VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belgaum-590018

A PROJECT REPORT **(15CSP85)** ON

"STOCK MARKET PREDICTION USING MACHINE LEARNING"

Submitted in Partial fulfillment of the Requirements for the Degree of

Bachelor of Engineering in Computer Science & Engineering

By

ARPIT KUMAR (1CR16CS029)

SHAHVEZ ALAM (1CR16CS184)

ALOK SOLANKI (1CR16CS013)

Under the Guidance of,

SHASHIKALA K.S

Assistant Professor, Dept. of CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CMR INSTITUTE OF TECHNOLOGY

#132, AECS LAYOUT, IT PARK ROAD, KUNDALAHALLI, BANGALORE-560037

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

Certified that the project work entitled **"STOCK MARKET PREDICTION USING MACHINE LEARNING"** carried out by **Mr. ARPIT KUMAR**, USN **1CR16CS029**, **Mr. SHAHVEZ ALAM**, USN **1CR16CS184** and **Mr. ALOK SOLANKI**, USN **1CR16CS013,** bonafide students of CMR Institute of Technology, in partial fulfillment for the award of **Bachelor of Engineering** in Computer Science and Engineering of the Visveswaraiah Technological University, Belgaum during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

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(Shashikala K.S)	**Dr. Prem Kumar Ramesh**	**Dr. Sanjay Jain**
(Assistant Professor)	**Professor & Head**	**Principal**
Dept. of CSE, CMRIT	**Dept. of CSE, CMRIT**	**CMRIT**

DECLARATION

We, the students of Computer Science and Engineering, CMR Institute of Technology, Bangalore declare that the work entitled "**STOCK MARKET PREDICTION USING MACHINE LEARNING**" has been successfully completed under the guidance of Asst. Prof. **SHASHIKALA K.S**, Computer Science and Engineering Department, CMR Institute of technology, Bangalore. This dissertation work is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Engineering in Computer Science and Engineering during the academic year 2019 - 2020. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

Place: **BANGALORE**

Date: **31-May-2020**

Team members:

ARPIT KUMAR (1CR16CS029) _____

SHAHVEZ ALAM (1CR16CS184) _____

ALOK SOLANKI (1CR16CS013) _____

ABSTRACT

75% of Business leaders state ‘growth’ as the key source of value from analytics but only 60% of those leaders have predictive analytics capabilities. So what’s preventing the businesses from achieving predictive analytics capabilities? The major roadblock is applying the right set of tools, which can pull powerful insights from this stockpile of data. But first, a big data system requires identifying and storing of digital information (lots of!!). Using Machine learning and Artificial Intelligence algorithms, businesses can optimize and uncover new statistical patterns which form the backbone of predictive analytics.

Machine learning is often used to build predictive models by extracting patterns from large datasets. These models are used in predictive data analytics applications including price prediction, risk assessment, predicting customer behaviour, and document classification.

The aim of the project is to examine a number of different forecasting techniques to predict future stock returns based on past returns and numerical news indicators to construct a portfolio of multiple stocks in order to diversify the risk. We do this by applying supervised learning methods for stock price forecasting by interpreting the seemingly chaotic market data.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany a successful completion of any task would be incomplete without the mention of the people who made it possible. So with gratitude we acknowledge all those whose guidance and encouragement served as beacon of light and crowned our effort with success. We would like to thank **Dr. Sanjay Jain**, Principal, CMRIT who provided us such an opportunity.

Conclusively, we could like to thank all the faculty members who have always been very cooperative and generous and The Head Of Department **Dr. Prem Kumar Ramesh**, Department of Computer Science & Engineering, CMRIT, Bangalore for giving us the opportunity to delve into the field of Machine Learning.

We consider it a privilege to express our sincere gratitude to our internal guide **Mrs. Shashikala K.S**, Asst. Professor, Dept. of Computer Science & Engineering, CMRIT, Bangalore for her valuable guidance, suggestions and inputs throughout the tenure of this project.

ARPIT KUMAR(1CR16CS029)
SHAHVEZ ALAM(1CR16CS184)
ALOK SOLANKI(1CR16CS013)

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CHAPTER 1

INTRODUCTION

Nowadays, as the connections between worldwide economies are tightened by globalization, external perturbations to the financial markets are no longer domestic. With evolving capital markets, more and more data is being created daily.

The intrinsic value of a company's stock is the value determined by estimating the expected future cash flows of a stock and discounting them to the present, which is known as the book value. This is distinct from the market value of the stock, that is determined by the company's stock price. This market value of a stock can deviate from the intrinsic value due to reasons unrelated to the company's fundamental operations, such as market sentiment.

The fluctuation of stock market is violent and there are many complicated financial indicators. Only few people with extensive experience and knowledge can understand the meaning of the indicators and use them to make good prediction to get fortune. Most people have to rely solely on luck to earn money from stock trading. However, the advancement in technology, provides an opportunity to gain steady fortune from stock market and also can help experts to find out the most informative indicators to make better prediction. The prediction of the market value is of paramount importance to help in maximizing the profit of stock option purchase while keeping the risk low.

1.1 Relevance of the project

There has been much work done in the field of stock market prediction which has been based on neural network, hidden Markov model etc. To keep our project simple with a decent level of accuracy, and also owing to the time constraint we opted for Markov chain process to make the predictions based on. The field of prediction is progressing each day, with constant attempts to increase the accuracy of the predictions and hence this project also leaves a lot of chance for future works and enhancements.

1.2 Problem Statement

Our main aim of the project is to make a web application, with the help of which user should be able to get future predictions for the stocks of a particular company. Also, we need to provide a window through which user should be able to send his/her queries to us in case of bugs in our application or any other run time errors.

1.3 Objective

To achieve our goal of developing stock market prediction web application, we need perform following tasks in the same order as stated.

-Data Collection and Analysis

-Determination of transition matrix

-Determination of steady state probabilities

-Prediction

-Developing database for inserting companies data

-Developing various web pages using HTML5 and CSS

-Integrating front end and back end

1.4 Scope of the project

Stock market analysis and prediction is one of the interesting areas in which past data could be used to anticipate and predict data and information about future. Technically speaking, this area is of high importance for professionals in the industry of finance and stock exchange as they can lead and direct future trends or manage crises over time. Using the stochastic process called Markov Chains, we sought out to predict the immediate future stock prices for a few given companies. We found the moving averages for the data and the grouped them into ten different states of results. We then applied Markov Chain calculations to the data to create a 4x4transitional probability matrix. Using this transition matrix, we solved a system of equations and found 4steady states that were variables that represented the probability that a stock price for a given day would fall into one of the four states. When we use this information, we can apply our actual data to these equations and predict the next stock prices for the near future. We were able to successfully predict the next few days of stock prices using this method.

1.5 Methodology

In our project, we analysed a year's worth of stock portfolio for a selected group of companies and apply moving averages and Markov Chains to the data in hopes to predict the stock prices for the near future. The first thing we did was to apply moving averages to create an approximate evaluation of the data. In order to find moving averages, we first had to apply a moving average with an increment of three. This involves taking the sum of three days of stock and then dividing it by three. However, one can only do this starting at day three, because there was enough data to actually create a moving average. We eventually had a data set that included a moving average price and a closing price.

We then needed to find a difference data set to apply Markov Chains to. We took the difference of the closing price and the moving average price. These differences were going to be what we applied Markov Chains to. However, we first had to group the differences into four blocks. The reason why we did this was to create more accurate observations that it makes it more exact when we analyse the data. We then create a transition matrix. The entries in the matrix represented how many times the data points go from one block to another. This leads to 16 observations of data. For example, the first row of entries the matrix represents the number of times the data goes from the first block and stays in the first block, the number of times the data goes from the first block to the second block, the number of times the data goes from the first block to the third block, and finally the number of times the data goes from the first block to the fourth block. All entries needed to be in decimal form, so the total number of observation points divided each entry.

With the matrix, we could now apply Markovian properties to our data. In other words, using Markovian properties we created a system of equations with the unknown variables being our steady states that we are aiming to obtain. These equations are sums of probabilities multiplied by our unknown variables. We then aimed to solve the system of equations to find our steady state probabilities.

With our steady state probabilities, we were now able to predict where each immediate stock price can fall into an interval. These probabilities are now good indicators of where the stock prices will fall. We then observed the new data and made some observations. We were able to predict what the possible price range for a given day could be. In conclusion, applying Markov Chains is an effective way to predict stock prices.

CHAPTER 2

LITERATURE SURVEY

Using the stochastic processes called Markov Chains, we sought out to predict the immediate future stock prices for a given company. We found the moving averages for the data and the grouped them into four different states of results. We then applied Markov Chain calculations to the data to create a 4x4 transitional probability matrix. Using this transition matrix, we solved a system of equations and found four steady states that were variables that represented the probability that a stock price for a given day would fall into one of the four states. When we use this information, we can apply our actual data to these equations and predict the next stock prices for the near future. We were able to successfully predict the next few days of stock prices using this method as discussed in [3].

In this project, we applied supervised learning technique in predicting the stock price trend of a single stock. All classification tasks depend upon labelled datasets which we have arranged from yahoo finance as discussed in [4]; that is, humans must transfer their knowledge to the dataset in order for a neural network to learn the correlation between labels and data. This is known as supervised learning and we have used Markov chains as discussed in [1].

As for our future work, we believe we can make the following improvements: 1. Test our predictor on different stocks to see its robustness. Try to develop a “more general” predictor for the stock market. 2. Construct a portfolio of multiple stocks in order to diversify the risk. Take transaction cost into account when evaluating strategy’s effectiveness as discussed in [2]. Portfolio based on information about the stock which is obtained in the form of quotes as discussed in [5].

A Markov Chain is a stochastic process that has the Markovian property.

Definition 2.1: A stochastic process is defined to be an indexed collection of random variables {Xt}, where the index t runs through a given set T, generally labelled with the set of non-negative integers. The variable Xt is meant to represent a measurable characteristic, or point of interest. For example, if one were to look at a collection of muffins, some with blueberries and some without blueberries, the variable Xt can be used to label muffins with blueberries. Supposedly, if there were four blueberry muffins within a given collection, the set Xt could be designated as the set of blueberry muffins, with each muffin labelled as X1, X2, X3, or X4. Thus, it is evident from this example that stochastic processes are discrete collections of random variables.

A stochastic process often has the following structure:

The current status of the system can fall into any one of a set of (M+1) mutually exclusive categories called states. For convenience, these states are labelled with integers from 0 to M. The random variable Xt represents the state of the system at time t, so its only possible values are 0 to M. The system is observed at particular points of time, labelled t= 0 to M. Thus, the stochastic process {Xt} = {X0, X1, X2…} provides a mathematical representation of how the status of the physical system evolves over time. Using the previous example of a collection of muffins, the variable X2 here would represent the number of blueberry muffins at time, t=2.

Definition 2.2: A stochastic process {Xt} is said to have the Markovian property if P {Xt+1=j| X0= k0, X1= k1,…,Xt-1= kt-1, Xt= i} = P{Xt+1= j| Xt= i}, for t = 0,1,2… and every sequence i, j, k0, k1,…, kt-1. This is saying that the probability of Xt+1being equal to j is solely dependent upon the preceding event of what Xt equals.

