the equilibrium price via mini-trading, which has desirable properties of price stability and bounded loss for the market-maker, thus mini-trading can used as a framework to produce aggregations that are closer to the equilibrium price using the sequential market approach.

Sarika et al., (2013)\(^{61}\), presented a rule based trading approach for algo trading by incorporating the concepts of Elliott waves. “The study consists of three phases. In the first phase, they selected a technical indicator. In the second phase, they defined the rules for conducting trade using the selected technical indicator. In the third phase they analyzed the trend using Elliot waves. They found the third page depict the market behavior. It is found that Employing automated trading strategies eliminates all influences from emotion driven human trading and allows a pure systematic trading approach. It uses computer algorithms to analyze quote data and detect and exploit trading opportunities, with windows as short as milliseconds or even microseconds. Further they found that it needed a reasonably good computer, a broker and a source of historical data. If you want to automate your algorithmic trading, that is, make your computer place orders for you, then you will also need good programming skills and an application programming interface (API) from your broker.”


A study conducted by Principal Management Corporation, Investment Manager (2013)\textsuperscript{62}, Utilizing Liquid Alternatives in Portfolio Construction found that through the growth of liquid alternatives, alternative investment strategies are now made available to a much broader investor base. “In the context of liquid alternatives, the potential benefits of these strategies were typically realized over a long-term time horizon (i.e., a complete market cycle). Therefore, patience may be required to realize the ultimate objectives of these strategies. It was also found that investment risk may be magnified with the use of alternative strategies.” When using hedging strategies investors should not expect significant outperformance during market rallies.

Loukine (2013)\textsuperscript{63}, Investing in real asset through liquid real assets examined various components of real assets from the Canadian and U.S. perspective, their liquid implementation, as well as the benefits of adding liquid real assets to a portfolio of traditional investments. He found that the magnitude and timing of future changes in realized inflation and interest rate term structure are difficult to predict. Adding liquid real assets to clients’ portfolios would enhance diversification, introduce additional sources of return, and help protect the capital against the erosion of purchasing power without significantly changing the risk/return profile of the portfolio based on historical analysis. A portfolio with an allocation to liquid real assets would be better positioned for future unexpected changes in inflation and/or interest rates.

Kirilenko et al., (2013)\textsuperscript{64}, in his paper talked about innovation in trading technology starting from 1950(portfolio optimization) and end with late 2000s (HFT), as well as opportunities, challenges, and economic incentives. They have explained the potential threats to financial stability provided by algorithmic trading.


Bell et al., (2013), described the HFT and algorithmic trading and the role of regulators for the same. He also focused on potential market risk associated with HFT and algorithmic trading.

Kirilenko et al., (2013), found that Automation of the trading process, including computerized algorithmic trading, has drastically reduced the costs to the intermediaries of maintaining a continuous market presence. They suggested that regulators need to encourage safeguards at multiple levels of the system and to change their surveillance and enforcement practices to be more cyber centric rather than human-centric. Financial regulation should be designed to encourage innovation in technology and finance.

Treleaven et al., (2013), discussed that AT (algorithmic trading) is not only the part of automated trade cycle while it also involves in learning, dynamic planning, reasoning and decision making, computational trading terms which would be used for systematic trading, HFT, Ultra HFT.

Aggarwal et al., (2014), found that securities with higher algorithmic trading have lower liquidity costs, order imbalance, and order volatility. There was new evidence that higher algorithmic trading leads to lower intraday liquidity risk and a lower incidence of extreme intraday price movements. Two areas where the results provide new insight were the intraday volatility of liquidity and the probability of an extreme price change and reversal over a very small period during the day, often referred to as a flash crash.

---

Viljoen et al., (2014)\textsuperscript{69}, found that algorithmic trading shows a strong reverse U-shape intraday pattern, and greater activity to lower effective spreads, higher realized spreads and lower adverse selection risk, which suggests that algorithmic traders strategically enter the market when transaction costs and information asymmetry are lower. His study suggested that algo traders are informed and contribute to liquidity and price discovery on the future market.

