AN EMPIRICAL STUDY ON STOCK INDEX TREND PREDICTION USING MARKOV CHAIN ANALYSIS

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ABSTRACT

The Indian Stock Market has been in action for quite some time and is in the limelight amidst others in the global capital markets. We can also see that the stock market indices around the globe are soaring to unprecedented heights and some markets are found to be encouraging investment destinations. Typically stock market indices are the performance indicators for the entire market. They act as barometers, which enable us to get an idea about the performance of the entire market in general. Interested investors all around the globe keep track of the movement of various stock market indices to get an idea about how the global markets are moving. With the globalization of the capital markets, we see that investors are not restricting their investments to a single market. Investments are made in different markets, enabling investors to enjoy the benefit of diversification of markets. Investors base their investments and make a choice of their investment destinations based on the movements of the stock markets. Investors worldwide try to

watch the movement of market indices and have always shown keen interest in trying to predict the share market trend.

The present study aims at trying to predict the stock index trend of various global stock indices using Markov Chain Analysis. *"A Markov Chain is a special kind of stochastic process where the outcome of an experiment depends only on the outcome of a previous experiment".* In other words, the next state of the system depends only on the current state and not on the previous states. Stochastic processes are of interest for describing the behavior of a system evolving over a period of time. In this study the First Order Markov Chain Model is applied to indices of various stock exchanges round the globe. Indices from markets like the American stock markets (DJIA, S&P 500), European Markets (FTSE, FTSH), Australian markets (AUSTA^ORD), China (SSE^), South East Asian markets (Hang Seng), Pakistan (KSE), India (BSE, NSE) etc. are chosen for the study. All major stock market indices representing popular investment destinations are included in the study. The results of the trend prediction using Markov Chain analysis is compared with the results obtained through traditional trend prediction tools. The prediction of the trend using Markov Chain Model is done using short term (one year data), medium term (3 year data) and long term (5 year data) and the results are compared. The results of the study show that majority of the time, Markov model outperforms the traditional trend prediction methods.

1. INTRODUCTION

The Indian Stock Market has been in action for quite some time and is in the limelight amidst others in the global capital markets. We can also see that the stock market indices around the globe are soaring to unprecedented heights and some markets are found to be encouraging investment destinations. Typically stock market indices are the performance indicators for the entire market. They act as barometers, which enable us to get an idea about the performance of the entire market in general. Interested investors all around the globe keep track of the movement of various stock market indices to get an idea about how the global markets are moving. With the globalization of the capital markets, we see that investors are not restricting their investments to a single market. Investments are

made in different markets, enabling investors to enjoy the benefit of diversification of markets. Investors base their investments and make a choice of their investment destinations based on the movements of the stock markets. Investors worldwide try to watch the movement of market indices and have always shown keen interest in trying to predict the share market trend.

The prediction of financial market is a complex task since the distribution of financial time series is changing over a period of time. These changes could be attributed to many reasons like changes in economic conditions, investors' expectations, relative performance of other stock markets or exchange rates etc. In the recent years, investors have started to show interest in trading on stock market indices as it provides an opportunity to hedge their market risk, and at the same time it offers a good investment opportunity for speculators and arbitrageurs. Investors adopt unique trading strategies depending on the trend prevailing in the stock market. Hence predicting the stock market trend has become an important activity. This gives the possible trend that would prevail in the stock market, and therefore be helpful for investors to adopt a suitable investment strategy.

There have been a number of studies trying to predict the stock market trend of financial markets. Many studies have tried to forecast financial time series of developed markets like the UK and the US, not many empirical studies have been carried out to predict the stock market trend of emerging markets. There is a lot of untapped potential in the emerging markets and, overseas investors are looking for investing huge amounts of money in these markets. Hence, the present study attempts to predict the stock market trend of various developed as well as emerging markets using a First Order Markov Chain analysis. All the traditional methods aim at predicting the future price of the share, and not many research are undertaken to predict the movement of the prices (i.e.) the share price trend (Bullish or Bearish). **The decision to invest is initially influenced by the trend and then by the prices**. Hence an attempt is made in the present study to

predict the stock market trend using First Order Markov Chain analysis of various Global Stock Indices.