Conditional probabilities for Markov Chains are called transition probabilities.

Definition 2.3: If Conditional probabilities are defined as $P\{Xt+1=j|Xt=i\}$ then, for each i and j, stationary one-step transition probabilities for a Markov Chain are defined as, $P\{Xt+1=j|Xt=i\}=P\{X1=j|X0=i\}$ for all $t=1,2,\ldots$

Stationary transition probabilities indicate that transition probabilities do not change over time. Aside from one-step transition probabilities, Markov Chains can also have n-step transition probabilities, which is the conditional probability that the process will be in state j after n-steps provided that it starts in state i at time t.

Definition 2.4: n-step transition probabilities are defined as the conditional probability $\{Xt+n=j|Xt=i\} = P\{Xn=j|X0=i\}$ for all t=0,1, …

Therefore, a Markov Chain is a stochastic process that states that the conditional probability of a future event relies on the present state of the process, rather than any past states, or events. A conventional way to note stationary transition probabilities that will be seen later in this paper is: -

$Pij=\{Xt+1=j|Xt=i\}$

$(n)=\{Xt+1=j|Xt=i\}$.

2.1 Chapman-Kolmogorov Equations:

We use Chapman-Kolmogorov Equations to provide a method to compute all of the n-step transition probabilities:

$(n)= \Sigma(m)pkj(n-m)$ For all i = 0, 1, . . ., M,

j = 0, 1, . . ., M,

And any m = 1, 2, . . ., n -1,

n = m + 1, m + 2, . . .

These equations are used to point out that when we go from one steady state to another in n steps, the process will be in some other state after exactly m (m is less than n) states. Thus, the summation is just the conditional probability that, given a starting point in one state, the process goes to the other state after m steps and then to the next state in n –m steps.

Therefore, by summing up these conditional probabilities over all the possible steady states must yield

$(n)=\Sigma pik(n-1)$

And

$(n)=\Sigma\ (n-1)\ pkj$

This means that these expressions allow us to obtain the n-step probabilities from the one-step transition probabilities recursively.

2.2 Transition Matrix

The conditional probabilities for a stochastic process can be organized into an n-step transition matrix. A transition matrix shows the transition probability in a particular column and row as the transition from the row state to the column state. Since transition matrices are comprised of conditional probabilities, each entry of a transition matrix is nonnegative and less than 1. Each row of a transition matrix must also sum to the value 1 since each row signifies a state of the overall stochastic process, and each entry within each row is a conditional probability for the process to be in that state.

2.3 State Transition Diagrams: A convenient and useful method to visualize the state of Markov Chains when they have stationary transition probabilities and a finite number of states is through the use of a state transition diagram. In such diagram, each state of a Markov chain is drawn as a numbered node, and the conditional probability of moving from one state to another is drawn by connecting the nodes with an edge and labelling the edge with the numbered probability.

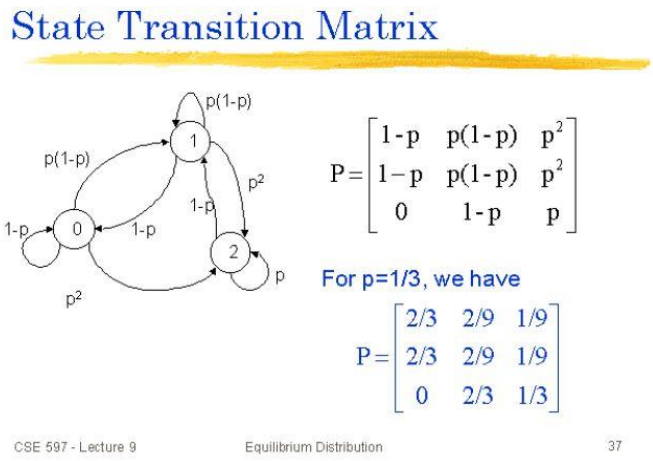

Figure 2.1 State Transition Matrix

2.4 Categorizing States of Markov Chains

Since Markov chains are long run stochastic processes that include transitional probabilities which indicate the likelihood the process will move from one state to another, it is often necessary to categorize, or classify, the varying types of states.

Definition 2.5: A state k is said to be accessible from a state j if$(n)>0$ for some $n\geq 0$, or simply stated, the system can eventually move from state j to state k.

Definition 2.6: If a state j is accessible from a state k and k is accessible from state j then states j and k are said to communicate with one another.

In a Markov chain, every state communicates with itself, since (0) $=P\{X0=j|X0=j\}$ =1, and if a state j is said to communicate with another state k then k communicates with j. If a state j communicates with k and k communicated with l then state j communicates with state l.

Since different states can communicate with one another within the same system, Markov Chains can be placed into classes, which are groupings of states that only communicate with one another. If every state of a Markov chain communicates with every other state within the chain, that is if the entire Markov chain is in itself one class, then the chain is said to be irreducible.

2.5 Transient States

When studying a Markov chain, certain states may only be accessible from others and often times whether or not the system will move from one state to another is convenient to know.

Definition 2.7: If some state j is accessible from state k, but k is not accessible from j (provided that $j \neq k$), then j is considered a transient state. Therefore, a transient state is one where once the process enters the state, the process can never return to the state, and once the process enters the state, there exists a positive probability that the process will move to another state and will never return to the original state. Thus, the chain will only enter transient states a finite number of times.

2.6 Recurrent States and Absorbing States

Aside from transient states where once the process enters, it can leave, but will never return, other states have the characteristic that the process will most certainly return to it after it has entered it once, and certain others have the characteristic that once the process enters the state, it will never leave the state.

Definition 2.8: If a stochastic process, such as a Markov chain, enters a state, and will definitely return to it, the state is said to be recurrent. Hence, recurrent states cannot be transient; however, they can be absorbing.

Definition 2.9: A state is considered to be absorbent, if after entering the state, the process will never leave the state. If for example, the state j is an absorbing state, then $Pjj=1$.

From the above definitions, it is apparent that when grouping the states of a Markov chain into classes, each state belonging to a class is either transient or recurrent. For an irreducible finite-state Markov chain, every state is recurrent, and for any finite-state Markov chain, all the states cannot be transient.

2.7 Periodicity and Ergodicity

Periodicity is defined as the following:

Definition 2.10: For a state j in a Markov chain, the period is the largest integer t (where $t>0$) such that $Pjj(n)=0$ for all values of n other than t, 2t, 3t, …

If a process can be in a state j at times m and m+1, the state of the period is 1, and is called aperiodic. Every state within a class of a Markov chain shares the same period. For finite-state Markov chains, aperiodicity can lead to ergodicity.

Definition 2.11: In a finite-state Markov chain, recurrent states that are aperiodic are called ergodic states, and a Markov chain is called ergodic if all of its states are ergodic (or, aperiodic) states.

2.8 Steady State Probabilities

After the n-step transition probabilities for a Markov chain have been calculated, the Markov chain will display the characteristic of a steady state. Meaning, that if the value of n is large enough, every row of the matrix will be the same, and such, the probability that the process is in each state does not depend on the initial state of the process. Therefore, the probability that the process will be in each state k after a certain number of transitions is a limiting probability that exists independently of the initial state. This can be defined as:

For any irreducible ergodic Markov chain, $limn\rightarrow\infty(n)$ exists and is independent of i. Furthermore, lim $n\rightarrow\infty(n)=\pi j>0$

where the πj uniquely satisfy the following steady-state equations:

$\pi j=\Sigma\pi jpij$ for $j=0, 1\ldots, M$,

$\Sigma\pi j=1$.

The steady state probabilities of the Markov chain are πj. These values indicate that after a large number of transitions the probability of finding the process in a particular state such as j tends to the value of πj which is independent of the initial state. The πj are also known as stationary probabilities, when if the initial probability of being in state j is given by πj for all j, then the probability of finding the process in state j at time n=1, 2… is also given by πj, or $P\{Xn=j\} = \pi j$.

2.9 Applying Steady State Probabilities to the Transition Matrix

In order to solve for the steady state probabilities discussed above, the aforementioned formulas must be applied to the transition matrix, and the linear system needs to be solved.

2.10 Stock Terminology

In order to proceed with the application of Markov chains to the prediction of stock prices, a set of terminology regarding stocks is also useful to have. This project in particular uses opening and closing prices.

Definition: A stock market is an exchange where security trading is conducted by professional stockbrokers. It is a public market in which shares of different companies are bought and sold. The technical analysis for it is anticipating future price movements using historical prices, trading volume, open interest, and other trading data to study price patterns.

Definition: The opening price refers to the price of each individual share on the beginning of that trading day.

Once a list of stock prices has been found, calculating a moving average for the prices provides a method for forecasting the stock prices. Moving averages show the general tendency of the stock prices over the long run, and therefore provide a simple and useful way to predict the future of the prices.

Definition: Given a sequence, $\{ai\}=1N$, an n-moving average is a new sequence $\{si\}i=1N-n+1$ defined from the ai by taking the average of the subsequence of n terms15, $si= 1/ (\sum aj)\ j=1i+n-1$.

Figure 2.2 Bar Graph

CHAPTER 3

REQUIREMENTS SPECIFICATION

The requirements can be broken down into 3 major categories namely functional, hardware and software requirements.

Functional Requirements:

- It should provide user with various companies to predict future returns on their stocks
- After performing prediction, it should provide the most positive result
- User should be able to register itself on the website so he/she can login to his/her account anytime.

Hardware Requirements:

The hardware requirement is minimal and the software can run with minimal requirements. The basic requirements are as enlisted below:

1. Processor: Intel Core2Duo processor or a processor with higher specifications
2. Processor speed: 1.5GHz or above.
3. RAM : 1GB or above
4. Storage space : 1GB or above
5. Monitor resolution: A colour monitor with a minimum resolution of 640*480

Software Requirements:

1. An MS-DOS based operating system like Windows 98/2000/XP/Vista/7/8/10/, Linux, MacOS.

2. Python 3

3. XAMPP Server

4. Sublime Text Editor

CHAPTER 4

SYSTEM ANALYSIS AND DESIGN

4.1 System Architecture

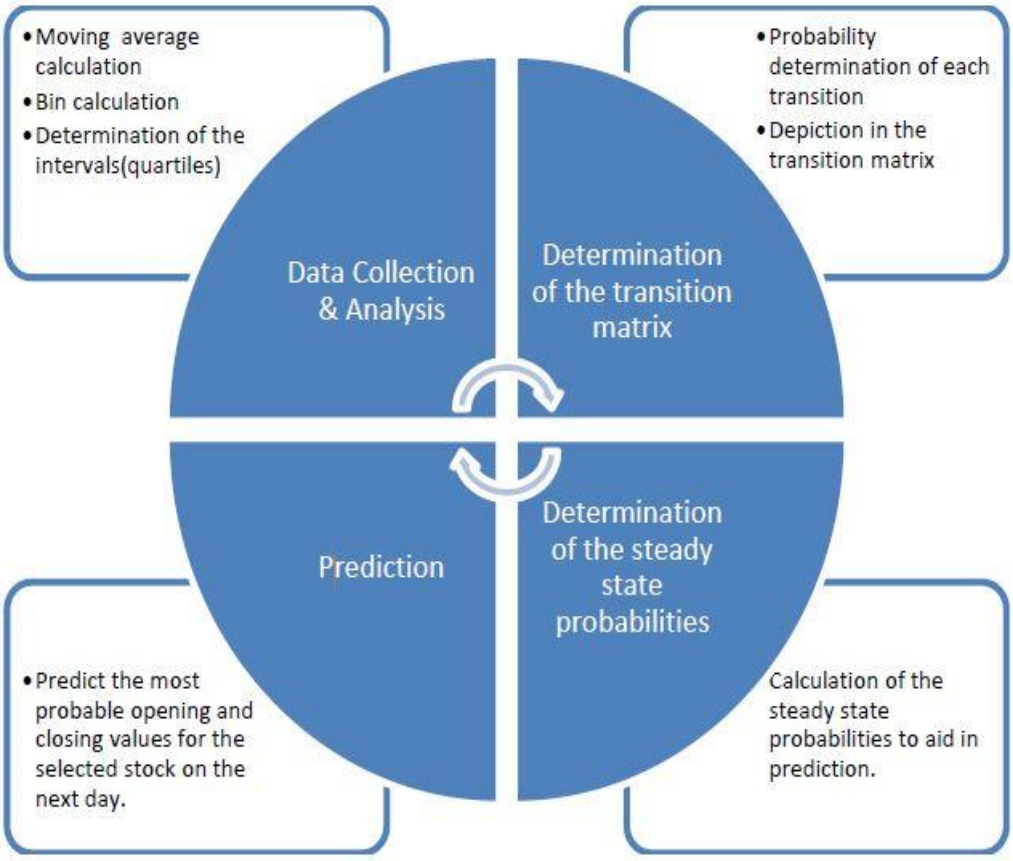

Figure 4.1 System Architecture and Design

4.2 Process Overview

As mentioned earlier, the final objective of this project is to examine a set of stock prices and use the probability method of Markov chains to predict the values of the stock prices in their immediate future. Thus, to conduct this work, a data set of such prices was first collected, examined, and then the probability method was applied as shown in Figure 4.1. We have selected one year's worth data for five different stocks and have applied Markov chain calculations on this data in order to make the predictions.

Once the stock prices were found, the first step towards applying Markov chains to the data set began with the calculation of moving averages. Moving averages provide a forecast for future prices and therefore are crucial to our work here. Using the difference between the forecasted and actual prices enabled us to make our predictions for the possibility of where future prices may lie. These moving averages were calculated for both opening and closing prices for an interval (called i) of 3days.

After the moving averages were calculated for the set of stock prices, the difference between each actual price and the moving average of each individual day was calculated. This information is what we would use to predict future stock prices. Once the difference between each day's price was calculated, we then focused on binning each of the difference prices into four intervals set within the larger interval from the lowest difference price to the highest difference price. The bins were calculated using the following formula:

K = sqrt(N),

where K is the total number of bins and N stands for the total number of readings taken into consideration. The width of each bin is calculated using the following formula,

w = (max value –min value) / K,

where 'max value' and 'min value' refers to the max and min of the difference (between the actual value and the moving average). The intervals were then calculated based on quartile calculations (i.e. at intervals of N/4, 2N/4 and 3N/4). Each of the intervals was labelled P1, P2, P3, P4respectively. After the intervals were established for each data set of difference prices, each individual difference price was labelled as to which interval it fell in.

Once each difference price was labelled with its corresponding interval, the number of transitions for each individual difference price interval to the next difference price interval was counted. For example, if Day 115's difference price belonged to interval P2, and Day 116's difference price belonged to interval P3, then a one count was added to the transition from P2 to P3 (labelled for convenience as P23). Every such transition from each interval, or state, was counted and recorded. The number of points belonging to each interval was also recorded.

Once all the above information was recorded, a one-step transition matrix was ready to be prepared. Each entry of the matrix is supposed to be the probability of the data points moving from, or transitioning from, one state to another, with the states corresponding to the appropriate rows and columns. In order to calculate each entry of the matrix, the values of pij were divided by the total number of difference prices in the interval pi, which corresponds to the aforementioned Pi.

After this one-step transition matrix is built for each interval on which the moving averages were created, the steady state probabilities can be found. The steady state probabilities are found solving the linear systems with the transition matrix multiplied with the vector πj. The steady states indicate the probability that the difference of the prices will be within the aforementioned intervals. This provides a percentage of where future difference prices may fall, and thus provides for a prediction of what the future holds for these stocks. Our transition matrix is of the following form:

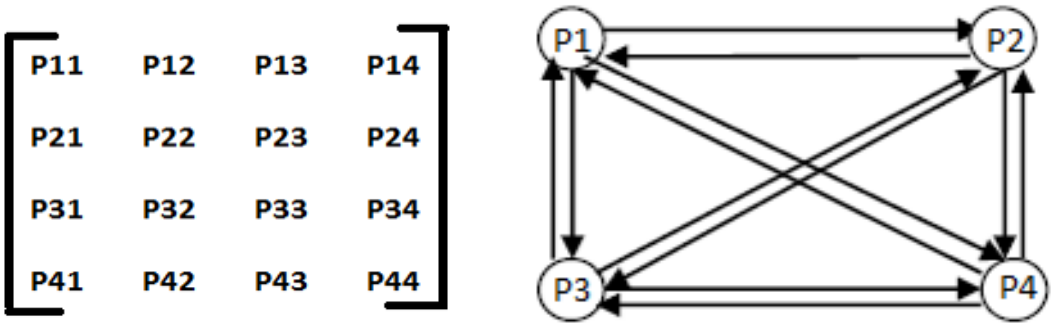

Figure 4.2 Transition matrix

In this transition matrix (Figure 4.2) each column represents the probability of being in a particular interval (calculated based upon the bin). For example, the first column shows the probability of the price lying in interval P1, the second column depicts the probability of the price lying in interval P2 and so on. Let us say, that our transition matrix is represented by Q.

We have based our calculations to obtain the steady state probabilities by considering various methods before we came up with the following technique. We iteratively compute Q2, Q3, Q4, ……., Q8. We stop at Q8 because we observe that the probabilities take a constant value after 5 or 6 iterations. We have still considered till 8 iterations for issues of accuracy.

Then we have considered the steady state probability of being in a particular state as 1, that is, we form 4 steady state probability matrices to tell us the probability or possibility of the stock price lying in a particular range. The matrices are of the form:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 & 1 & 0 & 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 0 & 0 & 1 & 0 \end{bmatrix}$$

$$D = \begin{bmatrix} 0 & 0 & 0 & 1 \end{bmatrix}$$

Figure 4.3 Probability matrices

Matrix A as shown in Figure 4.3 when multiplied with Q2, Q3, ……, Q8 iteratively, finally give us the probability of the stock price lying in interval P1. Similarly, when matrix B is multiplied iteratively, it gives the probability of the stock price lying in interval P2, matrix C gives us the probability for interval P3 and D for interval P4 respectively.

CHAPTER 5

IMPLEMENTATION

5.1 Finding data of a stock

- Here we are arranging data for a stock from the database.

```
function find_data_for_stock($stock, $field){
        global $connection;
        $query = "SELECT {$field} ";
   $query .= "FROM {$stock} ";
   $query .= "WHERE 1";
        $data_set = mysqli_query($connection, $query);

        confirm_query($data_set);

   while($data = mysqli_fetch_assoc($data_set)){
     $data_array[] = $data[$field];
   }
   mysqli_free_result($data_set);
   return $data_array;
  }
```

5.2 Finding maximum value

- Here we are finding the maximum value of a stock field.

```
function find_max_data($stock, $field){
   global $connection;
   $query = "SELECT max({$field}) ";
   $query .= "FROM {$stock} ";
   $query .= "WHERE 1";
   $max_data_set = mysqli_query($connection, $query);
```

```
  confirm_query($max_data_set);
  if ($max_data = mysqli_fetch_row($max_data_set)) {
    mysqli_free_result($max_data_set);
    return $max_data[0];
  } else{
    return null;
  }
}
```

5.3 Finding minimum value

- Here we are finding minimum value of a stock field.

```
function find_min_data($stock, $field){
  global $connection;
  $query = "SELECT min({$field}) ";
  $query .= "FROM {$stock} ";
  $query .= "WHERE 1";
  $min_data_set = mysqli_query($connection, $query);
  confirm_query($min_data_set);
  if ($min_data = mysqli_fetch_row($min_data_set)) {
    mysqli_free_result($min_data_set);
    return $min_data[0];
  }else{
    return null;
  }
}
```

5.4 Finding number of fields

- Here we are finding number of fields in the stock data.

```
function find_no_of_fields($stock, $field){
   global $connection;
   $query = "SELECT count({$field}) ";
   $query .= "FROM {$stock} ";
   $query .= "WHERE 1";
   $count_set = mysqli_query($connection, $query);
   confirm_query($count_set);
   if ($count = mysqli_fetch_row($count_set)) {
     mysqli_free_result($count_set);
     return $count[0];
   }else{
     return null;
   }
 }
```

5.5 Finding frequency

- Here we are performing binning on our stock data.

```
function find_bin($stock, $field){
   $count = find_no_of_fields($stock, "id");
   $k = sqrt($count);
   $max = find_max_data($stock, "{$field}_diff");
   $min = find_min_data($stock, "{$field}_diff");
   $h = ($max-$min)/$k;
   $bin[] = $min;
   while ($min<=$max) {
     $bin[] = $min + $h;
     $min += $h;
   }
```

```
  return $bin;
 }

 function find_freq($stock, $field, $bin){
  $count = find_no_of_fields($stock, "id");
  $freq = array_fill(0, count($bin), 0);
  $diff = find_data_for_stock($stock, "{$field}_diff");

  for ($i=0; $i < $count; $i++) {
   for ($j=0; $j < count($bin) ; $j++) {
    if($bin[$j] <= $diff[$i] && $diff[$i] < $bin[$j+1]){
     $freq[$j]++;
    }
   }
  }

  return $freq;
 }
```

5.6 Finding cumulative frequency

- Here we are finding cumulative frequency of the available data.

```
function find_cum_freq($freq){

  $cum_freq = array_fill(0, count($freq), 0);
  for ($i=0; $i < count($freq) ; $i++) {
   for ($j=0; $j <= $i; $j++) {
    $cum_freq[$i] += $freq[$j];
   }
  }
```

```
    return $cum_freq;
  }
```

5.7 Finding quartile range

- This will yield four prediction percentages since it is a quartile range.

```
function find_quartile_range($bin, $freq, $cum_freq){
    $n = end($cum_freq);
    $n1 = $n/4;
    $n2 = $n/2;
    $n3 = ($n*3)/4;
    $range[] = $bin[0];
    for ($i=0; $i < count($cum_freq) ; $i++) {
      if ($cum_freq[$i]<=$n1 && $n1<$cum_freq[$i+1]) {
        $range[] = ($n1-$cum_freq[$i])<($cum_freq[$i+1]-$n1) ? $bin[$i] : $bin[$i+1];
      }
      if ($cum_freq[$i]<=$n2 && $n2<$cum_freq[$i+1]) {
        $range[] = ($n2-$cum_freq[$i])<($cum_freq[$i+1]-$n2) ? $bin[$i] : $bin[$i+1];
      }
      if ($cum_freq[$i]<=$n3 && $n3<$cum_freq[$i+1]) {
        $range[] = ($n3-$cum_freq[$i])<($cum_freq[$i+1]-$n3) ? $bin[$i] : $bin[$i+1];
      }
    }
    $range[]=end($bin);

    return $range;

  }
```

