PRICING OF OPTIONS IN INDIAN DERIVATIVES MARKET

- AN EMPIRICAL STUDY

THESIS SUBMITTED TO GOA UNIVERSITY

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BY

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DECLARATION

I Ms. Felcy Remy Coelho ,do hereby declare that the thesis titled "**Pricing of Options In Indian Derivatives Markets - An Empirical Study** " submitted to the Goa University, Goa for the award of the degree of Doctor of Philosophy is an original and independent research work done by me during the period May 2012 to May 2018 under the supervision and guidance of Professor Y.V.Reddy, Registrar, Goa University, Goa .It has not formed the basis for award of any degree, diploma, certificate, associateship, fellowship or similar title of this university or any other universities.

Date: 14-05-2018 **Felcy Remy Coelho**

Place: Goa

CERTIFICATE

This is to certify that the thesis titled "**Pricing of Options In Indian Derivatives Markets - An Empirical Study**" for the award of Ph.D degree in Commerce, is a bonafide record of the research work done by Ms. Felcy Remy Coelho during the period of study under my supervision. This thesis has not formed the basis for award of any degree, diploma, certificate, associateship, fellowship or similar title of this university or any other universities.

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FELCY REMY COELHO

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF TABLES IN APPENDIX I

LIST OF ABBREVIATONS

ACC	-	ACC Limited
AMBUJACEM	-	Ambuja Cements Limited
ARCH	-	Autoregressive Conditional Heteroskedasticity.
ASIANPAINT	-	Asian Paints Limited
AXISBANK	-	Axis Bank Limited
BAJAJ-AUTO	-	Bajaj Auto Limited
BANKBARODA	-	Bank of Baroda
BHEL	-	Bharat Heavy Electricals Limited
BHARTIARTL	-	Bharti Airtel Limited
BPCL	-	Bharat Petroleum Corporation Limited
BS	-	Black-Scholes
BSE	-	Bombay Stock Exchange
CEV	-	Constant Elasticity of Variance model.
CIPLA	-	Cipla Limited
COALINDIA	-	Coal India Limited
DRREDDY	-	Dr. Reddy's Laboratories Limited
EGARCH	-	Exponential GARCH .
EViews	-	Econometric Views.
EWMA	-	Exponentially Weighted Moving Average
GAIL	-	GAIL (India) Limited
GARCH	-	Generalized Autoregressive Conditional Hetroscedasticity
GJR-GARCH	-	Glosten Jagannathan Runkle GARCH.
GRASIM	-	Grasim Industries Limited
HCLTECH	-	HCL Technologies Limited

HDFCBANK	-	HDFC Bank Limited
HEROMOTOCO	-	Hero MotoCorp Limited
HINDALCO	-	Hindalco Industries Limited
HINDUNILVR	-	Hindustan Unilever Limited
HDFC	-	Housing Development Finance Corporation Limited
ISD	-	Implied standard deviation .
ITC	-	ITC Limited
ICICIBANK	-	ICICI Bank Limited
KOTAKBANK	-	Kotak Mahindra Bank Limited
LIFFE	-	London International Financial Futures and Options Exchange
LT	-	Larsen & Toubro Limited
LTCM	-	The Long-Term Capital Management .
LUPIN	-	Lupin Limited
M&M	-	Mahindra & Mahindra Limited
MARUTI	-	Maruti Suzuki India Limited
MFIV	-	Model-free implied volatility.
NGARCH	-	Nonlinear GARCH.
NSE	-	National Stock Exchange
NTPC	-	NTPC Limited
ONGC	-	Oil & Natural Gas Corporation Limited
OTC	-	Over the Counter
POWERGRID	-	Power Grid Corporation of India Limited
RELIANCE	-	Reliance Industries Limited
SBIN	-	State Bank of India
SPSS	-	Statistical Package for the Social Sciences.

SUNPHARMA	-	Sun Pharmaceutical Industries Limited
T- bills	-	Treasury bills
TATAMOTORS	-	Tata Motors Limited
TATAPOWER	-	Tata Power Company Limited
TCS	-	Tata Consultancy Services Limited
TATASTEEL	-	Tata Steel Limited
TSRV	-	Two Scale Realised Volatility.
ULTRACEMCO	-	UltraTech Cement Limited
VKOSPI	-	Korea's representative implied volatility index.
VIX	-	Volatility Index.
WIPRO	-	Wipro Limited

CHAPTER ONE

INTRODUCTION

1.1 Introduction:

Derivatives, such as futures or options, are financial contracts which derive their value from a spot price, which is called the "underlying". An option is a contract between two parties in which one party has the right but not the obligation to buy or sell some underlying assets, at a stated price on or before a specified future date. The best known options are calls and puts. A Call option grants its purchaser the right to buy, the Put option grants its purchaser the right to sell. Strategies of options help the investors to limit the downside risk as well as to keep the upside potential unlimited. There has been a tremendous growth in the use of financial derivatives instruments in India. On the National Stock Exchange the Equity derivatives turnover in the year 2000-01 was ₹ 2,365 crores which has risen to ₹ 9,43,70,301.61 crores in 2016-17. The equity derivatives products include Stock Options, Index options, Stock Futures, Index Futures and Volatility Futures. Among these products the growth rate of Index options has been remarkable. Derivatives enable transferring of risk from the market participants who are having risk and not liking to take risk to the participants who have risk appetite. Due to this there are more players participating in the market leading to increased trading volumes in the market of underlying assets. The derivatives market has led to shifting the trades arising from speculation to a greater controlled conditions. Derivatives facilitate investment and have led to rise in investment and savings eventually.

Due to risk management and trading, the option pricing Models occupied an important place in the derivatives market. Correct pricing is crucial to make a decision to buy or sell. There are many option pricing models which include Black-Scholes model,

Black's model, Binomial model, Hull and White model, Model of Heston and so on. The option pricing model of Black-Scholes represents a milestone in the Derivatives history. Black- Scholes model is the most accepted model for pricing options. It is used all over the world by major stock exchanges and the stock market participants. Risk assessment and price determination of the asset is mainly dependent on the calculated volatility of the asset. In view of obtaining precision in the process of determining the price of the option and making hedging most effective, it's imperative to have the most appropriate method of calculating the volatility.

Volatility is a critical factor influencing the option pricing; however, it is an extremely difficult factor to forecast. Hence the crucial problem lies with the accurate estimation of volatility. The estimated volatility can be used to determine future prices of the stock or the stock option, and thus an investor can use arbitrage strategies accordingly to benefit from the model.

Attempts were made to modify the Black- Scholes model as it was observed that there is a difference between the price prevailing in the market and the calculated price using the model. Black included forward price instead of spot price in the option pricing model and developed another option pricing model. Binomial option pricing model is relatively simple and easy to understand but a powerful technique for pricing different types of options. Many researchers have tested the applicability of various option pricing models and attempted to discover the most suitable option pricing model. This study tries to examine the applicability of option pricing models for Derivatives market of India including three models namely Black- Scholes, Black's and Binomial Model for pricing of all the stock call options which were on the Nifty index for a continuous period of five years from April 2012-March 2017 and three index options namely Nifty 50 Index, Nifty

Bank Index and Nifty IT Index. Pricing is done using Historical volatility as well as time series econometric volatility using GARCH model. To know whether there is significant difference between the calculated model premiums and market premiums, Paired sample t-test using SPSS statistic is used.

1.2 Problem of the study

Various pricing models have been used in various studies on pricing of options which include Black-Scholes model, Black's Model, Binomial Model, Artificial neural network, One – factor model of interest rates etc for different products like commodity futures, stock options, index options, options on Treasury bonds, interest rates, compound options etc and attempts are made to find the relevance of the models in pricing the products. Very less research has been done on comparison between Black- Scholes, Black's and Binomial model on Indian options market. In the study an attempt is made to combine the study on applicability of pricing models along with research done on forecasting volatility. In India there are very few studies which tried to conduct empirical test of Black -Scholes, Black's and Binomial options pricing model on Stock options and index options of National Stock Exchange. The present study tries to do such empirical tests of the three option pricing models for stock as well as index options and tries to find the relevance of these models in Indian options market on recent data set. The study also introduced modifications in the Black-Scholes, Black's and Binomial option Models related to the assumption based on volatility variable. GARCH volatility was used in place of historical volatility in the pricing equations. The study aims to find out which of the volatility variable i.e. Historical

volatility or GARCH volatility variable leads to better pricing performance of the three option pricing models.

1.3 Importance of the study

The present study on option pricing will have implications for various groups in the financial market like investors and financial managers etc. The study tries to know applicability of Black -Scholes model, Black's and Binomial pricing models. The study has combined stock options pricing and index options pricing. The study also introduced modifications in the Black-Scholes, Black's and Binomial option Models related to the assumption based on volatility variable. GARCH volatility was used in place of historical volatility in the pricing equations. The study will reveal whether change in volatility input affects the model's performance for Indian market. It will enable the market participants to understand the mechanism of option pricing as this study attempts to analyze the applicability of Black -Scholes model, Black's and Binomial model for Derivative market in India for Stock as well as index options using historical volatility as well as time series volatility using GARCH model.

This will enable calculation of a correct and logical option price by making use of suitable pricing model which will help in deciding whether to buy or sell the option in order to control risks and earn unlimited profits. The present study helps in finding the relevance of the three option pricing models in Indian options market on recent data set.

1.4 Objectives of the study

1.4.1 To determine the theoretical prices of Stock options using Black-Scholes model, Black's model and Binomial Option Pricing Model with historical and GARCH volatility.

1.4.2 To determine the theoretical prices of Index options using Black-Scholes model, Black's model and Binomial Option Pricing Model with historical and GARCH volatility.

1.4.3 To find out whether there is a significant difference between model prices and the actual market prices of options.

Based on the objectives of the study, the following hypotheses are framed:

H_o: There is no significant difference between the model prices and market prices of options.

H_1**:** There is a significant difference between the model prices and market prices of options**.**

1.5 Methodology

This study is an applied research as it intends to find the relevance of Black-Scholes Model, Black's and Binomial Option pricing models in Indian Derivative Market.

Study population constitutes 39 stock options which are the constituents of the Nifty 50 index continuously for five years period from April 2012- March 2017 and three index options namely Nifty 50 Index, Nifty Bank Index and Nifty IT Index. Deliberate Sampling method is applied; the historical data has been collected from the National Stock

Exchange website. Weighted average interest rate of central government securities is taken as proxy for risk free rate. Annualized volatility has been computed based on the daily closing prices of the previous financial year for each stock and each index. GARCH volatility is calculated using EViews. Parameters of GARCH model have been estimated on a rolling window. For each window, one step ahead forecasts were obtained, use of one-year rolling window was done from the first month. The result is given by twelve series of one-month-step-ahead forecasts, each series formed by twelve months period. Daily volatility was multiplied by number of trading days to arrive at annualized volatility. Actual option prices of all the stocks and all indices of the year are used for comparing with the model prices. Pricing is made in four weeks advance for two strike prices, one at In- the -Money and the other one Out- of- the Money. The call prices are calculated for select stocks and indices using Black-Scholes Option Pricing Model, Black's model and Binomial Option. For the Volatility variable in the all the three option pricing formulas Historical as well as GARCH volatility is used. Paired sample T-test using SPSS software is used to compare the actual option prices prevailing in the market with the option prices calculated as per Black-Scholes Option Pricing Model, Blacks and Binomial Option pricing model and to know whether there exists a significant difference between the two prices. The significance level of 5 % is used for interpretation of the Paired Sample t-test results.

Table 1.1.: Names of Company Stocks from the NSE chosen for the study.

1) ACC Limited	21) ITC Limited
2) Ambuja Cements Limited	22) ICICI Bank Limited
3) Axis Bank Limited	23) Larsen & Toubro Limited
4)Asian Paints Limited	24) Lupin Limited
5) Bajaj Auto Limited	25) Kotak Mahindra Bank Limited
6) Bank of Baroda	26) Mahindra & Mahindra Limited
7) Bharat Heavy Electricals Limited	27) Maruti Suzuki India Limited
8) Bharti Airtel Limited	28) NTPC Limited
9) Bharat Petroleum Corporation Limited	29) Oil & Natural Gas Corporation Limited
10) Cipla Limited	30) Power Grid Corporation of India Limited
11) Coal India Limited	31) Reliance Industries Limited
12) Dr. Reddy's Laboratories Limited	32) Sun Pharmaceutical Industries Limited
13) GAIL (India) Limited	33) State Bank of India
14) Grasim Industries Limited	34) Tata Motors Limited
15) HCL Technologies Limited	35) Tata Consultancy Services Limited
16) HDFC Bank Limited	36) Tata Power Company Limited
17) Hero MotoCorp Limited	37) Tata Steel Limited
18) Hindalco Industries Limited	38) UltraTech Cement Limited
19) Hindustan Unilever Limited	39) Wipro Limited
20) Housing Development Finance Corporation Limited	

1.6 Limitations of the study

- The study is restricted only to options traded on NSE.
- The study is done on pricing of Call options only.
- The study uses only five years data for analysis.

- The study is confined to only three Option pricing models.
- The study is restricted to Indian stock market only.

1.7 Chapterisation

The study is divided into five chapters.

Chapter 1: **INTRODUCTION** deals with the background with which the study has been carried out. The importance of the study and the research gap .The chapter also mentions Objectives of the study, source of the data and the methodology. The chapter points out the limitations of the study and the chapter layout.

Chapter 2: **REVIEW OF LITERATURE**.

Chapter 3: **THEORETICAL BACKGROUND** gives an overall picture of Derivatives Market. It also provides an understanding of various Option Terminology, Option Pricing , Volatility Measurement approaches and Pricing models used in the study.

Chapter 4: **EMPIRICAL ANALYSIS OF OPTION PRICING** gives the empirical results of Pricing of Stock and Index Options using Black-Sholes, Black's and Binomial model with historical and GARCH volatility along with interpretations.

Chapter 5: gives the **FINDINGS, CONCLUSION AND SUGGESTIONS**. The chapter summarises the findings. It provides suggestions for the market participants . The scope for further research has been included in this chapter.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Review of Literature:

Black and Scholes (1973) derived a theoretical valuation formula for options and did empirical tests of the valuation formula. The results revealed that actual prices of options vary from calculated model price. **Black (1976)** presented formulas for the values of forward contracts and commodity options in terms of the futures price and other variables. **Cox, Ross and Rubinstein (1979)** provided a simple discrete-time model for valuing options.

Panduranga (2013) has empirically tested Black-Scholes on selected Indian banks and found the model appropriate for pricing majority bank stocks. However in the other research paper for select cement stock options, calculated model prices and market prices showed differences which were significant. The results show that model is relevant for the former and partially relevant for the latter.

Singh and Ahmad (2011) tried to forecast the option prices of index options by using inputs of implied and time series econometric volatility models in the Black-Scholes pricing equation. The findings show that in most of the moneyness-maturity groups implied volatility performed better that GARCH volatility and Volatility Index models.

Tripathi and Gupta (2011) examined the predictability of the Black-Scholes model for pricing the Nifty index option contracts and tried to compare the results of skewness and

kurtosis adjusted BS model of Corrado and Su (1996) with the original BS model . The results showed that the modified BS model is more effective than the original one.

Singh (2013) empirically analyses the comparative competitiveness of the family of option pricing models by finding the pricing accuracy of the models on Nifty index options data. The results show that all the models have price bias however the Practitioner Black-Scholes and Heston model has smaller out of sample valuation errors in pricing options as compared to the Constant Elasticity of Variance, Gram-Charlier, and Hull & White models.

In the papers of **Mitra (2012) and Mitra (2008)** Black-Scholes as well as Black's model was used to calculate option prices and these were compared to the market prices. Findings show that the predictablilty of Black's model is better than the Black-Scholes model.

Nagendran and Venkateswar (2014) tried to find out the relevance of Black-Scholes model for stocks options of India. It was observed that the model is relevant and if implied volatility was used in the model then it leads to improvement of its pricing efficiency. **Gupta (2014)** found that in comparison to historical volatility, the implied volatility gives better option prices .

Fleming (1998) examined the performance of the S&P 100 implied volatility as a forecast of future stock market volatility. The results show that the implied volatility is an upward biased forecast, but it also contains relevant information regarding future volatility. In

terms of ex ante forecasting power the implied volatility dominates the historical volatility rate and its forecast error is orthogonal to parameters linked to conditional volatility.

Singh and Vipul (2015) tested the pricing performance of Black-Scholes model with the volatility of the underlying estimated with the two-scale realised volatility measure (TSRV) proposed by Zhang et al. (2005). The results show that there is negative pricing bias for all the options under Black-Scholes model, which is dependent on the moneyness of the option and the volatility of the underlying.

Macbeth and Merville (1979) found out implied standard deviation. Their results contradicted to those reported by Black and Scholes model. They have given the following basis for the same contradictory reports. They have shown that out-of-the-money call options were overpriced and in-the-money call options were under-priced by Black-Scholes model. They assumed all along market efficiency, and assigned the deviations between the model price and actual price to the weakness of the model, especially to its assumption of a constant variance of the stocks rate of return.

Latane and Rendleman (1976) used a weighted average implied standard deviation (WISD) in which the ISDs for all options on a given underlying stock were weighted by the partial derivative of the BS equation with respect to each implied standard deviation. It was found that the WISD was a better predictor of future variability than standard deviation predictors and the options were generally over-priced in terms of the Black and Scholes model.

Biger and Hull (1983) have given a direct derivation of valuation formulas for European put and call foreign exchange options using the Black-Scholes methodology. They have illustrated the formulas with an example.

Chicaiza and Cabedo **(2009)** used the Black-Scholes option valuation formula for calculating high-cost illness reinsurance premiums in the Colombian health system. The premium calculated using the Black and Scholes model was within the range of premiums calculated by the actuarial method.

Gay (2011) has used the Black-Scholes risky asset model to find out the choice of optimal investment term in a reinvestment chain model. Two criteria involving the BS model were applied. The results show that both criteria provide useful income stream funding strategies.

Pavlatka (2010) has shown that for European derivatives in energy markets, namely options the derivative market prices are similar to the prices calculated using Black-Scholes option pricing formula.

Schaefer and Schwarz (1987) have formulated a model to value debt options and compared the option prices calculated using this model with the option prices using Black and Scholes and Brennan and Schwartz models. The results show that there is a difference between the prices calculated using their model and Black and Scholes model. While the prices calculated using their model and Brennan and Schwartz models are similar.

Lauterbach and Schultz (1990) have made a comparison of the warrant prices using Black and Scholes model and CEV model. The results show that CEV model performs better than the Black and Scholes model.

Savickas (2002) introduced a simple option-pricing formula based on the Weibull distribution. Application to S&P 500 options shows that the pricing biases present in the Black-Scholes model are eliminated. Prices produced by the presented model generally lie within or close to the bid-ask spread. The Weibull formula exhibits significantly higher precision than the Black-Scholes formula does.

Amilon (2003) examines whether a neural network (MLP) can be used to find a call option pricing formula better corresponding to market prices and the properties of the underlying asset than the Black–Scholes formula. The results indicate that the neural network models outperform the benchmarks both in pricing and hedging performances.

Bennell and Sutcliffe (2004) compares the performance of Black–Scholes with an artificial neural network (ANN) in pricing European-style call options. It allows for dividends in the closed-form model. For out-of-the-money options, the ANN is clearly superior to Black–Scholes. For in-the-money options, the performance of the ANN is comparable to that of Black–Scholes.

Wang, Shen, Jiang, and Huang (2016) have proposed a closed-form pricing formula for the Chicago Board Options Exchange Volatility Index (CBOE VIX) futures based on the classic discrete-time Heston–Nandi GARCH model. Based on the results they recommend the use of both VIX and VIX futures prices for a joint estimation of model parameters as this can effectively capture the variations of the market VIX and the VIX futures prices .

Arnold, Crack and Schwartz (2007) have valued a real option on a commodity using an implied binomial tree (IBT) calibrated using commodity futures options prices. An example is given using gold futures options and a real option to extract gold from a mine. A detailed out-of-sample test is included that shows how IBT option pricing errors evolve on sub trees emanating from future levels of the underlying asset

Huang, Wang and Hansen (2017) have derived a pricing formula for European options for the Realized GARCH framework based on an analytical approximation using an Edge worth expansion for the density of cumulative return. They have conducted an extensive empirical analysis on index options and the results show that their computationally fast formula outperforms competing methods in terms of pricing errors, both in-sample and out-of-sample.

Yung and Zhang (2003) have analyzed the empirical performance of the GARCH option pricing model relative to the ad hoc Black-Scholes (BS) model of Dumas, Fleming, and Whaley. They have found that the EGARCH model performs better than the ad hoc BS model both in terms of in-sample valuation and out-of-sample forecasting.

Kallsen and Taqqu (1998) have shown that completeness of the market holds for a broad class of ARCH-type models defined in a suitable continuous-time fashion. As an example they have focused on the GARCH (1,1)- M model and obtain, through their method, the same pricing formula as Duan, who applied equilibrium-type arguments.

Ubukata and Watanabe (2014) have examined option pricing performance using realized volatilities. The dynamics of realized volatility is specified by ARFIMA(X) and HAR(X) models. The main results are that the ARFIMAX model performs best, the Hansen and Lunde (2005a) adjustment for non-trading hours improves the performance, methods for reducing microstructure noise-induced bias yield better performance, while if the Hansen–Lunde adjustment is used, the other methods are not necessarily needed and the performance is unaffected by removing large jumps from realized volatility.

Eraker (2004) has studied the empirical performance of jump diffusion models of stock price dynamics from joint options and stock markets data. The paper introduces a model with discontinuous correlated jumps in stock prices and stock price volatility, and with state-dependent arrival intensity. They have shown that while complex jump specifications add little explanatory power in fitting options data, these models fare better in fitting options and returns data simultaneously.

Lin and Chen (2009) provided non-parametric empirical evidence regarding negative volatility risk premium using LIFFE equity index options. They incorporated the moment-adjusted option delta hedge ratio to mitigate the effect of model misspecification. The results show that the delta-hedged gains are negative and with a correction for model misspecification, higher-order moments measures show less significance and the volatility risk premium still plays a key role in affecting delta-hedged gains. All empirical evidence supports the existence of negative volatility risk premium in LIFFE equity index options.

Zhang and Lim (2006) have provided an analytical approach to American option pricing under stochastic volatility. Simulation results show that a non lattice method performs better than the lattice-based interpolation methods. The stochastic volatility model is also empirically tested. Incorporating stochastic volatility is shown to improve pricing, hedging, and profitability in actual trading.

Marsh and Kobayashi (2000) have discussed jump-diffusion and stochastic volatility models, subordinated models, fractal models and generalized binomial tree models for stock price dynamics and option pricing. They have also addressed questions as to whether derivatives trading poses a systemic risk in the context of models in which stock price movements are endogenized, and given their views on the 'LTCM crisis' and liquidity risk.

Rhee, Byun and Kim (2011) have conducted a comparative analysis of implied volatilities from the Black–Scholes model, Heston's model, the MFIV, and VKOSPI for their abilities to forecast future volatility. The results of the empirical analysis indicate that Heston's model can eliminate most of the bias associated with the Black–Scholes model, whereas the MFIV and VKOSPI do not show any improvement in terms of forecasting performance.

Sarwar and Krehbiel (2000) examines the out-of-sample pricing performance and biases of the Heston's stochastic volatility and modified Black-Scholes option pricing models in valuing European currency call options. It is observed that the stochastic volatility model may provide improved estimates of the measures of option price sensitivities to key option

parameters that may lead to more effective hedging and speculative strategies using currency options.

Bolia and Juneja (2005) reviewed regression-based methods, random tree methods and stochastic mesh methods and their application to pricing options. They have shown how importance sampling technique, may be combined with these methods to increase their effectiveness.

Xiaoping and Jie (2014) studied through the numerical example, the sensitivity analysis of American put option price to the random binary tree parameters. The results exhibit that the impact of the occurrence probability of the random binomial tree environment on American option prices is very significant.

Geske (1979) derived a new formula for the value of a call option as a compound option which introduces leverage effects into put-call option pricing. The results show that the new option pricing model corrects some important biases of the Black-Scholes model.

Black, Derman and Toy (1990) described a model of interest rates which can be used to value any interest rate security and have shown the application of valuing options on Treasury Bonds.

Moraleda and Pelsser (2000) tested three spot rate and two forward rate models on cap and floor data from 1993–1994 the results show that the spot rate models outperform the forward rate models.

Miltersen and Schwartz (1998) developed a model to value options on commodity futures with stochastic interest rates as well as stochastic convenience yields. They presented closed-form solutions generalizing the Black-Scholes/Merton's formulas and provided numerical examples with realistic parameter values.

Macbeth and Merville (1980) tested the Cox call option pricing model for constant elasticity of variance diffusion processes against Black-Scholes call option pricing model. They found that common stock prices are generated by constant elasticity of variance diffusion processes and Cox call option pricing model is pricing more effectively than the Black -Scholes call option pricing model.

Scott (1987) scrutinized the pricing of European call options on stocks having variance rates that change randomly. They examined continuous time diffusion processes for the stock return and standard deviation parameter, and found that one should make use of the stock and two options in order to form a riskless hedge. They show that through Monte Carlo simulations accurate option prices can be calculated and have shown application of the model using actual prices.

Bi, Yousuf and Dash (2014) applied the GARCH model to estimate the volatility and applied this estimated volatility to calculate option prices with the help of Black-Scholes-Merton model. They tried to analyse systematic mispricing of stock and index options on the NSE .The results reveal that options are significantly overpriced and that this overpricing decreases with expiration period. Also that put overpricing is significantly higher than call overpricing particularly for longer expiration periods.

Kanojia and Jain (2017) investigated and examined seven models of volatility forecasting, namely unconditional standard deviation (also written as Long Term Moving Volatility), Standard GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model, GJR-GARCH model, Exponential GARCH model (eGARCH), Asymmetric Power GARCH model (apGARCH), Component Standard GARCH model (csGARCH) , and Option Implied Volatility model to gauge the most appropriate model of volatility forecasting in Nifty constituent companies. The findings suggest option implied volatility as the best performing model except in few categories of option data where VIX outperformed. Similarly on empirical performance of Black-Scholes model the findings reveal that performance is not same across various maturities which indicate volatility is not constant as assumed by BS model during the tenure of the study in Indian market.