2. REVIEW OF LITERATURE

Large amount of research works are undertaken to study the behavior of stock markets all round the world. Each research work throws new insight owing to the dynamic nature of the capital market. There is never ending debate that is going on as to whether the stock markets are predictable or not. Many research studies have shown empirical evidence stating that the stock markets are not predictable and therefore efficient, and there is equal number of works showing the predictability of stock market prices. ***Cutler, Potermer and Summers (1989)*** tried to explore whether the Stock price movements are attributable to changes in only fundamental values or are they reflecting something other than news about Fundamental values. The results showed that the movements in stock prices reflect something other than the news about fundamental values. The study concluded that it could be due to the problem of accounting causing variations in asset prices. At the same time research by ***Fama and French (1992)*** have shown that variables like earnings yield, cash flow yield, book to market ratio and size are to some extent helpful in predicting stock returns. ***Fersson and Harvey (1993)*** based on their research work indicate that returns are to a certain extent predictable in the European markets. ***Jaffe and Westerfield (1985)*** empirically showed the evidence of predictability of the behavior of index returns. ***Bipul Malakar, Rajnarayan Gupta (1999)*** formulated a simultaneous equation model to learn the behavior of share prices. A model with five endogenous variables like share price, DPS, EPS, Investment expenditure, sales proceeds and two lagged endogenous variables and one pure exogenous variable were constructed. The empirical findings suggested that the model is a close approximation of factual world showing that the simultaneous equation model works better than single equation in investigating determinants of share price. Few studies indicated that the traditional statistical techniques for forecasting time series were able to predict linear dependencies alone, but are unable to predict the non-linear dependencies in the data set. In the recent times Artificial Neural Networks have become a popular model for predicting future

stock prices. ***Cao Quing, Leggio B Karyl, Schniederjans (2004)*** in their study used the Artificial Intelligence and neural networks to predict stock price movement for firms traded in the Shanghai stock Exchange. The results of the study indicate that neural network out perform the linear models and proved to be an efficient tool for stock price prediction. ***Samanta G P, Sanjib Bordoloi (2005*)** applied the Artificial Neural Network Technique (ANN) for forecasting stock market returns in India. They also used another data driven approach called the Genetic Algorithm for choosing the optimum structure of ANN. The results of the tests showed that the performance of ANN Technique in forecasting all these series was very reliable. ***Manish Kumar, Thenmozhi M (2005)***, in their study attempted to predict the direction of S&P CNX NIFTY using the Random Forest and Support Vector Machines (SVM). Empirical experimentation suggests that the SVM outperforms the neural networks, discriminant analysis and logit model used in the study.

Traders in the market often use technical tools to guide their investment decisions. They often rely on more than one method to predict the future price of shares in the market. The main assumption behind the use of technical analysis is that history repeats itself, and therefore by identifying the recurring patterns, future price movements are predictable. Widely used technical indicators are the Moving Average (MA), Momentum (M), RCI, and Stochastics etc. Man-chung et al. used various technical indicators to gain insight into the direction that the Shanghai's Stock Exchange market may be going. In an interesting study ***Kaushik Bhattacharya (2002)*** specified a two state Markov Chain Model on the categorized returns and proposed a measure for financial market efficiency and related it to the speed of convergence of the Markov chain to its steady state. By specifying a two state Markov chain model for the discretized returns, he used the modulus of the second highest Eigen value of the transition matrix of the chain as a measure for market efficiency. The application of a stochastic model like Markov Chains to the stock market helped in understanding the nature of stock price movements. By and large we can find that majority of the studies aim at predicting the future prices of shares or the indices and there are not many studies done to predict the

trend of the stock markets. However, some recent studies have suggested that trading strategies guided by forecasts on the direction of price change (i.e.) the trend may be more effective to generate profits than the prediction of stock prices.

3. OBJECTIVES OF THE STUDY

The present studies aims to use the First Order Markov Chain Model to predict the stock market trend of various global stock indices. The results of the trend prediction using Markov Chain Model is compared with the results obtained through traditional trend prediction tools. The prediction of the trend using Markov Chain Model is done using short term (one year data), medium term (3 year data) and long term (5 year data) and the results are compared.