5.8 Finding states

- And now we are finding the current state.

```
function find_p_states($stock, $field, $range){
  $diff = find_data_for_stock($stock, "{$field}_diff");
  foreach ($diff as $key => $value) {
   if ($range[0] <= $value && $value < $range[1]) {
    $p_states[$key] = "P1";
   }elseif ($range[1] <= $value && $value < $range[2]) {
    $p_states[$key] = "P2";
   }elseif ($range[2] <= $value && $value < $range[3]) {
    $p_states[$key] = "P3";
   }elseif ($range[3] <= $value && $value < $range[4]) {
    $p_states[$key] = "P4";
   }else{
    $p_states[$key] = null;
   }
  }
  return $p_states;
 }
```

5.9 Finding transition states

- This is used to find the transition states for our probability.

```
function find_transition_states($p_states){
  for($key=0; $key < count($p_states)-1; $key++) {
   for ($i=1; $i <= 4; $i++) {
    for ($j=1; $j <= 4 ; $j++) {
     if (($p_states[$key] == "P" . $i) && ($p_states[$key+1] == "P" . $j) ) {
      $transition_states[$key+1] = "P_" . $i . $j;
     }
    }
   }
```

```
  }
  return $transition_states;
 }
```

5.10 Finding state count

- Now here we are finding the count of each state.

```
function find_state_count($p_states, $transition_states){
  $state_count = array(
   'P1' => 0 ,'P2' => 0 ,'P3' => 0 ,'P4' => 0 ,
   'P_11' => 0 ,'P_12' => 0 ,'P_13' => 0 ,'P_14' => 0 ,
   'P_21' => 0 ,'P_22' => 0 ,'P_23' => 0 ,'P_24' => 0 ,
   'P_31' => 0 ,'P_32' => 0 ,'P_33' => 0 ,'P_34' => 0 ,
   'P_41' => 0 ,'P_42' => 0 ,'P_43' => 0 ,'P_44' => 0
   );
  foreach ($p_states as $key => $value) {
   if ($value == "P1") {
    $state_count["P1"]++;
   }elseif ($value == "P2") {
    $state_count["P2"]++;
   }elseif ($value == "P3") {
    $state_count["P3"]++;
   }elseif ($value == "P4") {
    $state_count["P4"]++;
   }
  }
  foreach ($transition_states as $key => $value) {
   for ($i=1; $i <= 4; $i++) {
    for ($j=1; $j <= 4 ; $j++) {
     if ( $value == "P_" . $i . $j) {
      $state_count["P_" . $i . $j]++;
```

```
        }
      }
    }
  }

  return $state_count;
}
```

5.11 Creating Transition Matrix

- Finally using the transition states a transition matrix is being created.

```
function create_transition_matrix($state_count){
  $transition_matrix = array(

      array($state_count["P_11"]/$state_count["P1"] , $state_count["P_12"]/$state_count["P1"], $state_count["P_13"]/$state_count["P1"], $state_count["P_14"]/$state_count["P1"]),

      array($state_count["P_21"]/$state_count["P2"] , $state_count["P_22"]/$state_count["P2"], $state_count["P_23"]/$state_count["P2"], $state_count["P_24"]/$state_count["P2"]),

      array($state_count["P_31"]/$state_count["P3"] , $state_count["P_32"]/$state_count["P3"], $state_count["P_33"]/$state_count["P3"], $state_count["P_34"]/$state_count["P3"]),

      array($state_count["P_41"]/$state_count["P4"] , $state_count["P_42"]/$state_count["P4"], $state_count["P_43"]/$state_count["P4"], $state_count["P_44"]/$state_count["P4"])


    );
  return $transition_matrix;
}
```

5.12 Multiplying matrices

- Performing matrix multiplication.

```
function matrix_mult_4_4($m1,$m2){
   for($row = 0; $row < 4; $row++){
     for($column = 0; $column < 4; $column++){
        $sum = 0;
        for($ctr = 0; $ctr < 4; $ctr++){

         $sum = $sum + ($m1[$row][$ctr] * $m2[$ctr][$column]);

        }
        $sol[$row][$column] = $sum;
     }
   }
   return $sol;
 }
```

5.13 Finding transition probabilities

- Finding transition probabilities for each stock data.

```
function find_transition_probabilities($transition_matrix){
   $q[1] = $transition_matrix;
   for ($i=2; $i < 9; $i++) {
     $q[$i] = matrix_mult_4_4($q[$i-1], $transition_matrix);
   }
   $probabilities = array($q[8][0][0], $q[8][0][1], $q[8][0][2], $q[8][0][3]);

   return $probabilities;
 }
```

5.14 Finding probable range

- This is the range in which stock prices lie for each stock.

```
function find_probable_range($stock, $field, $range){
   $price = find_data_for_stock($stock, $field);
   $last_price = reset($price);
   for ($i=0; $i < 5; $i++) {
    $probable_range[] = $last_price + $range[$i];
   }
   return $probable_range;
 }
```

5.15 Prediction for opening price

- Displaying output for opening price prediction of a stock.

```
function predict_for_opening_price($stock){
   $bin = find_bin($stock,"open");

   $freq = find_freq($stock, "open", $bin);

   $cum_freq = find_cum_freq($freq);

   $range = find_quartile_range($bin, $freq, $cum_freq);

   $p_states = find_p_states($stock, "open", $range);

   $transition_states = find_transition_states($p_states);

   $state_count = find_state_count($p_states, $transition_states);

   $transition_matrix = create_transition_matrix($state_count);

   $probabilities = find_transition_probabilities($transition_matrix);
```

```
$probable_range = find_probable_range($stock, "open", $range);

for ($i=0; $i < 4 ; $i++) {
 echo "<p>There is a " . $probabilities[$i]*100 . "% chance that the tommorrows opening price of {$stock} will lie from $" . $probable_range[$i] . " to $" . $probable_range[$i+1] . "</p>";
 echo "<br/>";
}
}
```

5.16 Prediction for closing price

- Displaying output for closing price prediction of a stock.

```
function predict_for_closing_price($stock){
$bin = find_bin($stock,"close");

$freq = find_freq($stock, "close", $bin);

$cum_freq = find_cum_freq($freq);

$range = find_quartile_range($bin, $freq, $cum_freq);

$p_states = find_p_states($stock, "close", $range);

$transition_states = find_transition_states($p_states);

$state_count = find_state_count($p_states, $transition_states);

$transition_matrix = create_transition_matrix($state_count);

$probabilities = find_transition_probabilities($transition_matrix);
```

```
$probable_range = find_probable_range($stock, "close", $range);


for ($i=0; $i < 4 ; $i++) {
 echo "<p>There is a " . $probabilities[$i]*100 . "% chance that the tommorrows closing price of {$stock} will lie from $" . $probable_range[$i] . " to $" . $probable_range[$i+1] . "</p>";
 echo "<br/>";
}
}
```

5.17 Contact page

- This our contact us page from where customers can contact us for feedback/complaints.

```
<?php include("header.php");?>
<?php require_once("db_connection.php");?>
<?php require_once("functions.php");?>
<?php require_once("validation_functions.php");?>

<!-- Header -->
 <div id="header" class="skel-panels-fixed">

  <div class="top">

   <!-- Logo -->
    <div id="logo">
     <a href="index.php"><span class="image avatar48"><img src="images/avatar.jpg" alt="" /></span></a>
     <a href="index.php"><h1 id="title&lt;Arpit, Shahvez & Alok presenting you&gt;</h1></a>
     <span class="byline">Predicting The Unpredictable</span>
    </div>

   <!-- Nav -->
```

```
            <nav>
              <ul>
                <li><a href="index.php"><span class="icon icon-
home">            
            
Home     </span></a></li>

              </ul>
            </nav>

        </div>

        <div class="bottom">

          <!-- Social Icons -->
            <ul class="icons">
              <li><a href="http://www.facebook.com/" target="_blank" class="icon icon-
facebook"><span>Facebook</span></a></li>
              <li><a href="https://github.com/" target="_blank" class="icon icon-
github"><span>Github</span></a></li>
              <li><a href="mailto:kumararpit13@gmail.com" class="icon icon-
envelope"><span>Email</span></a></li>
            </ul>

        </div>

      </div>

      <div id="main">

                        <!-- Intro -->
```

```
<section id="top" class="one">
<div class="container">

<?php
if(isset($_POST['name'])){

// Validations.
$required_fields = array("name",
"email","message");
validate_presences($required_fields);

$fields_with_max_lengths = array("name" => 32,
"email" => 64, "message" => 1024);

validate_max_lengths($fields_with_max_lengths);

if(empty($errors)){
//Perform update.

$name = mysql_prep($_POST["name"]);
$email = mysql_prep($_POST["email"]);

$message = mysql_prep($_POST["message"]);

$query = "INSERT INTO messages ";
$query .= "(name, email, message) ";
```

```
                                        $query .= "VALUES ('{$name}', '{$email}',
'{$message}')";

                                        $result = mysqli_query($connection, $query);
                                        // Test if there was a query error.
                                        if($result &&
mysqli_affected_rows($connection) >= 0){
                                          //Success
                                          echo "<h2>Your Message has been sincerely
recieved by Us!! Thank You...</h2";

                                        } else {
                                          //Failure
                                          echo "<h2>Due to some error, your request
cannot be processed by us!! Please try again later...<h2>";
                                        }

                                      }
                                     } else{
                                      redirect_to("index.php");
                                     }

                                    ?>

                                    <h3>
                                    <?php echo form_errors($errors);?>
                                    </h3>
                                </div>
                            </section>
                        </div>
```

```
</body>
</html>
```

5.18 Database Connections

- Here we making a connection between backend SQL and frontend HTML/PHP.

```
<?php
 define("DB_SERVER", "localhost");
 define("DB_USER", "root");
 define("DB_PASS", "");
 define("DB_NAME", "iterators");

 //1. Create a database connection.

 $connection = mysqli_connect(DB_SERVER, DB_USER, DB_PASS, DB_NAME);

 // Test if connection was successful.
 if(mysqli_connect_errno())
 {
        die("Database connection failed:" . mysqli_connect_error() . "(" . mysqli_connect_errno()
. ")");
 }
?>
```