Sheraz and Preda (2014) derived some extensions of Black and Scholes model with GARCH volatility and used Taylor approximation .Using this model the implied volatility of the stock, which varies over time can be determined .

Bhat and Arekar (2016) analyzed the comparative empirical performance of the Black-Scholes-Merton model (BSM) and Duan's NGARCH option pricing model for pricing currency options. The results show that NGARCH option pricing model is unable to outperform the BSM model in terms of pricing performance and that the GARCH model is free of the moneyness and maturity biases exhibited by the BSM model as demonstrated by orthogonality tests.

Mohammad (2013) attempted to find out whether Nifty returns follow normal distributions, to assess whether BS model is misspecified by investigating the existence of

volatility smile in case of S&P CNX Nifty options traded at NSE, to examine determinant of volatility using different specifications such as moneyness and time to maturity etc. to investigate the accuracy of BS model in pricing, the Nifty index options contracts, and to compare the performance of skewness and kurtosis adjusted BS model of Corrado & Su (1996) with the original BS model. The results reveal that there is the presence of implied volatility smile, non normality of return distribution and statistically significant pricing errors of market price from the model price which suggest the empirical failure of the Black- Scholes model to price Nifty options in India. The reason for empirical failure may not lie in non-normality of return as the skewness and kurtosis adjusted BS model does not improve the performance. It is also reported that there is a presence of strike-price bias and the presence of time to expiration bias and moneyness bias.

Khan (2013) tried to introduce modifications in Black-Scholes Model related to the assumption based on risk free interest rate variable. Empirical testing of Modified Black-Scholes Option Pricing Formula at calculated risk free interest rate and Original Black-Scholes Option Pricing Formula at assumed risk free interest rates was done with respect to the market value of option contract. The findings suggest that calculated risk free interest rate variable gave better results than assumed risk free interest rate.

Sharma (2012) tried to identify and measure various volatility model's performances in predicting the future volatility of Nifty, to test the pricing and hedging efficiency of the BS model with various alternative volatility measures. Twelve volatility models were empirically tested and their result of forecasting accuracy was categorized into three categories, i.e., symmetric error statistics, asymmetric error statistics and the directional

measure. Combining all the results and observing the overall performance of all the volatility models the best model is the EWMA model. It is seen that the ranking of the different models significantly depends upon the choice of the error metrics and different volatility models tested do not perform equally. The market participants should take into consideration this sensitivity in ranking and should use that error statistics which serves their purpose the best. From amongst the historical prices based volatility models, there is no single historical volatility model, which consistently leads to better results for all categories of call options, though GARCH (1,1) and EWMA model are good performers for some categories of options. The simple models seem to prevail over the more complex ones in enhancing the BS model's hedging performance.

Nagendran (2008) did the empirical study on call option pricing of various industries using BS formula covered all the aspects , such as sensitivity of the model to its variables, predictability of the model, weakness of the model like biases, validity of the assumptions of the model, test of model adequacy through residual analysis and improvement of the model. The predictability have confirmed some systematic biases towards many of the parameters / variables. Deviations in some model assumptions in practice, with majority of the assumptions valid, do not affect the predictability of the model much. The study confirms the acceptability of the model in the market as in developed nations. The model adequacy tests pass all the variables and parameters of the model for their conceptualization and incorporation except the volatility. Mean implied volatility was also used. The predictability actually improved at a very high percentage by using the Mean Implied Volatility (MIV).

Frino, Khan and Lodh (1991) carried out tests of the Black Scholes model by making use of the most recent data available of Australia. The tests show that the evidence of mispricing or systematic biases of Black-Scholes model in the pricing of Australian options was insufficient. The findings indicate the effectiveness of the Black-Scholes model for pricing options and hence the model can be used for effectively pricing options in Australia.

Khan, Gupta and Siraj (2013) made modification to the Black-Scholes option pricing model formula with regards to the risk-free interest rate variable. A calculated new risk-free interest rate was used in the model. They conducted empirical tests of the original and modified Black-Scholes equation on the various situations by making use of the assumed and calculated risk free rate. The results of pricing call and put options by making use of calculated risk free interest rate was better than that of assumed risk free rate. .

Nagarajan and Malipeddi (2009) have shown that the call option price of CNX Nifty using Black-Scholes is closer to the actual market price in comparison to the Modified Black-Scholes pricing model by Corrado & Su which uses non normal skewness and kurtosis. During the bullish market the index call options are priced at a much higher price than Black-Scholes price in comparison to that of a call option during bearish period. They have shown that there is a concrete evidence for proving that sentiments play an vital role in pricing index call option.

Mundra and Agarwal (2009) conducted a study on pricing of Indian Index and Equity options and tried to find out the applicability of theoretical pricing models, especially

Black-Scholes Model. They have compared the market price with the theoretical price. It is observed that there exists a wide difference between the theoretical and market prices and the main reason for this is volatility. This provides arbitrage opportunity.

Bandivadekar and Ghosh (2003) used the ARCH/GARCH method to evaluate the impact of introduction of derivative products on the volatility of spot market in stock markets of India. The analysis show that for S&P CNX Nifty and BSE Sensex the volatility has reduced in the period after the introduction of index futures.

Thakker and Attarwala (2016) tested the effectiveness of the Binomial option pricing Model for Indian Equity Options Markets from the year 2010 to 2015 by making use of Nifty Option. The results show that there is significant difference between the market price and the calculated price which shows the ineffectiveness of the Binomial Option Pricing model in pricing nifty call options.

Kaminski (2013) used several option pricing models to find out their application and tested them for options traded on the Warsaw Stock Exchange. Using each chosen model option prices were calculated and then a comparison of the calculated model prices and market prices was done. The study also covers the impact of the implied dividend yield on option prices.

Posedel (2006) analyzed volatility implications of option pricing that changes over time and recommended the nonlinear-in-mean asymmetric GARCH model. They have given an illustration using NGARCH model for pricing of foreign currency options. Option Prices

are found out using Monte Carlo simulations for options with different maturities and strike prices. The NGARCH model includes the risk premium. The results show that the NGARCH model can be applied for pricing options on every asset on the Croatian stock exchange.

Saedi and Tularam (2018) have analysed critically the advances done recently in the Black-Scholes model and the methods of solution. The current financial derivatives markets has some main issues which include large preferences by investors, transaction costs, high volatility and are illiquid. Due to the Complexity there is a need of non-linear solutions to the Black-Scholes equation and hence the R3C scheme and Crank-Nicolson method should be focused more by including more real-life assumptions of current day trading.

Saravanan and Kumar (2012) attempted to find out the accuracy of the Black-Scholes option pricing model in pricing the stock option. Mean Absolute Percentage Error and Mean Absolute Deviation tools are employed to find the pricing errors between the calculated option prices and Market price of the option. The findings show that there is a small difference between the market prices and the calculated option market price.

Arora and Sharma (2015) calculated the theoretical prices of equity options using Black-Scholes Model and compared with the market prices. Mean Squared Error Method is used to know the difference in prices. Depending upon the prices of stock, its volatility and volume of stock the efficiency of Black Scholes Model differs .

Balaji and Nagaraju (2013) explored the strength of the factors which include strike price, current market price, time to expiry and volatility of underlying of European Stock options from five major industries individually as well as collectively. Empirical tests were done to find out the validity and veracity of Black-Scholes model in knowing whether it undervalues or overvalues the option prices and the degree of undervaluation and overvaluation. The findings indicate the determinants of option prices for the Indian Options market as a whole can be arranged in the descending order of the strength of their influence on option prices as: Spot Price, Strike Price, Time to Expiry and Volatility of spot price of underlying stock prices.

On review of the literature, it is found that various pricing models have been used in various studies on pricing of options which include Black-Scholes model, Black's Model, Binomial Model, Artificial neural network, One-factor model of interest rates etc for different products like commodity futures, stock options, index options, options on Treasury bonds, interest rates, compound options etc and attempts are made to find the relevance of the models in pricing the products. From the literature it is found that Black-Sholes has a possibility of modification in calculation of option prices since it is based on various assumptions. Very less studies has been done on comparison between Black-schools, Black's and Binomial model on Indian options market. The present study attempts to anlayse the applicability of Black-Scholes, Black's and Binomial Model with historical and GARCH volatility for stock as well as index options from NSE on recent data set. The present study adds to the literature as it will enable traders and investors to calculate a correct and logical option price by making use of suitable pricing model which

will help in deciding whether to buy or sell the option in order to control risks and earn unlimited profits.

CHAPTER THREE

THEORETICAL BACKGROUND

3.1 Concept of Derivatives.

A derivative is an instrument whose value is derived from the value of the underlying assets , which may be commodities, foreign exchange, bonds, stocks, stock indices etc. For example, in the case of a wheat derivative, say 'wheat futures', the underlying asset is wheat, which is a commodity. The value of 'wheat futures' will be derived from the current price of wheat. Similarly in the case of 'index futures', say NSE Index Futures, the NSE Index (Nifty) is the underlying asset. These instruments derive their value from the price and other related variables of the underlying asset. They do not have worth of their own and derive their value from the claim they give to their owners to own some other financial assets or security. The asset underlying a derivative may be Commodities including grain, coffee beans, orange juice, Precious metals like gold and silver, Foreign exchange rates or currencies, Bonds of different types, including medium to long term, negotiable debt securities issued by governments, companies, etc, Shares and share warrants of companies traded on recognized stock exchanges and Stock Index, Short term securities such as T-bills; and money market products such as loans or deposits.

Derivatives are derived values. A derivative is a financial instrument or contract whose value is derived from some other assets or economic variable which is called an underlying asset.

The term derivative may be defined in ordinary language as well as in language of finance in the following lines:

i. Derivatives in Ordinary Language

"A substance that can be derived from another substance"

-The Merriem Webster Dictionery

ii. Derivatives in Financial language

"A financial instrument whose value depends on (or derived from) the value of other, more basic underlying variables."

-John C. Hull

"A derivative is simply a financial instrument (or even more simply an agreement between two parties) which has a value determined by the price of something else."

-Robert L. McDonald

The Securities Contracts (Regulations) Act, 1956, defines "derivatives" as under:

"Derivative" includes the following:

a) Security derived from a debt instrument, share, loan whether secured or unsecured, risk instrument or contract for differences or any other form of security.

b) A contract which derives its value from the prices or index of prices of underlying securities.

3.2 Features of Financial Derivatives.

i. It is a Future Contract:

A derivative contract is basically a future contract between two parties.

ii. A Derivative has Derived Value:

The value of the derivative instrument is derived from one or more basic variables called underlyings or bases. Thus, a derivative has no independent value and depends on their underlying asset price movements.

iii. Specific Type of Derivative Creates Specific Obligation of the Counterparty:

Obligation (sell/buy/settle the payment) of the counterparty under the specific type of derivative is unique. Essentially, depending upon the kind of derivative product its nature of obligation would differ.

iv. A Business Transaction through a Derivative may be Customised or Standardised:

A forward derivative is a contract between two parties who mutually agree to transact (buy/sell) an underlying at a certain price at a certain date in future. Hence, it is a privately negotiated, customized, over-the-counter (OTC) traded derivative. But a "Futures" contract is standardised and exchange traded derivative.

v. The Trading Results through Financial Derivatives are Not Shown in the Financial Statements, i.e. Off-balance Sheet in nature:

Particularly, in case of option potential loss in underlyings and potential pay-off of derivatives is different. Due to this limitation, the trading results of options, will not be reflected in the financial statement, i.e., Balance Sheet. However, Accounting standards are now introduced to eliminate this limitation.

3.3 Commonly used derivative products.

3.3.1 Forwards :

A forward contract is an agreement between two parties to buy or sell an asset at a specified point of time in the future. In case of a forward contract the price which is paid/ received by the parties is decided at the time of entering into contract. It is the simplest form of derivative contract mostly entered by individuals in day to day's life. Forward contract is a cash market transaction in which delivery of the instrument is deferred until the contract has been made. Although the delivery is made in the future, the price is determined on the initial trade date. One of the parties to a forward contract assumes a long position (buyer) and agrees to buy the underlying asset at a certain future date for a certain price. The other party to the contract known as seller assumes a short position and agrees to sell the asset on the same date for the same price. The specified price is referred to as the delivery price. The contract terms like delivery price and quantity are mutually agreed upon by the parties to the contract. No margins are generally payable by any of the parties to the other. Forwards contracts are traded over-the- counter and are not dealt with on an exchange unlike futures contract. Lack of liquidity and counter party default risks are the main drawbacks of a forward contract. A forward contract is a customized contract between two entities, where settlement takes place on a specific date in the future at today's contracted specific price. For example: suppose on 20th June 2016, the finance manager of Infosys knows that the industry will receive 100 million US dollar after three month i.e. 20th September 2016, and wants to hedge against the exchange rate movement. In such kind of situation finance manager of Infosys will contact the bank and find out that the exchange rate for a three month forward contract on dollar against rupee i.e. $\frac{\$}{₹}$ = 0.0209 , and agrees to sell 100 million dollar. It means that finance manager has short

"forward contract" on US dollar or we called Infosys finance manager has agreed to sell 100 million dollar on 20th September 2016 to the bank at the future dollar rate 0.0209. On the other hand bank has a "long forward" contract on dollar. Both the parties have made a commitment or contract.

3.31.1 Features of a Forwards contract:

i. It is a Customised Contract:

A Forward contract is custom designed, and hence, it is unique in terms of contract size, maturity date, quality and quantity of asset, etc.

ii. The Contract is Settled by Delivery:

The contract is normally settled by the delivery of asset on the expiration date.

iii. It is Exposed to Counterparty Risk:

Forward contracts are bilateral contracts and hence are exposed to risk of counter party.

iv. Cancellation or Reversion can be made only through the Same Counterparty:

There is a need to go to the same counterparty if the party wants cancellation of contract or wishes to cancel any of the terms of the contract.

3.3.2. Futures:

A future contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Futures contracts are standardized exchange-traded

contracts. Futures is a standardized forward contact to buy (long) or sell (short) the underlying asset at a specified price at a specified future date through a specified exchange. Futures contracts are traded on exchanges that work as a buyer or seller for the counterparty. Exchange sets the standardized terms in term of Quality, quantity, Price quotation, Date and Delivery place (in case of commodity). The important types of financial futures contract include Stock Future or equity futures, Stock Index Futures, Currency futures and Interest Rate bearing securities like Bonds, T- Bill Futures.

3.3.2.1 Features of Futures :

i. Standardised Specifications:

A futures contract is characterised by standardised specifications- i.e., the underlying asset, quality of the asset, the month and date of delivery, etc.

ii. Clearing House:

It is associated with a clearing house to ensure smooth functioning of the market.The clearing house, being the counter party to both sides of a transaction, provides a mechanism that guarantees the honouring of the contract and ensuring very low level of default .

iii. Traded on an Organised Exchange :

Futures are traded on an organised exchange like NSE, BSE, etc. Futures contracts being traded on organized exchanges impart liquidity to the transaction.

iv. Margin Requirements and Daily Settlement:

The clearing house usually fixes the margin money to be deposited by the trader (through his broker). This margin money is treated as collateral security in order to minimise the risk of default by either party in the futures contract.

v. Existence of Regulatory Authority:

All the futures contracts are regulated through exchanges (stock/commodity).

vi. Settlement in Cash for Difference:

A party in short (seller) or long (buyer)-position has to settle in cash for the difference between the agreed price at which the contract was entered and the cash price at expiration date. This cash settlement is encouraged due to inconvenience or impossibility in delivery of underlying assets.

3.3.3. Options:

An option is a contract which gives the buyer the right, but not the obligation , to buy or sell the underlying asset at a specific price for a specified time. The primary characteristics of options are: it includes limited loss, high leverage financial derivative product and options product also have limited life. Options derivative products also provide “limited loss” facility to their buyer or seller. With a small amount of money there may be chances to generate or obtain high profit. There are two types of options-calls and puts.

3.3.4. Warrants:

Options worldwide generally have lives up to one year, the majority of options traded on options exchanges having a maximum maturity of nine months. Longer dated options are called warrants and are generally traded over-the-counter.

3.3.5. LEAPS:

The acronym LEAPS means Long-Term Equity Anticipation Securities. These are options having a maturity of up to three years.

3.3.6. Baskets:

Basket options are options on portfolios of underlying assets. The underlying asset is usually a moving average of a basket of assets. Equity index options are a form of basket options.

3.3.7. Swaps:

Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They can be regarded as portfolios on forward contracts. A swap can be defined as a barter or exchange. It is a contract whereby parties agree to exchange obligations that each of them have under their respective underlying contracts or we can say, a swap is an agreement between two or more parties to exchange stream of cash flows over a period of time in the future. The parties that agree to the swap are known as counter parties.

The two commonly used swaps are:

i. Interest rate swaps:

The Interest rate swaps entail swapping only the interest related cash flows between the parties in the same currency, and

ii. Currency swaps:

These entail swapping both principal and interest between the parties, with the cash flows in one direction being in a different currency than the cash flows in the opposite direction.

3.4 Types of Risks.

Risks involved in derivatives trading can be of the following kinds:

i. Credit Risk or Default Risk:

The risk that the counterparty will default on its obligations. This is generally negligible for exchange-traded derivatives but needs careful attention in the case of OTC derivatives.

ii. Operational Risks:

The risk that errors (or fraud) may occur in carrying out trades, in placing orders, making payments, or accounting for them etc.

iii. Model Risk or Formula Risk:

Options and many synthetic derivatives are priced using complicated mathematical formulae which make numerous assumptions. There can be occasions when the models fail to give accurate price data because the assumptions no longer hold (e.g. actual volatility far exceeds historically-based estimates) or because of undetected flaws in the

models. Many traders, especially the less-experienced ones, take the model as infallible gospel, especially as most of the models work well most of the time. The risk is increasing with the increased use of computerised pricing models based on elaborate mathematics which the trader may not understand. A trade which fully complies with all pricing policies may thus still end up with unexpected and disastrous results.

3.5 History of Derivative Market: A Global perspective.

Stage I: The concept of derivative was conceived and used in ancient ages probably in 2000 BC.

Stage II: The concept of Forward contracts were used during 12th century in England and France and restricted to agricultural produces, i.e. rice. Historically it is evident that the Forward contracts for rice were in practice in Japan during 17th century. It was known as Cho-at-Mai a kind of rice traded forward contract.

Stage III: First Futures Exchange Base set up in 1730.

It is evident from history that the world's first organised Futures Exchange was set up in 1730, in Osaka, Japan. It was known as Dojima Rice Futures Market. The landlords in Japan were used to sell “RICE TICKETS". These rice tickets were bought or sold in the Dojima Rice Futures Exchange. These tickets were served as Future derivatives and represented the underlying as rice in warehouse or in the field. This is the origin of first Future derivative in the world.

Stage IV: 19th Century Futures markets on commodity and agricultural produces.

i. Global Futures Markets.

1848 - Establishment of Chicago Board of Trade.

1872 - Butter and Cheese exchange of New York was set up.

1877 - New York Mercantile Exchange (NYMEX) was set up.

1898 - a. London Metal exchange was set up.

b. Chicago Mercantile exchange (CME) was set up.

ii. Indian Futures Market.

1875 - Bombay Cotton Trade Association Ltd., was set up. This is the first organised future market in India.

1893 - Bombay Cotton Exchange Ltd., was set up.

1900- Gujarati Vyapari Mandali was set up.

Stage V: 20th Century Derivative Market - The Emergence of Financial Derivatives.

During 19th century and even up to 1960, the futures markets were confined to commodities like soya, eggs, cheese, wheat and metals. In the early 1970s, it was witnessed that the financial markets were highly volatile and instable. All the commodities were exposed to various types of financial risks. As a result, Financial Derivatives emerged. The first financial derivatives were created only in 1970. By the end of 1990, it was found that financial derivatives accounted for 60% of derivative trading and financial contracts. The first financial futures market was the International Monetary market, set up

in 1972, by the Chicago Mercantile Exchange. Similarly, London International Financial Futures Exchange was set up in 1982.

Stage VI: 21st Century Derivative Market- The Remarkable Growth Stage.

From 2001 , the global derivative markets developed at an astonishing pace.

3.6 Evolution of Derivatives in India.

The history of derivatives in India is surprisingly longer than what most people think. It was the derivative in commodities market that came first. Derivatives in commodities market have a long history. The first commodity futures exchange was set up in 1875, in Mumbai, under the aegis of Bombay Cotton Traders Association. A clearing house for clearing and settlement of these trades was set up in 1918. In oilseeds, a futures market was established in 1900. Wheat futures market began in Hapur in 1913. Futures market in raw jute was set up in Calcutta in 1912 and the bullion futures market in Bombay in 1920.

In the equities market also, derivatives have existed for long. In fact official history of the Native Share and Stock Brokers Association, which is now known as the Bombay Stock Exchange, suggests that the concept of options existed from as early as 1898.

The first step towards introduction of derivatives trading in India was the promulgation of the Securities Laws (Amendment) Ordinance, 1995. SEBI set up a 24-member committee under the Chairmanship of Dr. L.C. Gupta on November 18, 1996 to develop appropriate regulatory framework for derivatives trading in India. The committee recommended that derivatives should be declared as ‘securities’ so that regulatory framework applicable to trading of ‘securities’ could also govern trading of derivatives. SEBI also set up a group in June 1998 under the Chairmanship of Prof. J.R. Varma , to

recommend measures for risk containment in the derivatives market in India. The report submitted gave the details of margining system, methodology for charging initial margins, broker net worth, deposit requirement and real-time monitoring requirement. The SCRA was amended in December 1999 to include derivatives within the ambit of 'securities' and the regulatory framework was developed for governing derivatives trading.

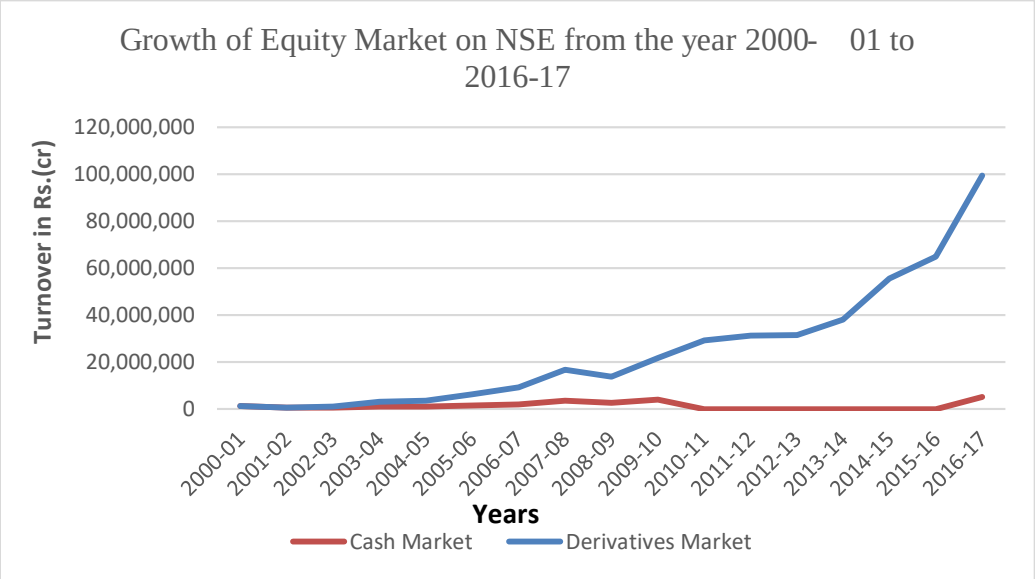
Derivatives trading commenced in India in June 2000 after SEBI granted the final approval to this effect in May 2000. SEBI permitted the derivative segment of two stock exchanges ,NSE and BSE, and their clearing house to commence trading and settlement in approved derivatives contracts. To begin with ,SEBI approved trading in index futures contracts based on S&P CNX NIFTY and BSE -30 (Sensex) index. This was followed by approval for trading in options based on these two indexes and options on individual securities. The trading in index options commenced in June 2001 and trading in options on individual securities commenced in July 2001. Futures contracts on individual stocks were launched in November 2001. Trading of Interest rate futures at NSE was started in June 2003.Trading of Mini Index futures and options at NSE was started on 1 January 2008 . On 22 August 2008 NSE started zero-fee policy for trading in currency. National Commodity & Derivatives Exchange Limited (NCDEX) stared its operations in December 2003, to provide platform for commodities trading. Trading of currency futures started at NSE on 29 August 2008. A clearing and settlement arrangement on a non-guaranteed basis was put in place for the OTC interest rate derivatives trade on 27 November 2008. In March 2009, 13 members participated in non guaranteed settlement of OTC rupee interest-rate derivative. On 08 January 2010 SEBI standardized lot size for equity derivative. Currency futures were launched in February 2010 on additional currency pairs. On 20 September 2010 it began currency futures trade. European style stock options at NSE were introduced on 01

October 2010. On 27 October 2010 NSE started currency options. 91 day GOI trading Bill futures by NSE commenced on 10 July 2011. Derivative on Global Indices at NSE were launched on 22 August 2011. On 08 September 2011 derivatives on CNXPSE and CNX infrastructure Indices were launched in NSE. In the year 2012 NSE launched SME-specific EMERGE platform for the listing and trading of securities of SMEs and commenced trading in index futures and Option contracts on FTSE 100 index. NSE launched the debt segment in the year 2013. In 2014 NSE launched NMF-II platform for mutual funds, NBF-II segment for interest rate futures, trading on India VIX index futures and commenced Nifty 50 on Osaka exchange. In 2015 NSE renamed CNX NIFTY to Nifty 50 and entered into a memorandum of understanding to enhance the level of cooperation with the London Stock Exchange Group. In the year 2016 NSE launched Nifty 50 index futures trading on TAIFEX, electronic book - building platform for private placement of debt securities and platform for sovereign gold bond issuances.

3.7 Growth of Derivatives Market in India.

Equity derivatives market in India has registered an "explosive growth". Since its inception in the year 2000, financial derivatives market in India has shown a remarkable growth both in terms of volumes and numbers of traded contracts. India's experience with the launch of equity derivatives market has been extremely encouraging and successful. The derivatives turnover on the NSE has surpassed the equity market turnover. NSE alone accounts for major derivatives trading in Indian markets. The introduction of derivatives has been well received by stock market players. Trading in derivatives has gained wide popularity. India is one of the most successful developing countries in terms of a vibrant market for exchange-traded derivatives. The derivatives market in India has grown exponentially, especially at NSE.

