# *Using Monte Carlo Simulation for Estimating the Intrinsic Value of a Stock*

VISHAL VAMAN MEHTRE
Assistant Professor
Department of Electrical Engineering
Bharati Vidyapeeth (Deemed to be University)
College of Engineering
Pune-411043, India

ANKIT KUMAR JHA
BTech Student
Department of Electrical Engineering
Bharati Vidyapeeth(Deemed to be University)
College of Engineering
Pune-411043, India

***Abstract*— Stock market forecasting has long been a source of frustration for investors and one of the most difficult problems for the artificial intelligence (AI) industry to solve. The performance of national stock markets has a significant impact on their economies. Markets have become more accessible as a means of investment. Uncertainty is a characteristic that all stock markets share. This stock value unpredictability is unwelcomed in both short and long-term potential investments. Stock market forecasting is crucial in the investment process. Technical issues, such as computing share of dividends and state vector when using stochastic modelling for risk analysis, are drawbacks of the existing method. To solve the shortcomings of the existing approach, the suggested system attempts to generate a combination of over one lakh seventy thousand scenarios in order to determine the intrinsic worth of a company, with the findings displayed in graphical depiction. The system's production of unique intrinsic stock value will supply intrinsic stock value for each situation. A vast set of values for all the input parameters, such as high growth value, declining growth value, terminal growth value, and return on equity, must be produced in order for the system to generate feasible intrinsic value. The system will determine statistical indicators such as mean, median, mode, skewness, and kurtosis from a vast data collection containing the company's intrinsic worth. The technology will be able to add a rigorous statistical logic for investment decision by comparing statistically determined intrinsic value and current market pricing. There will be no human or emotional biases in this reasoning because there will be no human intervention in determining the stock's final intrinsic value. The best technique for generating random scenarios that follow the Brownian walk motion of stocks is Monte Carlo simulation of stock prices.**

***Keywords— current stock price, return on investment, graphical visualization, stock market, price action, trend analysis, outcomes***

## I. INTRODUCTION

Financial features of a business include revenues, net profit, net working capital, depreciation, debt, and so on [1]. It is vital to quantify the influence of any choice on the company's value prior to making it. Over the previous two decades, globalisation has been a major subject for investors and corporations. Investors put their money into real estate, which generates cash flow and income. Investors are drawn to changing stock markets for a variety of reasons, the most obvious of which being rapid economic growth. Economic growth is linked to good earnings growth, which is associated with stronger stock returns for investors, thus developing market enticement could be strong. The economy's unpredictable, volatile, and probabilistic behaviour are signs. The capital markets facilitate the purchase and sale of equities and debt instruments. It is a method of saving and investing between capital providers, such as retail and institutional investors, and capital users, such as enterprises, governments, and individuals. These marketplaces are necessary for the operation of an economy since capital is a necessary component of economic output. Primary markets, in which new stock and bond offerings are sold to investors, are referred to as capital markets. Secondary markets, on the other hand, are where current securities are traded.

An investor allocates cash with the expectation of a financial return in the future [3]. Equity, debt securities, real estate, currency, and commodity investments, as well as derivatives such as put and call options, are among the various types of investments [4][5]. There is no distinction between people who trade on primary and secondary markets. Investors look for stocks that have a strong chance of becoming multibaggers. Within three to five years, these stocks can multiply five to 10 times. As a result, investors have a five-year time horizon.

For risk analysis and firm development predictions, the existing system use stochastic modelling. Because of the variability in financial features, practical application encounters technical challenges. According to economic theory, demand and supply are always present. There are two values in a stock: (a) intrinsic value and (b) market premium. According to analysts, if the stock's intrinsic worth is.100 but it's trading at.140 in the market, the market is paying a.40 premium owing to supply and demand. Stock predictions are made because investors are exposed to risk and want to know what the possibilities are that their stock will provide significant returns, such as growing two, five, or ten times its current value, and what the value of their stock will be in various situations. Humans can perform basic analysis on an excel sheet, but they are unable to design more than fifty scenarios. Additionally, there is a chance of making mistakes while constructing scenarios, such as spelling typos. Even if a scenario is established, auditing it is impossible. As a

result, we require a system that can quickly produce one lakh seventy thousand scenarios while saving around five lakhs forty thousand man hours for each company's stock value. If a stock is recognised as having an intrinsic value of.300 and a market value of.200, the stock has the potential to become worth more than.300 in the next six to twelve months. The proposed technology calculates intrinsic value after creating over one lakh seventy thousand scenarios and automatically recommends whether or not to invest in stock to its user. No software solution now provides artificial intelligence data visualisation capacity, and it is also not available to individual or retail investors.