4. DATA AND SOURCES OF DATA

The research data used in this study is the daily closing index values of global stock markets. In this study the First Order Markov Chain Model is applied to indices of various stock exchanges round the globe. Indices from markets like the American stock markets (DJIA, S&P 500), European Markets (FTSE, FTSH), Australian markets (AUSTA^ORD), China (SSE^), South East Asian markets (Hang Seng), Pakistan (KSE), India (BSE, NSE) etc. are chosen for the study. The data are downloaded from the stock exchange website for the period 1.1.2002 to 16.10.2009 (7 years). The data is divided into two periods-the first period from 1st January 2002 to 6th October 2009, which is used for estimating the trend. The second period runs from 7th October 2009 to 16th October 2009 are used for comparison and evaluation.

4. METHODOLOGY

The present study aims at trying to predict the stock index trend of various global stock indices using Markov Chain Model. *"A Markov Chain is a special kind of stochastic process where the outcome of an experiment depends only on the outcome of a previous experiment".* In other words, the next state of the system depends only on the current

state and not on the previous states. Stochastic processes are of interest for describing the behavior of a system evolving over a period of time.

MARKOV CHAINS

Markov chains have the special property that probabilities involving how the process will evolve in the future depend only on the present state of the process, and so are independent of events in the past. A stochastic process $\{X_t\}$ is said to have the Markovian property if $P\{X_{t+1} = j/X_0 = k_0, X_1 = k_1, \ldots\ldots X_{t-1} = k_{t-1}, X_t = i\} = P\{X_{t+1} = j/X_i = i$, for t= 0,1,……and every sequence i, j, k_o, k_j,…….k_{t-1}.

In words this Markovian property says that the conditional probability of any future "event", given any past "event" and the present state $X_t = i$, is independent of the past "event" and depends only upon the present state. The conditional probabilities $P(X_{t+1} = j/ X_t = i\} = p_{ij}$ are called transition probabilities. They can be arranged in the form of a n x n matrix known as the Transition Probability Matrix. It is given by

$$P = \begin{bmatrix} p_{11} & p_{12} & - & p_{1n} \\ p_{21} & p_{22} & - & p_{2n} \\ - & - & - & - \\ p_{n1} & - & - & p_{nn} \end{bmatrix}$$

The matrix has the following properties,

1. $p_{ij} > 0$ for all i and j.
2. $\sum_{j=1}^{n} p_{ij} = 1$ for all i and j, (i.e) sum of the element in each row is equal to 1. This is true because the sum represents total probability of transition from state i to itself or any other state.
3. The diagonal element represents transition from one state to same state.

TWO STATE MARKOV CHAIN

A particular case of the Markov chain is a two state Markov Chain with states 0 and 1 whose Transition Probability Matrix can be given as

$$P = \begin{bmatrix} a & 1-a \\ 1-b & b \end{bmatrix}$$

Where a = $\{P(X_{t+1} = 0/ X_t = 0\}$ and

b = $\{P(X_{t+1} = 1/ X_t = 0\}$

Markov process models are useful in studying the evolution of systems over repeated trials. The repeated trials are often successive time periods where the state of the system in any particular period cannot be determined with certainty. Rather, transition probabilities are used to describe the manner in which the system makes transitions from one period to the next. It helps us to determine the probability of the system being in a particular state at a given period of time.

CONSTRUCTION OF A MARKOV CHAIN MODEL FOR ESTIMATING STOCK INDEX TREND

To apply Markov process to share market behavior, share price can be viewed as a system toggling between bullish and bearing state. We construct a transition probability matrix from the past behavior of the system and this transition probability matrix in conjunction with the probability values of the present state of the system is used to determine the probabilities of the next state.

The value on the S&P 500 at time n is r_n (n=1,2, N+1). We define a set of random variables

Y_n =0, if share index values< 0,

Y_n=1, if share index values > 0

Assuming that (Y_n) follows a stationarity first order Markov chain and future movement of (Y_n) depends only on its current state.

Let the transition matrix of (Y_n) be,

$$P = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$$

$0<P_{ij}<1$, $P_{i1} + P_{i2} = 1$ for i= 1,2 ; j=1,2

P_{ij} is the conditional probability of moving into state j from state i.

For convenience the probability of absorbing states is ruled out. Let the unique state probability vector be $\Pi(\Pi_1+\Pi_2)$, $0 < \Pi_1 <1$, $\Pi_1+\Pi_2 =1$,

Solving $\Pi P = \Pi$.

