Stock Market Analysis and Prediction Using Big Data Analytics

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Abstract

Big data analytics are primarily used in different sectors for accurate prediction and analysis of large data sets. They allow the discovery of important information from the large data sets, which is otherwise hidden. The sophistication of the modern big data analytics tools allows establishing unknown relationships between the data sets. The analysis done through different big data analytics techniques allow the generation of important insights, which are pivotal for different organizations, companies and departments. In this report, the big data analytics are used for efficient stock market analysis and prediction. Generally, stock market is a domain where uncertainty and inability to accurately predict the stock values may result in huge financial losses. In this report, two different big data analytics techniques: association rule learning and regression analysis are combined to form a hybrid solution. The information obtained by this solution can be categorized based on volume, velocity and variety. Furthermore, different financial institutions and organizations could utilize this information to carry out efficient trading decisions.

Keywords: Big data analytics, big data, stock market, association rule learning, regression analysis

Introduction

The Purpose of the Study

The purpose of this research is to develop a unique solution based on the combination of two different big data analytics methods. Through, the developed solution efficient prediction and analysis of the stock market could be made possible. The two different big data analytics used in this research are: association rule learning, and regression analysis. Both these techniques are individually used in different sectors. However, their utilization to form a hybrid solution for stock market analysis and prediction is a novel concept.

Traditionally, big data has been extensively used in different sectors to identify patterns, trends and predict the outcome of certain events. Through, the proposed hybrid solution, association rule learning and regression analysis of big data would reveal important insights for the traders to accurately analyze stock behavior and invest in profitable stocks. The starting point of this research were two main research papers on the use of big data in stock market prediction presented by Attigeri, Pai and Nayak (2015), and Singh, Dimri and Rastogi (2014).

The Significance of the Study

Big data holds great importance for the proliferation of a number of sectors. It has been extensively used by business organizations to develop important business insights and intelligence. Further, it has been utilized by the healthcare sector to discover important patterns and knowledge to improve the modern healthcare systems. Besides, big data holds prime importance for the information and technology and cloud computing sector.

Recently, the banking and finance sector utilized big data to track the financial market activity. Big data analytics and network analytics were used to catch illegal trading in the financial markets. Similarly, traders, big banks, financial institutions and companies utilized big

data for generating trade analytics utilized in high frequency trading. Besides, big data analytics also helped in the detection of illegal activities such as: money laundering and financial frauds (KumarSingh, Dimri, & Nand Rastogi, 2014).

In comparison with other sectors where big data analytics were used extensively, stock market also generates immense volume of data related to the stock values.

Technically, the stock market data included the daily exchange of shares, stock values, and stock market calculation. By using big data analytics on the stock market data, parameters affecting the stock value could be discovered (Attigeri, MM, Pai & Nayak, 2015). Furthermore, variation in the value of a specific stock could be predicted with this method. Based on volume, velocity and variety, different financial institutions and organizations could utilize this information to carry out efficient trading decisions. Moreover, for quant trading, prediction of the stock market could be hugely beneficial.

The design solution developed in this research incorporated two different big data analytics: association rule learning, and regression analysis. The association rule learning involved the discovery of important relations and establishing co-relations between different variables in a large data set. The use of this technique for stock market analysis would allow the discovery of important relationships between different stocks. On the other hand, the regression analysis technique involved the observation that how the value of a dependent variable changed when the value of an independent variable was changed. This technique would allow the prediction of the factors that can impact the stock values. Thus, combining both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

The Research Objectives

The major research objectives of this paper were:

Development of a hybrid solution based on big data analytics: The major objective of this research paper was the development of a big data analytics solution for stock market analysis and prediction, by the amalgamation of association rule learning, and regression analysis techniques. The hybrid solution formed by the combination of two different big data analysis techniques would provide an efficient output of results, pivotal for stock market analysis and prediction.

Validation of the proposed solution: This step incorporated the analysis and review of already existing research papers on big data analytics, stock market prediction, association rule learning, and regression analysis. With the analysis of the existing research papers, it could be evaluated if the proposed research solution would be an optimum and efficient solution for stock market analysis and prediction, or not.