## II. Literature Survey

Valuation of business is done by several methods employed for cash flow forecasting. The methods can be separated into three main categories [1]:

- Heuristic Methods.
- Methods based on illustration of past data and trend detection using regression model, auto regressive models and learning models.
- Methods based on creation of imitational model, describing company parameters interconnection.

The stochastic model is used to analyse risk and forecast the development of a company that has no primary challenge. Meanwhile, practical implementation is beset by a slew of technical issues stemming from the formulation of the problem. A company can be described as a set of financial characteristics, such as revenues, net profit, net working capital, depreciation, debt, and so on, in which a state vector whose components are net profit, fixed assets, net working capital, and so on can be described using a finite-difference equation like the one shown below:

$$A_t = F(A_{t-1}) \quad (1)$$

Equation (1) can be used to find the state at moment "t" if the state at instant "t-1" is known (state vector value in year "t" dictates state vector value in year "t + 1," value in year "t + 1" dictates value in year "t + 2," and so on).It is important to distinguish between characteristics that can be adjusted by the manager (business policy) and parameters that are independent (market price), as well as financial metrics that are determined from the financial statements of the company [1]. As a result, by executing a mathematical model, the optimum managerial options are derived. The concept of value-based management can be realised using stochastic modelling. Control parameters are important value generators.

When it comes to stock prediction, artificial neural networks (ANN) outperform other strategies. In the subject of finance, artificial neural networks are used as a data mining tool to try to replicate human behavioural patterns for stock market investment. [19]. To predict stock price, different ANN architectures such as simple feed forward back propagation neural network (FFBPNN), elman recurrent network, and radial basis function network (RBFNN) are developed and tested. Stock market moves are predicted using artificial intelligence. Artificial neural networks (ANNs) are the most used machine learning technology for stock market forecasting [7]. Methods for stock market prediction include support vector machines and neural networks [6]. [17]. Artificial neural networks [7] [13] can be used to forecast financial outcomes in one of three ways:

- Inputs are supplied into the ANN, allowing it to learn rules that link the current state of the system to future states.
- A window of inputs exists that describes a fixed set of recent past states and links them to future states.
- It could be built with an internal state that allows it to investigate the relationship between an infinite number of past inputs and future states.

Neural networks may solve every machine learning problem using two basic methodologies: (a) fundamental analysis and (b) technical analysis. Although neural networks have not been shown to be successful in certain problem domains, as a user of machine learning technology, humans are better suited using approaches with a stronger theoretical foundation, such as the ones listed below. x Neural Networks are far too mysterious: It becomes challenging to train because the results can be non-deterministic and are highly dependent on the initial parameters used. Because the problems are so opaque, it's difficult to tell how they're being solved.

1. Neural Networks aren't based on probability: The output of a neural network may be a continuous number, but converting that into a problem statement is typically problematic.
2. Neural networks aren't good for delving into problems in depth.
3. Only numerical inputs and vectors with a fixed number of elements are suitable for artificial neural networks for values and data set with non-missing data.
4. As artificial neural networks are data-driven control procedure, it cannot be used for sensitive or risky applications where trial error cannot be done when investing in a company or evaluating intrinsic value of company.

Brownian-walk implementation in practise In forecasting, Monte Carlo simulation is basically a mix of a spreadsheet and time-dependent historical data. Standard data regression techniques cannot be used to model historical data. It describes Monte Carlo simulation, a more robust process (no human interaction and operates on random data sets). Data extrapolation (the process of estimating beyond the initial

observation in statistics) and forecasting that exceeds the known data points, as well as interpreting the predicted range of outcomes, are both efficient applications of Monte Carlo [9]. Forecasting models aren't declarations of what will happen, but rather predictions based on specific data, assumptions, and analytical approaches. Market concept, regulatory activity, and producer and customer behaviour are all examples.