Let the limiting steady state matrix of P be Π where,

$$\Pi \quad \text{Lim } P^n = \begin{bmatrix} \Pi_1 & \Pi_2 \\ \Pi_1 & \Pi_2 \end{bmatrix}$$

Using this notation, the steady state probabilities for period n+1 by multiplying the known state probabilities for period n by the transition probability matrix. Using the vector of state probabilities and the matrix of transition probabilities, the multiplication can be expressed as follows:

Π (next period) = Π.(current period)P

or

$\Pi.(n+1) = \Pi. (n)P$

Beginning with the system in state 1 at period 0, we have Π.(0) = [1,0]. Therefore, we can compute the state probabilities for period 1 as follows:

$\Pi.(1) = \Pi.(0)P$

or $[1,0]\begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$

For example, an illustration

$[1,0]\begin{bmatrix} 0.496045 & 0.503955 \\ 0.495565 & 0.504435 \end{bmatrix}$

The state probabilities $\Pi_1(1) = 0.49$and $\Pi_2(1) = 0.51$ are the probabilities that a bearish trend previous day will follow a bullish trend during the 1st day. Similarly using the same equation the state probabilities for the second day, third day can be computed as follows:

$\Pi(2) = \Pi(1)P$

$\Pi(3) = \Pi(2)P$

$\Pi(4) = \Pi(3)P$

$\Pi(n+1) = \Pi(n)P$

As we continue the Markov process, it can be seen that the probability of the system being in a particular state after a large number of periods is independent of the beginning state of the system. The probability that is obtained after a large number of transitions is referred to as the **steady-state probabilities**.

5. ANALYSIS AND INTERPRETATION

The Markov Chain model is applied to 14 stock indices and the trend prediction is carried out separately using 7year, 3 year and 1 year data. In order to check for the efficiency of the Markov model is predicting the stock index trend, it is compared with the existing forecasting models like 90 Day Moving average and Trend prediction. Using the above forecasting methods, the stock index values of the selected indices are forecasted for the same period and the estimated values are converted into probability. These probabilities are then compared with the results of the Markov Chain Model.

Table 1 shows the trend of the individual stock indices predicted using 7-year data. The results are compared with the actual observed trend, and it is seen that the Markov Model has predicted the trend correctly for 8 indices (57% accuracy). The results obtained by the Markov Chain model are compared with the results of the traditional forecasting methods like the moving average method and the trend projection method. The comparison showed that the Traditional methods could predict the trend accurately only for 7 indices (50% accuracy).

Similarly the stock market trend is predicted using the Markov Model and other traditional methods using 3 years data. The results are tabulated in Table 2. When the results are compared with the actual observed trend, and it is seen that the Markov Model has predicted the trend accurately for 11 indices out of the 14 indices taken for study. It is found that the traditional methods also predicted the trend accurately for 11 indices. Similarly trend prediction is carried out using 1-year data and the results are tabulated in Table 3. When the results of the Markov model is compared with the actual observed trend, it is found that the Markov Chain model could predict the stock index trend accurately for 12 indices (85% accuracy) out of the 14 indices taken for the study. The traditional methods like the moving average and trend projection technique could predict the trend accurately only for 9 indices (64%).

Table 1: Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 7 years data

Model	No. of Trials	Accurate predictions	Accuracy of Prediction
Markov Chain Model	14	8	57.14%
Moving Average	14	7	50%
Trend Projection	14	7	50%

* Refer the Appendix 1 for the detailed results of Stock Market Trend Prediction using Markov Chain Analysis for Individual Stock Indices

Table 2: Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 3 years data

Model	No. of Trials	Accurate predictions	Accuracy of Prediction
Markov Chain Model	14	11	78.57%
Moving Average	14	11	78.57%
Trend Projection	14	11	78.57%

* Refer the Appendix 2 for the detailed results of Stock Market Trend Prediction using Markov Chain Analysis for Individual Stock Indices

Table 3: Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 1-year data

Model	No. of Trials	Accurate predictions	Accuracy of Prediction
Markov Chain Model	14	12	85.71%
Moving Average	14	11	64.28%
Trend Projection	14	11	64.28%

* Refer the Appendix 3 for the detailed results of Stock Market Trend Prediction using Markov Chain Analysis for Individual Stock Indices

From the above analysis, it can be seen that in majority of the cases Markov Model is outperforming the traditional methods in predicting the trend of the stock market. The Markov Chain model shows superior results when the trend is predicted using short-term data (i.e.) for a period of 1 year. **In all the three periods the trend prediction of ^NZ50 and S&P500 indices turned out to be inaccurate**.