Definition of Terms and Concepts

- **Stock market:** Stock market is the place where publicly listed companies avail their shares for trading. The shares are floated to the public in the form of an initial public offering (IPO) in order to raise capital for the company. Once, the shares are sold in the primary market, then they are traded in the secondary market. In the secondary market, investors purchase shares from one another at a certain price. This secondary market is called as the stock exchange ("Definition of Stock Market | What is Stock Market? Stock Market Meaning - The Economic Times", 2018).
- **Stocks:** A stock is generally a term used to denote the ownership certificates belonging to a particular company. Stock is different from a share, as the later refers to the stock certificates of a specific company. While, holding the shares of a particular company makes us a shareholder. Stocks are mainly of two types: common and preferred.

Common stocks provide voting rights to be exercised in corporate decisions, and the later doesn't ("Definition of Stocks | What is Stocks? Stocks Meaning - The Economic Times", 2018).

- **Big data:** It is the term which is used to describe a huge volume of data that can be structured, unstructured and semi-structured. Big data is significant because it has the potential to be harnessed for the generation of important information. The term big data is characterized by 3Vs: volume, variety and velocity of data ("What is big data? - Definition from WhatIs.com", 2018).
- **Big data analytics:** Big data analytics is the process of analyzing large sets of differentiated and undifferentiated data. Big data analytics allows the discovery of important information from the large data sets, which is otherwise hidden. The sophistication of the modern big data analytics tools allows establishing unknown relationships between the data sets. The discovery of such insights helps in developing business strategies and proliferate efficient business decision making ("What is big data analytics? - Definition from WhatIs.com", 2018).

Literature Review

Stock market is the place where publicly listed companies avail their shares for trading. The shares are floated to the public in the form of an initial public offering (IPO) in order to raise capital for the company. Once, the shares are sold in the primary market, then they are traded in the secondary market. In the secondary market, investors purchase shares from one another at a certain price. This secondary market is called as the stock exchange. Stock market involves a number of complicated processes and underlying factors that makes it highly unpredictable and uncertain. Due to this uncertain nature of the stock market, prediction holds prime importance for

stock market investment. Further, stock market prediction can be broadly categorized into two main categories: fundamental and technical.

In the paper presented by Kanade, Phadatare, Munde and Sonone (2017), a technique based on fundamental analysis was provided. This technique involved the analysis of social media data by sentiment analysis. The research explained the benefit of social media analysis which can be pivotal for stock market prediction. Their proposed method involved the collection of news and social media data to extract sentiments expressed by different individuals. Based on this data, a correlation was established between the sentiments and stock values, leading to efficient prediction of the stock market.

Similarly, in the research paper submitted by Kavitha, Vadhana and Nivi (2015), the researchers vindicated the use of big data for the prediction and analysis of stock market. As per the authors, big data was responsible for creating accurate predictions over business information. Moreover, with the development of sophisticated technologies such as: Hadoop and NoSQL, financial sector has seen an increase in the use of big data analytics. By using these tools in the stock market, accurate predictions and analysis of the stocks was possible. However, the authors have also mentioned that for the accurate prediction of stock values, real-time and regular data from the stock market was essential.

Such a data could be collected from stock exchange reviews, historic statistics related to economy, and other types of day-to-day information related to the stock market. The research paper also tested the viability and performance of different algorithms to predict the stock values. Importantly, two main algorithms were analyzed: SVM algorithm, and GARCH model. Primarily, SVM algorithm was tested for sentimental classification, whereas, GARCH model

was used for time series data analysis. The research established that the combination of SVM and GARCH models was highly effective in the prediction of stocks for more profit.

In the research presented by Angadi and Kulkarni (2015), the authors had proposed a technique for time series data analysis for stock market prediction. As per the authors, future stock returns had a predictive relationship with publicly available information and historical data related to the stock market. Hence, with the analysis of the information, accurate analysis and prediction of the stock values was possible. In their research, the authors had proposed a model based on ARIMA to carry out a time series data analysis for stock market prediction. The proposed model would automate the process of direction of future stock prices. As per the authors, their proposed model had a strong potential for short-term prediction of stock values.

The stock market data included the daily exchange of shares, stock values, and stock market calculation. By using big data analytics on the stock market data, parameters affecting the stock value could be discovered (Attigeri, MM, Pai & Nayak, 2015). Furthermore, variation in the value of a specific stock could be predicted with this method. Based on volume, velocity and variety, different financial institutions and organizations could utilize this information to carry out efficient trading decisions. Moreover, for quant trading, prediction of the stock market could be hugely beneficial.

Likewise, in the research presented by Rai and Seeru (2017), a technique based on MapReduce and genetic algorithm was proposed for the prediction of stock values. As per the authors, for the successful prediction of different stock values require considerable resources. Hence, MapReduce was selected for processing the big data sets from the stock market. Further, a genetic algorithm was applied to this data, which would forecast the results for the given year.