Forecasted trends are suggestive of real-world tendencies rather than projections of specific real-world outcomes. Monte Carlo simulation [10] is a well-known mathematical technique for analysing uncertain scenarios and delivering probabilistic analyses of various situations. Monte Carlo simulation is used for probability-based applications, which are equations with variables substituted by a random number generator. A Monte Carlo simulation is a method for evaluating a deterministic model utilising sets of random integers as inputs in an iterative manner. When the model is sophisticated, nonlinear, or has more than a few uncertain parameters, this strategy is frequently used. The primary reason for utilising Monte Carlo analysis is because it is simple and straightforward. First, who can describe a system that uses a collection of basic math components without knowing how all of the separate components can supply solution points to produce market insights.

Second, computers can create estimates faster than humans can work out a complex arithmetic answer, which still requires complex and time-consuming computer programming to run several case studies [9]. Monte Carlo simulations can be run in Microsoft Excel utilising add-ins (software that can be installed on a computer to offer more features or functionalities).The disadvantage of Monte Carlo is that it does not rely on historical trends and instead considers future data sets based on random scenario development [11]. If no previous data is available, a Monte Carlo forecast can be anything that is thought to be reasonable. Users of the application should be able to validate a known value with some precision before attempting to utilise Monte Carlo to calculate probability. They won't be able to tell when the programme is right, when to use it, or if the result is practical, approximated, and promptly validated if they don't have this information. approximated and quickly validated.

## III. PROPOSED SYSTEM

Based on the flaws discovered in the literature review, the system attempts to generate a combination of over one lakh seventy thousand scenarios in order to determine the intrinsic value of a stock, the results of which are displayed using graphical visualisation. For each share, the system does statistical analysis on a big data set of intrinsic values. Investors will be able to add sound statistical rationale to their investment decision by comparing this statistically computed value to the current market price. There will be no human or emotional biases in this reasoning because there will be no human intervention in determining the final value.

Figure 1 depicts a block schematic of the proposed system that quickly outlines the system's process flow. The system's key requirement is to obtain financial data from the previous five years, which includes the company's profit loss statement and balance sheet to be evaluated [15]. The Monte Carlo simulation block receives this historical data and performs the full evaluation process. A variety of vectors are used as input in the Monte Carlo simulation block, such as growth rate, high growth years, cost of equity, beta () index sensitivity to the nifty 50, and reinvestment ratio. Then, using two input vectors, growth rate and ROE created, a computer analysis is performed on the input vector using discounted cash flow (DCF), as well as high and declining growth periods. Utilizing the Gordon growth model, terminal growth rate value derives terminal values using input vectors return on equity, earnings before income and taxes, and free cash flow to equity. As a result, intrinsic value per share is determined, statistical analysis is conducted, and output is provided in the form of graphs and charts.

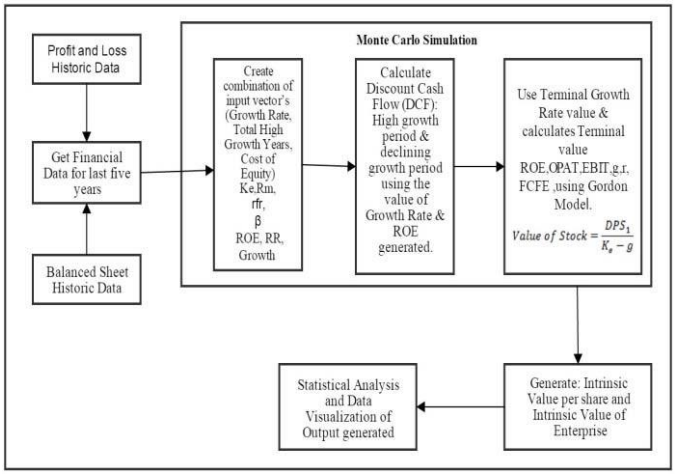



Fig. 1. Block diagram of proposed system.

Fig. 2. Monthly Chart of ONGC (NSE)

The component of proposed system includes:

*a) Input Data:*

Historical data like profit and loss, balance sheet, income statement of any company can be taken from www.yahoofinance.com. According to securities exchange

board of India (SEBI), all the companies are required to provide their financial statements, historical data free to the public hence getting historical data does not incur cost. Thus, system imports the data required for stock evaluation process.