6. CONCLUSIONS

This study used the Markov Chain Model to predict the daily trend of various global stock indices and compared the results with that of traditional forecasting methods. The results show that the Markov Model outperformed the traditional models used in the study during the three time periods taken in the study. The Markov predictions showed high level of accuracy when one-year data is used to predict the trend. The superiority of the method could be due to the fact that the Markov model calculates the day-to-day changes in the index values and categorizes them into Bullish and Bearish states. Further the transitions from one state to the other are computed using the transition probability matrix. Since it is used to predict the future trend, the accuracy is the results are obtained. When compared with other traditional models, Markov model outperformed in

terms of accuracy of prediction. This model will help researchers in identifying the future trends in the stock markets. It would be a useful indicator for the investors to make better investment decisions. However, the present study is conducted only with the First Order Markov Chain assuming only two possible states (Bull and Bear), and further studies could be conducted using higher order Markov chains to gain better insight into the behavior of the market.

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Appendix 1

Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 7- year data

	Observed			Markov				Moving Average				Trend Projection			
Index	1	0	Trend	1	0	Trend	Decision	1	0	Trend	Decision*	1	0	Trend	Decision
^FCHI	0.5000	0.5000	Bull	0.5091	0.4909	Bull	1	0.0000	1.0000	Bear	0	1.0000	0.0000	Bull	1
^HIS	0.4000	0.6000	Bear	0.5122	0.4878	Bull	0	1.0000	0.0000	Bull	0	1.0000	0.0000	Bull	0
^KLSE	0.7500	0.2500	Bull	0.5300	0.4700	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
^NZ50	0.1667	0.8333	Bear	0.5576	0.4424	Bull	0	0.4286	0.5714	Bear	1	1.0000	0.0000	Bull	0
AUSTA^ORD	0.5000	0.5000	Bull	0.5399	0.4601	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
BSE 30	0.5000	0.5000	Bear	0.5569	0.4431	Bull	0	1.0000	0.0000	Bull	0	1.0000	0.0000	Bull	0
Cairo-CMAGENL	0.7778	0.2222	Bull	0.5666	0.4334	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
DIJA	0.4286	0.5714	Bear	0.5190	0.4810	Bull	0	1.0000	0.0000	Bull	0	1.0000	0.0000	Bull	0
FTSE-100	0.8571	0.1429	Bull	0.5148	0.4852	Bull	1	0.2857	0.7143	Bear	0	0.0000	1.0000	Bear	0
JAJARTHA-JKSE	0.8571	0.1429	Bull	0.5459	0.4541	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NASDAQ-Composite	0.7500	0.2500	Bull	0.5221	0.4779	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NIKKEI-225	0.6667	0.3333	Bull	0.5010	0.4990	Bull	1	0.0000	1.0000	Bear	0	0.0000	1.0000	Bear	0
S&P 500	0.5000	0.5000	Bear	0.5221	0.4779	Bull	0	1.0000	0.0000	Bull	0	1.0000	0.0000	Bull	0
SSE	0.7500	0.2500	Bull	0.4950	0.5050	Bear	0	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
							8				7				7
Accuracy							57.1429				50				50