All the research papers analyzed in the literature review support the method of big data analytics for accurate prediction of stock market values. However, as the stock market values are influenced by a large number of factors, it is important to utilize real-time and regular stock market data for the accurate prediction of the stock market values.

Design

Overview of the Research Design and Methods

The purpose of this research was to develop a novel solution based on the combination of two different big data analytics methods: association rule learning, and regression analysis. The development of a hybrid solution by incorporating both these big data analytics techniques was a unique concept. With this solution efficient prediction and analysis of the stock market was possible.

Over the recent years, big data was utilized in different fields to identify patterns, trends and predict the outcome of certain events. Through the proposed hybrid solution, association rule learning and regression analysis of big data would reveal important insights for the traders to accurately analyze stock behavior and invest in profitable stocks.

The main objectives of the research were:

- **Development of a hybrid solution based on big data analytics:** The major objective of this research paper was the development of a big data analytics solution for stock market analysis and prediction, by the amalgamation of association rule learning, and regression analysis techniques. Primarily, association rule learning involved the discovery of important relations, insights and patterns and establishing co-relations between different variables in a large data set. With its use in stock market analysis, co-relations between different stocks could be established. Likewise, regression analysis dealt in the

observation of the relationship between dependent and independent variables. If the value of the independent variable was changed, it created an effect on the value of the dependent variable. Thus, regression analysis could investigate the relation between different factors that affect the stock behavior. Hence, combination of both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

- **Validation of the proposed solution:** This step incorporated the analysis and review of already existing research papers on big data analytics, stock market prediction, association rule learning, and regression analysis. The analysis of the already existing research papers would establish that the big data analytics was a viable and potent technique to predict stock behavior and stock values, efficiently. However, it is also important to consider that the design solution would require adequate testing and ongoing research to develop more sophisticated prediction tools based on big data analytics for the future challenges.

Description of the Subject Matter

Big data was significant for the growth and development of various business companies and sectors. Business organizations had been using it for the generation of business insights and intelligence. More recently, healthcare sector had adopted it for the discovery of important disease patterns and analysis. With the use of big data, the banking sector was able to track the financial market. Moreover, big data analytics were utilized to track a financial market activity. As per the research done by KumarSingh et al. (2014), big data analytics could also be used for tracking illegal activities, such as: money laundering and financial frauds.

Recognizing patterns is essential in stock market prediction. In any case, how would you recognize a pattern is troublesome, as the market never moves in a straight line. A stock would never fall constantly on a given day and ascend on another. For the most part, higher highs and higher lows show an uptrend, while bringing down highs and lower lows mean a downtrend.

Examiners and market specialists take the assistance of different parameters to affirm if a stock is an exchange pick. The most utilized tools are different types of stock analysis software. These incorporate 200-day moving average, relative quality record, moving average divergence, Fibonacci retracement and candle value graph. The terms may sound overwhelming, however software applications available to analysts have made things simple (Attigeri et al., 2015).

In this paper, the big data analytics were used for stock market prediction, which included prediction of stock values, economy and stock market calculation. As per Attigeri et al. (2015), parameters affecting the stock value could be discovered with the use of big data analytics.

The design solution developed in this research incorporated two different big data analytics: association rule learning, and regression analysis. The association rule learning involved the discovery of important relations and establishing co-relations between different variables in a large data set. The use of this technique for stock market analysis would allow the discovery of important relationships between different stocks. On the other hand, the regression analysis technique involved the observation that how the value of a dependent variable changed when the value of an independent variable was changed. This technique would allow the prediction of the factors that can impact the stock values. Thus, combining both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

General Background Information

Anticipation of the stock market has been the bane and objective of investors since the establishment of modern stock markets. Regularly billions of dollars are exchanged on the trade, and behind every dollar is a financial specialist planning to make a profit. Entire organizations and companies rise and fall day by day in view of the performance of the stock market. Many financial specialists have the capacity to precisely foresee the continuous developments in the stock market. This phenomenon is called stock market prediction.