- Import 10-year historical record of profit and loss statement and balance sheet.
- Identify the historical growth rate in revenue, operational profit, earnings per share and profit after tax.
- Calculate the log returns
- Visualize the percentage graph over the year
- Input the current total equity. x Input the

  beginning and ending year of valuation.
- Input expected terminal return on equity & terminal growth rate.
- Input the current total liabilities. x

  Input the excess cash that company

  may have.
- Input the total value of non-cash investments made by the company.

***c) Monte Carlo Simulation and Evaluation:***

**Step 1:** Import Libraries for calculation and plotting and visualisation. Group of libraries and modules that can be imported when carrying out this task. Besides the classical NumPy and Pandas, we will need "norm" from SciPy and some specific Matplotlib features

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from scipy.stats import norm
%matplotlib inline
```

**Step 2:** Importing Historical Data from Yahoo Finance using pandas_datareader

```
ticker = 'ONGC.NS'
data = pd.DataFrame()
data[ticker] = wb.DataReader(ticker, data_source='yahoo', start='2007-1-1')['Adj Close']
```

**Step 3:** Calculate the log return for plotting the percentage change in the stock price

```
log_returns = np.log(1 + data.pct_change())
log_returns.tail()
```

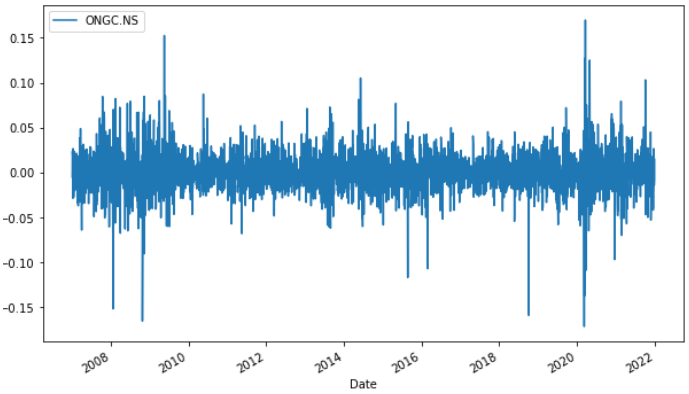
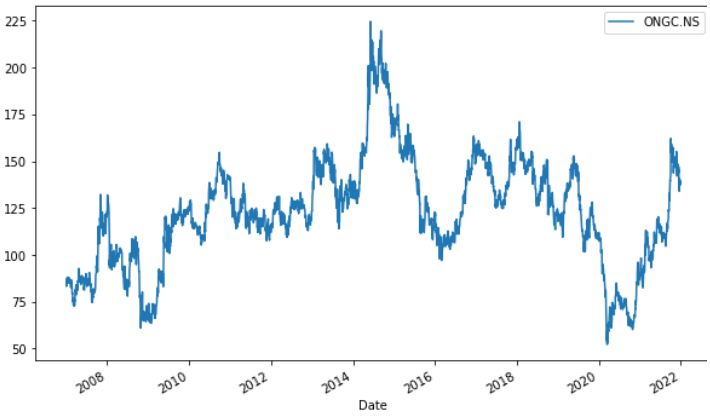



Fig. The picture tells us the returns are normally distributed and have a stable mean

**Step 4**: Plotting the percentage graph

```
data.plot(figsize=(10, 6));
```




**Step 5:** Calculating mean and variance for calculation of Brownian Motion

```
u = log_returns.mean()
u
```

```
ONGC.NS    0.000135
dtype: float64
```

```
var = log_returns.var()
var
```

```
ONGC.NS    0.00049
dtype: float64
```

**Step 6**: Calculate the drift component It is the best approximation of future rates of return of the stock. The formula to use here will be “U”, which equals the average log return, minus half its variance.