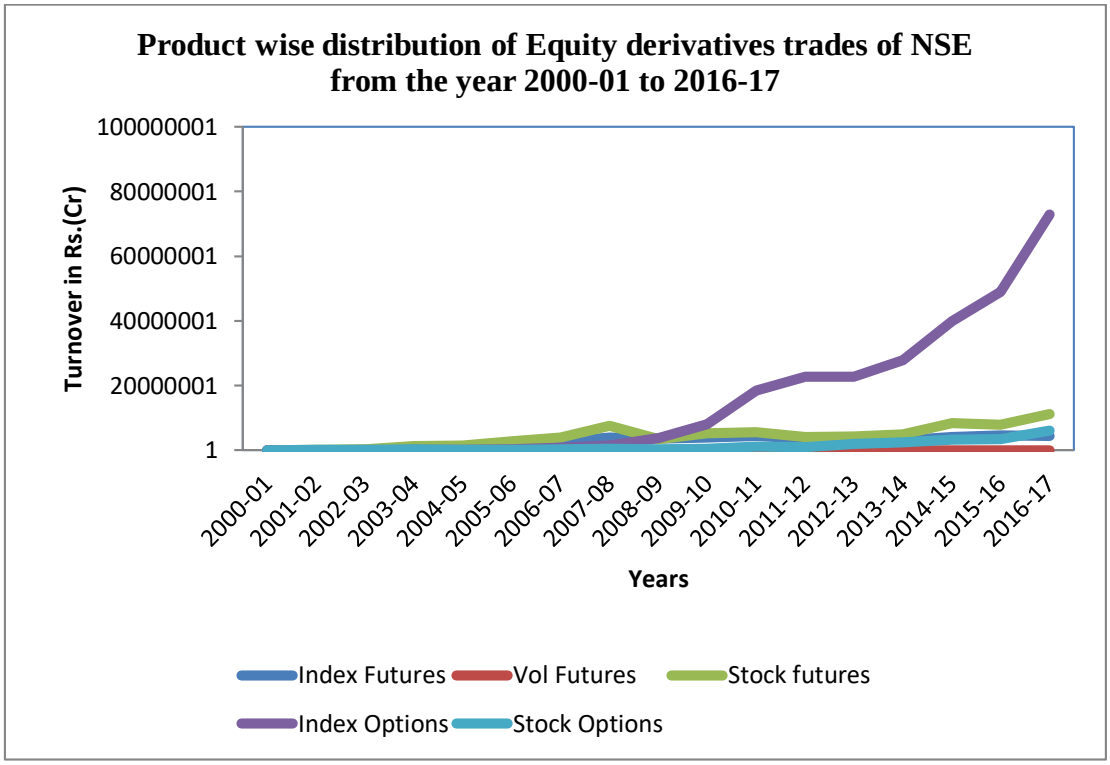
Figure 3.1: Growth of Equity Market on NSE from the year 2000-01 to 2016-17.



Source: Compiled from data available at www.nseindia.com

The above figure shows that turnover of derivatives on the NSE increased from ₹ 2365 Cr. in 2000-01 to ₹ 94370301.61 Cr. in 2016-17 . Over the years the turnover of the NSE derivatives market exceeded the turnover of the NSE cash market. For example, in the year 2016-17, the value of the NSE derivatives markets was ₹ 94370301.61 Cr. whereas the value of the NSE cash markets was only ₹ 5055913Cr.

Figure 3.2: Product wise distribution of Equity derivatives trades of NSE from the year 2000-01 to 2016-17.



Source: Compiled from data available at www.nseindia.com

The above figure shows that in the year 2016-17 among all the equity derivatives product Index options have a highest turnover followed by stock futures, stock options, index futures and volatility futures.

3.8 Participants in Derivatives Market.

i. Hedgers:

Hedgers are those who wish to protect their existing exposures and essentially are safety-driven. Hedging is the process of stabilising the value (including cash flows) of a given portfolio by neutralising adverse market movements. They use derivative to transfer the

risk of the underlying asset to eliminate the exposure of price movements. For example a holder of an asset can sell forward or purchase a put option to reduce the risk of loss from decreases in the price of the asset. Majority of the participants in derivatives market belong to this category. They use futures and options derivatives to reduce or eliminate the risk associated with price of an asset in the market. Most producers and trading companies participate in the derivative market to shift or reduce the price risks in the underlying asset markets to secure anticipated profits.

ii. Speculators:

Speculators are risk-seeking traders or investors. They are willing to assume risk by positions with the expectation to earn profits. They have specialised expertise in forecasting the future economic conditions. They can predict the directions of market's movements and accordingly take a position, i.e., long or short. Speculators only have a particular view about future price commodity, shares, stock index, interest rates or currency. They consider various factors like demand and supply, market position, open interests, economic fundamentals, international events, etc., to make prediction. Thus, a speculator assumes the price risk hoping to gain risky profits by holdings certain positions (long or short).

Speculators use futures and option contract to get extra leverage in betting on future movements in the price of underlying assets. By making use of derivatives speculators can increase potential gains as well as potential losses in a speculative venture. Speculators are indispensable for the existence of hedging business. They take over the price risks shifted from the hedgers. Hence, the speculators bear the major risks in the derivative market.

iii. Arbitrageurs:

Arbitrage is the simultaneous purchase and sale of the same underlying in two different markets with an objective to make profit from price discrepancies between the two markets. Arbitrageur is third important group of participants in Futures, Forwards and option derivative markets. They are in business to take advantage of a discrepancy between prices in two different markets. They lock in a riskless profit by simultaneously taking offsetting positions in two or more markets. Arbitrage is not the same as speculation. Speculation is to seek profits promised by scientific forecasting of future prices, and thus risky. Arbitrage is to snatch profits originated in the reality of the price difference between markets and is therefore riskless.

An arbitrageur takes advantage of the price difference between markets. Hence, he gains riskless instant profits and such opportunity cannot last long. When an opportunity for arbitrage arises, the market price will soon reach a new balance due to these actions of the arbitraguers and then the opportunity will disappear.

3.9 Role of Derivatives.

i. Risk Management :

This is the most important function of derivatives. Financial derivatives provide a powerful tool for limiting risks that individuals and organizations face in the ordinary conduct of their business. Participants face different kinds of risk which include credit risk, market risk, liquid risk, legal risk and operational risk. Thus derivatives offer protection from possible adverse market movements and can be used to manage or offset exposures by hedging or shifting risks particularly during period of volatility thereby

reducing costs. Risk management is not about the elimination of risk rather it is about the management of risk. Because derivative prices are related to the prices of the underlying spot market of goods, they can be used to reduce or increase the risk owning the spot items. Derivative markets enable those investors who wish to reduce their risk to transfer it to those wishing to increase it. Consequently, investors are willing to supply more funds to the financial markets. This benefits the economy, because it enables more firms to raise capital and keeps the cost of that capital as low as possible.

ii. Operational efficiency:

Derivative markets offer several operational advantages

a. They entail lower transaction costs. This means that commissions and other trading costs are lower for traders in these markets. This makes it easy and attractive to use these markets either in lieu of spot market transactions or as complement to spot positions.

b. Derivative markets often have greater liquidity than the spot markets. Although spot markets generally are quite liquid for the securities of major companies they cannot absorb some of the large currency transactions without substantial price changes. In some cases one can obtain the same levels of expected return and risk by using derivative markets. Returns and risks can be adjusted at any level desired, but because less capital is required, these markets can absorb more trading.

c. Derivative markets allow investors to sell short in an easier manner. Securities markets impose several restrictions designed to limit or discourage short selling that are applied

to derivative transactions. Consequently many investors sell short in these markets in lieu of selling short the underlying securities.

d. Market Efficiency :

Financial derivatives allow for free trading of risk components and that leads to improving market efficiency. Traders can use a position in one or more financial derivatives as a substitute for a position in the underlying instruments. In many instances, traders find financial derivatives to be a more attractive instrument than the underlying security. This is mainly because of the greater amount of liquidity in the market offered by derivatives as well as the lower transaction costs associated with trading a financial derivative as compared to the costs of trading the underlying instrument in cash market.

iv. Speculation:

Derivative markets provide an alternative and efficient means of speculation. Instead of trading the underlying securities, an investor can trade a derivative contract. Many investors prefer to speculate with derivatives rather than with the underlying securities. The ease with which speculation can be done using derivatives in turn makes it easier and less costly for hedgers.

v. Price discovery:

Another important application of derivatives is the price discovery. Prices in an organized derivatives market reflect the perception of market participants about the future and lead the prices of the underlying assets to the perceived future level. The prices of derivatives converge with the prices of the underlying assets at the expiration of the derivative contract. Thus derivatives help in discovery of future as well as current prices.

vi. Price stabilization function:

Derivatives provide a significant mechanism through which all the investors or the participants can judge the movement of prices and protects themselves from financial risk. Indirectly derivatives stabilize the price movements through a participative controlled mechanism. Derivative market helps to keep a stabilizing influence on spot prices by reducing the short-term fluctuations. In other words, derivative reduces both peak and depths and leads to price stabilization effect in the cash market for underlying asset.

vii. Catalyst for New Entrepreneurial Activity:

Derivatives offer new business and employment opportunities across the globe. At present, there are so many active people working in the stock market as agents, traders, advisors and many more with distinctive responsibilities. The attractive gains through low investment instils a drive within educated people to earn more and start their own business.

3.10 Factors contributing to the growth of derivatives.

i. Increased Volatility in the world economy.

Presently the business scenario is highly uncertain and hence the importance of risk management is much greater than ever before. Financial derivatives protect from possible adverse market movements and can be used to manage or offset exposures by hedging or shifting risks particularly during the periods of volatility and thereby reduce costs. Derivatives provide less costly solution to the problem of risk that is embedded in the price unpredictability of the underlying assets. Due this factor, since its inception in June 2000, derivatives market has exhibited exponential growth both in terms of volume and number of traded contracts in India.

ii. Technological Advances.

The world is changing. New technologies emerge, the dynamics of trade shifts, flexibility and ability to quickly respond to change is the name of the game. The use of the modern computers and software makes possible such flexibility, the emergence of internet technology has permitted the growth of mass customisation where a customer selects the future desire in a product online. The service provider develops the system capable of meeting the customers demands. Advancement achieved in the computer and satellite technology has helped storage and rapid transmission of information. Technological advancements increase volatility , derivative instruments and risk management products become much more important.

iii. Globalisation of Markets.

The growing integration of national markets and international markets is one of the major factors for the growth of financial derivative market. Globalisation has increased the size of markets and has simultaneously enhanced competition. This competition has benefited consumers who earlier, could not obtain better quality goods at a lower cost. It has also exposed modern businesses to significant risks and , in many cases, led to cutting of profit margins. Globalisation of industrial and financial activities necessitated the use of derivative instruments to guard against future losses. This factor alone has contributed significantly to the growth of derivative instruments.

iv. Advances in financial theories.

Advances in financial theories gave birth to derivatives. Initially forward contracts in their traditional form were the only hedging tool available. Option pricing models developed by Fisher Black and Myron Scholes in 1973 were used to determine the prices of call and put options. In the late 1970s, Lewis Edeington extended the earlier work of Johnson and started the hedging of financial price risks with financial futures. The work of other economic theorists gave rise to new products for risk management, this development led to the growth of derivative instruments in the financial markets.

v. Political developments.

In the 1960s, governments were viewed as the principal vehicle for economic growth. Widespread dissatisfaction with these policies led to major political changes in the 1970s.

These created a worldwide movement to market oriented policies and deregulation of financial markets.

3.11 Option terminology.

i. Index options:

These options have the index as the underlying. Some options are European while others are American. Index options contracts are cash settled.

ii. Stock options:

Stock options are options on individual stocks.

iii. American Option:

American options are options contracts that can be exercised at any time upto the expiration date. Options on individual securities available at NSE are American type of options.

iv. European Options:

European options are options that can be exercised only on the expiration date.

v. Buyer of an option:

The buyer of an option is the one who by paying the option premium buys the right but not the obligation to exercise his option on the seller/writer.

vi. Writer of an option:

The writer of a call/put option is the one who receives the option premium and is thereby obliged to sell/buy the asset if the buyer exercises on him.

vii. Call option:

A call option gives the holder the right but not the obligation to buy an asset on a certain date for a certain price. Example: An investor buys one call options of Reliance Industries at the strike price of ₹ 5,000 at a premium fee of ₹ 500. If the market price of Reliance Industries on the day of expiry is more than ₹ 5000, options execute automatically with the help of software. The buyer of call options will earn profit, when share price crosses ₹ 5,500 [(Strike price + Premium), or (₹ 5,000+ ₹ 500 = ₹ 5,500)]. Let the stock price be ₹ 6,000, the options will be exercised and buyer of call options or investor will buy one share of Reliance Industries from the seller of the options at ₹ 5,000 and sell it in market at ₹ 6,000 and generate a profit of ₹ 500 [(Spot price- Strike price)- Premium paid] or [(₹ 6,000- ₹ 5000)- ₹ 500= ₹ 500]. In another case, if at the time of expiry, stock price or market price falls below to ₹ 5,000, let it strike to ₹ 4,000, the buyer of call options will choose not to execute or exercise his options. In this case buyer of call options loses the premium paid ₹ 500 and on the other hand this loss amount to be the profit earned by the seller of call options.

viii. Put option:

A put option gives the holder the right but not the obligation to sell an asset on a certain date for a certain price. Example: An investor buys one Put options of ACC, at the strike price of ₹ 5,000 at the premium of ₹ 100. Let the market price of ACC on the day of

expiry is less than ₹ 5,000, options can be exercised as the name "In the Money". At that point buyer of put options came at the situation of no profit no loss or Break Even Point. BEP = ₹ 4,900 (Strike price - Premium paid) or (₹ 5,000 - ₹ 100), investor will only earn profit when market falls below ₹ 4,900. Let price of put options of ACC fall to ₹ 4,000. Then options holder automatically buys ACC share at ₹ 4,000 and executes his options selling at ₹ 5000, and generates profit of ₹ 900 [(Strike price –Spot price) -Premium paid] or [(₹ 5,000- ₹ 4,000) - ₹ 100]. In another case, if at the time of expiry stock price of ACC increases up to ₹ 5,500. Then the buyer of put options will choose not to execute his options to sell. In such kind of situation, buyer of put options loses his premium of ₹ 100 and this lost premium is the profit of seller of put options.

ix. Option price:

Option price is the price which the option buyer pays to the option seller. It is also referred to as the option premium.

x. Expiration date:

The date specified in the options contract is known as the expiration date / the exercise date /the strike date or the maturity.

xi. Strike price:

The price specified in the options contract is known as the strike price or the exercise price.

xii. In-the-money option:

An in-the-money (ITM) option is an option that would lead to a positive cash flow to the holder if it were exercised immediately. A call option on the index is said to be in-the-money when the current index stands at a level higher than the strike price (i.e. spot prices> strike price). If the index is much higher than the strike price, the call is said to be deep ITM. In the case of a put, the put is ITM if the index is below the strike price.

xiii. Out –of -the-money option:

A call option on the index is said to be Out-of -the-money when the current index stands at a level lower than the strike price (i.e. spot prices< strike price). In the case of a put, the put is OTM if the index is above the strike price.

xv. At-the-money option:

An at-the-money (ATM) option is an option that would lead to zero cash flow if it were exercised immediately. An option on the index is at-the-money when the current index equals the strike price (i.e. spot price = strike price).

xv. Intrinsic value:

Intrinsic value in an option is that part of the option premium which represents the extent to which the option is In-the-money. Therefore an option which is Out-of-the-money or At-the-money, has zero intrinsic value. A buyer of call or put option would exercise only if he sees gains, i.e. only when it is In-the-money i.e. to say that only if it has intrinsic value.

xvi. Time value:

The difference between the Option premium and the Intrinsic value is the Time value. It is also called the extrinsic value of the option. It is the quantification of the probability of the change in the underlying price to become in the money during the remaining time until expiration. This value depends on the time to expiration of the option and volatility of the price of the underlying. Thus if the option is Out –of-the-money and At-the-money , the entire premium paid is the time value of option. Time value of option cannot be negative.

3.12 Factors affecting Option pricing.

Some important variables that affect option pricing are as follows:

i. Strike Price:

The Lower the strike price of a call option , the higher the call premium and the higher the strike price of a call option , the lower the call premium . For a put option lower the strike price the lower the put option premium and the higher the strike price of a put option , the higher the put option premium .

ii. Spot price of the asset:

In-the- money, out-of-the-money or at-the-money situations are dependent on the spot price of an asset. A call option will have more value if the spot price is high. The value of put option is the maximum when the spot price is the lowest. Spot prices are flexible and changing all the time, and options values change along with them.

iii. The time to expiration:

The more the time remaining for an option to expire, the higher the premium tends to be. This is because a longer time period increases the possibility of the price of the underlying asset moving to an in-the-money option, where the purchase and sale of the asset at the strike price will be profitable. The time value is what makes the difference to the option premium and its intrinsic value.

iv. Volatility of stock or asset:

The volatility of a stock price or index movement is a measure of the uncertainty about the movement of the future stock price/index. It is one of the inputs on the option pricing models which cannot be directly observed. But many option strategies require an accurate prediction of volatility. Hence the option trader needs a method to find out if his expectations about volatility are actually realized in the market. With the increase in volatility, chances are that the price movement in stock will increase. The effect of volatility on option is always positive.

v. Risk-free interest rate:

A risk-free interest rate also affects the price of an option. As interest rates increase, the expected growth rate of the stock price also increases, but the present value of any future cash flow received by the holder of the option decreases. The value of a put option decreases with an increase in the interest rate. With an increase in the interest rate, the value of a call increases.

vi. Dividend:

Dividends have the effect of reducing the stock price on the ex-dividend date. With the decrease in the stock price, the intrinsic value of a call falls and that of a put increases. This has a negative effect on the value of the call and a positive effect on the value of a put. Wherever dividends are to be received on stocks or the shares in the index, the price of the stock or index is bound to fall. Dividend affects the premium of the options.

3.13 Concept of Volatility.

Price changes in a stock arise out of buying and selling decisions of many investors. The degree of price movement in a stock is referred as volatility. Large volatility values mean that prices fluctuate in a wide range. Increased volatility is more associated with falling stock prices. They are normally driven by human emotions such as greed and fear. Increasing or falling volatility commonly is a result of changes in investor emotions and psychology in the market place. If a company that has been announcing good quarterly results suddenly announces a bad quarter results, then it is likely to find its share price crashing, owing to 'fear' of uncertainty. Similarly, an excellent market friendly announcement would help the stock jump dramatically and aggressive buying would follow arising out of investor 'greed' to make more money. The impact of the news event will vary based on its relative importance and the degree to which it surprises investors. Volatility provides essential data about the probability of achieving certain outcomes in terms of price levels. In option pricing, an estimate of volatility is essential to the valuation of the instrument.

3.14 Volatility Estimation Approaches.

Estimation of the true volatility of the underlying asset price is difficult. In practice, a number of alternative approaches are used. The major approaches include:

- Historical /Empirical approach.
- Implied volatility approach.
- Auto regressive conditional hetroskedasticity models (ARCH)/ Generalised ARCH(GARCH).

i. Historical /Empirical approach.

Historical volatility is the measure of a stock's price movement based on historical prices. It measures how a stock has moved over a certain period of time with respect to its average. Usually, calculation of historical volatility is done by taking the daily percentage price changes in a stock and calculating the average over a given time period. This average is then expressed as an annualized percentage.

The following steps are involved for the calculation of historical volatility

a. Measure the day-to-day price changes in a market. Either percentage or natural logarithm of the ratios can be found out.
b. Calculate the average of the above day-to-day price changes over a certain period, say n period.
c. The historical volatility (HV) is the "average variance" from the mean (the "standard deviation").

d. Express volatility as annual percentage. To annualize the historical volatility, the variance is multiplied by the number of trading days in the year. This volatility is then used to calculate the option prices.

Every stock is unique in its behaviour and thus has unique level of volatility. When historical volatility is high, it shows that stock has been showing extreme fluctuations in price and when it is low it suggests that stock has been trading quiet or sideways. On comparison with other stocks we can comment on the relative volatility. To determine a normal volatility level for a particular stock or index, historical volatility across different time periods must be considered. This can help us to judge whether the volatility is rising or falling.

Historical volatility measures how far price swings over a given period tend to stray from a mean or average value. A value of say 35 % suggests that the stock is likely to fluctuate this far from its current price if its level of volatility remains constant. Option premiums rise when market participants expect greater stock volatility. When the historical volatility of the stock is high, there is tendency for the market to drive option premiums higher as well. One can expect a stock that has a high volatility to exhibit high volatility in the future, and the option premiums generally reflect those expectations. Volatility can be used to decide a price range for trading.

ii. Implied Volatility.

The Implied volatility approach calculates volatility implied by the current market value of options. This is undertaken by specifying the option price and calculating the volatility that would be needed in a mathematical option pricing formula such as Black-Scholes to

derive the specified market price as fair value of option. Implied volatility is the market's perception of the volatility of the underlying asset. This implied volatility can be compared to the historical volatility of the underlying in search of underpriced and overpriced options.

Since we have several different strike prices and expirations for options on a stock, the implied volatilities will all be different. Implied volatility represents the market's expectation of a stock's future moves. High implied volatility means the market expects the stock to continue to be volatile i.e., make large moves, either in the same direction or up or down. Conversely, low implied volatility means the market believes the stock's price moves will be rather conservative .This implied volatility levels of the options will help in determining what strategies to be used. When Implied volatility is high, market price of options that has been greater than theoretical price, options are considered expensive. An implied volatility pattern helps a trader to judge the market view on a stock.

iii. GARCH (Generalized Autoregressive Conditional Hetroscedasticity) Model

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models were propounded by Engle (1982) and Bollerslev (1986). The distinctive feature of these models is that they recognize that volatilities and correlations are not constant: i.e. volatility clustering and excess kurtosis. It is a model which includes historical volatilities (square root of variance) as an input for the estimation of future volatilities. The GARCH models are discrete-time models, attempting to track changes in the correlation and volatility over time. The GARCH model is used to estimate volatility for a variety of financial time series: stock returns, interest rates, and foreign exchange rates. GARCH

models have been applied in various fields such as asset allocation, risk management, and portfolio management, and option pricing. The GARCH (p, q) model is formulated as:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} a_j \in_{t-1}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-1}^2$$

where p is the order of the GARCH (lagged volatility) terms, and q is the order of the ARCH (lagged squared-error) terms. In the academic literature, the GARCH (1, 1) process seems to be perceived as a realistic data generating process for financial returns. An intuitively appealing interpretation of the GARCH (1, l) model is easy to understand. The GARCH forecast variance is a weighted average of three different variance forecasts. One is a constant variance that corresponds to the long-run average. The second is the forecast that was made in the previous period. The third is the new information that was not available when the previous forecast was made. This could be viewed as a variance forecast based on one period of information. The weights on these three forecasts determine how fast the variance changes with new information and how fast it reverts to its long-run mean. Volatility and risk both terms are used interchangeably today. If one decides to approach the difficult problem of forecast evaluation, the first consideration is: which volatility is being forecast? For option pricing, portfolio optimization and risk management one needs a forecast of the volatility that governs the underlying price process until some future risk horizon. Future volatility is an extremely difficult thing to forecast because the actual realization of the future process volatility will be influenced by events that happen in the future, e.g. large market movements at any time before the risk horizon. Thus the real problem is that of prediction of volatility. The predicted volatility

can be used to determine future prices of the stock or the stock option, and thus an investor can use arbitrage strategies accordingly to benefit from the model.

The daily logarithmic returns on both the Stock or Index options and underlying are computed as continuously compounded returns as under:

$$\ln R = \ln P_t - \ln P_{t-1}$$

where, R = Return on given Stock or Index Option /underlying

P = Closing price of given Stock or Index Option /underlying

All the return series are first tested for stationarity using Augumented Dicky Fuller test of unit root and were found to be stationary at levels. The principle methodology for modeling volatility in Stock or Index returns used in this study is Generalised Autoregressive Conditional Heteroscedasticity or GARCH. However, one of the most important issues before applying the GARCH methodology is to first examine the residuals for evidence of heteroscedasticity (Ahmed and Suliman, 2011). We therefore apply ARCH- LM test for this purpose. As a part of test procedure the residuals from the conditional mean equation given below are first obtained for Stock or Index returns.

$$\ln R = c + \mu$$

where, c is intercept and μ represents error term.

After obtaining the residuals, they are regressed on a constant and q lags as in the following equation:

$$e_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + \cdots + \alpha_q e_{t-q}^2 + \nu_t$$

The null hypothesis that there is no ARCH effect up to order q is formulated as:

$$H_0 := \alpha_1 = \alpha_{2..} = \alpha_q = 0$$

against alternative

$$H_1 := \alpha_i > 0$$

for at least one i = 1, 2, …, q.

The test statistics for joint significance of the q-lagged squared residuals is the number of observations times the R-squared TR^2 is evaluated against $x^2(q)$ distribution.

The GARCH model represents conditional variance as a linear function of its own lags. Given the fact that Stock options and Index options derive their returns from movements in underlying asset, we formulate the mean equation for GARCH as under:

For Stock Options : lnR = c + lnStock + Ɛ

For Index options : lnR = c + lnIndex + Ɛ

The variance equation for GARCH (1,1) model is given as under:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Where, $\omega > 0$ and $\alpha_1 \geq 0$ and $\beta_1 \geq 0$. The $\alpha_1 \geq 0$ and $\beta_1 \geq 0$ are imposed to ensure σ^2 is strictly positive. Thus, in GARCH model, the conditional variance is specified as a function of three terms, namely, a constant (ω), news about volatility from previous period (ε_{t-1}^2) which is the ARCH term and previous period forecast variance (σ_{t-1}^2) which is the

GARCH term. The large GARCH lag coefficient β_1 indicate persistence in volatility while large GARCH error coefficient α_1 means that volatility reacts quiet intensely to market movements. Further, if (α+ β) is close to unity, it means that a shock at time t will persist for many future periods. A high value of it implies a 'long memory'. The annualized volatility is calculated as Number of trading days *VL. This volatility is then used to calculate the option prices.