5.19 Home page

- This is the home page which will be displayed after successful logging in.

```
<?php include("header.php");?>

<!-- Header -->
    <div id="header" class="skel-panels-fixed">

      <div class="top">
```

```
<!-- Logo -->
  <div id="logo">
    <span class="image avatar48"><img src="images/avatar.jpg" alt="" /></span>
    <h1 id="title">&lt;Arpit, Shahvez & Alok presenting you&gt;</h1>
    <span class="byline">Predicting The Unpredictable</span>
  </div>

<!-- Nav -->
  <nav id="nav">
    <ul>
      <li><a href="#top" id="top-link" class="skel-panels-ignoreHref"><span class="icon icon-home">Home</span></a></li>
      <li><a href="#portfolio" id="portfolio-link" class="skel-panels-ignoreHref"><span class="icon icon-th">Predict The Future</span></a></li>
      <li><a href="#about" id="about-link" class="skel-panels-ignoreHref"><span class="icon icon-user">About The Project</span></a></li>
      <li><a href="#team" id="about-link" class="skel-panels-ignoreHref"><span class="icon icon-user">Our Team</span></a></li>
      <li><a href="#contact" id="contact-link" class="skel-panels-ignoreHref"><span class="icon icon-envelope">Contact</span></a></li>
    </ul>
  </nav>

</div>

<div class="bottom">

  <!-- Social Icons -->
    <ul class="icons">
```

```
            <li><a href="http://www.facebook.com/" target="_blank" class="icon icon-
facebook"><span>Facebook</span></a></li>

            <li><a href="https://github.com/" target="_blank" class="icon icon-
github"><span>Github</span></a></li>

            <li><a href="mailto:kumararpit13@gmail.com" class="icon icon-
envelope"><span>Email</span></a></li>

          </ul>


        </div>


      </div>


          <!-- Main -->

                <div id="main">


                      <!-- Intro -->

                            <section id="top" class="one">

                                  <div class="container">









                                                <img src="images/bag.png"/>


                                                <hr/>

                      <!-- Portfolio -->

                            <section id="portfolio" class="two">

                                  <div class="container">


                                                <h4>Select On a Stock to Dive Into The Future of
Stock Market Trading.</h4>
```

```
<hr/>
<div class="row">
    <div class="4u">
        <article class="item">
            <a href="predict.php?stock=microsoft" class="image full"><img src="img/microsoft_logo.jpg" alt="" /></a>
            <header>
                <h3>Microsoft</h3>
            </header>
        </article>
        <article class="item">
            <a href="predict.php?stock=facebook" class="image full"><img src="img/facebook_logo.jpg" alt="" /></a>
            <header>
                <h3>Facebook</h3>
            </header>
        </article>
    </div>
    <div class="4u">
        <article class="item">
            <a href="predict.php?stock=apple" class="image full"><img src="img/apple_vertical.png" alt="" /></a>
            <header>
                <h3>Apple</h3>
            </header>
        </article>

    </div>
```

```
                                        <div class="4u">
                                            <article class="item">
                                                <a
href="predict.php?stock=general_electrics" class="image full"><img src="img/ge_logo.jpg"
alt="" /></a>
                                                <header>
                                                    <h3>General
Electrics</h3>
                                                </header>
                                            </article>
                                            <article class="item">
                                                <a
href="predict.php?stock=ibm" class="image full"><img src="img/ibm_logo.jpg" alt="" /></a>
                                                <header>
                                                    <h3>IBM</h3>
                                                </header>
                                            </article>
                                        </div>
                                    </div>

                                </div>
                            </section>
                        <!-- About Me -->
                            <section id="about" class="three">
                                <div class="container">


                                    <h2>About The Project</h2>
                                    <hr/>
```

Stock market analysis and prediction is one of the interesting areas in which past data could be used to anticipate and predict data and information about future. Technically speaking, this area is of high importance for professionals in the industry of finance and stock exchange as they can lead and direct future trends or manage crises over time. Using the stochastic processes called Markov Chains, we sought out to predict the immediate future stock prices for a few given companies. We found the moving averages for the data and the grouped them into ten different states of results. We then applied Markov Chain calculations to the data to create a 4x4 transitional probability matrix. Using this transition matrix we solved a system of equations and found 4 steady states that were variables that represented the probability that a stock price for a given day would fall into one of the ten states. When we use this information we can apply our actual data to these equations and predict the next stock prices for the near future. We were able to successfully predict the next few days of stock prices using this method.

```
            </div>
        </section>
        <section id="team" class="one">
            <div class="container">

                <h2>Team CMRIT</h2>
                <hr/>
                <div class="row">
                    <div class="4u">
                        <article class="item">
                            <a
href="http://www.facebook.com/arpit.kumar.7798574" target="_blank" class="image
full"><img src="img/arpit.jpg" alt="" /></a>
                            <header>
                                <h3>ARPIT
KUMAR</h3>
                            </header>
                        </article>

                    </div>
```

```
                                    <div class="4u">
                                        <article class="item">
                                            <a
href="http://www.facebook.com/shahvez.alam.5688" target="_blank" class="image full"><img
src="img/shahvez.jpg" alt="" /></a>
                                            <header>
                                                <h3>SHAHVEZ
ALAM</h3>
                                            </header>
                                        </article>
                                        <article class="item">
                                            <a
href="http://www.facebook.com/CMRInstituteOfTechnologyBangalore" target="_blank"
class="image full"><img src="img/cmrit.png" alt="" /></a>
                                            <header>
                                                <h3>CMRIT</h3>
                                            </header>
                                        </article>
                                    </div>
                                    <div class="4u">
                                        <article class="item">
                                            <a
href="http://www.facebook.com/alok.solanki.756" target="_blank" class="image full"><img
src="img/alok.jpg" alt="" /></a>
                                            <header>
                                                <h3>ALOK
SOLANKI</h3>
                                            </header>
                                        </article>

                                    </div>
```

```
                    </div>


                </div>
            </section>

        <!-- Contact -->
            <section id="contact" class="four">
                <div class="container">

                    <h3>Feel free to drop a Message to Us!!!</h3>

                    <form method="post" action="contact.php">
                        <div class="row half">
                            <div class="6u"><input type="text"
class="text" name="name" placeholder="Name" /></div>
                            <div class="6u"><input type="text"
class="text" name="email" placeholder="Email" /></div>
                        </div>
                        <div class="row half">
                            <div class="12u">
                                <textarea name="message"
placeholder="Message"></textarea>
                            </div>
                        </div>
                        <div class="row">
                            <div class="12u">
                                <a href="#" class="button
submit">Send Message</a>
                            </div>
```

```
                                        </div>
                                    </form>

                                </div>
                            </section>

                        </div>

                <!-- Footer -->
                    <div id="footer">

                        <!-- Copyright -->
                            <div class="copyright">
                                <p>&copy; 2020 TeamCMRIT.in. All rights reserved.</p>

                            </div>

                    </div>

</body>
</html>
```

5.20 Login

- Here user provides his/her credentials for logging in.

```
<?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "iterators";
```

```
// Create connection
$conn = new mysqli($servername, $username, $password,$dbname);

// Check connection
if ($conn->connect_error) {
    die("Connection failed: " . $conn->connect_error);
}



$UserID=$_POST['UserID'];

$Password=$_POST['Password'];



$s= " select * from login where UserID = '$UserID'and Password='$Password'" ;

$result = mysqli_query($conn, $s);

$row = mysqli_fetch_array($result,MYSQLI_ASSOC);
$active = $row['active'];
$num = mysqli_num_rows($result);


if ($num == 1){
header("location: index.php");

}else
```

```
{
echo "SORRY!!!!    USERID DOES NOT EXISTS!!!!!!!!";
}
$conn->close();
?>
```

5.21 Sign up

- This used for registering a new user or first time customer.

```
<?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "iterators";
// Create connection
$conn = new mysqli($servername, $username, $password,$dbname);

// Check connection
if ($conn->connect_error) {
   die("Connection failed: " . $conn->connect_error);
}

$FirstName=$_POST['FirstName'];
$Email=$_POST['Email'];
$UserID=$_POST['UserID'];
$PhoneNumber=$_POST['PhoneNumber'];
$AdharNumber=$_POST['AdharNumber'];
$Password=$_POST['Password'];
#$RepeatPassword=$_POST['RepeatPassword'];
```

```
$s= " select * from login where UserID = '$UserID'";

$result = mysqli_query($conn, $s);

$num = mysqli_num_rows($result);

if ($num == 1){
echo"UserID already taken!!!!   Signup with different UserID ";

}else{

$sql="INSERT INTO login (Name,Email,UserID,PhoneNumber,AadharNumber,Password)
 VALUES('$FirstName','$Email','$UserID','$PhoneNumber','$AdharNumber','$Password')";
if ($conn->query($sql) === TRUE) {
   echo "New record created successfully";
   echo "Please go back and login";
} else {
   echo "Error: " . $sql . "<br>" . $conn->error;
}}
$conn->close();
?>
```

5.22 Validation functions

- Performing a check of user credentials with the backend database.

```
<?php
//* presence
// use trim() so empty spaces don't count.
// use === to avoid false positives.
// empty() would consider "0" to be empty.
```

```
$errors = array();

function fieldname_as_text($fieldname){
        $fieldname = str_replace("_", " ", $fieldname);
        $fieldname = ucfirst($fieldname);
        return $fieldname;
}

function has_presence($value){
        return isset($value) && $value !== "";
}

function validate_presences($required_fields){
        global $errors;
        foreach ($required_fields as $field) {
                $value = trim($_POST[$field]);
                if(!has_presence($value)){
                        $errors[$field] = fieldname_as_text($field) . " can't be blank";
                }
        }
}

// *String length
// max lentgh
function has_max_length($value, $max){
        return strlen($value) <= $max;
}
```

```
function validate_max_lengths($fields_with_max_lengths){
        global $errors;
        // Expects an assoc. array
        foreach ($fields_with_max_lengths as $field => $max) {
                $value = trim($_POST[$field]);
                if (!has_max_length($value, $max)) {
                        $errors[$field] = fieldname_as_text($field) . " is too long.";
                }
        }
}

function validate_password($pass1, $pass2){
  global $errors;
  if ($pass1 === $pass2) {
     return $pass1;
    } else {
     $errors["password"] = "Passwords don't match. Please try again";
    }
}

// Inclusion in a set.
function has_inclusion_in($value, $set){
        return in_array($value, $set);
}

?>
```

5.23 First page

- First page visible to the user as soon as he/she visits our webpage.

```
<!DOCTYPE html>
<html>
<title>Stock Price Prediction</title>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1">
<link rel="stylesheet" href="https://www.w3schools.com/w3css/4/w3.css">
<link rel="stylesheet" href="https://fonts.googleapis.com/css?family=Raleway">
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">
<style>
body,h1 {font-family: "Raleway", Arial, sans-serif}
h1 {letter-spacing: 6px}
.w3-row-padding img {margin-bottom: 12px}
</style>
<body>

<!-- !PAGE CONTENT! -->
<div class="w3-content" style="max-width:1500px">

<!-- Header -->
<header class="w3-panel w3-center w3-opacity" style="text-align: center;">
  <h1 class="w3-xlarge">Predict.Trade.Earn.Enjoy</h1>
  <h1>Stock Price Prediction</h1>

  <div class="w3-padding-32">
    <div class="w3-bar w3-border">
      <a href="login1.html" class="w3-bar-item w3-button">Login</a>
      <a href="sign11.html" class="w3-bar-item w3-button w3-light-grey">Sign Up</a>

    </div>
```

```
  </div>
</header>

<!-- Photo Grid -->
<div class="w3-row-padding w3-grayscale" style="margin-bottom:128px">
  <div class="w3-half">

    <img src="pr3.jpg" style="width:100%">
<img src="pr4.jpg" style="width:100%">
    <img src="pr5.jpg" style="width:100%">



  </div>

  <div class="w3-half">
    <img src="4.jpg" style="width:100%">
<img src="1.jpg" style="width:100%">

<img src="cars5.jpg" style="width:100%">
   -->
  </div>
</div>

<!-- End Page Content -->
</div>

<!-- Footer -->
<footer class="w3-container w3-padding-64 w3-light-grey w3-center w3-large">
  <i class="fa fa-facebook-official w3-hover-opacity"></i>
```

```
  <i class="fa fa-instagram w3-hover-opacity"></i>

  <i class="fa fa-snapchat w3-hover-opacity"></i>

  <i class="fa fa-pinterest-p w3-hover-opacity"></i>

  <i class="fa fa-twitter w3-hover-opacity"></i>

  <i class="fa fa-linkedin w3-hover-opacity"></i>

  <p>Powered by <a href="https://www.w3schools.com/w3css/default.asp" target="_blank"
class="w3-hover-text-green">w3.css</a></p>

</footer>


</body>

</html>
```