Sriwas et al., (2014)\textsuperscript{70}, analyzed index point of NSE with the help of using classification rules of data mining to find out the pattern and finally this pattern evaluated with the help of graph based analysis based on daily stock price. This study presented the set of classification rules of NSE to predict the stock market trend. These rules are generated by combining approach of graphical analysis and rule based classification of data mining. They checked the effect of news article to daily stock price also. First they found average pattern from graph based analysis and then all patterns were classified according to their time period. They found that approach is time consuming as we have to compare number of data’s at a time which is practically not possible to do prediction but with accuracy.

Shaikh et al., (2014)\textsuperscript{71}, proposed a method which can help to predict stock prices movements on the next day. They took 5 different categories of stock market, as given below, are used to test the accuracy of proposed applications: The 1st category is same company and different sector (related), example is the same company run in the banking industry and IT industry. The 2nd category is different company and same sector (related), example is the both company run on the banking industry. The 3rd category is different company and different sector (related), example is a company 1 run on the banking industry and company 2 run on the IT industry. The 4th category is different company and different sector (not related), example is a company 1 run on the banking industry and company 2 run on the technology-based industry. The 5th category is same company and different sector (not related), example is the same company run in the technology based industry and IT industry. It was found that these rules can only be applied when the left side have a patterns occur. Therefore it is still become a challenge to be able to apply all extracted rules at any given time to predict the


Rechenthin, M. D., (2014)\(^{72}\) built a decision support framework to advise the investors about the future stock price and their move. They used traditional technical analysis as visual and quantitative technical analysis as numerical to program easily in computer. Researcher examined attributes creation for high-frequency stock prediction. It includes the use of sentiment analysis and also technical analysis indicators. He found that on an average the market escapes the confines of the bid and ask after several seconds, and that high probability events could be observed until several minutes. They suggest on average, larger training set sizes outperform smaller ones and rarely is there much difference in the average distance of the classifier from the current time \(t\) in the performance.

A study conducted by Shriwas et al., (2014)\(^{73}\), examined that investment strategy based on technical indicator help in positive result in trading. He also suggested a combination of classical trading strategy with real-time technical indicator for the better stock price prediction.

Sun et al., (2014)\(^{74}\), tried to found the influence of information asymmetry on the cross-sectional variation of volume-return relation. They found that the dynamic volume-return relation within medium-size trades has the most significant response to the degree of information asymmetry. It was also found that the effect of information asymmetry on the volume-return dynamics migrates to small-size trades in recent years, especially in larger stocks and importance of incorporating informed traders’ trade-size decision in the examination of the dynamic volume-return relation.


Michael A. et al., (2014) 75, examined the impact of high speed trading on the performance of securities markets and also examined the regulatory questions if any for the safeguard over the fairness and risk of high speed, computerized trading. They described the evolution of increasingly fast automated trading over the past decade and some key features of associated practices, strategies, and apparent profitability.

Davey et al., (2014) 76, tried to found three mistakes of trading system development in Complications & obfuscations, Friction-free trading and all data used. If the approach made finding systems easier, or always created better back tests, it was a warning sign that something may be wrong. In the long run, developing the correct way is always preferable to losing money in the market due to a development mistake.

Scholtus et al., (2014) 77, showed that the effect of algorithmic trading is depends upon the types of algorithm active and speed of the algorithm decide the profit and loss of the trade also. They found that trading speed is very important around macroeconomic news announcements, both in economic and statistical terms. For success ratios of 60% and higher, any delay from 10 ms to 1 second leads to a statistically significant decrease in performance. The economic significance of speed increases with the degree of success with which the trade direction is predicted. Traders that could predict the correct trade direction for 70% of the news announcements lose about 0.33 (0.62) basis points (bps) per event when trades are delayed by 300 ms (1 second) compared with instantaneous execution. The corresponding loss per year is 0.80% for a 300 ms delay and 1.48% for a delay of 1 second. A trader with a success rate of 100% incurred a loss of 0.81 (1.62) bps per event, or 1.94% (3.90%) per year from a delay of 300 ms (1 second). In relative terms (with respect to the total return of a strategy), the losses due to delays by 300 ms or 1 second for a strategy with a success ratio of 70% are 10.85% and 20.05%, respectively. This was substantially higher than the 2.03% relative decline in performance when the execution of interval-based technical trading.