```
drift = u - (0.5 * var)
drift
```

```
ONGC.NS   -0.00011
dtype: float64
```

Step 7: Generating random set of matrix and assigning it in norm.ppf(arr). Norm.ppf(arr) if is equal to 1.65 then the event has 95% chance of occurring

```
Z = norm.ppf(np.random.rand(10,2))
Z
```

```
array([[-0.47620416, -0.13032332],
       [ 0.93114832, -1.27919076],
       [-0.82424048, -0.34615828],
       [-0.48674153,  2.48712239],
       [ 1.563623  ,  0.98676106],
       [ 1.28676543, -0.9390719 ],
       [-0.1065451 , -0.62090078],
       [-1.48151361, -0.38486772],
       [-0.15704796, -0.52439551],
       [ 1.30316426,  0.08843202]])
```

**Step 8:** Setting up number of interval and calculating daily return using euler’s e

```
daily_returns = np.exp(drift.values + stdev.values * norm.ppf(np.random.rand(t_intervals, iterations)))
```

```
daily_returns
```

```
array([[1.01400233, 1.00250792, 1.02260119, ..., 1.04309279, 1.03518045,
        1.02548104],
       [0.98962588, 1.01023944, 1.00489111, ..., 0.99352656, 1.0195669 ,
        1.01256185],
       [0.99256678, 1.01597032, 1.00702368, ..., 0.97263202, 1.01507105,
        0.99906963],
       ...,
       [0.97485422, 0.98492355, 0.98640932, ..., 1.00282   , 0.98648689,
        1.01384473],
       [1.00174473, 0.990103  , 0.99870621, ..., 0.9938169 , 0.95488172,
        1.01682386],
       [0.97503505, 0.9826806 , 1.0037477 , ..., 1.03507084, 0.99422945,
        0.97838716]])
```

**Step 9**: Generating first estimation using .iloc function and then creating loop for 1000 days for final estimation

```
S0 = data.iloc[-1]
S0
```

```
ONGC.NS    137.649994
Name: 2021-12-29 00:00:00, dtype: float64
```

Fig. The price here is 137.649994 which is the first estimation

```
for t in range(1, t_intervals):
    price_list[t] = price_list[t - 1] * daily_returns[t]
```

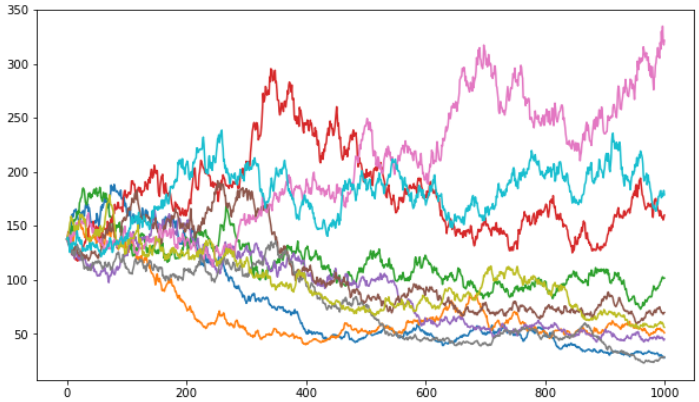
```
price_list
```

```
array([[137.6499939 , 137.6499939 , 137.6499939 , ..., 137.6499939 ,
        137.6499939 , 137.6499939 ],
       [136.2219963 , 139.05945262, 138.32325529, ..., 136.75892491,
        140.34337765, 139.37913244],
       [135.20942761, 141.28027701, 139.29479324, ..., 133.01610977,
        142.45849974, 139.24945846],
       ...,
       [ 28.56608546,  52.34658234, 101.37468637, ...,  27.96411469,
         59.04151218, 179.7172843 ],
       [ 28.61592545,  51.82850806, 101.24352835, ...,  27.79120991,
         56.37766068, 182.74082266],
       [ 27.90153034,  50.93086931, 101.62295895, ...,  28.76587104,
         56.0523304 , 178.79127407]])
```

Fig. This is an array for various estimation 137.649994, 136.2219963 etc.

**Step 10:** Plotting the Monte Carlo Graph for various outcomes of the stock price