CHAPTER 6

RESULTS AND DISCUSSION

6.1 First page

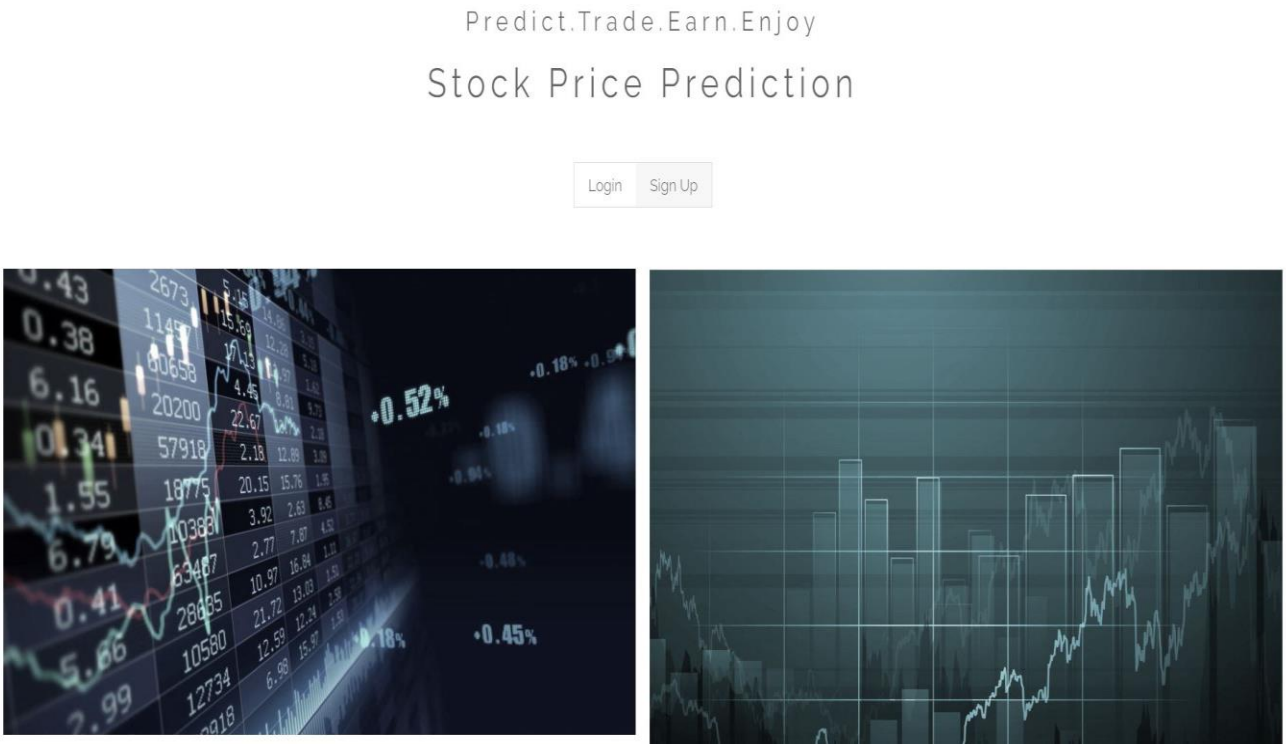

Figure 6.1 First page

Above Figure 6.1 shows the first page of the web application which will be visible to the user as soon as he/she goes to our website. This page gives two options to the user i.e. either to Login if the user already has the account with the website or to Sign Up to register itself with the website and create an account for future logins.

6.2 Sign Up page

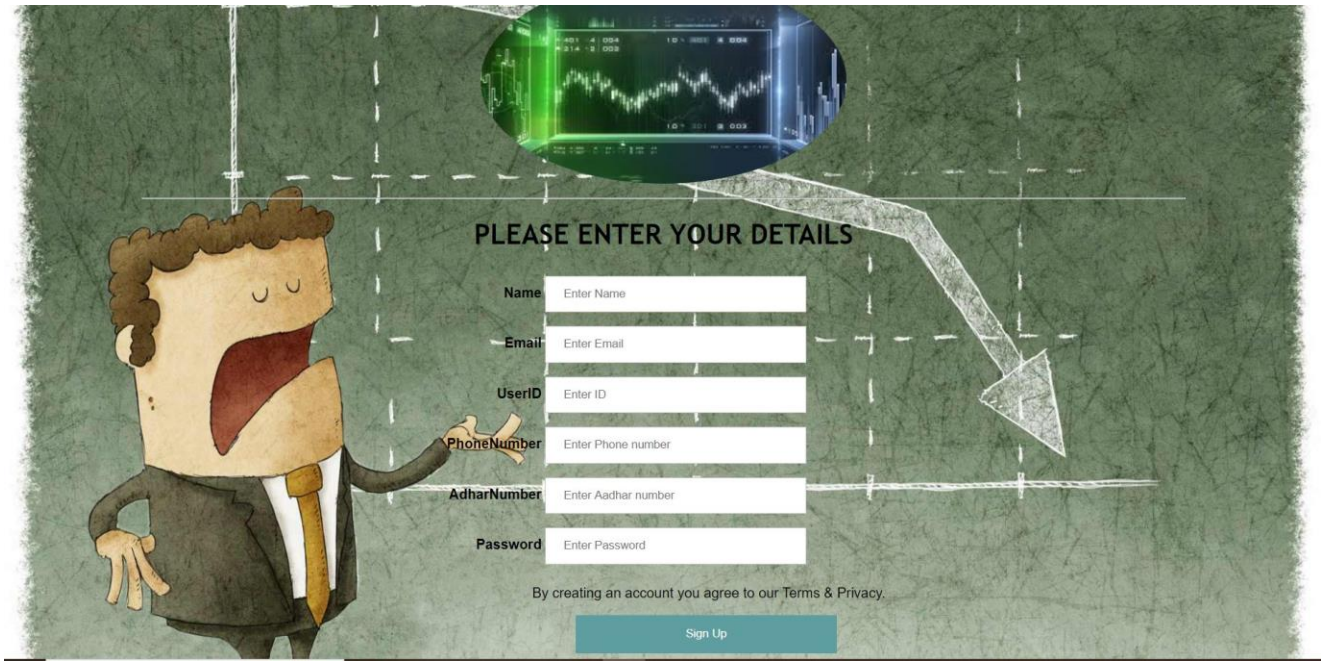

Figure 6.2 Sign Up page

Above Figure 6.2 shows the Sign Up page which user would be able to see as soon as he/she clicks on Sign Up option on the first page. Here user has to enter his basic details to register.

6.3 Login page

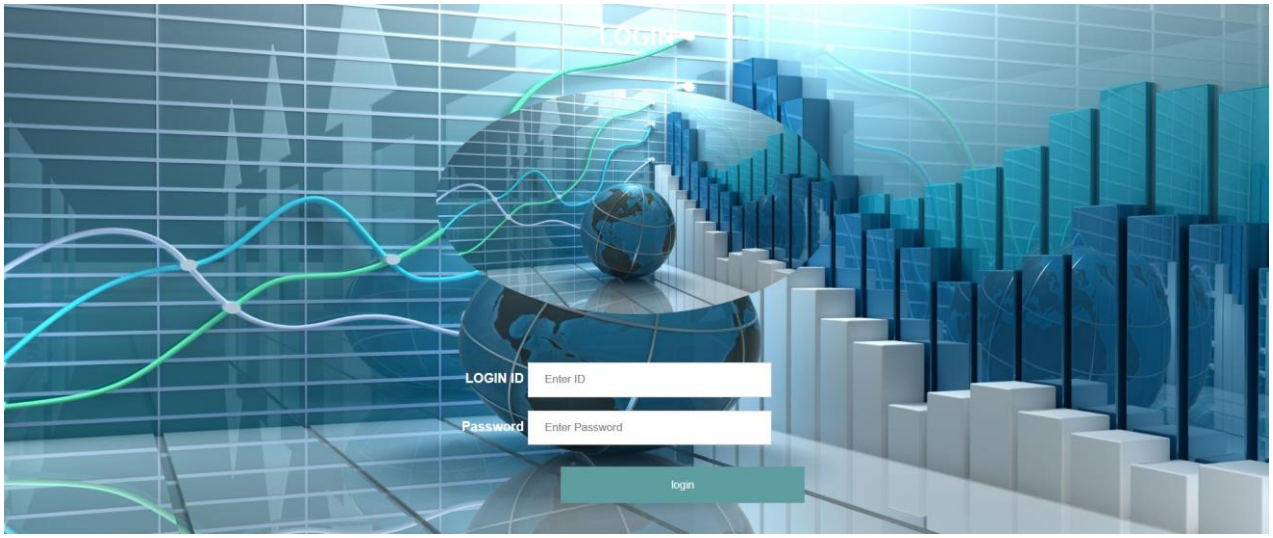

Figure 6.3 Login page

Above Figure 6.3 shows the Login page which user would be able to see as soon as he/she clicks on Login option on the first page. Here user has to enter his login details to login into his account.

6.4 Home page

Figure 6.4 Home page

Above Figure 6.4 shows the Home page of the website which would be visible after user logs in. Various options are available on this page to choose from like Predict the Future, About the Project, Our Team, Contact, etc. User can click on any of these options as per his needs.

6.5 Predict the Future

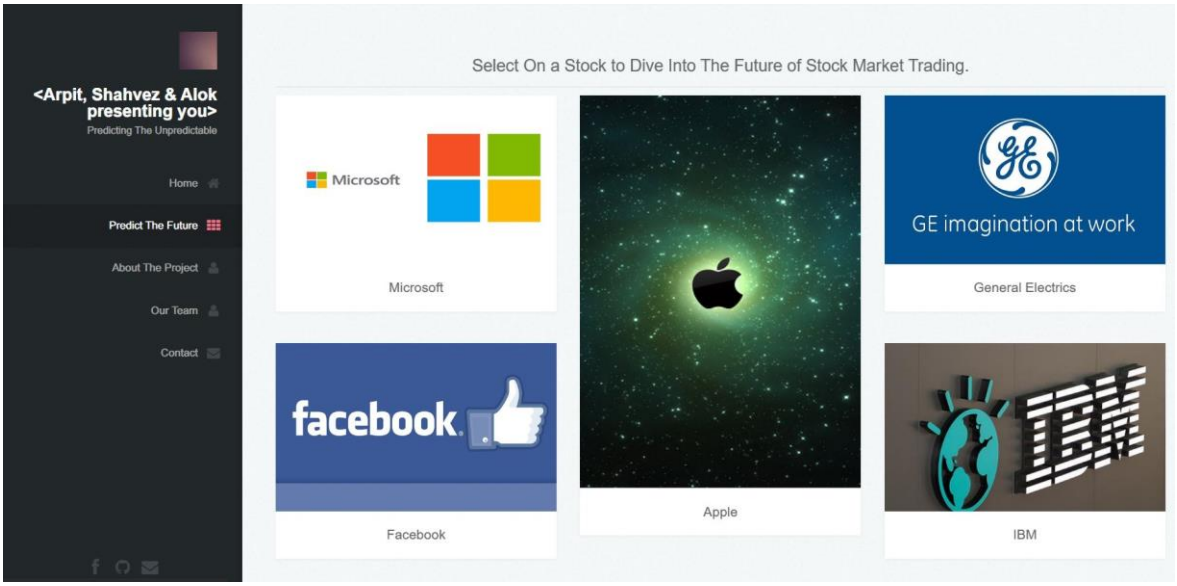

Figure 6.5 Predict the Future

Above Figure 6.5 shows Predict the Future page where user gets various stocks to choose from. Prediction for any of the available stock can be made just by clicking on the company logo.