strategies was delayed by 1 second (Scholtus and van Dijk, 2012). The impact of speed on returns is higher for announcements at 10:00 a.m., on days with high volatility, and for high impact news. The impact of algorithmic trading on market quality during macroeconomic news arrivals was analyzed by examining the behavior of spreads, order book depth, trading volume, and realized volatility measures.

Gofer, E. (2014)78, dealt with the general theory of regret minimization, and with its implications for pricing financial derivatives. He presented algorithms and analysis for a novel regret minimization setting of branching experts, in which the set of experts may grow over time according to a tree-like structure, determined by an adversary. Researcher developed a general new formula that allows regret bounds to be directly converted to a financial setting. As a result, existing regret bounds may be applied without any need for algorithmic modifications or additional analysis. This method is applied to obtain new variation-based price upper bounds that are applicable in broader settings than the one considered in.

MacKenzie, D. (2014)79, proposed and exemplifies a sociology of algorithms that is historical (demonstrates path-dependence in the development of automated markets), ecological (how automated high-frequency trading is both itself an ecology and also is shaped by other linked ecologies and Zelizerian, importance of boundary work, especially of efforts to distinguish good and bad actors and algorithms). He found that sociological analysis of algorithmic markets will require not just an extension of existing cultural, network, and other approaches, but new approaches and certainly new methods.

Jagongo et al., (2014)80, tried to find the factors influencing investment decisions at the Nairobi Stock Exchange (NSE). Friedman’s ranking was used to identify the most important individual factors that influence investment decision in NSE. Researcher found that certain degree of correlation between the factors that behavioral finance theory and previous empirical evidence identify as the for the average equity investor. The researcher found out that the most important factors that influence individual investment decisions were reputation of the firm, firm’s status in industry, expected corporate earnings, profit and condition of statement, past performance firms stock, price per share, feeling on the economy and

---

The researcher recommends that the investors need to analyze the investment factors carefully using the reasonable business information before making an investment decision. He suggested investors should also be able to interpret the market and economic indicators since they influence the performance of the share on the market. They should evaluate all the variables in the environment instead of considering only one variable. Investors do also need to diversify their investment in different companies by developing a portfolio of investments to minimize risks and maximize returns.

Mahato(2014)\textsuperscript{81}, designed and implemented various generative and no generative ensemble methods for predicting the stock price movement. It has shown better accuracy than individual methods. This study proposed an ensemble model to predict the price movement of a stock. Initially we examine different machine learning techniques. Choosing best 9 methods we will apply to our ensemble models. They examined various generative and non-generative ensemble models to get best prediction model. They found that stacking methods has worked significantly well with Logistic machine learning technique as Meta classifier. Due to this prediction accuracy investors make profitable trading decisions.

Kaur et al., (2015)\textsuperscript{82}, developed a Time-Series neural network that achieved a highest percent probability of predicting a market rise and market drop as compare to existing methods with the help of new modified algorithm. This study was based on the alteration and conversion of the previously used Time Series Neural Network algorithm into a new refined and enlightened algorithm for the stock Rate Prediction. They proposed the stock rate prediction steps and techniques which can be used for forecast the stock price based on time series and neural network. This study was modified and enhanced the algorithms to produces the accurate prediction in timely manner.

Abraham et al., (2015)\textsuperscript{83}, found factors that are responsible for the up down trends in the equity market. They executed computational methods to stock market data to model pattern in financial markets more efficiently and on a scale well beyond the boundary of traditional controlled experiments. This study integrated two methods such as Particle swarm optimization (PSO) and least square support vector machine (LS-SVM). The PSO algorithm

was employed to reform LS-SVM to foretell the price of daily stock. PSO will be used to get the best combination of parameters for LS-SVM. The financial technical indicators used were relative strength index, money flow index, exponential moving average, stochastic oscillator and moving average convergence/divergence. The PSO was employed continuously as global optimization algorithm to optimize LS-SVM for forecasting the stock market price.