3.15 Black – Scholes Option Pricing Model.

The Black-Scholes model for pricing stock options was developed by Fischer Black and Myron Scholes. It is widely accepted and used option pricing model. Options trading got a boost after this model was developed in 1973. The model requires five variables which include spot price, variance, strike price, time to expiry and risk free rate. The formula for calculating Call option price is as under:

Call Option Premium

$$C = SN(d_1) - Xe^{-rt}N(d_2)$$

$$d_1 = \frac{(\text{Ln}(S / X) + (r + \sigma^2 / 2)^* t)}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

Here,

C = price of a call option

S = price of the underlying asset

X = Strike price of the option

r = rate of interest

t = time to expiration

σ = volatility of the underlying

N represents a standard normal distribution with mean = 0 and

standard deviation = 1

These equations are easy to use, since B-S model requires five variables, of which four are easily available. These include current stock price, strike price, risk-less rate of interest, and the options time to expiration. The only variable that is not directly available is the expected volatility of the returns on the stock. This is estimated using historical data.

3.15.1 BS model assumptions.

The BS model is built on the following main assumptions

i. Stock prices follow random walk.

ii. Stock returns are log normally distributed.

iii. Continuous time frame is assumed.

iv. Continuous compounded risk free interest rate **r** and volatility **σ** of the log-returns on the stock are constant throughout the life of the options.

v. No taxation and transaction cost and stocks are perfectly divisible.

vi. Options are European and stocks pay no dividend.

vii. There are no risk-less arbitrage opportunities.

3.15.2 Advantage of Black-Scholes model.

The main advantage of Black-Scholes model is speed. It is possible to calculate a very large number of option prices in a very short time.

3.15.3 Limitations of Black-Scholes model.

i. The major limitation of the Black-Scholes model is that it cannot be used to accurately price options with an American –style exercise as it only calculates the option price at one point of time at expiration. It does not consider the steps along the way where there could be the possibility of early exercise of an American option.

ii. It cannot accurately calculate the theoretical value of a dividend paying stock option.

3.16 Black's Option Pricing Model.

Black made an attempt to address the problem of negative cost of carry. He used forward price in option pricing model instead of spot price. He replaced the spot term (S) by the discounted value of future price $F.e^{-rt}$ in the original Black- Scholes Option Pricing formula. The Black's model uses the following equation for pricing call options:

$$C = F.e^{-rt}N(d_1) - Xe^{-rt}N(d_2)$$

3.17 Binomial Option Pricing Model.

The Binomial Option Pricing Model (BOPM) provides a generalized numerical method for the valuation of options. The original version of this Binomial model was developed by John Cox, Stephen Ross and Mark Rubinstein in 1979. This model is also known as C-R-R model. This model is a discrete time model. It is a simple and extremely flexible

pricing model to price all kinds of complex derivatives. This model has a large popularity. The Binomial model breaks down the time to expiration into potentially a very large number of time intervals, or steps. A tree of stock prices is initially produced working forward from the present to expiration. At each step it is assumed that the stock price will move up or down by an amount calculated using volatility and time to expiration. This produces a binomial distribution or recombining tree of underlying stock prices. The tree represents all the possible paths that the stock price could take during the life of an option. At the end of the tree i.e. at expiration of the option, all the terminal option prices for each of the final possible stock prices are known as they simply equal their intrinsic values. A three step binomial tree is considered for calculation of option price in the study. The calculation is done as follows:

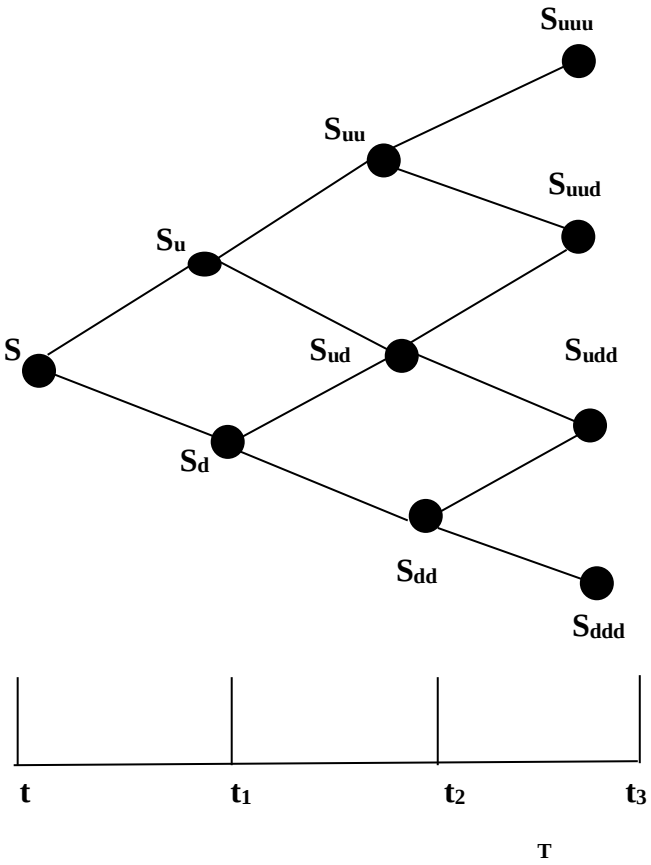


Fig 3.3: Three step Binomial Tree

- Stock price is considered to be S at Time t. In Binomial model the price can either go up or down over a period of time. At time t_1 i.e. after one time interval the price can either go up or down. Since the possible prices "branch" out over a period of time this option pricing method is known as Binomial tree
- Stock price is multiplied by the up ratio and the down ratio i.e. S_u =S*u and S_d= S*d.

  This is calculation is constant throughout the tree.

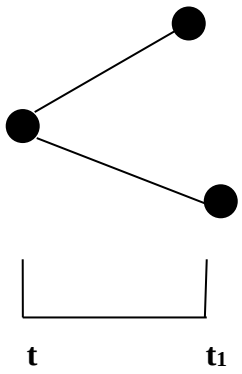
  $u = e^{\sigma.\sqrt{\Delta t}}$

  $d = e^{-\sigma.\sqrt{\Delta t}} = \frac{1}{u}$

  p= $\frac{e^{r.\Delta t - d}}{u-d}$

The probability of S rising to S_u is p, the probability of S falling to S_d is 1-p.

The expected price at t_1 = p. S_u + (1-p)..S_d



In order to make the model risk neutral Binomial model, a riskless asset should grow by a factor of $e^{r.\Delta t}$ after delta t, with r as the risk free rate.

Expected value of S = $e^{-r.\Delta t}p.\,S_u + (1-p).\,S_d$

3.17.1. Assumptions of Binomial model.

The assumptions in binomial option pricing model are as follows:

i. Stock price movements obeys the binomial process in short periods:

Binomial Option pricing model assumes that during a short interval of time, the stock can take only two values-the up move or the down move. The two possible prices are the up-price and down-price.

ii. Use of priori or transition probability to quantity the uncertainty about stock price movements:

The uncertainty is that we do not know which of the two states (up or down) will happen. But it is possible to determine the chance of happening such upward or downward state in advance by using priori or transition probability.

iii. Constant interest rate :

It is assumed that there is no interest rate uncertainty .The rate of interest (r) is constant throughout the life of the option.

iv. Markets are perfect:

- No arbitrage opportunities.
- No commission.
- No bid-ask spreads.
- No taxes.
- No margin requirements.
- No transaction cost.
- No dividends.

v. Participants use Red Ocean Strategy:

Red Ocean Strategy implies to involve in full competition. Thus, the market participants act as price-takers and not price-makers.

vi. Risk –neutral Investors :

Investors are risk neutral i.e. investors are indifferent towards risk.

3.17.2 Charateristics of Binomial Option Pricing model.

i. It is a Constant Discrete-Time model:

This model breaks down the total time of expiration into potentially a very large number of time intervals. The length of such time intervals remain constant throughout the Binomial tree. The end of each time interval is known as 'node'.

ii. Volatility remains constant throughout the model:

Volatility is the variability about the mean value of the stock price. The Volatility remains constant throughout the Binomial tree.

iii. Probablility remains constant:

The probability of an up movement and the down movement remain constant throughout the model.

iv. The Binomial tree is Recombinant:

The Binomial model ensures that the tree is recombinant ,i.e., if the underlying asset moves up and then down the price will be the same as if it has moved down and then up. Hence the two paths merge and recombine.

v. Option price is determined by Backward process calculation :

The option price at each step are calculated working back from expiration to the present. The option prices at each step are used to derive the option prices at next step of the tree using the risk neutral method .The value computed at each stage is the value of the option at that point of time.

3.17.3. Advantages of Binomial Option pricing model.

i. The major advantage of the Binomial model is that as the time to maturity is segmented into a series of discrete time steps, the model can take into account specific option values prior to maturity. This allows the binomial approach to be used to provide a solution not only to European option pricing problem but also for the more difficult American option pricing problems when numerical simulation approaches must be employed.

ii. This model uses simple mathematical calculations for stock prices as well as option prices.

iii. It is easy to calculate the option price with a computer spreadsheet.

iv. This model can accommodate more complex option pricing problems , such as no-constant interest rates and volatility, debt options and exotic options such as path

dependent structures. Dividends can also easily be incorporated into the binomial model.

v. The most valuable feature of the model is that it enables to see how the construction of a dynamic risk free hedge leads to a formula for the option price.

3.17.4 Limitations of Binomial Option pricing model.

i. It is relatively slow speed. It is very difficult to calculate thousands of option prices quickly for a multi-step binomial model.

ii. It is a much more complex model than the Black-Scholes model.

3.18 Paired Samples t Test.

The Paired Samples *t* Test compares two means that are from the same individual, object, or related units. The two means typically represent two different times (e.g., pre-test and post-test with an intervention between the two time points) or two different but related conditions or units (e.g., left and right ears, twins). A paired samples (dependent) t test checks whether the means of two continuous fields are statistically different. If the significance value is less than the significance level, the means are significantly different. The fields must have similar scales. The Paired Samples *t* Test is a parametric test. This test is also known as Dependent *t* Test, Paired *t* Test and Repeated Measures *t* Test. The variable used in this test is known as Dependent variable, or test variable (continuous), measured at two different times or for two related conditions or units. The significance level of 5% is used in the study for interpretation of Paired sample t-test results.

CHAPTER FOUR

EMPIRICAL ANALYSIS OF OPTION PRICING

The study aims to investigate the predictive performance of Black-Scholes, Black's and Binomial Option pricing models with historical volatility and GARCH volatility. The Empirical analysis is divided into following sections.

- Pricing of Stock Options using Black-Scholes, Black's and Binomial Model with Historical Volatility.
- Pricing of Stock Options using Black-Scholes, Black's and Binomial Model with GARCH volatility.
- Pricing of Index Options using Black-Scholes, Black's and Binomial Model with Historical Volatility.
- Pricing of Index Options using Black-Scholes, Black's and Binomial Model with GARCH volatility.

4.1 Analysis of Stock options pricing using Black-Scholes, Black's and Binomial Model with Historical Volatility.

Model prices are calculated by using the three option pricing models namely, Black-Scholes Option Pricing Model, Black's model and Binomial option pricing model. Historical volatility is used for volatility variable while calculating option prices in all the three option pricing equations. The analysis covers the paired sample t-test results of the 39 stock options from the Nifty 50 index for the period from April 2012- March 2017. For stock call options the paired sample t-test is done between the calculated premium using Black-Scholes Option Pricing Model and the actual market prices of stock call options, the calculated premium using Black's Option Pricing Model and the actual market prices of

stock call options and calculated premium using Binomial Option Pricing Model and the actual market prices of stock call options. The Paired sample t-test reveals whether there is a significant difference between the calculated call option prices and the market price of options and it also shows whether the models are overestimating or underestimating the call option premiums.

Table 4.1: Comparison of Market premiums and model estimate premium as per Black-Sholes, Black's and Binomial Option Pricing model of stock options with Historical volatility.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ACC	Mktpremium - BSmodelpremium	2.47519E1	26.14003	2.38625	20.02691	29.47692	10.373	119	.000
	Mktpremium - Bmodelpremium	2.74983E1	25.16317	2.29707	22.94990	32.04677	11.971	119	.000
	Mktpremium - Binmodelpremium	2.44953E1	26.35483	2.40586	19.73142	29.25908	10.182	119	.000
AMBUJACEM	Mktpremium - BSmodelpremium	3.91975	3.29283	.30059	3.32455	4.51495	13.040	119	.000
	Mktpremium - Bmodelpremium	4.28550	3.41382	.31164	3.66843	4.90257	13.752	119	.000
	Mktpremium - Binmodelpremium	3.89025	3.42073	.31227	3.27193	4.50857	12.458	119	.000
AXISBANK	Mktpremium - BSmodelpremium	9.94517	20.65593	1.88562	6.21145	13.67888	5.274	119	.000
	Mktpremium - Bmodelpremium	1.15864E1	21.14445	1.93022	7.76440	15.40844	6.003	119	.000
	Mktpremium - Binmodelpremium	9.02983	21.81261	1.99121	5.08704	12.97263	4.535	119	.000
ASIANPAINT	Mktpremium - BSmodelpremium	2.70664E1	108.24319	9.88121	7.50064	46.63219	2.739	119	.007
	Mktpremium - Bmodelpremium	2.58186E1	110.38242	10.07649	5.86613	45.77104	2.562	119	.012
	Mktpremium - Binmodelpremium	2.53264E1	108.98594	9.94901	5.62638	45.02645	2.546	119	.012
BAJAJ-AUTO	Mktpremium - BSmodelpremium	3.52388E1	26.69650	2.43705	30.41324	40.06443	14.460	119	.000
	Mktpremium - Bmodelpremium	3.89818E1	25.53666	2.33117	34.36589	43.59778	16.722	119	.000
	Mktpremium - Binmodelpremium	3.30910E1	30.55730	2.78949	27.56754	38.61446	11.863	119	.000
BANK BARODA	Mktpremium - BSmodelpremium	1.16259E1	18.59025	1.69705	8.26559	14.98625	6.851	119	.000
	Mktpremium - Bmodelpremium	1.25629E1	19.61879	1.79094	9.01667	16.10916	7.015	119	.000
	Mktpremium - Binmodelpremium	1.11390E1	18.77752	1.71415	7.74482	14.53318	6.498	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
BHEL	Mktpremium - BSmodelpremium	.85992	6.16255	.56256	-.25401	1.97384	1.529	119	.129
	Mktpremium - Bmodelpremium	2.01275	6.45925	.58965	.84519	3.18031	3.413	119	.001
	Mktpremium - Binmodelpremium	.54517	6.63860	.60602	-.65481	1.74514	.900	119	.370
BHARTIARTL	Mktpremium - BSmodelpremium	5.77633	2.17454	.19851	5.38327	6.16940	29.099	119	.000
	Mktpremium - Bmodelpremium	6.34775	2.66749	.24351	5.86558	6.82992	26.068	119	.000
	Mktpremium - Binmodelpremium	5.87208	2.21313	.20203	5.47204	6.27212	29.065	119	.000
BPCL	Mktpremium - BSmodelpremium	9.79367	12.49204	1.14036	7.53564	12.05170	8.588	119	.000
	Mktpremium - Bmodelpremium	1.04510E1	10.82096	.98781	8.49503	12.40697	10.580	119	.000
	Mktpremium - Binmodelpremium	9.34592	12.63576	1.15348	7.06191	11.62992	8.102	119	.000
CIPLA	Mktpremium - BSmodelpremium	8.46817	4.27712	.39045	7.69504	9.24129	21.688	119	.000
	Mktpremium - Bmodelpremium	8.81508	4.24221	.38726	8.04827	9.58190	22.763	119	.000
	Mktpremium - Binmodelpremium	8.72425	4.41075	.40264	7.92697	9.52153	21.667	119	.000
COAL INDIA	Mktpremium - BSmodelpremium	4.01175	5.49107	.50126	3.01920	5.00430	8.003	119	.000
	Mktpremium - Bmodelpremium	4.68458	5.21956	.47648	3.74111	5.62806	9.832	119	.000
	Mktpremium - Binmodelpremium	4.08775	5.42108	.49487	3.10785	5.06765	8.260	119	.000
DRREDDY	Mktpremium - BSmodelpremium	4.61113E1	81.24701	7.41680	31.42524	60.79726	6.217	119	.000
	Mktpremium - Bmodelpremium	4.99769E1	81.00231	7.39447	35.33514	64.61870	6.759	119	.000
	Mktpremium - Binmodelpremium	4.52640E1	81.32462	7.42389	30.56396	59.96404	6.097	119	.000
GAIL	Mktpremium - BSmodelpremium	5.56958	3.27133	.29863	4.97827	6.16090	18.650	119	.000
	Mktpremium - Bmodelpremium	6.70633	3.08442	.28157	6.14880	7.26387	23.818	119	.000
	Mktpremium - Binmodelpremium	5.67317	3.28495	.29987	5.07939	6.26695	18.919	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
GRASIM	Mktpremium - BSmodelpremium	6.50752E1	82.57817	7.53832	50.14862	80.00188	8.633	119	.000
	Mktpremium - Bmodelpremium	6.79537E1	82.47809	7.52918	53.04513	82.86220	9.025	119	.000
	Mktpremium - Binmodelpremium	6.38202E1	82.96550	7.57368	48.82361	78.81689	8.427	119	.000
HCLTECH	Mktpremium - BSmodelpremium	1.10791E1	13.30062	1.21417	8.67490	13.48327	9.125	119	.000
	Mktpremium - Bmodelpremium	1.30888E1	13.39528	1.22282	10.66745	15.51005	10.704	119	.000
	Mktpremium - Binmodelpremium	1.03794E1	13.88931	1.26792	7.86882	12.89002	8.186	119	.000
HDFCBANK	Mktpremium - BSmodelpremium	3.05942	19.86216	1.81316	-.53082	6.64965	1.687	119	.094
	Mktpremium - Bmodelpremium	3.41042	19.71417	1.79965	-.15307	6.97390	1.895	119	.061
	Mktpremium - Binmodelpremium	2.13267	21.26662	1.94137	-1.71144	5.97677	1.099	119	.274
HERO MOTOCO	Mktpremium - BSmodelpremium	2.93532E1	15.38606	1.40455	26.57202	32.13431	20.899	119	.000
	Mktpremium - Bmodelpremium	3.69638E1	12.16977	1.11094	34.76406	39.16361	33.272	119	.000
	Mktpremium - Binmodelpremium	3.06552E1	13.45888	1.22862	28.22237	33.08796	24.951	119	.000
HINDALCO	Mktpremium - BSmodelpremium	2.83867	1.31946	.12045	2.60017	3.07717	23.567	119	.000
	Mktpremium - Bmodelpremium	2.83975	1.60106	.14616	2.55035	3.12915	19.430	119	.000
	Mktpremium - Binmodelpremium	2.86542	1.21526	.11094	2.64575	3.08508	25.829	119	.000
HINDUNILVR	Mktpremium - BSmodelpremium	7.78208	5.73602	.52362	6.74525	8.81891	14.862	119	.000
	Mktpremium - Bmodelpremium	8.95458	5.27666	.48169	8.00079	9.90838	18.590	119	.000
	Mktpremium - Binmodelpremium	7.92342	5.51307	.50327	6.92689	8.91995	15.744	119	.000
HDFC	Mktpremium - BSmodelpremium	1.30029E1	8.58457	.78366	11.45119	14.55464	16.593	119	.000
	Mktpremium - Bmodelpremium	1.44840E1	8.10166	.73958	13.01956	15.94844	19.584	119	.000
	Mktpremium - Binmodelpremium	1.27008E1	8.59654	.78475	11.14686	14.25464	16.184	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ITC	Mktpremium – Bsmodelpremium	3.76500	2.33292	.21297	3.34331	4.18669	17.679	119	.000
	Mktpremium – Bmodelpremium	4.12942	2.14929	.19620	3.74092	4.51792	21.047	119	.000
	Mktpremium – Binmodelpremium	3.85708	2.36925	.21628	3.42882	4.28534	17.834	119	.000
ICICIBANK	Mktpremium – Bsmodelpremium	9.48025	14.21992	1.29810	6.90989	12.05061	7.303	119	.000
	Mktpremium – Bmodelpremium	1.03820E1	14.90944	1.36104	7.68701	13.07699	7.628	119	.000
	Mktpremium – Binmodelpremium	8.77042	14.54840	1.32808	6.14068	11.40015	6.604	119	.000
KOTAK BANK	Mktpremium - BSmodelpremium	7.64742	11.49022	1.04891	5.57047	9.72436	7.291	119	.000
	Mktpremium - Bmodelpremium	9.00517	11.52902	1.05245	6.92121	11.08912	8.556	119	.000
	Mktpremium - Binmodelpremium	7.01925	12.06663	1.10153	4.83811	9.20039	6.372	119	.000
LT	Mktpremium - BSmodelpremium	2.08159E1	8.45892	.77219	19.28690	22.34493	26.957	119	.000
	Mktpremium - Bmodelpremium	2.26061E1	8.37071	.76414	21.09301	24.11915	29.584	119	.000
	Mktpremium - Binmodelpremium	2.01687E1	8.99910	.82150	18.54209	21.79541	24.551	119	.000
LUPIN	Mktpremium - BSmodelpremium	2.14345E1	12.36116	1.12841	19.20013	23.66887	18.995	119	.000
	Mktpremium - Bmodelpremium	2.24822E1	12.61994	1.15204	20.20102	24.76332	19.515	119	.000
	Mktpremium - Binmodelpremium	2.17883E1	12.74062	1.16305	19.48537	24.09130	18.734	119	.000
M&M	Mktpremium - BSmodelpremium	1.66241E1	5.84476	.53355	15.56760	17.68057	31.157	119	.000
	Mktpremium - Bmodelpremium	1.90101E1	5.97222	.54519	17.93056	20.08961	34.869	119	.000
	Mktpremium - Binmodelpremium	1.73912E1	7.00663	.63962	16.12466	18.65767	27.190	119	.000
MARUTI	Mktpremium - BSmodelpremium	4.03632E1	20.46686	1.86836	36.66371	44.06279	21.604	119	.000
	Mktpremium - Bmodelpremium	4.37481E1	21.74546	1.98508	39.81743	47.67874	22.038	119	.000
	Mktpremium - Binmodelpremium	4.24822E1	19.62517	1.79153	38.93477	46.02957	23.713	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
NTPC	Mktpremium - BSmodelpremium	1.76483	1.08838	.09936	1.56810	1.96157	17.763	119	.000
	Mktpremium - Bmodelpremium	2.00058	.95483	.08716	1.82799	2.17318	22.952	119	.000
	Mktpremium - Binmodelpremium	1.98167	1.16974	.10678	1.77023	2.19311	18.558	119	.000
ONGC	Mktpremium - BSmodelpremium	4.35692	3.00340	.27417	3.81403	4.89980	15.891	119	.000
	Mktpremium - Bmodelpremium	4.98592	2.87345	.26231	4.46652	5.50531	19.008	119	.000
	Mktpremium - Binmodelpremium	4.48908	3.03852	.27738	3.93985	5.03832	16.184	119	.000
POWERGRID	Mktpremium - BSmodelpremium	1.43067	1.67384	.15280	1.12811	1.73323	9.363	119	.000
	Mktpremium - Bmodelpremium	1.58783	1.64838	.15048	1.28988	1.88579	10.552	119	.000
	Mktpremium - Binmodelpremium	1.72442	1.53363	.14000	1.44720	2.00163	12.317	119	.000
RELIANCE	Mktpremium - BSmodelpremium	1.20093E1	4.72625	.43145	11.15503	12.86364	27.835	119	.000
	Mktpremium - Bmodelpremium	1.27225E1	4.79052	.43731	11.85658	13.58842	29.092	119	.000
	Mktpremium - Binmodelpremium	1.18355E1	11.28439	1.03012	9.79576	13.87524	11.489	119	.000
SUNPHARMA	Mktpremium - BSmodelpremium	9.19108	9.18121	.83813	7.53151	10.85066	10.966	119	.000
	Mktpremium - Bmodelpremium	9.92450	9.30418	.84935	8.24270	11.60630	11.685	119	.000
	Mktpremium - Binmodelpremium	8.78542	9.83553	.89786	7.00757	10.56326	9.785	119	.000
SBIN	Mktpremium - BSmodelpremium	1.83753E1	25.34355	2.31354	13.79421	22.95629	7.942	119	.000
	Mktpremium - Bmodelpremium	2.02795E1	27.38395	2.49980	15.32964	25.22936	8.112	119	.000
	Mktpremium - Binmodelpremium	1.73169E1	25.59477	2.33647	12.69047	21.94337	7.412	119	.000
TATA MOTORS	Mktpremium - BSmodelpremium	4.35025	8.54816	.78034	2.80511	5.89539	5.575	119	.000
	Mktpremium - Bmodelpremium	4.90700	8.52416	.77815	3.36619	6.44781	6.306	119	.000
	Mktpremium - Binmodelpremium	4.51067	9.55506	.87225	2.78352	6.23782	5.171	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
TCS	Mktpremium - BSmodelpremium	2.54017E1	13.17249	1.20248	23.02064	27.78269	21.124	119	.000
	Mktpremium - Bmodelpremium	2.99719E1	12.68137	1.15765	27.67966	32.26417	25.890	119	.000
	Mktpremium - Binmodelpremium	2.55312E1	13.01198	1.18783	23.17915	27.88318	21.494	119	.000
TATA POWER	Mktpremium - BSmodelpremium	-.16800	4.23460	.38656	-.93344	.59744	-.435	119	.665
	Mktpremium - Bmodelpremium	-.11683	4.14286	.37819	-.86569	.63202	-.309	119	.758
	Mktpremium - Binmodelpremium	-2.42467	24.23183	2.21205	-6.80475	1.95542	-1.096	119	.275
TATASTEEL	Mktpremium - BSmodelpremium	6.52967	2.77015	.25288	6.02894	7.03039	25.821	119	.000
	Mktpremium - Bmodelpremium	7.33175	2.26289	.20657	6.92272	7.74078	35.492	119	.000
	Mktpremium - Binmodelpremium	7.16425	3.23748	.29554	6.57905	7.74945	24.241	119	.000
ULTRATECH CEMCO	Mktpremium - BSmodelpremium	3.87202E1	28.37501	2.59027	33.59125	43.84925	14.948	119	.000
	Mktpremium - Bmodelpremium	4.37050E1	28.31042	2.58438	38.58768	48.82232	16.911	119	.000
	Mktpremium - Binmodelpremium	3.77611E1	28.25912	2.57969	32.65303	42.86913	14.638	119	.000
WIPRO	Mktpremium - BSmodelpremium	7.68817	5.73160	.52322	6.65214	8.72420	14.694	119	.000
	Mktpremium - Bmodelpremium	8.49342	5.30898	.48464	7.53378	9.45305	17.525	119	.000
	Mktpremium - Binmodelpremium	8.46458	5.87870	.53665	7.40196	9.52720	15.773	119	.000

In the case of stock options of ACC Ltd. when historical volatility is used in the three option pricing models namely Black-Scholes model, Black's model and Binomial option pricing model the results show that the p value is less than 0.05 which indicates that there is a significant difference between the calculated model prices and actual market prices of ACC Ltd. Stock call options. Black-Scholes model, Black's model and Binomial model is underestimating call option premium of ACC Ltd.