6.6 Opening & Closing Price Prediction

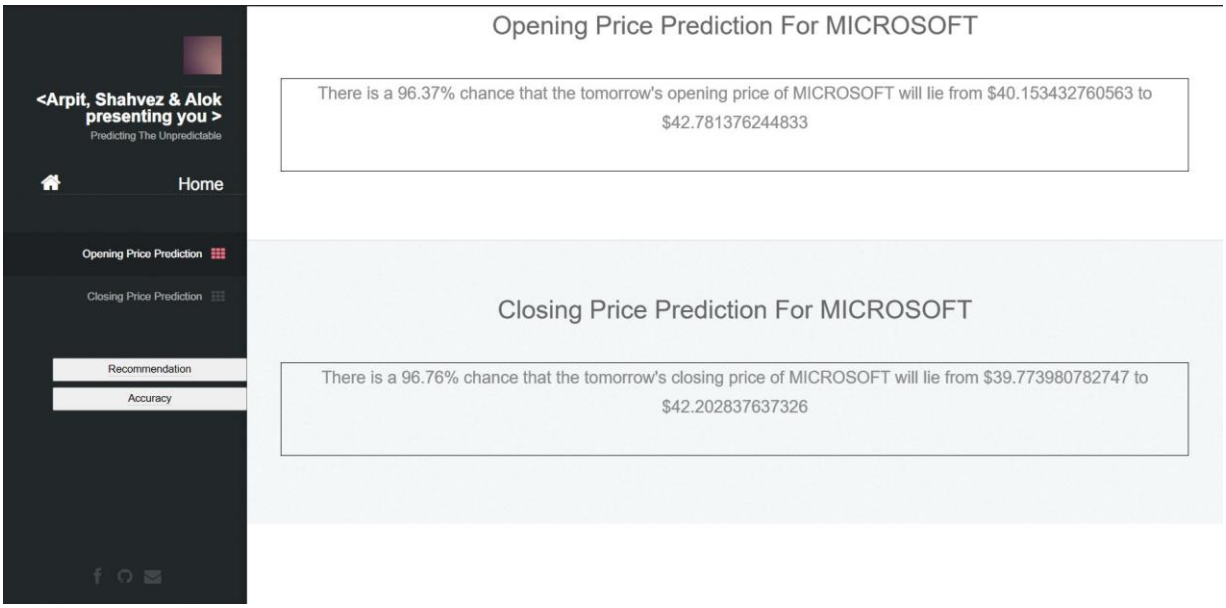

Figure 6.6 Opening & Closing price prediction

Above Figure 6.6 shows the opening and closing price prediction of Microsoft as soon as the user clicks on the Microsoft company's logo.

6.7 Recommendation

Figure 6.7 Recommendation

Above Figure 6.7 shows the recommendation of Microsoft as when user select that option. It is showing not recommended because prices are decreasing from opening to closing price.

6.8 Accuracy

Figure 6.8 Accuracy of prediction in case of Microsoft

Above Figure 6.8 shows accuracy of opening price prediction in case of Microsoft where actual value is 40.240 and predicted value is 40.400. Hence accuracy is 96.949 %.

6.9 About the Project

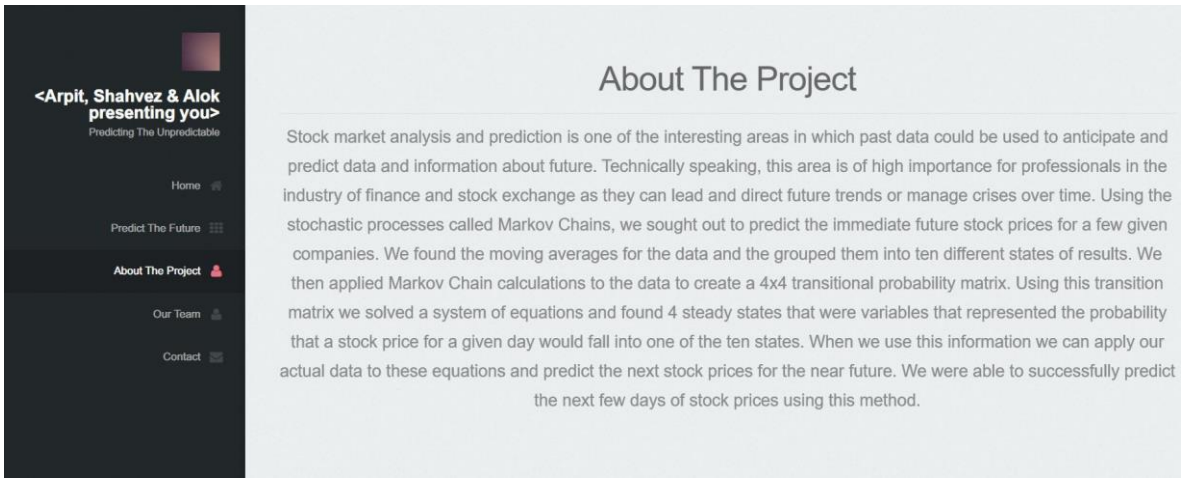

Figure 6.9 About the project

Above Figure 6.8 shows About the Project page which gives details and essential information about the web application like concepts or algorithms being used.

6.10 Our Team

Figure 6.10 Our team

Above Figure 6.9 shows all the members of the team who were involved in the development of this web application. By clicking on any member's photo it will take user to that member's Facebook profile.

6.11 Contact page

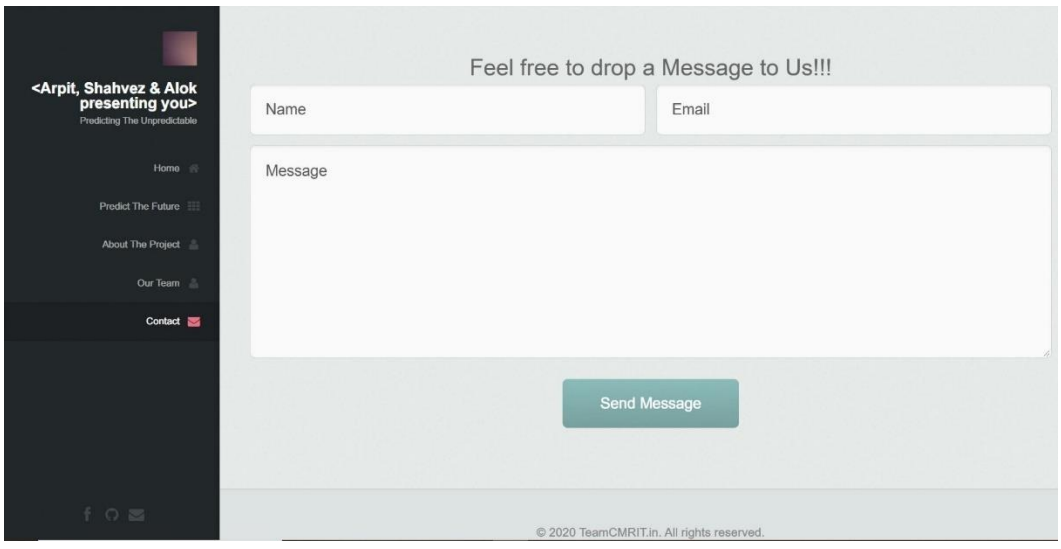

Figure 6.11 Contact page

Above Figure 6.10 shows the contact page using which a user can contact us by sending a mail whenever user wants to provide any feedback or if in case of bugs or any other technical issues, users can easily inform us.

CHAPTER 7

TESTING

7.1 Testing the prediction function

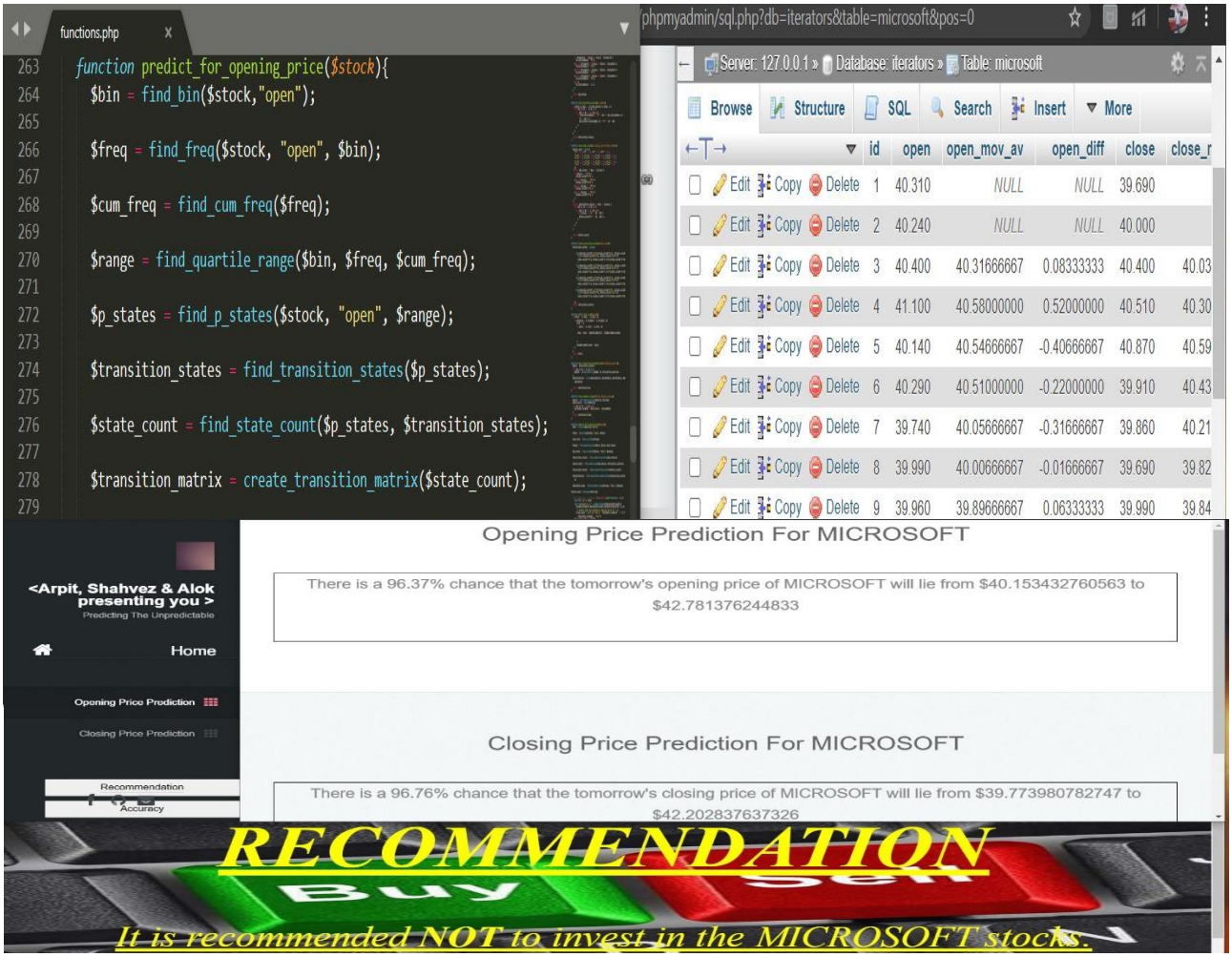

Figure 7.1 Testing of prediction function

Here we are performing a test on our prediction function. It basically consists of two functions i.e. one for opening price prediction and other for closing price prediction. Data for the companies have been stored in the database. And finally test results i.e. the prediction values are analysed as shown in Figure 7.1.