Bhatt (2015)\textsuperscript{84}, described the effects of algorithmic trading (AT) on financial market activities. It also described the various types of trading algorithms and how they can be used to solve financial trading problems and the recent trends observed related to algorithmic trading and its likely impact on the present financial markets. They found various drawbacks of algorithmic trading and suggestive measures to overcome them in the future, leading to efficient and automated algorithmic trading.

Cumming, J. (2015)\textsuperscript{85}, proposed a novel reinforcement learning approach to the algorithmic trading problem which we define in terms of the classic reinforcement learning problem framework. Reinforcement learning methods, which aim to optimize an agent's performance within an unknown environment, are very much in active development and cutting edge solutions are regularly being introduced and improved upon. He used state-of-the-art techniques based upon least-squares temporal difference learning to evaluate the success of our approach in the foreign exchange market and identify its limitations. He found that his trading system were not very much profitable and feels that there are still opportunities to be explored within this approach.

O’Hara, M. (2015)\textsuperscript{86}, investigated the implications of technology and high frequency trading for high frequency market microstructure. Researcher described the new high frequency world with the help of more important aspects with a particular focus on how HFT affects the strategies of traders and markets. He found that HFT is not just about speed only, but instead reflects a fundamental change in how traders trade and how markets operate. He suggested a variety of theoretical and empirical issues we need to address in high frequency market microstructure research.


Suganthi, R., & Kamalakannan, P. (2015)\textsuperscript{87}, compared different types of clustering algorithm with the help of data mining tool WEKA. It shows the strength and accuracy of each algorithm for clustering in terms of performance, efficiency and time complexity required. Researcher focused on comparing the performance of machine learning algorithms that are trained with data relating to intraday trade with the aim of obtaining good stocks sectors for taking decision by their own of customers that will provide the proper alignment of daily basis trading data. It is the first model to provide the graphical user interface of the user in order to performing the clusterization with the help of NSE data.

Ding et al., (2015)\textsuperscript{88}, proposed a deep learning method for event driven stock market prediction. The events are extracted from news text, and represented as dense vectors, trained using a novel neural tensor network. A deep convolutional neural network is used to model both short-term and long-term influences of events on stock price movements. Researcher found that model can achieve nearly 6\% improvements on S&P 500 index prediction and individual stock prediction, respectively, compared to state-of-the-art baseline methods. Experimental results showed that event embeddings-based document representations are better than discrete events-based methods, and deep convolutional neural network can capture longer-term influence of news event than standard feed forward neural network. He has compared this new model with his previous model and found better performance which indicates the robustness of the model.

Singh, R., & Kumar, A. (2015)\textsuperscript{89}, introduced a stock trading strategy based on daily stock volatility. Researcher exploited the moment of the stock and used daily stock range (High price – Low price) and developed a strategy which recommends buying and selling at different prices with different quantities. The traders are required to pick the stock which are volatile and have liquidity. Volatility of stock can be determined.

Chordia et al., (2015) found that marginal investors immediately follow the release of macroeconomic information (due to computer algorithms) for exploring the profitability. The result was a remarkably efficient response to news with prices responding to announcement surprises within milliseconds. Although HFTs respond swiftly and convincingly to macroeconomic news releases, researcher found small trading profits on announcement surprises as compared to reported in the popular press. The main finding of the study was consistent with increasing competition over time among HFTs. Researcher observed a reduction in the informativeness of the post-announcement order flow over time. The findings suggested an increasing ability for HFT quotes to respond directly to announcement surprises rather than indirectly through trading.

Brogaard et al., (2015), examined the correlation between the direction of market order trading and price movement. They found that HFTs dominating limit order book activity leading to more efficient prices and a virtually integrated limit order book. The significant contemporaneous price discovery across markets and HFTs reacting more to orders across multiple exchanges is consistent with HFTs integrating markets.