Principal research is a compulsory technique for any financial specialist. The technique includes fastidious concentrate of an organization's monetary wellbeing, the estimation of benefits, obligations, money, incomes, costs, gainfulness and plans of improvement. Major research is a balanced stock forecast strategy for every information that really matters. Different factors are considered while deciding the genuine estimation of a stock. An organization may produce sound income yet inferable from immense costs, they may not be profoundly gainful. It is basic for a well performing organization to sit on a heap of money and not utilize it carefully in other venture or expansion roads. Having every one of these measurements can be exceptionally helpful for any financial specialist (Iknowfirst.com, 2018). When one has this data, it is anything but difficult to decide whether the estimation of a stock is overhyped or worse than average. Along these lines, it is simpler to figure the eventual fate of a stock and decide if to gain a stock or to offer one. Crucial research likewise helps a speculator since it offers bits of knowledge to profits the organization has been paying throughout the years and one can have some factual stock expectation and not simply instability.

However, knowing basics isn't sufficient. It is basic for stocks to move in waves. Stocks dependably vary amongst "oversold" and "overbought" conditions. These terms depict the

changing interest or fame and are in respect to the time span and to other speculation settings. At the point when gold winds up mainstream, bunches of financial specialists get captured in the "gold rush" and overlook the stock essentials and pitch stocks to purchase gold. They overlook that gold does not make anything and just stays there. It's only a trophy, reward or an insurance against high price rise in best case scenario (Iknowfirst.com, 2018). This is only one case of how extraordinary markets cooperate. Along these lines knowing the stock essentials isn't sufficient. One can purchase a decent stock at the wrong time and lose cash. Without a doubt, in the end it should pay off, however then, one is in a shortage. Hence, one must have the capacity to foresee where the stock is heading (Iknowfirst.com, 2018).

Furthermore, it offers a tempting lure of riches for the investors. It is no big surprise then that the stock market has a deep impact on the economy and the people of a country. For instance, the 2008 crisis had a similar impact, which was confirmed by a number of news stories and documentaries made on this crisis. The common knowledge obtained from the 2008 financial crisis was that only a selected few individuals had the information about the working of the stock market (Attigeri et al., 2015). If this information was widely available to the investors, then the situation could have been evaded. This ideology forms the basis of this research paper.

Stock market had been highly unpredictable with stock values changing every day. Although, there were a number of important factors that contributed to the change in stock values, the most common were: interest rates, energy prices, oil prices, internal and domestic issues, inflation and earnings. With so many factors that were highly dynamic in nature, it had become difficult to accurately predict stock behavior.

In spite of its prominence, stock market expectation remained a discreet and experimental trade. Barely any individual would share what successful techniques they had for accurate stock

market investment. A major objective of this research paper was to add to the scholarly perspective of stock market prediction by different techniques. It could be expected from this research that with the knowledge of how the stock market behaves, investors would be better prepared to make contingency plans for emergency situations.

Detailed Information of Issues related to the Specific Problem

The major issues related to stock market prediction were related to the highly dynamic nature of the stock values. With such a volatile nature of the stocks, most prediction methods had failed to accurately predict stock values with precision.

Though many researchers would incorporate different kinds of scientific and non-scientific methods to carry out accurate stock market predictions, however, no method provided a concrete success. Traditionally, the past performance of a particular stock was seen as a pointer for future stock behavior.

Further, computing techniques had also been used to predict the nature of the stock market in the future. However, lack of accuracy had daunted such methodologies. Although, with the development of data mining and machine learning techniques over the past decade, an improvement was seen in the stock market predictions.

The major hindrance of such techniques was that they were based on the assumption of the stock values. Thus, it included some degree of error as well. Due to this factor, there was considerable risk involved in such methods. Commonly, researchers have used fundamental information which was easily available to the general public to develop relationships between different economic events and their impact on the stock values.

For instance, the increase and decrease in the interest rates and exchange rates set by the central banks had a different impact on the stock market. If the rates set by the central banks

favored investment, then the stock values would rise. On the other hand, if the central bank of a country did not favor investment, then the stock values would eventually fall.

In addition to that, there were factors such as industrial production and consumer price index, which allowed investors to develop a favorable investment policy. However, these assumptions and predictions were still difficult for the common man or an individual who did not have any prior information about the stock behavior and the factors influencing it. For this situation, this research paper presented a unique stock market prediction tool based on big data analytics.

Although, big data analytics was an important tool to discover patterns and hidden insights in the large undifferentiated data, its use in the stock market was not yet explored. Moreover, it was considered highly difficult to integrate all the factors affecting the stock values to create a prediction algorithm (Rai & Seeru, 2017).

Detailed Description of the Design Solution

The proposed design solution integrated two different big data analytics techniques: association rule learning and regression analysis. Primarily, association rule learning involved the discovery of important relations, insights and patterns and establishing co-relations between different variables in a large data set. With its use in stock market analysis, co-relations between different stocks could be established.