7.2 Testing the Sign-Up function

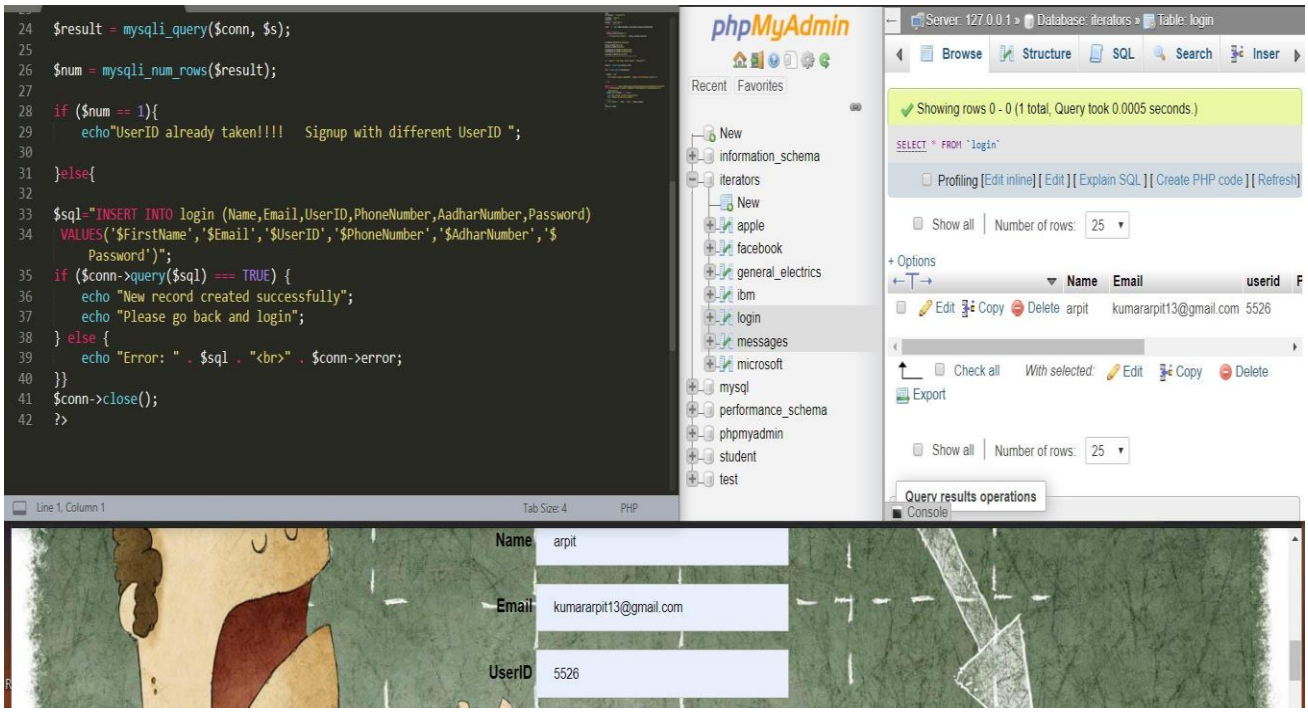

Figure 7.2 Testing of Sign Up function

As shown in Figure 7.2, here we are performing a test on our function which is performing sign up operation in our web application. First, we enter all the details in sign up form like name, email, UserID, etc. then after submitting the form, we go to our backend database to check whether all the details are properly stored or not. Also, we kept some of the fields in sign up form empty to check whether the website gives proper error messages or not.

7.3 Testing the Login function

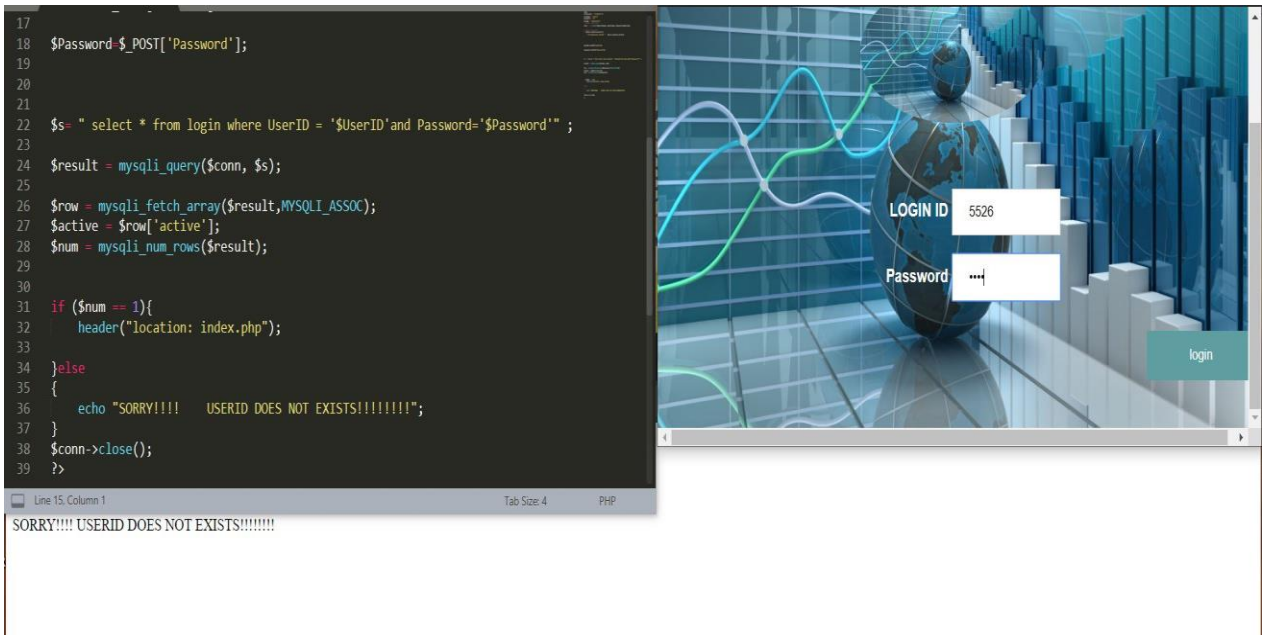

Figure 7.3 Testing of Login function

As shown in Figure 7.3, here we are performing a test on the functions which are responsible for handling the user login operations. Knowingly we enter a wrong password just to check whether the websites give a proper error message or not. Sometimes we also keep one of the fields empty like the Login ID field or Password to check whether how our websites handle such situations or whether it gives shows a proper error pop up to the user or not.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 Conclusion

Thus, we have built this web app in view of all those investors who are at a loss as to whether or not they should make any further investments in a particular share. Since the working algorithm of this app is a mathematical model, the accuracy of this app will be greatly enhanced. This app will be providing mathematical figures which will make it convenient for an investor to come to a decision and that too without the hassle of focusing all their grey cells in an attempt to take note of the expert advices available on various forms of media. This app will be providing predictions at the mere click of a finger. All the user needs to be concerned about is the stock that he/she wants to invest in. Although no prediction can be considered to be perfect, this app strives to achieve near perfection while making predictions thereby reducing the chances of incurring loss for an investor.

Our work thus far has implemented the use of Markov chains to predicting stock prices. Using the difference between forecast prices and actual prices, we have calculated the possible steady state, or probability of the future of the difference price. We checked our app to make predictions for selected stocks and the predictions were found to be nearly accurate. Our app also provides current news feed related to selected stocks, in addition to the prediction, as we have linked it to Yahoo Finance. We are using historical data, from Yahoo Finance, of the companies which are listed in NASDAQ. Our web app is scheduled for a CRON job to run a PHP script in order to update the data (based on which the predictions are made). Thus, our app is ready to enter the market in order to help all the investors.

8.2 Future Scope

Our project leaves a lot of scope for future enhancements. We can improve accuracy by implementing Hidden Markov model in conjunction with the Markov model. If we are to take our work forward, we might also consider basing our calculations on deciles instead of quartiles (i.e.10 intervals instead of 4) Although, nothing can be conclusively said about any prediction, it can be concluded that a lot of scope lies in the field of prediction based on such mathematical models.

Machine Learning and different techniques created new systems to spot patterns which the human brain is not capable of, and since finance is quantitative, to start with, it's laborious not to notice traction. Financial corporations have conjointly endowed heavily in AI in the past, and many others are starting to investigate and implement the financial applications of machine learning (ML) and deep learning to their operations. The high emotionalism of the crypto market ecosystem has already become a topic of study by developers who are attempting to come up with an Al-based solution to increase profit returns. One of the first steps taken in this area was the creation of models that use a neural network to make cryptocurrency valuation predictions. Another way crypto trading is being influenced by AI and ML is through the analysis of sentiments. Sentiment analysis is the processing of enormous volumes of information from various sources like articles, blogs, comments, social media posts, even video transcription to work out the market's "feelings" regarding a topic — to determine if it is positive, neutral or negative. Neural networks endlessly supply increased accuracy. Neural networks make predictions associated with crypto markets remarkably faster. Their nature is to crunch information of cryptocurrency exchange rates constantly. Which are then used to forecast market movements by minutes, hours and days. Fundamental analysis is employed by both cryptocurrency and stock traders. With Artificial Intelligence, all industries, whether informational, technical or operational will become interdependent and interconnected.

REFERENCES

1. http://en.wikipedia.org/wiki/Markov_chain

2. http://www.math.uah.edu/stat/markov/

3. Predicting Stock Prices— (Approved Paper) by Shuchi S. Mitra and Michael J. Riggieri [1]

4. http://ichart.finance.yahoo.com/table.csv?s=YHOO&a=04&b=2&c=2014&d=04&e=3&f=2014&g=d&ignore=.csv

5. http://finance.yahoo.com/d/quotes.csv?s=fb&f=snal1d1t1opghx