```
plt.figure(figsize=(10,6))
plt.plot(price_list);
```




## IV. Conclusion

Investors will be able to assess and make informed decisions regarding their previous and future investments if the proposed method is used on a regular basis. This approach can assist anyone with a basic understanding of stock valuation in judging money multiplying stocks with relative ease, higher probability prediction, and a high hit rate. Stocks such as PI Industries, 3M India, Delta Corp, and in this example ONGC, for example. In ten hours, twenty companies can be reviewed. Performing the same task with only human labour on an excel or other spreadsheet would require five lakhs forty thousand man hours of optimal efficiency.

*d) Reports:*

A data grid of all permutations and combinations will be generated based on the specified scenario, with detail about the outcome of each permutation presented in row format. This grid may be produced as excel sheets, which can be used to conduct financial analysis. The software will produce a report based on statistical evaluators such as mean, median, mode, kurtosis, and standard deviation. The software will also provide a graphical report with a paretto analysis graph that shows all of the conceivable scenarios. It will also generate a probability pie chart with five, ten, and twenty times price valuations, indicating the likelihood of the scrip to rise or fall to become five, ten and twenty times of its current market price.

*e) Performance analysis:*

Many brokerage firms develop stock ideas, which are investment concepts that can help investors grow their wealth ten or twenty times in a five-year period. Every year, there are about fifty to sixty such stocks. The top twenty stocks can be determined using this software, and the performance of those stocks can then be assessed every quarter using quarterly results and new data. Over the course of a year, this software can provide investors with credible advise on whether or not they should stay committed. It may be calculated that how many of the top twenty stocks chosen by this software increase an investor's wealth by more than twofold.

## V. References


[1] Investor [Online] Available: https://en.wikipedia.org/wiki/Investor [Accessed on October 12, 2016].

[2] Arbitrageur[Online]Available:http://www.investopedia.com/terms/a/arbitrageur.asp [Accessed on October 12, 2016].

[3] Trader[Online]Available:http://www.investopedia.com/terms/t/trader.asp [Accessed on October 12, 2016].

[4] Manasi Shah, Nandana Prabhu, Jyothi Rao, "Performance analysis of Neural Network Algorithms on Stock Market Forecasting," in International Journal Of Engineering And Computer Science (IJECS), ISSN:2319-7242, vol. 3, no. 9, pp.8347-8351, September 9,2014.

[5] What are the pros and cons of neural networks form a practical perspective? [Online] Available: https://www.quora.com/What-are-thepros-and-cons-of-neural-networks-from-a-practical-perspective [Accessed on October 15, 2016].

[6] Mr. James D. Whiteside II,PE, "A practical Application of Monte Carlo Simulation in Forecasting", in EST.04, pp.1-12, AACE, 2008.

[7] Samik Raychaudhuri, "Introduction to Monte Carlo Simulation," in Proceedings of the 2008 Winter Simulation Conference, pp. 91-100, IEEE 2008.

[8] Finance and Law: The Pros and Cons of Monte Carlo Simulation in Valuation [Online] Available:

http://abovethelaw.com/2016/05/financeand-law-the-pros-and-cons-of-monte-carlo-simulations-in-valuation/ [Accessed on October 15, 2016].

[9] J. G. Agrawal, Dr. V. S. Chourasia,Dr. A. K. Mittra, "State-of-the-Art in Stock Prediction Techniques," in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN-2278 – 8875, vol. 2, no.4, IJAREEIE April 2013.

[10] Dr. Debesh Bhowmik, "Stock Market Volatility: An Evolution," in International Journal of Scientific and Research Publications, ISSN 2250-3153, vol. 3, no. 10, pp. 1-18 IJSRP October 2013.

[11] Mohd Halim Kadri, Muhd Kamil Ibrahim, Rozainun Abdul Aziz, Hanim Norza Baba, "The Relevance Of Balance Scorecard in Predicting Future Market Price," in Symposium on Humanities, Science and Engineering Research, pp. 997- 1002, IEEE 2012.

[12] Venkates CK, Dr.Madhu Tyagi,Dr.Ganesh L, "Fundamental Analysis and Stock Returns: An Indian Evidence," in Global Advanced Research Journal of Economics, Accounting and Finance, vol. 1,no. 2, pp. 033039, December 2012.

[13] Shunrong Shen, Haomiao Jian, Tongda Zang, "Stock Market Forecasting Using Machine Learning Algorithm", pp. 1-5,CiteSeerx, 2012.

[14] Prashant S .Chavan, Prof. Dr. Shrishail. T. Patil , "Parameters for Stock Prediction,"in International Journal Computer Technology and Appliaction (IJCTA), ISSN: 2229-6093, vol. 4, no. 2, pp. 337-340, 2013.

[15] Selvan Simon, Arun Raoot, "Accuracy Driven Artificial Neural Networks in Stock Market Prediction," in International Journal of Soft Computing (IJSC), vol. 3,no 2, pp. 35-45, May 2012.