Likewise, regression analysis dealt in the observation of the relationship between dependent and independent variables. If the value of the independent variable was changed, it created an effect on the value of the dependent variable. Thus, regression analysis could investigate the relation between different factors that effect the stock behavior. Hence,

combination of both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

Figure 1 depicted the working of the association rule learning technique. In the figure, a buying behavior of a person was analyzed. If the person purchased bread and potatoes, he was highly likely to purchase meat as well, to make a burger. Hence, with this technique relationship between different stocks could be established.

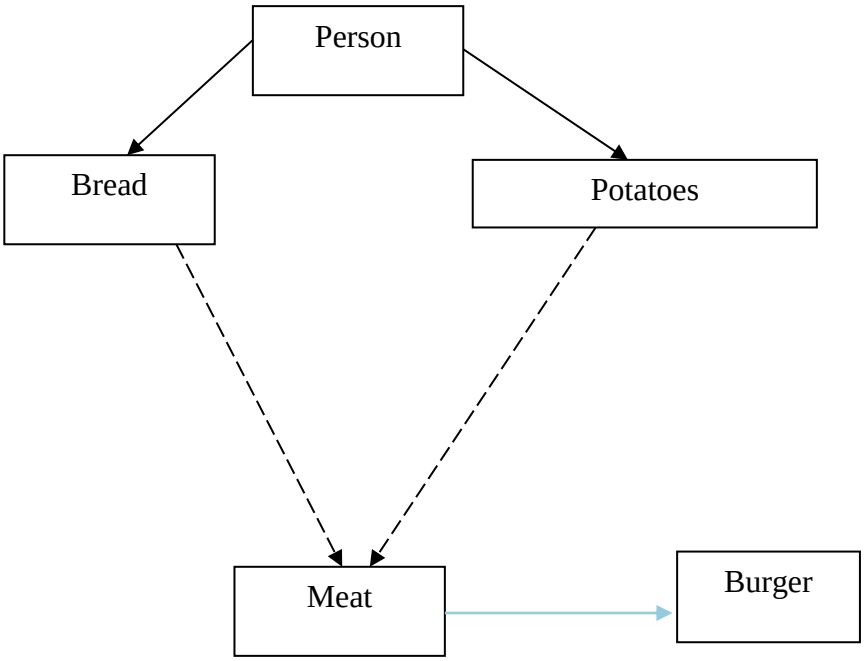

Figure 1: Association Rule Learning Method

Now, the regression analysis worked in a different manner. As per this technique if two variables were related, then with the value of one variable, we could predict the value of the other variable. Figure 2 represented the regression analysis. In this technique if we knew the value of one variable which is ‘happiness’, then the related variable ‘hours slept’ can be known.

With the use of both these techniques, efficient analysis and prediction of the stock market could be done. The association rule learning technique could be used for the prediction of an investment. Whereas, regression analysis could be used to predict the particular value of a stock (dependent variable), if the value of the related stock is known (independent variable). Hence, combination of both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

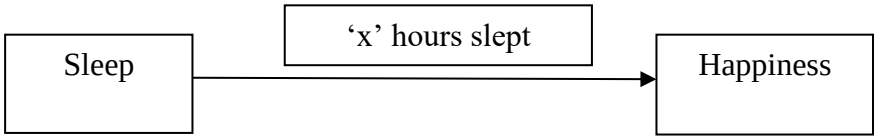

Figure 2: Regression Analysis

Validation of the Design

As per a paper presented by Angadi and Kulkarni (2015), a technique for time series data analysis for stock market prediction was proposed. This technique was a pioneer research in creating a predictive relationship with the publicly available information and historical data. The technique was able to analyze stock market behavior and predict the future value of stocks. As per the authors, future stock returns had a predictive relationship with publicly available information and historical data related to the stock market. Hence, with the analysis of the information, accurate analysis and prediction of the stock values was possible.

In the research paper submitted by Kavitha, Vadhana and Nivi (2015), the researchers vindicated the use of big data mining for the prediction and analysis of stock market. As per the

authors, big data mining was responsible for creating accurate predictions over business information.

Both these papers established that the big data analytics was a viable and potent technique to predict stock behavior and stock values, efficiently. However, further research was required to develop more sophisticated prediction tools based on big data analytics.