For Ambuja Cements Ltd. option pricing using historical volatility the results reveal that the p value is less than 0.05 under Black-Sholes model, Black's model and

Binomial option pricing model which indicates that there is a significant difference between the calculated model prices and actual prices. All the three option pricing models are underestimating call option premium of Ambuja Cements Ltd .

The results of Axis Bank Ltd. option pricing using historical volatility show that the p value is less than 0.05 under Black-Sholes model , Black's model and Binomial option pricing model which indicates that there is a significant difference between the calculated model prices and actual prices of Axis Bank Ltd. The results show that call option premium of Axis Bank Ltd. is underestimated by Black-Sholes model, Black's model and Binomial option pricing model .

The p value of Asian Paints Ltd. option is less than 0.05 under Black-Sholes model, Black's model and Binomial option pricing model when historical volatility is used. This indicates that difference between the calculated model prices and actual prices of Asian Paints Ltd. is significant. The three option pricing models are underestimating call option premium of Asian Paints Ltd.

For Bajaj Auto Ltd. option pricing using historical volatility the results show that the p value is less than 0.05 under Black-Sholes model , Black's model and Binomial option pricing model which indicates that there is a significant difference between the calculated model price and actual price of Bajaj Auto Ltd. call options . The results show that call option premium of Bajaj Auto Ltd. is underestimated by Black-Sholes model, Black's model and Binomial option pricing model .

The p value of Bank of Baroda call option is less than 0.05 under Black-Sholes model, Black's model and Binomial option pricing models when historical volatility is used indicating that difference between the calculated model prices and actual prices is

significant. The call option premium of Bank of Baroda is found to be underestimated by the three option pricing models.

In the case of Bharat Heavy Electricals Ltd. call option pricing using historical volatility the results reveal that the p value is more than 0.05 under Black-Sholes model and Binomial option pricing models which shows that there is a no significant difference between the calculated model price and actual price of Bharat Heavy Electricals Ltd. call options. This indicates that Black-Sholes model and Binomial option pricing models are effectively pricing call option of Bharat Heavy Electricals Ltd. But the p value is less than 0.05 under Black's option pricing model indicating that there is a significant difference between the calculated model prices and actual prices. Black-Sholes model, Black's model and Binomial option pricing models are underestimating call option premium of Bharat Heavy Electricals Ltd.

For Bharti Airtel Ltd. option pricing using historical volatility the results show that the p value is less than 0.05 under Black-Sholes model, Black's model and Binomial option pricing models which indicates that there is a significant difference between the calculated model prices and actual prices of Bharti Airtel Ltd. call options. The call option premium of Bharti Airtel Ltd. is found to be underestimated by the three option pricing models.

The p value of Bharat Petroleum Corporation Ltd. stock call option is less than 0.05 under Black-Sholes model, Black's model and Binomial option pricing models when historical volatility is used indicating that there is a significant difference between the calculated model prices and actual prices. Black-Sholes model, Black's model and Binomial option pricing models are underestimating call option premium of Bharat Petroleum Corporation Ltd.

For Cipla Ltd. option pricing using historical volatility the results show that the p value is less than 0.05 under Black-Sholes model, Black's model and Binomial option pricing models when historical volatility is used. This indicates that difference between the calculated model prices and actual prices of Cipla Ltd. is significant. The call option premium of Cipla Ltd. is found to be underestimated by the three option pricing models.

In the case of stock call options of Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., Grasim Industries Ltd. and HCL Technologies Ltd. the results reveal that that there is a significant difference between the calculated model prices and actual prices of these stocks when Black-Sholes model, Black's model and Binomial option pricing models with historical volatility are used for pricing. The p value is less than 0.05 in the case of these stock call options under all the three models when historical volatility is used. Black-Sholes model, Black's model and Binomial option pricing models are underestimating call option premium of these stocks.

For HDFC Bank Ltd. option pricing using historical volatility the results show that the p value is more than 0.05 under Black-Sholes model, Black's model and Binomial option pricing models which indicates that there is a no significant difference between the calculated model price and actual price. The Black-Sholes model, Black's model and Binomial option pricing models are effective in pricing call option of HDFC Bank Ltd. The call option premium of HDFC Bank Ltd. is found to be underestimated by the three option pricing models.

The p value is less than 0.05 in the case of stock call options of Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil

and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd., UltraTech Cement Ltd. and Wipro Ltd. option when historical volatility is used in the Black-Sholes model, Black's model and Binomial option pricing models. This indicates that for all these stock call options the difference between the calculated model prices and actual prices are significant. Black-Sholes model, Black's model and Binomial option pricing models are underestimating call option premium of these stocks when historical volatility is used in their equation.

For Tata Power Company Ltd. call option pricing using historical volatility the results reveal that the p value is more than 0.05 under Black-Sholes model, Black's model and Binomial option pricing model which shows that there is a no significant difference between the calculated model prices and actual prices of Tata Power Company Ltd. call options. The calculated model prices and actual market prices are closer under the three option pricing models. The Black-Sholes model, Black's model and Binomial option pricing models are found to be effective. Black-Sholes model, Black's model and Binomial option pricing models are overestimating call option premium of Tata Power Company Ltd.

The Black-Scholes option pricing model using historical volatility is found to be effectively pricing three stock call options. These three stock call options are of Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd. It is observed that in the case of stock call options of Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd., the p value is more than 0.05. This reveals that there is no significant difference between the calculated model prices using Black and Scholes model with historical volatility and the market prices .So we can accept the null hypothesis that

there is no significant difference between the actual and expected call option prices of stock option. While out of 39 stock options chosen for the study the p value of 36 stock call options namely ACC Ltd. , Ambuja Cements Ltd., Axis Bank Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Bank of Baroda, Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Cipla Ltd., Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., Grasim Industries Ltd., HCL Technologies Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd., UltraTech Cement Ltd. and Wipro Ltd. is less than 0.05 when Black-Scholes model with historical volatility is used for calculating option prices . This reveals that there exist a significant difference between the calculated model prices and actual prices of the these stock call options using Black-Scholes option pricing model with historical volatility. So we can reject the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option.

When Black's option pricing model with historical volatility is used it is observed that it has effectively priced two stock call options which include call options of HDFC Bank Ltd. and Tata Power Company Ltd. The results reveal that the p value is more than 0.05 in the case of HDFC Bank Ltd. and Tata Power Company Ltd. call options indicating that there is no significant difference between the calculated model prices using Black's model with historical volatility and the market prices. So we can accept the null hypothesis that there is no significant difference between the actual and expected call option prices of

stock option. While for 37 stock options which consists of stock call options of ACC Ltd., Ambuja Cements Ltd., Axis Bank Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Bharat Heavy Electricals Ltd., Bank of Baroda, Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Cipla Ltd., Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., Grasim Industries Ltd., HCL Technologies Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd., UltraTech Cement Ltd. and Wipro Ltd. it is observed that the p value of these stock call options is less than 0.05 when Black's model with historical volatility is used for calculating option prices . This reveals that there exist a significant difference between the calculated model prices and actual prices of the these stock call options using Black's option pricing model with historical volatility. So we can reject the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option .

The p value of Stock call options of Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd. is more than 0.05 when Binomial option pricing with historical volatility is used. This shows that there is no significant difference between the model prices calculated using Binomial model and the market price for Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd. call options. So we can accept the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option. But the p value is less than 0.05 for stock call

options of ACC Ltd., Ambuja Cements Ltd., Axis Bank Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Bank of Baroda, Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Cipla Ltd., Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., Grasim Industries Ltd., HCL Technologies Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd., UltraTech Cement Ltd. and Wipro Ltd. when option prices are calculated using Binomial option pricing model with historical volatility. This indicates that there is significant difference between the calculated model prices using Binomial model and actual prices of the stock call options. So we can reject the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option.

It is observed that when Option pricing is done using historical volatility in Black-Scholes model, Black's model and Binomial Option Pricing Model it resulted in underestimating most of the stock call option premiums. Only in the case of stock call option of Tata Power Company Ltd. the Black-Scholes model, Black's model and Binomial Option Pricing Model have resulted in overestimating its option premium.

4.2 Analysis of Stock options pricing using Black-Scholes, Black's and Binomial Model with GARCH Volatility.

Model prices are calculated by using the three option pricing models namely, Black-Scholes Option Pricing Model, Black's model and Binomial option pricing model. Volatility using GARCH model is used as a volatility variable while calculating option prices in all the three option pricing equations. The analysis covers the paired sample t - test results of the 39 stock options from the Nifty 50 index for the period from April 2012- March 2017. For stock call options the paired sample t-test is done between the calculated premium using Black Scholes pricing Model and the actual market prices of stock call options , the calculated premium using Black's option Pricing Model and the actual market prices of stock call options and calculated premium using Binomial option Pricing Model and the actual market prices of stock call options.. The Paired sample t-test reveals whether there is a significant difference between the calculated call option prices and the market price of options and it also shows whether the models are overestimating or underestimating the call option premiums.

Table 4.2.:Comparison of market premiums and model estimate premium as per Black-Sholes, Black's and Binomial Option Pricing model of stock options with GARCH volatility.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ACC	Mktpremium - BSmodelpremium	5.49042	26.01503	2.37484	.78800	10.19283	2.312	119	.023
	Mktpremium - Bmodelpremium	8.15858	25.10770	2.29201	3.62018	12.69699	3.560	119	.001
	Mktpremium - Binmodelpremium	3.30467	26.06298	2.37921	-1.40641	8.01575	1.389	119	.167
AMBUJACEM	Mktpremium - BSmodelpremium	.35225	3.55195	.32425	-.28979	.99429	1.086	119	.280
	Mktpremium - Bmodelpremium	.68042	3.67974	.33591	.01528	1.34556	2.026	119	.045
	Mktpremium - Binmodelpremium	-.05258	3.65903	.33402	-.71398	.60881	-.157	119	.875
AXIS BANK	Mktpremium - BSmodelpremium	-3.84642	16.60777	1.51608	-6.84840	-.84444	-2.537	119	.012
	Mktpremium - Bmodelpremium	-1.59300	15.72561	1.43555	-4.43552	1.24952	-1.110	119	.269
	Mktpremium - Binmodelpremium	-5.58683	17.49823	1.59736	-8.74977	-2.42390	-3.498	119	.001
ASIANPAINT	Mktpremium - BSmodelpremium	1.60587E1	101.37304	9.25405	-2.26528	34.38261	1.735	119	.085
	Mktpremium - Bmodelpremium	1.40778E1	103.84480	9.47969	-4.69290	32.84857	1.485	119	.140
	Mktpremium - Binmodelpremium	1.22874E1	101.90070	9.30222	-6.13190	30.70674	1.321	119	.189
BAJAJ-AUTO	Mktpremium - BSmodelpremium	3.63900	29.53353	2.69603	-1.69941	8.97741	1.350	119	.180
	Mktpremium - Bmodelpremium	7.23933	28.68478	2.61855	2.05434	12.42432	2.765	119	.007
	Mktpremium - Binmodelpremium	-1.93467	32.72927	2.98776	-7.85073	3.98140	-.648	119	.519
BANK BARODA	Mktpremium - BSmodelpremium	-4.71500	24.85342	2.26880	-9.20744	-.22256	-2.078	119	.040
	Mktpremium - Bmodelpremium	-3.80267	25.88061	2.36257	-8.48078	.87545	-1.610	119	.110
	Mktpremium - Binmodelpremium	-6.65742	26.09705	2.38232	-11.37466	-1.94018	-2.795	119	.006

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
BHEL	Mktpremium - BSmodelpremium	-3.44767	8.55443	.78091	-4.99395	-1.90139	-4.415	119	.000
	Mktpremium - Bmodelpremium	-2.22717	8.33070	.76049	-3.73300	-.72133	-2.929	119	.004
	Mktpremium - Binmodelpremium	-6.28550	20.39642	1.86193	-9.97231	-2.59869	-3.376	119	.001
BHARTI ARTL	Mktpremium - BSmodelpremium	-.41708	2.25122	.20551	-.82401	-.01016	-2.030	119	.045
	Mktpremium - Bmodelpremium	.11708	2.74397	.25049	-.37891	.61308	.467	119	.641
	Mktpremium - Binmodelpremium	-1.07192	2.48584	.22693	-1.52125	-.62258	-4.724	119	.000
BPCL	Mktpremium - BSmodelpremium	-4.03217	16.57041	1.51266	-7.02739	-1.03694	-2.666	119	.009
	Mktpremium - Bmodelpremium	-3.28325	14.26003	1.30176	-5.86086	-.70564	-2.522	119	.013
	Mktpremium - Binmodelpremium	-5.82667	17.37396	1.58602	-8.96714	-2.68619	-3.674	119	.000
CIPLA	Mktpremium - BSmodelpremium	1.22633	3.40666	.31098	.61055	1.84211	3.943	119	.000
	Mktpremium - Bmodelpremium	1.52517	3.29558	.30084	.92947	2.12087	5.070	119	.000
	Mktpremium - Binmodelpremium	.55650	3.84066	.35060	-.13773	1.25073	1.587	119	.115
COALINDIA	Mktpremium - BSmodelpremium	-1.25367	5.90320	.53889	-2.32071	-.18662	-2.326	119	.022
	Mktpremium - Bmodelpremium	-.60450	5.77766	.52743	-1.64886	.43986	-1.146	119	.254
	Mktpremium - Binmodelpremium	-1.91817	6.15829	.56217	-3.03132	-.80501	-3.412	119	.001
DRREDDY	Mktpremium - BSmodelpremium	7.68642	78.74600	7.18849	-6.54752	21.92035	1.069	119	.287
	Mktpremium - Bmodelpremium	1.16464E1	78.38435	7.15548	-2.52215	25.81498	1.628	119	.106
	Mktpremium - Binmodelpremium	2.99383	79.03210	7.21461	-11.29182	17.27948	.415	119	.679
GAIL	Mktpremium - BSmodelpremium	-1.11967	4.24354	.38738	-1.88672	-.35261	-2.890	119	.005
	Mktpremium - Bmodelpremium	-.03692	3.93939	.35962	-.74899	.67516	-.103	119	.918
	Mktpremium - Binmodelpremium	-1.78225	4.36609	.39857	-2.57145	-.99305	-4.472	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
GRASIM	Mktpremium - BSmodelpremium	1.76580E1	89.62918	8.18199	1.45685	33.85915	2.158	119	.033
	Mktpremium - Bmodelpremium	2.01470E1	89.59974	8.17930	3.95117	36.34283	2.463	119	.015
	Mktpremium - Binmodelpremium	1.27318E1	90.51327	8.26269	-3.62913	29.09279	1.541	119	.126
HCLTECH	Mktpremium - BSmodelpremium	-1.34197E1	27.87002	2.54417	-18.45738	-8.38195	-5.275	119	.000
	Mktpremium - Bmodelpremium	-1.12793E1	27.00597	2.46530	-16.16087	-6.39780	-4.575	119	.000
	Mktpremium - Binmodelpremium	-1.53658E1	26.75790	2.44265	-20.20253	-10.52914	-6.291	119	.000
HDFCBANK	Mktpremium - BSmodelpremium	-2.98983	19.93998	1.82026	-6.59414	.61447	-1.643	119	.103
	Mktpremium - Bmodelpremium	-2.68883	19.60633	1.78980	-6.23283	.85516	-1.502	119	.136
	Mktpremium - Binmodelpremium	-4.52125	21.50063	1.96273	-8.40765	-.63485	-2.304	119	.023
HERO MOTOCO	Mktpremium - BSmodelpremium	-7.06192	17.01291	1.55306	-10.13713	-3.98670	-4.547	119	.000
	Mktpremium - Bmodelpremium	.28883	15.23233	1.39051	-2.46452	3.04219	.208	119	.836
	Mktpremium - Binmodelpremium	-1.16311E1	18.02580	1.64552	-14.88938	-8.37278	-7.068	119	.000
HINDALCO	Mktpremium - BSmodelpremium	-.13883	1.18528	.10820	-.35308	.07541	-1.283	119	.202
	Mktpremium - Bmodelpremium	-.12942	1.33152	.12155	-.37010	.11127	-1.065	119	.289
	Mktpremium - Binmodelpremium	-.44675	1.35245	.12346	-.69122	-.20228	-3.619	119	.000
HINDUNILVR	Mktpremium - BSmodelpremium	-.76667	5.34274	.48772	-1.73241	.19907	-1.572	119	.119
	Mktpremium - Bmodelpremium	.33850	4.75195	.43379	-.52045	1.19745	.780	119	.437
	Mktpremium - Binmodelpremium	-1.64308	5.65814	.51651	-2.66583	-.62033	-3.181	119	.002
HDFC	Mktpremium - BSmodelpremium	-3.02442	8.48138	.77424	-4.55749	-1.49134	-3.906	119	.000
	Mktpremium - Bmodelpremium	-1.65692	8.08922	.73844	-3.11910	-.19473	-2.244	119	.027
	Mktpremium - Binmodelpremium	-4.92175	9.29470	.84849	-6.60184	-3.24166	-5.801	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
ITC	Mktpremium – Bsmodelpremium	-.96508	2.66805	.24356	-1.44735	-.48281	-3.962	119	.000
	Mktpremium - Bmodelpremium	-.63875	2.37002	.21635	-1.06715	-.21035	-2.952	119	.004
	Mktpremium - Binmodelpremium	-1.40550	3.13810	.28647	-1.97274	-.83826	-4.906	119	.000
ICICIBANK	Mktpremium - BSmodelpremium	-1.13196E1	28.44595	2.59675	-16.46140	-6.17776	-4.359	119	.000
	Mktpremium - Bmodelpremium	-1.02771E1	28.76623	2.62599	-15.47680	-5.07737	-3.914	119	.000
	Mktpremium - Binmodelpremium	-1.85114E1	45.76776	4.17801	-26.78429	-10.23855	-4.431	119	.000
KOTAK BANK	Mktpremium - BSmodelpremium	-1.03907E1	20.39081	1.86142	-14.07654	-6.70496	-5.582	119	.000
	Mktpremium - Bmodelpremium	-9.09375	19.81276	1.80865	-12.67506	-5.51244	-5.028	119	.000
	Mktpremium - Binmodelpremium	-1.25695E1	22.33042	2.03848	-16.60589	-8.53311	-6.166	119	.000
LT	Mktpremium - BSmodelpremium	-4.64775	15.65017	1.42866	-7.47664	-1.81886	-3.253	119	.001
	Mktpremium - Bmodelpremium	-2.95658	15.75267	1.43802	-5.80400	-.10917	-2.056	119	.042
	Mktpremium - Binmodelpremium	-8.21550	16.85903	1.53901	-11.26290	-5.16810	-5.338	119	.000
LUPIN	Mktpremium - BSmodelpremium	1.39458	13.08289	1.19430	-.97025	3.75941	1.168	119	.245
	Mktpremium - Bmodelpremium	2.46842	11.62487	1.06120	.36713	4.56970	2.326	119	.022
	Mktpremium - Binmodelpremium	-.62608	13.68328	1.24911	-3.09944	1.84727	-.501	119	.617
M&M	Mktpremium - BSmodelpremium	-.90333	5.93874	.54213	-1.97681	.17014	-1.666	119	.098
	Mktpremium - Bmodelpremium	1.39025	6.40827	.58499	.23191	2.54859	2.377	119	.019
	Mktpremium - Binmodelpremium	-2.54083	7.79597	.71167	-3.95001	-1.13165	-3.570	119	.001
MARUTI	Mktpremium - BSmodelpremium	-3.63083	21.76080	1.98648	-7.56426	.30260	-1.828	119	.070
	Mktpremium - Bmodelpremium	-.57083	22.69559	2.07181	-4.67323	3.53157	-.276	119	.783
	Mktpremium - Binmodelpremium	-8.94458	24.75369	2.25969	-13.41900	-4.47017	-3.958	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
NTPC	Mktpremium - BSmodelpremium	-.53533	1.40100	.12789	-.78858	-.28209	-4.186	119	.000
	Mktpremium - Bmodelpremium	-.31492	1.26754	.11571	-.54403	-.08580	-2.722	119	.007
	Mktpremium - Binmodelpremium	-.71783	1.42161	.12977	-.97480	-.46087	-5.531	119	.000
ONGC	Mktpremium - BSmodelpremium	-.85567	2.82978	.25832	-1.36717	-.34416	-3.312	119	.001
	Mktpremium - Bmodelpremium	-.29900	2.70198	.24666	-.78740	.18940	-1.212	119	.228
	Mktpremium - Binmodelpremium	-1.46067	2.95039	.26933	-1.99397	-.92736	-5.423	119	.000
POWERGRID	Mktpremium - BSmodelpremium	-.16417	1.71827	.15686	-.47476	.14642	-1.047	119	.297
	Mktpremium - Bmodelpremium	-.02850	1.67831	.15321	-.33187	.27487	-.186	119	.853
	Mktpremium - Binmodelpremium	-.26433	1.78949	.16336	-.58780	.05913	-1.618	119	.108
RELIANCE	Mktpremium - BSmodelpremium	-.13275	4.41464	.40300	-.93073	.66523	-.329	119	.742
	Mktpremium - Bmodelpremium	.56792	4.35831	.39786	-.21988	1.35571	1.427	119	.156
	Mktpremium - Binmodelpremium	-2.48817	10.81595	.98736	-4.44323	-.53310	-2.520	119	.013
SUNPHARMA	Mktpremium - BSmodelpremium	-6.21325	19.25245	1.75750	-9.69328	-2.73322	-3.535	119	.001
	Mktpremium - Bmodelpremium	-5.87558	19.35732	1.76707	-9.37457	-2.37660	-3.325	119	.001
	Mktpremium - Binmodelpremium	-8.55858	21.09885	1.92605	-12.37236	-4.74481	-4.444	119	.000
SBIN	Mktpremium - BSmodelpremium	-1.07147E1	28.97373	2.64493	-15.95197	-5.47753	-4.051	119	.000
	Mktpremium - Bmodelpremium	-8.84175	29.88875	2.72846	-14.24437	-3.43913	-3.241	119	.002
	Mktpremium - Binmodelpremium	-1.43502E1	29.75194	2.71597	-19.72814	-8.97236	-5.284	119	.000
TATA MOTORS	Mktpremium - BSmodelpremium	-2.76483	10.47158	.95592	-4.65765	-.87202	-2.892	119	.005
	Mktpremium - Bmodelpremium	-2.10692	10.29703	.93999	-3.96818	-.24565	-2.241	119	.027
	Mktpremium - Binmodelpremium	-3.79475	11.38587	1.03938	-5.85283	-1.73667	-3.651	119	.000

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
TCS	Mktpremium - BSmodelpremium	-5.28658	14.84506	1.35516	-7.96994	-2.60323	-3.901	119	.000
	Mktpremium - Bmodelpremium	-1.05008	15.27821	1.39470	-3.81174	1.71157	-.753	119	.453
	Mktpremium - Binmodelpremium	-8.59592	15.68369	1.43172	-11.43086	-5.76097	-6.004	119	.000
TATA POWER	Mktpremium - BSmodelpremium	-2.34792	10.15717	.92722	-4.18390	-.51193	-2.532	119	.013
	Mktpremium - Bmodelpremium	-2.29708	10.11535	.92340	-4.12551	-.46866	-2.488	119	.014
	Mktpremium - Binmodelpremium	-2.69667	10.70770	.97748	-4.63217	-.76117	-2.759	119	.007
TATASTEEL	Mktpremium - BSmodelpremium	-1.05067	3.08835	.28193	-1.60891	-.49242	-3.727	119	.000
	Mktpremium - Bmodelpremium	-.21575	2.88597	.26345	-.73741	.30591	-.819	119	.414
	Mktpremium - Binmodelpremium	-1.95883	3.32911	.30391	-2.56060	-1.35707	-6.446	119	.000
ULTRATECH CEMCO	Mktpremium - BSmodelpremium	-.54675	30.57614	2.79121	-6.07362	4.98012	-.196	119	.845
	Mktpremium - Bmodelpremium	4.11717	30.82557	2.81398	-1.45479	9.68912	1.463	119	.146
	Mktpremium - Binmodelpremium	-6.23068	31.34215	2.86113	-11.89601	-.56535	-2.178	119	.031
WIPRO	Mktpremium - BSmodelpremium	.42575	5.95210	.54335	-.65014	1.50164	.784	119	.435
	Mktpremium - Bmodelpremium	1.01058	5.94435	.54264	-.06390	2.08507	1.862	119	.065
	Mktpremium - Binmodelpremium	-.45933	6.17792	.56396	-1.57604	.65737	-.814	119	.417

It is observed that for Stock call option pricing of ACC Ltd. the results show that the p value is more than 0.05 under Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model prices and actual prices. Binomial option pricing model with GARCH volatility has effectively priced call option of ACC Ltd. But the p value is less than 0.05 when Black-Scholes model and Black's model with GARCH volatility is used for calculating option price indicating that there is a significant difference between the calculated model prices and

actual prices of ACC Ltd. call options. All the three models i.e. Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility are underestimating call option premium of ACC Ltd. option .

In the case of Ambuja Cements Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Ambuja Cements Ltd. Stock call option. While when Black's option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Ambuja Cements Ltd. Stock call options since the p value is less than 0.05. It is observed that the Black-Scholes and Black's model are underestimating call option premium of Ambuja Cements Ltd. Stock option while Binomial model has resulted in overestimating its call option premium.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Axis Bank Ltd. call option .The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Axis Bank Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Axis Bank Ltd.

Option pricing results of Asian Paints Ltd. using Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility reveal that the three models have priced the option effectively. For all the three option pricing models it is

found that the p value is more than 0.05 indicating that there is no significant difference between the calculated model prices and actual prices. All the three option pricing models have underestimated call option premium of Asian Paints Ltd.