Zhang (2015) proposed a hybrid neutral network to solve the difficulty of predicting stock market. Through learning on the stock market depth data mining, a multifactor stock selection model is established with a factor alpha can produce the benefits. Research found that depth of learning algorithms by multi factor can get a better return.

Yadav (2015) found that algorithmic trading has transformed securities market with advantages but also impose the cost. The paper represented a first step in drawing into relief the significance of algorithmic trading for capital allocation. It was ultimate goal lied in motivating deeper reflection about the prime place of securities prices at the center of regulation and how best to invest regulatory resources in making markets meaningfully informative. With growing market more automated this is a quite more challenging for the regulators.

A study conducted by Alam Miah et al., (2015)\textsuperscript{94}, focused on the creation of a strong knowledge based trained system with more valuable input data set to generate more error free prediction of stock price. They strived to out-perform the market, the use of fuzzy logic and neural networks to forecast stock market prices. They found that evaluation of the return on investment in share markets through any of the traditional techniques is tedious, expensive and a time-consuming process. They proposed an intelligent stock market forecasting system using the ability of neural network and fuzzy inference system to discover patterns in nonlinear and chaotic systems.

Borch et al., (2015)\textsuperscript{95}, compared the relationship between bodily rhythms and market rhythms in two distinctly different financial market configurations, like open-outcry pit and HFT. He also showed how current high-frequency trading, despite being purely algorithmic, does not render the traders' bodies irrelevant. Yet high-frequency trading did change the role of the body rather than seeking to attune their bodies to the markets, high-frequency traders seek to calibrate their bodies to their algorithms.

Kunz et al., (2015)\textsuperscript{96}, explored the impact of algorithmic trading in stock market on regulation of the security market and stability of it in the global market. It also showed the role of government and its broader implications. They demonstrated that AT closely monitor the market in terms of liquidity and information and react quickly to changes in market conditions. They found that no evidence of AT behavior that would contribute to volatility beyond making prices more efficient. This study results has important implications for academics, regulators, and market operators.


Leung, J. W. (2016), built trading strategies by applying machine-learning techniques to both technical analysis indicators and market sentiment data. The model can be employed as an artificial trader used to trade on any given stock exchange, here the researcher used S&P500 index. He examined the performance of these models on the out-of-sample test sets and our empirical results showed that, despite poor prediction accuracy, the resulting trading strategies outperformed the market over the period. Researcher found that the simple trading strategy based on the next day’s predicted returns are limited. The factors like transaction cost, bid-ask spreads and market impact of the trades could play a vital role in reducing the strategy’s returns.

Dr. Karthikeyan et al., (2016), explained the various models and applications of Artificial Neural Networks that predict the stock market returns and price. They surveyed the application of neural networks of financial markets with particular reference to stock market prediction. They found that the neural network models for forecasting stock market are at an initial phase and there are potential improvements in the prediction of accuracy and reliability of stocks. This study will help analyst or investors to understand how the market would behave if the Stock price increases or decreases.

Qiu M, Song Y (2016), compared two basic types of input variables to predict the direction of the daily stock market index in future, uses optimized ANN (an optimized artificial neural network) model in Japanese stock market. They optimized the ANN model using genetic algorithms (GA) in the system. It is found that Type 2 input variables can generate higher forecast accuracy and that it is possible to enhance the performance of the optimized ANN model by selecting input variables appropriately. The prediction performance of may be improved further in three ways. The first one is to combine the two types of input indicators, or test a subset of the variables. Second, optimal methods other than the GA may also be utilized to adjust the parameters of ANN model (based on probabilistic neural networks) for predicting the movement of the stock index. Lastly, proposed an investment strategy

---


(portfolio) based on the prediction outcomes of the study for future research, practical use and further validation.