*Decision 1 denotes – Accurate prediction

*Decision 0 denotes – Inaccurate prediction

Appendix 2

Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 3-year data

	Observed			Markov				Moving Average				Trend Projection			
Index	**1.0000**	**0.0000**	**Trend**	**1.0000**	**0.0000**	**Trend**	**Decision**	**1.0000**	**0.0000**	**Trend**	**Decision***	**1.0000**	**0.0000**	**Trend**	**Decision**
^FCHI	0.4000	0.6000	Bear	0.5353	0.4647	Bull	0	0.0000	1.0000	Bear	1	0.3333	0.6667	Bear	1
^HIS	0.5714	0.4286	Bull	0.5580	0.4420	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
^KLSE	0.7143	0.2857	Bull	0.5641	0.4359	Bull	1	0.8571	0.1429	Bull	1	1.0000	0.0000	Bull	1
^NZ50	0.2000	0.8000	Bear	0.5444	0.4556	Bull	0	0.4000	0.6000	Bear	1	1.0000	0.0000	Bull	0
AUSTA^ORD	0.5000	0.5000	Bull	0.5560	0.4440	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
BSE 30	0.5000	0.5000	Bull	0.5903	0.4097	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
Cairo-CMAGENL	0.8000	0.2000	Bull	0.5928	0.4072	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
DIJA	0.5000	0.5000	Bull	0.5465	0.4535	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
FTSE-100	0.8333	0.1667	Bull	0.5417	0.4583	Bull	1	0.3750	0.6250	Bear	0	1.0000	0.0000	Bull	1
JAJARTHA-JKSE	0.8571	0.1429	Bull	0.5785	0.4215	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NASDAQ-Composite	0.8000	0.2000	Bull	0.5597	0.4403	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NIKKEI-225	0.6250	0.3750	Bull	0.5340	0.4660	Bull	1	0.0000	1.0000	Bear	0	0.0000	1.0000	Bear	0
S&P 500	0.4444	0.5556	Bear	0.5611	0.4389	Bull	0	1.0000	0.0000	Bull	0	1.0000	0.0000	Bull	0
SSE	0.6667	0.3333	Bull	0.5441	0.4559	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
							11				11				11
Accuracy							**78.571**				**78.571**				**78.571**

*Decision 1 denotes – Accurate prediction

*Decision 0 denotes – Inaccurate prediction

Appendix 3

Table showing the Accuracy of Stock Market Trend Prediction using First Order Markov Chain Model using 1-year data

	Observed			Markov				Moving Average				Trend Projection			
Index	**1.0000**	**0.0000**	**Trend**	**1.0000**	**0.0000**	**Trend**	**Decision**	**1.0000**	**0.0000**	**Trend**	**Decision***	**1.0000**	**0.0000**	**Trend**	**Decision**
^FCHI	0.5000	0.5000	Bull	0.5273	0.4727	Bull	1	0.0000	1.0000	Bear	0	0.0000	1.0000	Bear	0
^HIS	0.5000	0.5000	Bull	**0.5675**	**0.4325**	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
^KLSE	0.7143	0.2857	Bull	0.6237	0.3763	Bull	1	0.8750	0.1250	Bull	1	0.0000	1.0000	Bear	0
^NZ50	0.375	0.625	Bear	0.5659	0.4341	Bull	0	0.5000	0.5000	Bull	0	0.0000	1.0000	Bear	1
AUSTA^ORD	0.5000	0.5000	Bull	0.5725	0.4275	Bull	1	1.0000	0.0000	Bull	1	0.0000	1.0000	Bear	0
BSE 30	0.5000	0.5000	Bull	0.6059	0.3941	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
Cairo-CMAGENL	0.8000	0.2000	Bull	0.5994	0.4006	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
DIJA	0.5000	0.5000	Bull	0.5960	0.4040	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
FTSE-100	0.7500	0.2500	Bull	0.5357	0.4643	Bull	1	0.0000	1.0000	Bear	0	0.0000	1.0000	Bear	0
JAJARTHA-JKSE	0.8571	0.1429	Bull	0.5872	0.4128	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NASDAQ-Composite	0.8333	0.1667	Bull	0.5941	0.4059	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
NIKKEI-225	0.6667	0.3333	Bull	0.5364	0.4636	Bull	1	0.0000	1.0000	Bear	0	0.0000	1.0000	Bear	0
S&P 500	0.4286	0.5714	Bear	0.5842	0.4158	Bull	0	1.0000	0.0000	Bull	0	0.0000	1.0000	Bear	1
SSE	0.6000	0.4000	Bull	0.6575	0.3425	Bull	1	1.0000	0.0000	Bull	1	1.0000	0.0000	Bull	1
							12				9				9
Accuracy							**85.7143**				**64.2857**				**64.2857**

***Decision 1 denotes – Accurate prediction

*Decision 0 denotes – Inaccurate prediction