In the case of Bajaj Auto Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Bajaj Auto Ltd. call option. While when Black's option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Bajaj Auto Ltd. call options since the p value is less than 0.05. It is observed that the Black-Scholes and Black's model are underestimating call option premium of Bajaj Auto Ltd. Stock option while Binomial model has resulted in overestimating its call option premium.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Bank of Baroda call option. The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Bank of Baroda it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Bank of Baroda stock .

In the case of Bharat Heavy Electricals Ltd. option pricing using GARCH volatility the results reveal that the p value is less than 0.05 under Black-Scholes model , Black's model and Binomial option pricing model with GARCH volatility indicating that there is a

significant difference between the calculated model price and actual price of Bharat Heavy Electricals Ltd. call options. All the three option pricing models are overestimating call option premium of Bharat Heavy Electricals Ltd.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Bharti Airtel Ltd. call option. The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Bharti Airtel Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Bharti Airtel Ltd. while the Black's model is underestimating its premium.

In the case of Bharat Petroleum Corporation Ltd. option pricing using GARCH volatility the results reveal that the p value is less than 0.05 under Black-Scholes model , Black's model and Binomial option pricing model with GARCH volatility indicating that there is a significant difference between the calculated model price and actual price of Bharat Petroleum Corporation Ltd. call options. All the three option pricing models are overestimating call option premium of Bharat Petroleum Corporation Ltd.

It is observed that for Stock call option pricing of Cipla Ltd. the results show that the p value is more than 0.05 under Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model prices and actual prices. Binomial option pricing model with GARCH volatility has effectively priced call option of Cipla Ltd. But the p value is less than 0.05 when Black-Scholes model and Black's model with GARCH volatility is used for calculating option price

indicating that there is a significant difference between the calculated model prices and actual prices of Cipla Ltd. call options. All the three models i.e. Black-Scholes model , Black's model and Binomial option pricing model with GARCH volatility are underestimating call option premium of Cipla Ltd. option.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Coal India Ltd. call option. The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Coal India Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model, Black's and Binomial option pricing model with GARCH volatility are overestimating call option premium of Coal India Ltd.

Option pricing results of Dr. Reddy's Laboratories Ltd. using Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility reveal that the three models have priced the option effectively. For all the three option pricing models it is found that the p value is more than 0.05 indicating that there is no significant difference between the calculated model prices and actual prices. All the three option pricing models have underestimated call option premium of Dr. Reddy's Laboratories Ltd.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Gail (India) Ltd. call option .The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Gail (India) Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices

and actual prices. Black-Scholes model, Black's and Binomial option pricing model with GARCH volatility are overestimating call option premium of Gail (India) Ltd.

It is observed that for Stock call option pricing of Grasim Industries Ltd. the results show that the p value is more than 0.05 under Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model prices and actual prices. Binomial option pricing model with GARCH volatility has effectively priced call option of Grasim Industries Ltd. But the p value is less than 0.05 when Black-Scholes model and Black's model with GARCH volatility is used for calculating option price indicating that there is a significant difference between the calculated model prices and actual prices of Grasim Industries Ltd. call options. All the three models i.e. Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility are underestimating call option premium of Grasim Industries Ltd. option .

In the case of HCL Technologies Ltd. option pricing using GARCH volatility the results reveal that the p value is less than 0.05 under Black-Scholes model , Black's model and Binomial option pricing model with GARCH volatility indicating that there is a significant difference between the calculated model price and actual price of HCL Technologies Ltd. call options . All the three option pricing models are overestimating call option premium of HCL Technologies Ltd.

In the case of HDFC Bank Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing HDFC Bank Ltd. call option. While when Binomial option pricing model with GARCH volatility

is used the results reveal that there is a significant difference between the calculated model prices and actual prices of HDFC Bank Ltd. call options since the p value is less than 0.05. It is observed that the Black-Scholes, Black's model and Binomial model are overestimating call option premium of HDFC Bank Ltd. option .

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Hero MotoCorp Ltd. call option. The p value more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Hero MotoCorp Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Hero MotoCorp Ltd. while the Black's model is underestimating its premium.

In the case of Hindalco Industries Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Hindalco Industries Ltd. call option. While when Binomial option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Hindalco Industries Ltd. call options since the p value is less than 0.05. It is observed that all the three option pricing models are overestimating call option premium of Hindalco Industries Ltd.

For Hindustan Unilever Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH

volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Hindustan Unilever Ltd. call option. While when Binomial option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Hindustan Unilever Ltd. call options since the p value is less than 0.05. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Hindustan Unilever Ltd. while the Black's model is underestimating its premium.

In the case of stock call options of Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd. and Larsen & Turbo Ltd., the results reveal that that there is a significant difference between the calculated model prices and actual prices of these stocks when Black-Sholes model, Black's model and Binomial option pricing models with GARCH volatility are used for pricing. The p value is less than 0.05 in the case of these stock call options under all the three models when GARCH volatility is used. Black-Sholes model, Black's model and Binomial option pricing models are overestimating call option premium of these stocks.

In the case of Lupin Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Binomial option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Lupin Ltd. call option. While when Black's option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Lupin Ltd. call options since the p value is less than 0.05. It is observed that the

Black-Scholes and Black's model are underestimating call option premium of Lupin Ltd. option while Binomial model has resulted in overestimating its call option premium.

The results reveal that Black-Scholes option pricing model with GARCH volatility effectively prices the Mahindra & Mahindra Ltd. call option . The p value more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black's and Binomial option pricing model with GARCH volatility are used to find the option price of Mahindra & Mahindra Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Mahindra & Mahindra Ltd. while the Black's model is underestimating its premium.

In the case of Maruti Suzuki India Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price. These models are effective in pricing Maruti Suzuki India Ltd. call option. While when Binomial option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of Maruti Suzuki India Ltd. call options since the p value is less than 0.05. Black-Sholes model, Black's model and Binomial option pricing models are overestimating call option premium of Maruti Suzuki India Ltd.

In the case of NTPC Ltd. option pricing using GARCH volatility the results reveal that the p value is less than 0.05 under Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility indicating that there is a significant

difference between the calculated model price and actual price of NTPC Ltd. call options. All the three option pricing models are overestimating call option premium of NTPC Ltd.

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Oil and Natural Gas Corporation Ltd. call option .The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Oil and Natural Gas Corporation Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. All the three option pricing models are overestimating call option premium of Oil and Natural Gas Corporation Ltd.

Option pricing results of Power Grid Corporation of India Ltd. using Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility reveal that the three models have priced the option effectively. For all the three option pricing models it is found that the p value is more than 0.05 indicating that there is no significant difference between the calculated model prices and actual prices . All the three option pricing models have overestimated call option premium of Power Grid Corporation of India Ltd.

In the case of Reliance Industries Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price . These models are effective in pricing Reliance Stock call option. While when Binomial option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model

prices and actual prices of Reliance Industries Ltd. call options since the p value is less than 0.05. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of Reliance Industries Ltd. while the Black's model is underestimating its premium.

In the case of stock call options of Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd. and Tata Power Company Ltd. the results reveal that that there is a significant difference between the calculated model prices and actual prices of these stocks when Black-Sholes model, Black's model and Binomial option pricing models with GARCH volatility are used for pricing . The p value is less than 0.05 in the case of these stock call options under all the three models when GARCH volatility is used. Black-Sholes model, Black's model and Binomial option pricing models are overestimating call option premium of these stocks .

The results reveal that Black's option pricing model with GARCH volatility effectively prices the Tata Consultancy Services Ltd. call option .The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option pricing model with GARCH volatility are used to find the option price of Tata Consultancy Services Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. All the three option pricing models are overestimating call option premium of Tata Consultancy Services Ltd.

In the case of Tata Steel Ltd. call option pricing the results reveal that Black's option pricing model with GARCH volatility effectively prices the Tata Steel option. The p value is more than 0.05 indicating that there is no significant difference between the calculated model price and actual price. But when Black-Scholes and Binomial option

pricing model with GARCH volatility are used to find the option price of Tata Steel Ltd. it is observed that the p value is less than 0.05 indicating that there is a significant difference between the calculated model prices and actual prices. All the three option pricing models are overestimating call option premium of Tata Steel Ltd.

In the case of UltraTech Cement Ltd. call option pricing the results show that the p value is more than 0.05 under Black-Scholes and Black's option pricing model with GARCH volatility which indicates that there is no significant difference between the calculated model price and actual price . These models are effective in pricing UltraTech Cement Ltd. call option. While when Binomial option pricing model with GARCH volatility is used the results reveal that there is a significant difference between the calculated model prices and actual prices of UltraTech Cement Ltd. call options since the p value is less than 0.05. Black-Scholes model and Binomial option pricing model with GARCH volatility are overestimating call option premium of UltraTech Cement Ltd. while the Black's model is underestimating its premium.

Option pricing results of Wipro Ltd. using Black-Scholes model, Black's model and Binomial option pricing model with GARCH volatility reveal that the three models have priced the option effectively. For all the three option pricing models it is found that the p value is more than 0.05 indicating that there is a no significant difference between the calculated model prices and actual prices . Black-Scholes model and Black's option pricing model with GARCH volatility are underestimating call option premium of Wipro Ltd. while the Binomial model is overestimating its premium.

The Black-Scholes option pricing model using GARCH volatility is found to effectively pricing fourteen stock call options. These stock call options are of Ambuja Cements Ltd., Asian Paints Ltd., Bajaj Auto Ltd, Dr. Reddy's Laboratories Ltd., HDFC

Bank Ltd. Hindalco Industries Ltd., Hindustan Unilever Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., UltraTech Cement Ltd. and Wipro Ltd. the p value is more than 0.05. This reveals that there is no significant difference between the calculated model prices using Black- Scholes model with GARCH volatility and the market prices .So we can accept the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option. While out of 39 stock options chosen for the study the p value of twenty five stock call options namely ACC Ltd., Axis Bank Ltd., Bank of Baroda, Bharat Heavy Electricals Ltd., Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Cipla Ltd., Coal India Ltd., Gail (India) Ltd., Grasim Industries Ltd., HCL Technologies Ltd., Hero MotoCorp Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata motors Ltd., Tata Consultancy Services Ltd., Tata Power Company Ltd. and Tata Steel Ltd. is less than 0.05 when Black- Scholes model with GARCH volatility is used for calculating option prices . This reveals that there exist a significant difference between the calculated model prices and actual prices of the these stock call options using Black-Scholes option pricing model with GARCH volatility. So we can reject the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option.

When Black's option pricing model with GARCH volatility is used it is observed that it has effectively priced nineteen stock call options which include call options of Axis Bank Ltd., Asian Paints Ltd., Bank of Baroda, Bharti Airtel Ltd., Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., HDFC Bank Ltd., Hero MotoCorp Ltd.,

Hindalco Industries Ltd., Hindustan Unilever Ltd., Maruti Suzuki India Ltd., Oil and Natural Gas Corporation Ltd., Reliance Industries Ltd., Power Grid Corporation of India Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd, UltraTech Cement Ltd. and Wipro Ltd . The results reveal that the p value is more than 0.05 in the case of Axis Bank Ltd., Asian Paints Ltd., Bank of Baroda, Bharti Airtel Ltd., Coal India Ltd., Dr. Reddy's Laboratories Ltd., Gail (India) Ltd., HDFC Bank Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Maruti Suzuki India Ltd., Oil and Natural Gas Corporation Ltd., Reliance Industries Ltd., Power Grid Corporation of India Ltd., Tata Consultancy Services Ltd., Tata Steel Ltd, UltraTech Cement Ltd. and Wipro Ltd call options indicating that there is no significant difference between the calculated model prices using Black's model with GARCH and the market prices .So we can accept the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option . While for twenty stock options which consists of stock call options of ACC Ltd. , Ambuja Cements Ltd., Bajaj Auto Ltd., Bharat Heavy Electricals Ltd., Bharat Petroleum Corporation Ltd., Cipla Ltd., Grasim Industries Ltd., HCL Technologies Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., NTPC Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata motors Ltd. and Tata Power Company Ltd., it is observed that the p value of these stock call options is less than 0.05 when Black's model with GARCH volatility is used for calculating option prices. This reveals that there exist a significant difference between the calculated model prices and actual prices of the these stock call options using Black's option pricing model with GARCH volatility. So we can reject the null

hypothesis that there is no significant difference between the actual and expected call option prices of stock option.

The p value ten Stock call options of ACC Ltd. , Ambuja Cements Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Cipla Ltd., Dr. Reddy's Laboratories Ltd., Grasim Industries Ltd., Lupin Ltd., Power Grid Corporation of India Ltd., and Wipro Ltd. is more than 0.05 when Binomial option pricing with GARCH volatility is used . This shows that there is no significant difference between the model prices calculated using Binomial model and the market price for ACC Ltd., Ambuja Cements Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Cipla Ltd., Dr. Reddy's Laboratories Ltd., Grasim Industries Ltd., Lupin Ltd., Power Grid Corporation of India Ltd., and Wipro Ltd. Stock call options. So we can accept the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option. But the p value is less than 0.05 for twenty nine stock call options of Axis Bank Ltd., Bank of Baroda, Bharat Heavy Electricals Ltd., Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Coal India Ltd., Gail (India) Ltd., HDFC Bank Ltd. HCL Technologies Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata motors Ltd., Tata Consultancy Services Ltd., Tata Power Company Ltd. Tata Steel Ltd and UltraTech Cement Ltd. when option prices are calculated using Binomial option pricing model with GARCH. This indicates that there is significant difference between the calculated model prices using Binomial model and actual prices of the stock call options. So we can reject

the null hypothesis that there is no significant difference between the actual and expected call option prices of stock option.

It is observed that when Option pricing is done using GARCH volatility in Black-Scholes model, Black's model and Binomial Option Pricing Model it resulted in overestimating most of the stock call option premiums . Very few stock option premiums are underestimated by the three option pricing models with GARCH volatility.

Black- Scholes option pricing model has overestimated stock options of thirty stock which include Axis Bank Ltd., Bank of Baroda, Bharat Heavy Electricals Ltd., Bharti Airtel Ltd., Bharat Petroleum Corporation Ltd., Coal India Ltd., Gail (India) Ltd., HDFC Bank Ltd. HCL Technologies Ltd., Hero MotoCorp Ltd, Hindalco Industries Ltd., Hindustan Unilever Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd. , Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata motors Ltd., Tata Consultancy Services Ltd., Tata Power Company Ltd. ,Tata Steel Ltd and UltraTech Cement Ltd. While the Black- Scholes model using GARCH volatility has underestimated call option premiums of nine stocks which include ACC Ltd. , Ambuja Cements Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Cipla Ltd., Dr. Reddy's Laboratories Ltd., Grasim Industries Ltd., Lupin Ltd. and Wipro Ltd.

Black's option pricing model has overestimated stock options of twenty four stock which include Axis Bank Ltd., Bank of Baroda, Bharat Heavy Electricals Ltd., Bharat Petroleum Corporation Ltd., Coal India Ltd., Gail (India) Ltd., HCL Technologies Ltd., Hindalco Industries Ltd., Housing Development Finance Corporation, HDFC Bank Ltd., ITC Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Maruti

Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd. ,Tata Power Company Ltd. and Tata Steel Ltd. While the Black's option pricing model using GARCH volatility has underestimated call option premiums of fifteen stocks which include ACC Ltd. , Ambuja Cements Ltd., Asian Paints Ltd., Bajaj Auto Ltd., Bharti Airtel Ltd., Cipla Ltd., Dr. Reddy's Laboratories Ltd., Grasim Industries Ltd., Hero MotoCorp Ltd., Hindustan Unilever Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Reliance Industries Ltd., UltraTech Cement Ltd. and Wipro Ltd.

Binomial option pricing model has overestimated stock options of thirty four stock which include, Ambuja Cements Ltd., Axis Bank Ltd., Bajaj Auto Ltd., Bank of Baroda, Bharti Airtel Ltd., Bharat Heavy Electricals Ltd., Bharat Petroleum Corporation Ltd., Coal India Ltd., Gail (India) Ltd., HCL Technologies Ltd., Hero MotoCorp Ltd., Hindalco Industries Ltd., Hindustan Unilever Ltd., HDFC Bank Ltd., Housing Development Finance Corporation, ITC Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd., Larsen & Turbo Ltd., Lupin Ltd., Mahindra & Mahindra Ltd., Maruti Suzuki India Ltd., NTPC Ltd., Oil and Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Sun Pharmaceutical Industries Ltd., State Bank of India, Tata Motors Ltd., Tata Consultancy Services Ltd., Tata Power Company Ltd. Tata Steel Ltd., UltraTech Cement Ltd. and Wipro Ltd. While the Black's option pricing model using GARCH volatility has underestimated call option premiums of five stocks which include ACC Ltd. , Asian Paints Ltd., Cipla Ltd., Dr. Reddy's Laboratories Ltd., and Grasim Industries Ltd.

4.3 Analysis of Index options pricing using Black-Scholes, Black's and Binomial Model with Historical Volatility.

Model prices are calculated by using the three option pricing models namely, Black-Scholes Option Pricing Model, Black's model and Binomial option pricing model. Historical volatility is used as a variable while calculating option prices in all the three option pricing equations. The analysis covers the paired sample t - test results of three indices namely Nifty 50 Index, Nifty Bank Index and Nifty IT Index for the period from April 2012- March 2017 .For Index Options the paired sample t-test is done between the calculated premium using Black Scholes Pricing Model and the actual market prices of index options , the calculated premium using Black's option Pricing Model and the actual market prices of index options and calculated premium using Binomial option Pricing Model and the actual market prices of index options. The Paired sample t-test reveals whether there is a significant difference between the calculated call option prices and the market price of options and it also shows whether the models are overestimating or underestimating the call option premium.

Table 4.3: Comparison of market premiums and model estimate premium as per Black - Scholes , Black's and Binomial Option Pricing model of Indices with Historical volatility.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
NIFTY 50 INDEX	Mktpremium - BSmodelpremium	6.15916E1	56.38091	5.14685	51.40031	71.78286	11.967	119	.000
	Mktpremium - Bmodelpremium	6.86469E1	65.03917	5.93724	56.89059	80.40324	11.562	119	.000
	Mktpremium - Binmodelpremium	5.95276E1	55.81383	5.09508	49.43881	69.61636	11.683	119	.000
NIFTY BANK INDEX	Mktpremium - BSmodelpremium	1.73030E2	89.67775	8.18642	156.82007	189.23993	21.136	119	.000
	Mktpremium - Bmodelpremium	1.78694E2	77.66524	7.08983	164.65534	192.73250	25.204	119	.000
	Mktpremium - Binmodelpremium	1.60350E2	89.97236	8.21331	144.08682	176.61318	19.523	119	.000
NIFTY IT INDEX	Mktpremium - BSmodelpremium	3.57119E2	350.29329	31.97726	293.80059	420.43691	11.168	119	.000
	Mktpremium - Bmodelpremium	3.66338E2	345.68266	31.55637	303.85316	428.82267	11.609	119	.000
	Mktpremium - Binmodelpremium	3.51550E2	350.49752	31.99590	288.19451	414.90466	10.987	119	.000

The above table shows that incase of pricing of index option it is observed that the p value for all the three index call options is less than 0.05 under all the three option pricing models when historical volatility is used . So we can reject the null hypothesis that there is no significant difference between the calculated model price and actual price. The results reveal that there is significant difference between the calculated model price and actual price of the all the three index call options.

When the use of historical volatility is done in the option pricing models the results show that Black-Scholes model, Black's model and Binomial model are underestimating option premium of all the three indices namely Nifty 50 Index, Nifty Bank Index and Nifty IT Index.

4.4. Analysis of Index options pricing using Black-Scholes, Black's and Binomial Model with GARCH Volatility.

Model prices are calculated by using the three option pricing models namely, Black-Scholes Option Pricing Model, Black's model and Binomial option pricing model. Volatility using GARCH model is used as a variable while calculating option prices in all the three option pricing equations. The analysis covers the paired sample t - test results of three indices namely Nifty 50 Index, Nifty Bank Index and Nifty IT Index for the period from April 2012- March 2017. For Index Options the paired sample t-test is done between the calculated premium using Black Scholes Pricing Model and the actual market prices of index options , the calculated premium using Black's option Pricing Model and the actual market prices of index options and calculated premium using Binomial option Pricing Model and the actual market prices of index options. The Paired sample t-test reveals whether there is a significant difference between the calculated call option prices and the market price of options and it also shows whether the models are overestimating or underestimating the call option premium.

Table 4.4 : Comparison of market premiums and model estimate premium as per Black - Scholes , Black's and Binomial Option Pricing model of Indices with GARCH volatility.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
NIFTY 50 INDEX	Mktpremium - BSmodelpremium	1.57083	50.84863	4.64182	-7.62044	10.76211	.338	119	.736
	Mktpremium - Bmodelpremium	8.41133	63.15638	5.76536	-3.00466	19.82733	1.459	119	.147
	Mktpremium - Binmodelpremium	-7.23367	51.03996	4.65929	-16.45953	1.99219	-1.553	119	.123
NIFTY BANK INDEX	Mktpremium - BSmodelpremium	-2.07618E1	90.00302	8.21611	-37.03048	-4.49302	-2.527	119	.013
	Mktpremium - Bmodelpremium	-1.88469E1	89.07397	8.13130	-34.94771	-2.74612	-2.318	119	.022
	Mktpremium - Binmodelpremium	-5.17412E1	92.42859	8.43754	-68.44833	-35.03400	-6.132	119	.000
NIFTY IT INDEX	Mktpremium - BSmodelpremium	2.50357E2	335.85829	30.65953	189.64849	311.06634	8.166	119	.000
	Mktpremium - Bmodelpremium	2.45094E2	356.52959	32.54655	180.64850	309.53934	7.531	119	.000
	Mktpremium - Binmodelpremium	2.33738E2	335.48631	30.62557	173.09606	294.37944	7.632	119	.000

The above table show that the p value is more than 0.05 for Nifty 50 Index under all the three models with GARCH volatility namely Black-Scholes model ,Black's model and Binomial option pricing model which indicates that there is no significant difference between the calculated model price and actual price of the these Nifty 50 Index call options . The three option pricing models are effectively pricing the option premium of Nifty 50 Index . In the case of Nifty Bank Index when Black-Scholes model, Black's model and Binomial model with GARCH volatility is used for calculating premium p value is less than 0.05 which shows that there is a significant difference between the calculated model price and actual price of the Nifty Bank Index call options .For Nifty IT Index the p value is less than 0.05 in the case of all the three option pricing models with GARCH volatility the results indicate that there is a significant difference between

the calculated model price and actual price of the Nifty IT Index call options using the three models .

When the use of GARCH volatility is done for the option pricing models the results show that Black-Scholes model and Black's model are underestimating option premium of Nifty 50 Index. While the Binomial model is overestimating option premium of Nifty 50 Index. For Nifty Bank Index the model premium of call options using the three option pricing models is found to be overestimated .While for Nifty IT Index call option premiums are found to be underestimated.

CHAPTER FIVE

FINDINGS ,CONCLUSION AND SUGGESTIONS

5.1 Major Findings of the Study

A) Pricing of Stock Options using Black-Sholes, Black's and Binomial model.

5.1.1 In the case of Black-Sholes option pricing model using historical volatility it is observed that out of 39 stock options chosen for the study pricing of three stock call options i.e. Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd. was done efficiently by the Black- Scholes model as the calculated prices are close to market prices but for most of the stocks i.e. for 36 stock call options it was observed that there is a significant difference between the actual and calculated call option prices of these stock option.

5.1.2 It is observed that the Black-Scholes model using historical volatility is underestimating majority of the stock call option premiums. Only in the case of stock call option of Tata Power Company Ltd. the Black-Scholes model has resulted in overestimating its option premium.

5.1.3 Pricing of stock options using Black's option pricing model with historical volatility revealed that out of 39 stock options chosen for the study Black's option pricing model effectively priced two stock call options i.e. HDFC Bank Ltd. and Tata Power Company Ltd. The calculated prices of these two options were close to market prices but for most of the stocks i.e. for 37 stock call options it was observed that there is a significant difference between the actual and calculated call option prices of these stock options .

5.1.4 When historical volatility is used in the Black's model it is found that the model resulted in underestimating majority of the stock call option premiums. Only Tata

Power Company Ltd. call option premium was overestimated by the Black's model .

5.1.5 Three stock call options i,e. Bharat Heavy Electricals Ltd., HDFC Bank Ltd. and Tata Power Company Ltd. are found to be having no significant difference between the calculated model price using Binomial model with historical volatility and the market price and hence are effective in pricing these options. While the remaining 36 stocks call options are found to be having a significant difference between the calculated model price using Binomial model and actual price .

5.1.6 It is observed that when historical volatility is used for calculation option prices using Binomial option pricing model majority of the stock option premiums are underestimated. Only Tata Power Company Ltd. call option premium was overestimated by the Binomial option pricing.

5.1.7 It is observed that when the use of historical volatility is done the Black-Scholes, Black's and Binomial option pricing models resulted in underestimating most of the stock option premiums.

5.1.8 In the case of Black- Scholes option pricing model using GARCH volatility it is observed that pricing efficiency improved . In the Black- Scholes model the calculated prices are close to market prices for fourteen stocks .

5.19. Black- Scholes option pricing model has overestimated stock options of thirty stock while it has underestimated nine stock option premiums.

5.1.10 Pricing of stock options using Black's option pricing model with GARCH volatility revealed that out of 39 stock options chosen for the study Black's option pricing model effectively priced nineteen stock call options . The calculated prices of these options were close to market prices .

5.1.11 Black's option pricing model has overestimated stock options of twenty four stock while it has underestimated fifteen stocks option premiums.

5.1.12 Ten stock call options are found to be having no significant difference between the calculated model price using Binomial model with GARCH volatility and the market price .

5.1.13 Binomial option pricing model has overestimated stock options of thirty four stock while it has underestimated call option premiums of five stocks

5.1.14 Among all the three option pricing models used in the present study by making use of GARCH volatility in their pricing equation , it is found that Blacks model is more efficient followed by Black-Scholes model and Binomial option pricing model .

5.1.15 It is observed that when the use of GARCH volatility is done in all the three models namely Black-Scholes, Black's and Binomial option pricing model these models have resulted in overestimating most of the stock option premiums.