Philip Baker (2016)\textsuperscript{100}, showed that share market is behave like casino which is powered by elite investors, high frequency algorithmic traders. It was found that each of the top fund managers has a different strategy for beating the stock market over time but most will be looking to see how negative everyone gets towards shares. They will be looking to see if it was so extreme that it provided a phenomenal buying opportunity. They called it capitulation and it was a signal to buy shares not sells them.

Prof. Kumbhar et al., (2016)\textsuperscript{101}, examined the movement of daily stock trend by collecting historical daily stock prices from the market. They used several approaches like walk forward method, baseline methods, evaluation metric for prediction of price movement but according to researcher stacking approach is considered as the best.

Peachavanish (2016)\textsuperscript{102}, developed a method that uses a combination of long-term and short-term trend and momentum technical indicators to identify outperform stocks in the market index. Cluster analysis tried to find the best combination of these indicators. The study suggested an improvement to identify reversal of price trend.

Al-Qaheri et al.,\textsuperscript{103} presented a generic stock pricing prediction model based on rough set approach. To increase the efficiency of the prediction process, rough sets with boolean reasoning discretization algorithm is used to discredited the data. Rough set reduction

\textsuperscript{100} Philip, B. (2016, February 25). Trading is rigged so head to property. Australian Financial Review. p. 32.


technique is applied to find all the reduces of the data, which contains the minimal subset of attributes that are associated with a class label for prediction. It is found that using rough set approach were compared to that of neural networks algorithm and it was shown that Rough set approach have a higher overall accuracy rate and generates more compact and fewer rules than neural networks.

Kakade et al.,\textsuperscript{104} introduced new online models for two important aspects of modern financial markets: Volume Weighted Average Price trading and limit order books. They provided an extensive study of competitive algorithms in these models and relate them to earlier online algorithms for stock trading. They found that in these models, only the distribution of maximum volume and price is known to the algorithm.

Rossi, S., & Tinn, K\textsuperscript{105}, presented a model of quantitative trading as an automated system under human supervision. They established price-contingent trading is the optimal strategy of large rational agents in a setting in which there is uncertainty about whether large traders are informed about the fundamental. The model explains why hedge funds and other large financial institutions who engage in automated trading with algorithms are systematically profitable; and it explains why the secrecy of their algorithms, trading portfolios, and exposures is the key to their success. The superior systematic performance of trend-following and contrarian strategies needs not stem from illegal practices, as the simple and perfectly legitimate market impact of trades, together with uncertainty about access to fundamental information, is sufficient to generate systematic profits.

Bojanc et al.\textsuperscript{106} presented a mathematical model which uses the quantitative analysis of different security measures that counteract individual risks by identifying the information system. This model allows deep analyses and computations providing quantitative assessments of different options for investments, which translate into recommendations facilitating the selection of the best solution and the decision-making thereof.

A study by Blanchet-Scalliet et al.,\textsuperscript{107} compared strategies design from possibly mis-specified mathematical models and strategies designed from technical analysis techniques. They use Monte Carlo numerical experiments and observed that technical analysis technique may over perform mathematical techniques in the case of severe misspecifications. The simulations show that under parameter mis-specification, the technical analysis technique out-performs the optimal allocation strategy but not the Model and Detect strategies. It provided a first step towards building a rigorous mathematical framework in which chartist and mathematical model based trading strategies can be compared. First, they examined and model the performance of other chartist based trading rules (like filter rules, point and figure charts, etc.). Second, they considered modeling the more realistic case where there are multiple changes in the drift of the stock returns: they examined the case where the instantaneous expected rate of return of the stock changes at the jump times of a Poisson’s process, and the value of this rate after each time change is unknown.

\subsection*{2.4 Key Observations:}

1. Fabozzi, F. J., Focardi, S. M., Kolm, P. N., Muehlberg, R. L., Othman, A and DiBartolomeo are the authors whose contribution in quantitative analysis and algorithmic trading is noticeable. They are frequently researching on the algorithms and machine based trading for the different findings.

2. Most of the studies conducted in United State of America, European country, china, Thailand, Nigeria, Greek, Japan and London. In short, very few studies related to algorithms were conducted in India.