Findings

Findings Overview

The objective of this research was to develop a unique solution for efficient prediction and analysis of the stock market. As stock market values were uncertain and dynamic, there was no specific solution to efficiently predict the stock values. The developed solution aimed to resolve this issue by developing a unique technique based on two big data analytics: association rule learning, and regression analysis.

The proposed design was a hybrid solution generated by the combination of two already existing techniques. The use of big data analytics techniques for the prediction of stock market values was a novel and unique concept.

Description and Explanation of the Results

The proposed design solution integrated two different big data analytics techniques: association rule learning and regression analysis. The association rule learning involved the discovery of important relations, insights and patterns and establishing co-relations between different variables in a large data set. With its use in stock market analysis, co-relations between different stocks could be established.

While, the regression analysis dealt in the observation of the relationship between dependent and independent variables. If the value of the independent variable was changed, it

created an effect on the value of the dependent variable. Thus, regression analysis could investigate the relation between different factors that affect the stock behavior.

With the use of both these techniques, efficient analysis and prediction of the stock market could be done. The association rule learning technique could be used for the prediction of an investment. Whereas, regression analysis could be used to predict the particular value of a stock (dependent variable), if the value of the related stock is known (independent variable).

Verification and Validation of the Findings

The verification of the solution proposed in this paper was done by the study of existing research papers presented by different scholars. Angadi and Kulkarni (2015) developed a technique for time series data analysis for stock market prediction. This technique was a pioneer research in creating a predictive relationship with the publicly available information and historical data. The technique was able to analyze stock market behavior and predict the future value of stocks. As per the authors, future stock returns had a predictive relationship with publicly available information and historical data related to the stock market. Hence, with the analysis of the information, accurate analysis and prediction of the stock values was possible.

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Both these papers established that the big data analytics was a viable and potent technique to predict stock behavior and stock values, efficiently. However, further research was required to develop more sophisticated prediction tools based on big data analytics.

Implementation Requirements

To implement the developed solution, a dedicated software must be developed to process the big data of the stock market and generate important insights. The big data from the stock market would be stored on a particular server. Upon this server, a software solution incorporating both association rule learning and regression analysis techniques would be used. This software would work in two-way mechanism. In the first step, association rule learning would be applied which would yield discovery of important relations, insights and patterns and establishing co-relations between different variables in a large data set. With its use in stock market analysis, co-relations between different stocks could be established.

Further, the regression analysis technique would observe the relationship between dependent and independent variables. If the value of the independent variable was changed, it created an effect on the value of the dependent variable. Thus, regression analysis could investigate the relation between different factors that affect the stock behavior. Finally, the software would generate important stock market prediction that would be accurate and precise.

Conclusions

Restatement of the Problem

Traditionally, stock market values were unpredictable and dynamic. Accurate analysis of the stock values could help the investors and business companies to invest better in the stock market. On the other hand, big data had been extensively used in different sectors to identify patterns, trends and predict the outcome of certain events. In this research report, big data analytics were used to develop important insights related to the stock values. These insights would help in accurate prediction of the stock values. Thus, helping the investors of the stock market.

New Knowledge Discovered

The new knowledge obtained in this report involved the combination of two big data analytics techniques into a single solution. These two techniques were association rule learning and regression analysis. The association rule learning involved the discovery of important relations, insights and patterns and establishing co-relations between different variables in a large data set. Likewise, the regression analysis dealt in the observation of the relationship between dependent and independent variables. With the use of both these techniques, efficient analysis and prediction of the stock market could be done. The association rule learning technique could be used for the prediction of an investment. Whereas, regression analysis could be used to predict the particular value of a stock (dependent variable), if the value of the related stock is known (independent variable). Hence, combination of both these techniques would serve as an efficient and effective solution for stock market analysis and prediction.

Significance of the Findings

The findings of the report signified that the big data analytics could play an important role in the accurate prediction of the stock values. Traditionally, stock market values were dynamic and unpredictable. Moreover, the existing research available in this domain did not involve big data analytics. Hence, with the use of big data analytics for stock market prediction, both the individual investors and companies investing in the stock market could make beneficial investments.

Recommendations for Further Investigation

Further improvements in the design solution could be made by introducing techniques such as machine learning and artificial intelligence to provide accurate prediction of the stock values. The use of such technologies would benefit the stock investors immensely. On the other

hand, the proposed solution could also be improved by the use of data mining technique. As data mining technique has reached a highly advanced stage, its combination along with big data analytics would sufficiently increase the efficiency of the developed solution. Moreover, with the help of data mining technique, reduction in time consumption by the proposed solution could also be achieved.

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