5.1.16 It is found that the pricing efficiency of Stock options improves when GARCH volatility is used instead of historical volatility for volatility variable in the pricing equation of all three option pricing models namely Black-Scholes, Black's and Binomial option pricing model.

5.1.17 It is observed that Black-Scholes, Black's and Binomial option pricing model with historical volatility resulted in underestimating most of the stock option premiums. While when GARCH volatility was used the models were found to overestimate the stock option premiums in most cases.

B) Pricing of Index Options using Black-Sholes , Black's and Binomial model .

5.1.18 The results of pricing of index option using Black-Scholes, Black's and Binomial option pricing model with historical volatility show that for all the three indices namely Nifty 50 Index, Nifty Bank Index and Nifty IT index call options there is significant difference between the calculated model price and actual price .

5.1.19 When the use of historical volatility is done for the option pricing models the results show that the BS model , Black's model and Binomial model are underestimating option premium of all the three indices namely Nifty 50 Index, Nifty Bank Index and Nifty IT Index.

5.1.20 It is observed that the three option pricing models with GARCH volatility are effectively pricing the option premium of Nifty 50 Index .

5.1.21 In the case of Nifty Bank Index when Black-Scholes model, Black's model and Binomial model with GARCH volatility is used for calculating premium it is observed that there is a significant difference between the calculated model price and actual price of the Nifty Bank Index call options .

5.1.22 The performance of the Black-Scholes model, Black's model for Bank Nifty index improved with GARCH volatility variable in comparison to historical volatility.

5.1.23 For Nifty IT index it is observed that there is significant difference between the calculated model price and actual price using all the three models with GARCH volatility .

5.1.24 When the use of GARCH volatility is done for the option pricing models the results show that BS model and Black's model is underestimating option premium of Nifty 50 Index while the Binomial model is overestimating its premium.

5.1.25 All the three option pricing models with GARCH volatility are overestimating call option premium of Bank Nifty Index.

5.1.26 All the three option pricing models with GARCH volatility are underestimating call option premium of Nifty IT Index.

5.1.27 It is found that the pricing efficiency of Nifty 50 Index options improved when GARCH volatility is used instead of historical volatility in the pricing equation of all three option pricing models namely Black-Scholes, Black's and Binomial option pricing model.

5.2 Conclusion

The present study conducted empirical tests of three option pricing models namely Black-Scholes, Black's and Binomial option pricing models. The study also introduced modifications in the Black-Scholes, Black's and Binomial option pricing models related to the assumption based on volatility variable. GARCH volatility was used in place of historical volatility in the pricing equations. Empirical tests were conducted of the Black-Scholes, Black's and Binomial option pricing models with GARCH volatility . The pricing was done for 39 stock call options and three index options which were on the National Stock Exchange for a continuous period of five years from April 2012- March 2017. The findings suggest that GARCH volatility variable resulted in improving pricing efficiency of the models in comparison to Historical volatility variable. Pricing performance of Black-Scholes, Black's and Binomial option pricing models for stock options as well as index options improved with the use GARCH volatility variable in the pricing equations in many cases. The calculated premiums using the Black-Scholes, Black's and Binomial option pricing models with GARCH volatility are very close to the

actual market premium. This improvement is largely due to the ability of the GARCH model to simultaneously capture the correlation of volatility with spot returns and the path dependence volatility. GARCH models use historical data to produce estimates of current and forecast of future volatility. GARCH models recognize that volatility is not constant, and attempt to keep track of its evolution throughout time. It is observed that the three models namely Black-Scholes, Black's and Binomial option pricing models with historical volatility resulted in underestimating most of the stock option premiums. While when GARCH volatility was used in these three option pricing models it resulted in overestimating most of the stock option premiums. In the case of Index options when option pricing is done using these three option pricing models with GARCH volatility, BS model and Black's model resulted in underestimating option premium of Nifty 50 Index and Nifty IT Index while it is overestimating call option premium of Bank Nifty Index. The Binomial model overestimated the Nifty 50 Index and Bank Nifty Index call option premiums while resulted in underestimating call option premium of Nifty IT Index. Black's model remains superior as it is found to be more efficient in estimating price of options followed by Black-Scholes and Binomial Model . Overall No single model perform best for all categories of options.

5.3 Suggestions

In this study an attempt is made to anlayse the applicability of Black-Scholes, Black's and Binomial Model with historical and GARCH volatility for stock as well as index options from NSE. Based on the above findings and conclusion, the following suggestions are offered .The concept of non –constant volatility has been introduced by GARCH process. It is revealed that all modes are effectively pricing most of the call options of stocks and

indices when GARCH volatility is used. Price is dependent upon the volatility calculated. Black-Scholes, Black's and Binomial Model with GARCH volatility can be used by investors and other participants to price the premiums as these models are found to be relevant for Indian market in many cases . Other approaches to test the model such as using implied volatility , calculated risk free rate etc can be carried out to evaluate the pricing performance .

5.4. Scope for further research

5.4.1 The current research is confined to NSE only ,the research can be further extend the study for other exchanges in India as well as foreign exchanges.

5.4.2 The study can be extended to pricing of Put options.

5.4.3 The present study has used only three models namely Black-Scholes, Black's and Binomial option pricing models. More option pricing models can be applied to know the pricing efficiency.

5.4.4 The present study is done for a period of five years . Study can be done for a longer time period.

5.4.5 A study on investor sentiments on options pricing can be done .

5.4.6 The volatility can be measured through other models of volatility measurement.

BIBLIOGRAPHY

- Ahmed, A. and Suliman, S., (2011), "Modeling Stock Market Volatility Using GARCH Models: Evidence from Sudan", *International Journal of Business and Social Science*, Vol.2, No.23, pp.114-128.

- Amilon H. (2003), "A Neural Network versus Black–Scholes: A Comparison of Pricing and Hedging Performances", *Journal of Forecasting,* J. Forecast. Vol 22, pp. 317–335.

- Arnold, T., Crack, T. F. and Schwartz, A. (2007), "Valuing Real Options Using Implied Binomial Trees and commodity Futures options",*The Journal of Futures Markets*, Vol. 27, No. 3, pp. 203–226.

- Arora, K. and Sharma, M.(2015), "Study of option price deviation using Black Scholes option pricing model for equity options in India" *International Journal of Research in Commerce ,Economics & Management,* Vol. 5, No.10, pp.18-23.

- Balaji , DK. and Nagaraju, Y.(2013), "An Empirical study on the determinants of Call European option prices and the veracity of black-Scholes model in Indian options market", *International Journal of Research in Computer Application & Management* , Vol. 3, No.1, pp. 122-127.

- Bandivadekar, S. and Ghosh S.(2003), "Derivatives and Volatility on Indian Stock Markets", *Reserve Bank of India Occasional Papers*, Vol. 24, No. 3, pp.187-201.

- Bennell, J. and Sutcliffe, C. (2004), "Black–Scholes Versus Artificial Neural Networks In Pricing FTSE 100 options", *Intelligent Systems in Accounting Finance and Management* ,Vol 12, pp. 243–260.

- Bhat, A. and Arekar, K.(2016), " Empirical Performance of Black-Scholes and GARCH Option Pricing Models during Turbulent Times: The Indian Evidence",*International Journal of Economics and Finance*, Vol. 8, No. 3, pp. 123-136.

- Bi, Z. ,Yousuf, A. and Dash, M. .(2014),," A Study on Options Pricing Using GARCH and Black-Scholes-Merton Model",*Asian Journal of Finance & Accounting* , Vol. 6, No. 1, pp. 423-439.

- Biger, N. and Hull, J. (1983) , "The Valuation of Currency Options", *Financial Management/Spring*, pp. 24-28

- Black, F. (1976), "The pricing of commodity contracts", *Journal of Financial Economics*, Vol 3, Nos. 1 & 2, pp.167-179.

- Black, F., Derman, E. and Toy, W. (1990), "A one-factor model of interest rates and its application to Treasury bond options", *Financial Analysts Journal*, 46, pp.33–39.

- Black, F. and Scholes, M. (1973), "The Pricing of Options and Corporate Liabilities", *The Journal of Political Economy*, Vol.81, No.3, pp.637-654.

- Bolia, N. and Juneja, S. (2005), "Monte Carlo methods for pricing financial options**",** *Sadhana,* Vol. 30, Parts 2 & 3, pp. 347–385.

- Chicaíza, L., Cabedo, D. (2009), "Using the Black Scholes method for estimating high cost illness insurance premiums in Colombia", *Está en: Inicio* , Vol. 19, No. 33, pp. 119-130

- Cox, J.C.,Ross, S. A. and Rubinstein, M.(1979) , "Option pricing: A simplified approach**" ,** *Journal of Financial Economics,* Vol.7, pp. 229-263.

- Eraker, B. (2004), "Do Stock Prices and Volatility Jump? Reconciling Evidence from Spot and Option Prices",*The Journal of Finance*,Vol. LIX, No. 3, pp.1367-1403.

- Fleming, J. (1998), "The quality of market volatility forecasts implied by S&P 100 index option prices", *Journal of Empirical Finance*, Vol.5, pp. 317–345.

- Frino, A., Khan, E., & Lodh, S. (1991), "The Black Scholes Call Option Pricing Model and the Australian Options Market: Where Are We After 15 Years", *Faculty of Business-Accounting & Finance Working Papers*, No. 24, pp. 1-21.

- Gay, R. (2011), " Using Black-Scholes to determine an optimal funding term" , *Managerial Finance*, Vol. 37, No. 11, pp. 985-994.

- Geske, R. (1979), "The valuation of compound options", *Journal of Financial Economics*, Vol.7, pp.63-81.

- Gupta S. (2014), "Effectiveness of the Black and Scholes Model in pricing Nifty Call Options", *The International journal of Business and Management*, Vol 2, No 7, pp.149-158.

- Huang, Z., Wang, T. and Hansen, P.R.(2017), "Option Pricing with the Realized GARCH Model: An Analytical Approximation Approach",*The Journal of Futures Markets*, Vol. 37, No. 4, pp.328–358 .

- Kallsen, J. and Taqqu, M.S. (1998), "Option Pricing In ARCH-Type Models", *Mathematical Finance*, Vol. 8, No. 1, pp. 13–26.

- Kaminski, S. (2013), "The pricing of options on WIG20 using GARCH models", Working Paper , *University of Warsaw, Faculty of Economic Sciences*, No.6 , pp.1-30.

- Kanojia, S. and Jain, N. (2017) , "Forecasting Volatility and Pricing Option: An Empirical Evaluation of Indian Stock Market",*IOSR Journal of Business and Management*, Volume 19, Issue 7. ,pp. 01-08.

- Khan, M.U. (2013) " The Analysis of Black-Scholes Option Pricing Model and Its Effectiveness in the Valuation of Options" Retreived from http://hdl.handle.net/10603/39685, pp.01-241.

- Khan, M. U., Gupta, A., & Siraj, S. (2013) "Empirical Testing of Modified Black-Scholes Option Pricing Model Formula on NSE Derivative Market in India", *International Journal of Economics and Financial Issues*, Vol. 3, No. 1,pp. 87-98.

- Latane H.A., and Randleman, R.J. (1976), "Standard Deviations of Stock Price Ratios Implied in Option Prices" *Journal of Finance* ,31 (2) pp. 369-381.

- Lauterbach, B. and Schultz, P. (1990), " Pricing Warrants :An Empirical Study of the Black –Scholes Model and its alternatives" , *Journal of finance*, Volume 45, Issue 4, pp. 1181-1209.

- Lin, B. and Chen, Y. (2009), "Negative Market Volatility Risk Premium: Evidence from the LIFFE Equity Index Options", *Asia-Pacific Journal of Financial Studies*, Vol 38. No 5, pp773-800.

- Macbeth, J.D. and Merville, L.J. (1979), "An Empirical Examination of Black – Scholes Call Option Pricing Model", *Journal of Finance*, 34(5), pp.1173-1186.

- Macbeth, J. D. and Merville, L. J. (1980), "Tests of the Black-Scholes and Cox Call Option Valuation Models" *Journal of finance*, Vol 35, Issue 2, pp.285-301.

- Marsh, T. and Kobayashi, T. (2000), "The Contributions of Professors Fischer Black, Robert Merton and Myron Scholes to the Financial Services Industry", *International Review of Finance*, Vol 1:4, pp. 295- 315.

- Miltersen, K. R. and Schwartz, E. S. (1998), "Pricing of options on commodity futures with stochastic term structures of convenience yields and interest rates", *Journal of Financial and Quantitative Analysis,* Vol 33, No.1 ,pp. 33–59.

- Mitra, S.K. (2008), "Valuation of Nifty Options Using Black's Option Pricing Formula". *The Icfai Journal of Derivatives Market*, Vol .5, No.1, pp. 50-61.

- Mitra, S.K. (2012), "Pricing of Index Options Using Black's Model", *Global Journal of Management and Business Research*, Vol. 12, No. 3, pp.89-96.

- Mohammad, F. (2013), "Empirical performance of the Black-Scholes model in India",pp.1-143 . Retrieved from http://hdl.handle.net/10603/180890

- Moraleda, J.M. and Pelsser, A. (2000) "Forward versus spot interest rate models of the term structure: An empirical comparison", *The Journal of Derivatives,* Vol.7, pp. 9–21.

- Mundra, N. and Agarwal, R. (2009), "Mispricing in Indian Derivatives Markets: An Analytical Study of Option Contracts", Working paper series, Available at SSRN: http://dx.doi.org/10.2139/ssrn.1441900 .

- Nagarajan, T. and Malipeddi, K.(2009), "Effects of market sentiment in index option pricing: a study of CNX NIFTY index option", *Munich Personal RePEc Archive*, No. 17943, pp.1-7.

- Nagendran, R. (2008), "An empirical study of the Black - Scholes European option pricing formula in pricing the stock call-options in indian stock option market" Retrieved from http://hdl.handle.net/10603/46, pp.01-333.

- Nagendran, R. and Venkateshwar, S. (2014) , " Validating Black –Scholes model in pricing Indian stock call options" , *Journal of Applied Finance and Banking* , Vol.4. No 3, pp. 89-101.

- P. Pavlatka (2010) ," Option Derivatives in Electricity Hedging" , *ActaPolytechnica Journal of Advanced Engineering* ,Vol. 50, No. 4, pp. 65-69.

- Panduranga, V. (2013), "An Empirical analysis of Black –Scholes option pricing model for select Banking stocks", *Vidyaniketan Journal of Management and Research*, Vol.1, No. 2, pp. 23-30.

- Panduranga, V. (2013), "Relevance of Relevance of Black –Scholes option pricing model in Indian Derivatives Markets -A Study of Cement Stock Options ", *International Journal of Multidisciplinary Research in Social and Management Sciences*, 1(4), pp.91-95.

- Posedel, P. (2006) "Analysis of the Exchange Rate and Pricing Foreign Currency Options on the Croatian Market: the NGARCH Model as an Alternative to the Black-Scholes Model", *Financial Theory and Practice* , Vol. 30 , No. 4 , pp. 347-368.

- Rhee,D.W., Byun, S. J. and Kim, S. (2011), "Empirical Comparison of Alternative Implied Volatility Measures of the Forecasting Performance of Future Volatility", *Asia-Pacific Journal of Financial Studies, Vol.* 41, pp. 103–124.

- Saedi, Y.H.A. and Tularam, G.A. (2018), "A Review of the Recent Advances Made in the Black-Scholes Models and Respective Solutions Methods", *Journal of Mathematics and Statistics*, Vol.14, No. 1, pp. 29-39.

- Saravanan S. and Kumar, G. P. (2012), "Estimation of Stock Option Prices using Black-Scholes Model", *International Journal of Research in Commerce , IT & Management*, Vol. 2, No. 11 , pp. 130-136.

- Sarwar, G. and Krehbiel, T. (2000), "Empirical Performance of Alternative Pricing Models of Currency Options",*The Journal of Futures Markets*, Vol. 20, No. 2, pp. 265–291 .

- Savickas, R. (2002), "A Simple Option-Pricing Formula",*The Financial Review*, Vol. 37, pp. 207—226.

- Schaefer,S.M. and Schwarz, E.S. (1987), "Time –Dependent Variance and Pricing of Bond Options" , *Journal of finance* ,Volume 42, Issue 5, pp. 1113-1128.

- Scott, L. O. (1987),"Option Pricing when the Variance Changes Randomly: Theory , Estimation , and an Application",*Journal of Financial and Quantitative Analysis* , Vol. 22, No. 4, pp. 419-438.

- Sharma, S. (2012) Empirical Testing of the Performance of Black and Scholes Option-Pricing Model with Alternative Volatility Measures, Retrieved fromhttp://hdl.handle.net/10603/31751, pp01-378.

- Sheraz ,M. and Preda, V. (2014) , " Implied volatility in black-scholes model with GARCH volatility" , *Procedia Economics and Finance* ,Vol 8, pp. 658 – 663 .

- Singh S. and Vipul (2015), "Performance of Black –Scholes model with TSRV estimates", *Managerial Finance*, Vol. 41 No. 8, pp. 857-870.

- Singh V.K. (2013), "Empirical performance of option pricing models : Evidence from India ", *International Journal of Economics and Finance* , Vol.5, No.2, pp. 141-154.

- Singh V.K. and Ahmad N. (2011), " Forecasting performance of Volatility Models for pricing S& P CNX Nifty Index Options via Black- Scholes model",The IUP Journal of Applied Finance , Vol 17, No 3,pp.53-64.

- Thakker, H. and Attarwala, A.A (2016),"Testing the efficiency of the Binomial option pricing model in the Indian equity options markets for the period 2010 to 2015 using the Nifty option", *Abhinav National Monthly Refereed Journal of Research in Commerce & Management,* Vol. 5, No.11, pp.29-36.

- Tripathi, V. and Gupta, S. (2011), "Effectiveness of the Skewness and Kurtosis adjusted Black- Scholes model in pricing Nifty call options", *The Indian Journal of Commerce*, Vol.64, No.4, pp.17-30.

- Ubukata, M. and Watanabe, T. (2014), "Pricing Nikkei 225 Options Using Realized Volatility", *The Japanese Economic Review,* Vol. 65, No. 4, pp.431-467

- Wang, T., Shen ,Y., Jiang, Y., and Huang, Z. (2016), "Pricing the CBOE VIX Futures with the Heston–Nandi GARCH Model", *The Journal of Futures Markets*, Vol. 37, No. 7, pp.641–659.

- Xiaoping, H. and Jie, C. (2014) "Randomized Binomial Tree and Pricing of American-Style Options", *Mathematical Problems in Engineering*, Vol. 2014, pp.1-6.

- Yung, H.H.M. and Zhang, H. (2003)," An Empirical Investigation of the GARCH Option Pricing Model: Hedging Performance", *The Journal of Futures Markets*, Vol. 23, No. 12, pp.1191–1207.

- Zhang, Z. and Lim, K.(2006), " A Non-Lattice Pricing Model Of American Options Under Stochastic Volatility", *The Journal of Futures Markets*, Vol. 26, No. 5, pp.417–448.

Websites References:

- https://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm#

- http://www.afriheritage.org/TTT/3%20Brooks_Introductory%20Econometrics%20for%20Finance%20(2nd%20edition).pdf

- https://rbi.org.in/scripts/PublicationsView.aspx?id=17251

- https://himayatullah.weebly.com/uploads/5/3/4/0/53400977/gujarati_book.pdf

- https://www.nseindia.com/global/content/about_us/AnnualReport-2016.pdf

- https://rbi.org.in/scripts/PublicationsView.aspx?id=17251

- https://www.nseindia.com/education/content/factbook.htm

- https://www.moneycontrol.com/stocks/marketstats/indexcomp.php?optex=NSE&opttopic=indexcomp&index=9

- http://www.moneycontrol.com/markets/indian-indices/

Books:

- Chance, D.M. and Brooks, R., (2010), "An Introduction to Derivatives and Risk Management", Eighth Edition, Pre-Press PMG, Canada .

- Das , S. (2006), "Derivatives products & pricing" , 3rd Edition Revised , John Wiley & Sons (Asia) Pte Ltd , Singapore .

- Dubofsky D. A. ,(1992), "Options and Financial Futures: Valuation Uses, International Edition, McGraw -Hill, Inc.

- Durbin M., (2006), "All about Derivatives ''**,** Tata McGraw –Hill Edition

- Gupta , S.L. , (2011), "Financial Derivatives Theory , Concepts and problems" , Eleventh Edition, PHI Learning private limited , New Delhi .

- Mahajan, R . (2002), "Future & Options: Indroduction to Equity Derivatives", (Revised Edition, Vision Books Pvt Ltd., New Delhi.

- Patwari, D.C. and Bhargava, A. , (2009), "Options and Futures An Indian perspective" , Third Edition, Jaico publishing house , Mumbai .

- Sharma , M. , (2015), " Financial Derivatives : A case study based learning", Durgaprintographics, Delhi.

- Somanathan, T.V. ,Nageswaran, V.A. and Gupta, H. , (2018), "Derivatives", Second Edition, Cambridge University Press New York.

- Sridhar,A.N. (2006), "Futures and Options Equities –Trading strategies and skills", Fourth Edition , Shroff publishers & distributors Pvt. Ltd. , Mumbai .

- Swain, P.K. (2012), "Fundamentals of Financial Derivatives", First Edition, Himalaya Publishing House, Mumbai.

APPENDIX-I

Table 1: Calculated option premiums and market premiums of ACC Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	43.3	28.36	18.2	29.41	42.47	33.12	44.99
	22.95	22.22	13.5	23.59	36.95	28.38	39.65
May-12	211.55	54.39	52.35	47.25	69.33	67.69	68.39
	36	17.09	15.63	18.14	39.42	38.17	42.53
Jun-12	180.95	28.3	32.19	28.82	49.36	52.68	52.24
	146.3	16.25	18.99	17.17	38.82	41.66	41.89
Jul-12	45.35	32.89	26.93	32.81	46.75	41.66	48.67
	22.1	7.46	5.08	3.7	22.06	18.88	22.15
Aug-12	50	54.35	41.84	48.23	63.91	53.39	62.01
	30.95	18.03	11.07	19.12	32.88	25.74	35.39
Sep-12	44.75	26.91	27.55	27.96	51.01	51.7	54.41
	22.2	20.84	21.31	22.14	45.73	46.36	49.24
Oct-12	54.4	37.49	31.79	37.53	59.13	54.4	62.02
	31.9	10.82	8.05	8.42	34.04	30.66	35.93
Nov-12	44.4	25.83	27.23	27.2	39.74	41.13	42.4
	22.7	20.14	21.27	21.38	34.44	35.7	37.04
Dec-12	63.85	47.03	47.97	44.08	57.01	57.81	56.86
	33.5	14.82	15.02	14.97	28.11	28.53	29.98
Jan-13	43.5	29.18	26.27	30.29	45.02	42.52	47.74
	21.85	6.96	5.66	1.18	22.04	20.4	21.16
Feb-13	57.9	34.19	33.22	34.11	60.89	60.2	64.2
	27.8	8.33	7.68	5	36.41	35.87	38.61
Mar-13	34.85	32.4	18.09	32.42	50.29	37.68	52.69
	16.6	7.27	2.56	3.31	25.87	17.88	26.53
Apr-13	40.15	18.73	17.75	19.81	32.69	31.92	35.02
	31.25	9.12	8.34	7.98	23.1	22.44	24.35
May-13	48.6	24.33	19.51	25.24	39.34	35.14	41.77
	40	18.22	14.09	19.32	33.91	30.06	36.44
Jun-13	60	31.82	30.27	31.32	47.17	45.94	49.04
	36.45	18.39	17.05	19.49	35.8	34.72	38.47

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	43.35	20.76	18.24	21.87	38.22	32.29	40.91
	32.5	10.66	8.88	10.04	28.42	22.83	30.36
Aug-13	45.7	26.68	19.56	27.16	65.14	59.31	69.56
	33.85	14.63	9.64	15.33	55.06	49.81	59.59
Spt-13	43.75	17.62	15.44	18.43	39.64	37.86	42.48
	28.2	7.56	6.16	6.6	29.98	28.47	32.25
Oct-13	161.65	30.76	34.6	29.81	48.56	51.62	50.52
	53	16.98	19.71	17.99	37.31	39.92	40.13
Nov-13	42.5	18.88	20.56	19.93	43.2	44.85	46.42
	32.8	9.13	10.03	8.1	33.62	35.01	36.13
Dec-13	48.5	28.43	30.6	28.02	44.96	46.77	46.97
	38.5	15.28	16.69	16.2	33.9	35.4	36.52
Jan-14	38.4	19.06	19.44	20.09	36.21	36.69	38.79
	30.3	9.16	9.23	8.26	26.52	26.88	28.28
Feb-14	33.1	22.91	18.55	23.21	39.95	36.35	42.22
	24.7	11.06	8.14	11.37	29.49	26.5	31.81
Mar-14	23.4	20.32	7.28	21.25	41.47	28.41	44.36
	15	9.87	2.52	9.42	31.61	20.81	34.01
Apr-14	51.25	23.9	22.79	26.8	44.36	43.44	48.94
	41.15	22.64	13.24	15.26	43.76	33.92	38.48
May-14	66.8	22.57	26.91	30.36	51.39	55.03	60.76
	53.05	22.59	15.96	18.82	51.41	45.02	50.53
Jun-14	103.95	34.35	32.3	34.76	66.74	64.9	67.51
	94.35	21.8	20.07	23.21	43.34	41.85	46.68
Jul-14	72.35	31	25.88	32.28	53.05	48.57	56.48
	48.65	19.65	15.68	20.73	42.69	38.76	46.06
Aug-14	121.6	33.99	31.21	34.64	56.8	54.52	60.04
	111.9	21.69	19.42	23.1	46.08	44.04	49.68
Spt-14	67	62.78	62.8	56.59	80.61	80.61	80.3
	45.55	26.07	25.8	27.72	50.48	50.41	54.28
Oct-14	54.9	34.72	32.41	35.52	58.54	56.66	61.96
	23.65	22.52	20.58	23.98	47.85	46.17	51.6
Nov-14	50	38.66	37.19	39.09	60.53	59.38	63.65
	39.9	25.9	24.58	27.54	49.49	48.44	53.22