3. Most of the studies come into the trend after 2014.

From the above literature review there are many key points observed. Many researchers found solution for some of the questions. These are:

- How to use Quantitative technique and how it is different from traditional technique?
- Whether it is useful in the investment or not?
- What is High frequency trading (HFT)?
- How to use HFT for profit making strategy in stock market?
- Is there any increase in volume of quantitative investment technique or not?
- What is the role of sentiments in investment strategy?
- What are the different models used for the investment?
- What are the factors which affects model preparation and investment decision?

According to researcher, This is a complete mathematical model based on algorithms which is based on historical data, financial analysis, technical analysis, simulation etc. it is not only depends upon automated trade cycle but also involve in learning, dynamic planning, reasoning, decision making, computational trading, information’s, communication technologies, artificial intelligent and behavioral finance.

They have also checked the validity for contextual framework for strategic investment decisions. They also try to analyze the risk in the investment through quant model. They tried to check the innovativeness in the technique. They tried to found the QT models having more error free predictions for the trade. They also tried to find the failure of Quant model on implementation, advantages of Quantitative investment and factors for the analysis. They found that risk plays a vital role in reward.

Researcher tried to find out the different ways to predict the stock price or the stock movement in any stock market. They checked different existing model, comparing those models and created new model to compare the existing model to find out the optimum accuracy in the stock price prediction. In some research, researcher investigates the factors used in model to get the stock price prediction in future.

From the above literature review, it is found that researchers are from outside India and from India. Most of the work was done by the international researcher for international market. In India, the concept of algorithms is quite new and upcoming for the stock market. There is lots of scope for the study in algorithms in India.
This is the approximate classification of literature review for the research. It is further classified as below:

**Indian literature Review**

- SVM hybrid, ANN
- Data Mining Tool
- Mini Trading By WEKA
- Daily Volatility
- Trading algorithm
- VWAP trading & LOB
- Genetic algorithm
- Time series neutral network
- Elliott Waves
- Mean Variance skewness portfolio
- Generative & no generative ensemble methods
- Fundamental analysis
- Technical analysis
- Trend momentum (long & short term)
- Historical data analysis
- Closing price trend
2.5 Research Gap

Most studies are based on the Quant models and their impact on trading profit or gain only. Maximum researcher worked upon development of Quant model and the factors to develop it. Some of them focus on Investment quantitative technique with traditional trading technique. Some of them talk about High frequency trading and high frequency algorithmic trading. One or two of them talked about regulatory bodies. Most of the studies held in US market, UK market, China, and Greek market. In Indian market, few studies are there related to algorithmic trading. But basically on impact of algorithmic trading and model creation. Still, there is no study about the awareness of algorithmic trading in Indian stock market, regulatory body regulations in Indian market related to algorithmic trading. None of them talked about difference between trading in traditional style and trading in algo in India. The role of stock broker is also neglected by the researcher. A large number of researches have been done on quantitative technique of investment and the framework for strategic investment decision through mathematical but almost all of them have been conducted for risk analysis, innovativeness, performance attribution, machine learning, financial modelling, quantitative methods, etc mostly outside India. Hence it is important to comprehensively analyze the alternative way of investment strategy through quantitative analysis in financial market in India especially in Financial Hub i.e., in Mumbai. No work has been carried to evaluate the perception of broker and retail investor against quantitative analysis for the investment purpose in India. Furthermore the reasons behind the popularity or non-popularity of quantitative investment strategy in financial market are not well explored. Little work has
been undertaken to analyse the different factors affecting the strategy of investment in financial market.

**Chapter summery**

The main aim of this chapter is to analyze the past studies related to algorithm trading in stock market. It also includes the key observations of the literature review. It shows the maximum contribution of researcher in the related field and prospects of the research. This chapter also classifies the literature review on the basis of demography and objective of the studies. This chapter ended with key observations, classification of literature review (on the basis of first national and international author then national author papers subject matter) research gap which shows the reason for choosing researcher study to fill the gap.