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	42.9	35.54	31.35	36.39	56.68	53.12	59.88
	33.05	23.33	19.94	24.84	45.88	42.73	49.43
Jan-15	52	32.89	34.48	33.78	53.92	55.39	57.09
	32.1	20.93	22.02	22.24	43.27	44.53	46.66
Feb-15	54.15	27.65	25.26	29.37	50.69	48.62	54.44
	40.45	17.63	15.72	17.83	40.93	39.1	43.98
Mar-15	48.1	37.65	21.47	38.99	62.31	47.31	44.1
	41.45	25.79	13.26	27.44	51.68	38.41	38.78
Apr-15	79.5	30.68	34.79	31.94	55.26	58.94	58.91
	54	24.61	28.18	26.14	49.93	53.38	53.71
May-15	54.9	32.95	30.97	33.64	55.41	53.83	58.62
	45.7	20.75	19.09	22.06	44.7	43.29	48.21
Jun-15	54.25	32.04	33.42	33.01	54.88	56.18	58.24
	30.55	8.51	8.86	4.04	31.21	32.06	32.2
Jul-15	40.8	23.34	17.71	24.76	43.33	38.07	46.52
	32.05	13.49	9.52	13.17	33.64	29.17	36.04
Aug-15	44.5	26.79	24.04	27.98	48.45	46.12	51.7
	34.45	15.81	13.7	16.39	38.28	36.25	41.29
Spt-15	48.8	23.56	17.22	24.9	41.88	35.98	44.87
	40.25	13.42	9.01	13.31	32.05	27.08	34.36
Oct-15	67.3	32.34	26.71	32.53	46.28	41.42	48.34
	45.05	19.69	15.37	20.95	35.07	30.94	37.73
Nov-15	66	35.06	29.61	34.92	48.75	44.08	50.63
	39.4	21.96	17.66	23.33	37.27	33.26	40.01
Dec-15	43.3	30.1	27.07	30.76	32.13	29.2	33.07
	32.5	18.08	15.71	19.17	20.38	18.05	21.71
Jan-16	41.5	30.73	27.93	31.37	45.94	43.58	48.36
	26.8	18.64	16.42	19.78	35.07	33.02	37.78
Feb-16	30.85	19.97	15.98	21.21	41.51	37.84	44.66
	26.75	10.51	7.84	9.62	32.03	28.91	34.3
Mar-16	44.7	26	22.4	26.65	45.11	42.08	47.82
	36.55	14.37	11.75	15.07	34.68	32.09	36.45
Apr-16	50.25	29.91	25.47	30.46	45.21	41.38	47.57
	40.5	17.81	14.44	18.91	34.34	31.08	37.01

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	43.3	23.45	22.99	24.78	44.39	44.11	47.6
	31.8	13.29	12.85	13.23	34.57	34.3	37.18
Jun-16	33	24.52	24.95	25.93	38.67	39.17	41.36
	37.45	14.34	14.51	14.39	28.74	29.12	30.69
Jul-16	54.2	35.34	33.49	35.78	49.16	47.6	51.38
	42.2	22.76	21.18	24.23	37.87	36.49	40.7
Aug-16	48	30.54	24.74	31.89	45.59	40.34	48.43
	40.6	19.33	14.89	20.34	35.09	30.61	37.74
Spt-16	52	36.2	37.95	36.57	51.59	53.17	53.95
	55	23.51	24.76	25.02	40.3	41.63	43.32
Oct-16	59	36.85	32.41	36.91	46.72	42.79	48.27
	44.05	23.87	20.27	25.37	34.95	31.59	37.45
Nov-16	48	33.41	33.11	33.77	53.44	53.27	56.25
	38.25	20.87	20.5	22.22	42.51	42.33	45.8
Dec-16	48	25.4	22.26	26.26	39.61	36.88	41.95
	41.65	14.12	11.82	14.71	29.15	26.87	31.38
Jan-17	39.35	26.83	19.7	27.56	46.43	40.2	49.25
	29.35	15.22	10.19	16.01	35.99	30.67	38.86
Feb-17	42.9	28.01	18	28.91	45.7	36.61	48.45
	33	16.49	9.42	17.36	35.19	27.51	37.95
Mar-17	38.15	32.58	27.58	32.65	45.43	41.11	47.3
	40.25	19.82	15.96	21.11	34.09	30.43	36.67

Source: Authors compilation

Table 2: Calculated option premiums and market premiums of Ambuja Cements Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	7.85	4.79	4.62	4.9	8.32	8.18	8.82
	3.5	2.1	1.97	2.09	5.82	5.71	6.28
May-12	28.2	9.79	9.14	8.04	11.56	11.02	10.99
	5.2	2.3	1.94	2.43	5.46	5.1	5.91
Jun-12	32.3	8.9	6.19	7.49	10.86	8.68	10.49
	24.6	2.81	1.39	3	5.96	4.45	6.43
Jul-12	7.1	6.15	4.35	5.98	9.14	7.61	9.47
	2.95	2.97	1.82	3.17	6.4	5.17	6.92
Aug-12	12.5	13.22	10.22	10.57	15	12.53	13.93
	2.5	2.18	1.09	2.16	5.84	4.43	6.28
Sep-12	8.35	7.32	7.3	6.92	9.88	9.87	10.05
	3.9	1.65	1.61	1.31	4.68	4.65	4.9
Oct-12	9	5.24	5.32	5.42	9.03	9.12	9.6
	4.55	2.58	2.61	2.62	6.54	6.61	7.05
Nov-12	12.1	10.1	9.9	9.03	12.8	12.63	12.67
	6.4	3.23	3.08	3.42	6.98	6.85	7.54
Dec-12	10.9	9.93	9.42	8.91	12.43	12.01	12.29
	5.7	3.13	2.82	3.3	6.62	6.32	7.15
Jan-13	8.2	4.78	5.09	5.01	7.75	8.05	8.27
	3.8	2.29	2.46	2.21	5.32	5.55	5.68
Feb-13	15.4	10.5	8.95	9.17	12.04	10.71	11.5
	6.1	3.34	2.47	3.56	5.81	4.93	6.27
Mar-13	7.6	5.42	4.52	5.53	9.61	8.83	10.18
	3.1	2.63	2.04	2.72	7.08	6.44	7.65
Apr-13	9.4	6.1	6.05	5.81	8.43	8.39	8.62
	6.85	2.77	2.71	2.95	5.58	5.55	6.02
May-13	8.7	5.05	4.99	5.1	7.11	7.06	7.43
	6.2	2.21	2.15	2.24	4.47	4.43	4.79
Jun-13	7	4.81	4.61	4.88	8.57	8.41	9.07
	4.9	2.04	1.89	2.02	6.05	5.91	6.52

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	7.4	4.55	4.19	4.68	9.99	9.7	10.67
	4.9	1.91	1.68	1.83	7.56	7.31	8.17
Aug-13	10.1	5.24	4.23	5.2	8.6	7.76	9.02
	7.7	2.26	1.64	2.34	5.98	5.31	6.47
Spt-13	5.7	4.11	5.15	4.25	8.37	9.24	8.92
	4.6	1.57	2.14	1.39	5.95	6.65	6.4
Oct-13	16.5	6.46	7.09	6.15	8.95	9.47	9.15
	9.95	3.09	3.5	3.3	6.08	6.5	6.56
Nov-13	9.55	5.52	5.69	5.48	8.91	9.06	9.34
	6.5	2.51	2.59	2.62	6.27	6.38	6.77
Dec-13	10.55	7.17	7.47	6.66	9.81	10.06	9.96
	4.95	2.09	2.21	2.08	5.42	5.58	5.83
Jan-14	8.4	6.79	6.35	6.39	10.17	9.82	10.46
	6.1	3.32	2.99	3.53	7.35	7.05	7.91
Feb-14	7.2	5.79	4.38	5.46	9.35	8.23	9.69
	5.15	2.45	1.59	2.6	6.63	5.72	7.17
Mar-14	6.8	5.04	4.21	4.98	8.29	7.61	8.69
	4.25	2.06	1.56	2.12	5.68	5.14	6.13
Apr-14	10.1	3.48	4.52	6.88	8.13	9.52	11.36
	7.5	3.81	3.25	4.07	8.18	7.65	8.82
May-14	20	6.81	6.97	6.12	12.44	12.58	13.11
	10.35	3.68	3.77	4.78	9.82	9.94	10.62
Jun-14	10.9	5.96	4.9	5.78	10.39	9.47	11.02
	8.7	3.15	2.43	4.44	7.84	7.07	8.48
Jul-14	11.35	5.32	4.81	5.52	9.58	9.14	10.23
	8.8	2.73	2.37	4.18	7.12	6.75	7.68
Aug-14	11.9	6.2	6.02	5.89	9.62	9.48	10.09
	6.3	3.22	3.08	4.55	6.97	6.84	7.53
Spt-14	12.2	10.35	10.38	7.29	12.89	12.92	12.7
	5.7	3.37	3.35	4.61	7	7	7.56
Oct-14	8.1	5.49	5.4	5.6	8.73	8.67	9.26
	6.2	2.81	2.73	4.26	6.21	6.15	6.68
Nov-14	9	6.18	5.59	5.86	9.11	8.59	9.61
	6.2	3.37	2.94	4.52	6.5	6.07	7.01

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	12	7.82	7.9	6.48	10.87	10.95	11.23
	7.3	4.55	4.59	5.14	8.03	8.09	8.64
Jan-15	8.65	5.14	5.49	5.42	8.32	8.66	8.89
	6.2	2.66	2.88	4.08	5.9	6.17	7.62
Feb-15	10.5	7.34	7.03	7.42	10.38	10.12	10.86
	9.2	4.32	4.07	4.61	7.65	7.43	8.26
Mar-15	9.8	8.22	5.58	8.26	12	9.65	8.18
	8.15	5.1	3.14	5.45	9.25	7.25	6.86
Apr-15	9.5	4.69	5.1	4.98	8.28	8.68	8.89
	7.5	2.33	2.57	2.14	5.91	6.22	6.29
May-15	9.05	5.04	4.78	5.29	12.28	12.07	13.18
	6.4	2.51	2.31	2.45	9.88	9.69	10.69
Jun-15	9.85	5.82	5.97	5.96	9.49	9.63	10.03
	7.15	2.99	3.07	3.12	6.9	7.01	7.45
Jul-15	8.1	5.24	4.64	5.42	8.92	8.41	9.48
	6.5	2.55	2.15	2.58	6.41	5.99	6.9
Aug-15	9.65	5.53	5.43	5.69	13.04	12.98	13.95
	7.1	2.77	2.68	2.85	10.59	10.53	11.47
Spt-15	9.55	4.3	4.09	4.51	7.66	7.49	8.19
	7.2	1.86	1.72	1.67	5.26	5.12	5.61
Oct-15	10.5	5.55	4.95	5.56	8.05	7.53	8.4
	7.6	2.6	2.2	2.72	5.37	4.96	5.79
Nov-15	9.5	4.86	4.64	5.01	7.89	7.71	8.36
	5.8	2.2	2.04	2.17	5.38	5.23	5.77
Dec-15	7.85	5.23	4.81	5.3	7.17	6.81	7.5
	5.3	2.4	2.12	2.46	4.53	4.25	4.85
Jan-16	6.25	4.02	3.58	4.25	8.22	7.84	8.83
	4.1	1.7	1.43	1.41	5.88	5.57	6.28
Feb-16	6.15	3.66	3.08	3.88	5.58	5.04	5.98
	3.95	1.45	1.12	1.04	3.3	2.91	3.33
Mar-16	8.5	6.04	5.97	5.84	8.49	8.44	8.74
	6.85	2.81	2.75	3	5.7	5.65	6.15
Apr-16	6.9	4.18	3.78	4.44	7.04	6.68	7.55
	6.15	1.9	1.65	1.62	4.71	4.43	4.94

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	8.05	4.32	4.48	4.55	8.84	9.01	9.48
	5.65	1.91	1.99	1.73	6.46	6.59	6.94
Jun-16	7.25	4.03	3.91	4.29	7.66	7.57	8.24
	5.3	1.79	1.7	1.47	5.35	5.27	5.66
Jul-16	10	6.11	6.06	6.22	8.21	8.17	8.58
	7.25	3.22	3.17	3.4	5.52	5.48	5.94
Aug-16	9.05	5.31	4.59	5.59	8.56	7.9	9.14
	6.75	2.78	2.29	2.77	6.09	5.56	6.52
Spt-16	9	5.17	4.79	5.44	8.49	8.16	9.08
	6.9	2.66	2.4	2.62	6.05	5.77	6.47
Oct-16	9.85	5.3	5.38	5.52	8.58	8.67	9.12
	7.35	2.68	2.71	2.7	6.07	6.14	6.52
Nov-16	8.4	4.91	4.99	5.14	12.12	12.22	13.01
	5.8	2.37	2.41	2.32	9.72	9.8	10.53
Dec-16	9.25	5.35	4.6	5.35	8.2	7.57	8.59
	6.9	2.43	1.95	2.53	5.56	5.06	6.01
Jan-17	7.15	4.26	3.73	4.45	7.29	6.83	7.77
	4.6	1.8	1.48	1.63	4.87	4.51	5.19
Feb-17	7.95	5.68	3.77	5.77	9.33	7.63	9.85
	5.75	2.82	1.62	2.95	6.73	5.35	7.28
Mar-17	9.6	7.18	5.63	6.9	9.71	8.38	9.93
	6.85	3.83	2.74	4.09	6.81	5.74	7.33

Source: Authors compilation

Table 3: Calculated option premiums and market premiums of Axis Bank Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	80	58.63	57.37	53.76	78.79	77.77	79.38
	52.6	24.63	23.68	26.42	50.23	49.41	54.27
May-12	47.1	27.89	18.48	29.63	57.04	47.74	61.35
	28.05	8.07	4.36	2.3	35.34	28.65	36.49
Jun-12	66.5	27.45	23.55	29.2	54.36	50.7	58.48
	40	7.88	6.21	1.87	32.82	30.19	33.5
Jul-12	45.05	33.12	27.41	33.86	47.53	42.36	49.98
	35.25	21.37	16.97	22.93	36.81	32.38	39.74
Aug-12	63	33.64	32.43	34.17	39	37.88	40.28
	38.25	21.66	20.66	23.23	27.59	26.64	29.69
Sep-12	48.85	30.01	30.51	31.11	57.19	57.71	60.99
	37.8	18.87	19.19	20.17	47.16	47.61	51.09
Oct-12	55.2	35.98	33.51	36.99	59.01	56.88	62.52
	46.15	24.29	22.27	26.06	48.55	46.64	52.45
Nov-12	74	64.66	63.77	58.86	72.98	72.17	70.43
	37.75	19.76	19.12	20.59	31.67	31.09	33.93
Dec-12	50.35	42.66	37.9	43.69	47.34	42.77	48.99
	26.8	17.07	14.32	16.36	22.05	19.17	22.26
Jan-13	55.3	37.05	37.64	39.02	57.14	57.78	60.99
	31.45	14.38	14.58	11.68	34.14	34.55	35.39
Feb-13	49.45	40.57	36.27	42.81	80.15	56.39	64.45
	27.1	17.45	14.9	15.47	57	34.16	38.72
Mar-13	49.65	39.68	35.24	41.39	72.25	45.82	52.79
	27.6	15.81	13.3	14.06	48.74	23.41	26.54
Apr-13	49.6	33.14	28.71	33.84	60.43	56.74	64.11
	39.05	21.02	17.54	22.39	49.93	46.63	53.91
May-13	59.05	30.65	25.28	32.25	53.79	48.96	57.52
	47.75	19.86	15.69	20.8	43.68	39.43	47.12
Jun-13	54.4	32.29	29.2	33.58	58.93	56.32	62.82
	43.55	20.88	18.4	22.13	48.64	46.31	52.54

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	43.25	27.04	14.22	28.49	84.85	72.16	91.39
	35.55	16.51	7.54	17.04	75.31	63.59	81.68
Aug-13	61.05	24.57	25.51	25.61	89.62	90.59	96.5
	52	13.74	14.28	14.16	80.22	81.12	87.05
Spt-13	83.7	39.85	43.22	34.9	104.42	106.73	110.5
	57.05	7.31	8.53	6.27	80.87	82.84	87.87
Oct-13	87.05	40.73	40.43	37.54	77.02	76.83	80.49
	61.7	9.76	9.41	8.91	51.73	51.57	56.07
Nov-13	67.7	34.3	35.95	34.29	75.17	76.59	79.87
	42.35	8.71	9.21	5.66	51.25	52.34	55.2
Dec-13	58.45	24.46	25.52	25.66	51.02	52.08	54.66
	35.4	10.01	10.46	8.48	36.78	37.62	39.42
Jan-14	84.5	56.01	57.23	50.4	82.83	83.77	84.38
	55.3	20.45	20.94	21.77	54.76	55.46	59.18
Feb-14	52.8	35.74	27.95	34.76	62.83	56.57	65.87
	30.25	19.19	13.67	20.44	49.37	43.97	53.28
Mar-14	48.6	33.8	24.41	34.15	62.33	54.32	65.98
	26.25	21.3	14.18	22.7	51.74	44.61	55.84
Apr-14	56.95	37.8	28.53	40.39	63.04	59.89	67.83
	47.85	27.84	20.28	29.56	53.37	45.16	57.7
May-14	91.7	45.73	44.08	48.12	74.68	73.24	79.77
	82.05	34.72	33.26	37.29	64.47	63.14	69.69
Jun-14	72.5	55.35	43.12	58.15	84.78	73.19	90.38
	61.3	44.1	33.49	47.32	74.36	63.69	80.22
Jul-14	83.95	53.09	53.53	56.35	125.39	126	134.99
	73.45	42.39	42.72	45.52	115.71	116.28	125.3
Aug-14	99	11.42	10.87	12.04	9.32	8.72	9.71
	40	9.2	8.7	9.87	6.98	6.45	7.45
Spt-14	16.45	13.35	12.74	13.83	23.13	22.61	24.6
	11.25	7.9	7.44	8.42	18.12	17.67	19.63
Oct-14	19.1	15.76	13.88	15.65	38.1	36.56	40.55
	13.75	9.55	8.12	10.24	33.18	31.77	35.89
Nov-14	18.05	16.82	14.91	16.91	16.12	14.16	16.08
	12.3	10.72	9.23	11.5	9.9	8.4	10.6

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	18.65	12.75	12.74	13.6	73.25	73.31	79.15
	13.95	7.95	7.91	8.18	69.03	69.08	74.9
Jan-15	21.7	14.96	15.53	15.71	18.4	18.96	19.49
	16.45	9.67	10.08	10.3	13.25	13.69	14.26
Feb-15	30.2	19.54	19.19	20.21	44.83	44.58	47.97
	25.4	13.78	13.47	14.79	39.9	39.66	43.18
Mar-15	29.2	18.42	18.24	19.13	16.97	16.76	11.48
	23.7	12.77	12.6	13.72	11.18	10.99	8.61
Apr-15	29.65	49.67	51.64	53.38	17.19	19.39	17.9
	24.2	44.94	46.79	48.72	11.65	13.4	12.52
May-15	26.15	52.5	51.99	56.31	18.05	17.39	18.51
	20.9	47.71	47.22	51.65	12.17	11.63	13.07
Jun-15	25.85	52.51	52.68	56.51	16.3	16.42	17.04
	16.35	43.43	42.58	47.19	6.74	6.76	6.13
Jul-15	22	50.86	47.94	54.72	24.18	21.18	25.69
	13.15	41.79	39.21	45.4	14.7	12.53	15.47
Aug-15	28.05	55.55	55.5	59.18	39.46	39.4	41.56
	17.65	45.94	45.9	49.86	29.3	29.24	31.78
Spt-15	27.9	47.28	47	50.66	27.51	27.2	29.09
	17.75	38.05	37.8	41.34	17.77	17.53	19.08
Oct-15	30.3	46.44	46.37	49.85	36.2	36.12	38.72
	24.55	41.69	41.62	45.19	31.28	31.21	33.9
Nov-15	20.4	43.14	42.38	46.36	19.99	19.18	21.16
	15.4	38.44	37.73	41.7	14.83	14.15	16.02
Dec-15	18.85	40.64	40.87	43.91	17.45	17.65	18.75
	14	36.12	36.33	39.24	12.74	12.89	13.61
Jan-16	20.15	43.22	43.07	46.11	25.46	25.29	26.62
	14.7	38.23	38.19	41.45	20.03	19.87	21.6
Feb-16	20.1	38.93	38.16	41.58	22.07	21.23	23.09
	14.5	34.09	33.37	36.92	16.7	15.99	18.05
Mar-16	24.15	36.03	35.64	38.59	20.93	20.51	22.12
	18.9	31.28	30.92	33.93	15.8	15.44	17.11
Apr-16	22.8	15.44	14.15	15.16	24.76	23.68	25.86
	17.4	9.04	8.05	9.68	19.32	18.39	20.85

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	18.85	10.91	11.04	11.54	19.65	19.8	21.07
	13.85	5.98	6.04	6.06	14.84	14.96	16.01
Jun-16	21.45	11.72	12.43	12.4	19.31	20	20.68
	16.35	6.75	7.22	6.93	14.46	15.02	15.57
Jul-16	16.85	12.63	8.96	13.33	22.41	18.89	24.01
	12.5	7.55	4.96	7.86	17.52	14.53	18.94
Aug-16	22.35	14.7	14.88	15.18	21.22	21.4	22.41
	16.85	9.08	9.18	9.71	15.97	16.11	17.26
Spt-16	20.55	15.65	14.12	16.19	27.4	26.06	29.15
	15.55	10	8.81	10.72	22.27	21.08	24.11
Oct-16	23.95	11.7	11.76	12.45	25.89	26	27.88
	18.75	6.88	6.9	6.98	21.16	21.25	22.91
Nov-16	20.6	14.04	13.82	14.31	22.93	22.77	24.23
	15	8.25	8.07	8.84	17.71	17.57	19.17
Dec-16	19.8	10.2	9.79	10.85	16.11	15.75	17.29
	14.85	5.5	5.2	5.38	11.4	11.1	12.14
Jan-17	21.7	15.48	14.04	15.18	20.16	18.89	20.69
	16.1	9.07	7.98	9.71	14.42	13.37	15.52
Feb-17	18	11.19	10.32	11.79	15.73	14.92	16.76
	13.25	6.17	5.55	6.32	10.81	10.16	11.56
Mar-17	24.4	15.86	15.3	15.91	24.04	23.57	25.18
	19.05	9.73	9.28	10.44	18.62	18.21	20.1

Source: Authors compilation

Table 4: Calculated option premiums and market premiums of Asian Paints call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	60.5	77.9	79.86	77.7	119.74	121.54	125.28
	50.05	45.35	46.36	48.08	91.88	93.32	98.86
May-12	120.9	68.85	55.87	71.21	125.72	114.73	133.79
	39.8	39.97	30.35	41.58	99.82	90.25	107.64
Jun-12	118.25	74.08	274.21	75.77	122.17	288.51	129.19
	103.85	43.82	224.99	46.14	95.41	246.55	102.79
Jul-12	129.4	84.84	84.72	86.19	145.81	146.01	154.13
	80.05	53.38	52.8	56.56	118.8	118.9	127.98
Aug-12	103.1	57.6	56.83	60.73	104.54	104.27	111.94
	62.35	31.98	31.01	31.1	79.84	79.52	85.44
Sep-12	353.7	82.74	86.77	83.43	133.36	136.94	140.31
	323.4	50.76	53.39	53.8	105.9	108.92	113.99
Oct-12	134.75	82.89	84.32	84.72	131.85	133.35	139.2
	109.65	52.07	52.69	55.1	104.67	105.87	112.66
Nov-12	103.35	75.01	69.25	77.81	130.02	125.38	138.3
	125.15	46.07	41.31	48.18	103.88	99.75	111.92
Dec-12	121.85	85.78	70.58	88.53	148.49	135.61	157.7
	98.95	55.76	43.65	58.9	121.93	110.47	131.38
Jan-13	160	96.69	104.12	98.08	145	151.56	152.29
	102	64.58	70.12	68.45	116.96	122.63	125.58
Feb-13	116.85	97.36	87.86	99.22	140.08	132.05	147.06
	76.2	65.64	57.59	69.59	111.92	104.77	120.1
Mar-13	278	72.54	59.09	76.41	120.62	108.61	128.9
	74	45.75	35.38	46.78	95.22	84.79	102.09
Apr-13	111.65	75.32	65.81	79.38	126.5	118.34	135.26
	96	48.57	40.84	49.27	101.1	93.88	108.18
May-13	145	72.05	71.74	75.9	121.56	121.83	129.95
	109.25	45.36	44.56	45.78	96.2	96.3	102.91
Jun-13	118	79.03	50.53	82.87	125.26	97.92	132.38
	80.35	51.13	29.57	52.76	98.17	75.51	105.15

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	124.55	91.35	84.85	93.47	181.89	177.04	193.49
	90.35	59.97	54.28	63.36	155.46	150.99	167.59
Aug-13	218.15	90.17	89.63	93.65	174.43	174.57	186.06
	150.35	60.45	59.43	63.53	148.29	148.34	159.85
Spt-13	17.4	6.73	3.56	7.06	13.84	10.85	14.82
	487.6	4.02	1.81	4.05	11.33	8.71	12.2
Oct-13	694.95	10.04	11.73	10.13	17.53	18.91	18.51
	660.95	6.74	8.07	7.12	14.78	16.03	15.89
Nov-13	19.65	9.69	8.8	10.06	18.7	18.01	19.95
	12.05	4.34	3.71	4.03	13.71	13.12	14.7
Dec-13	19.9	9.7	10.83	9.96	17.94	18.92	19.06
	10.6	4.16	4.76	3.94	12.87	13.65	13.82
Jan-14	18	9.09	6.27	2.07	15.15	12.83	15.9
	13.8	4.58	2.69	1.93	11.34	9.41	12.23
Feb-14	14	9.23	7.07	1.62	15.46	77.65	45.36
	9.6	4.73	3.22	1.48	11.66	70.76	41.67
Mar-14	13	7.13	5.22	1.55	16.61	15.63	17.8
	7.65	4.25	2.84	1.45	11.62	10.82	12.52
Apr-14	24	68.86	67.67	73.94	22.76	21.42	23.55
	17.8	64.25	63.12	69.5	17.04	15.89	18.31
May-14	11.25	63.6	64.04	68.69	19.04	19.45	20.13
	20.35	59.12	59.54	64.11	13.83	14.15	14.89
Jun-14	19	63.96	61.62	68.92	20.38	17.86	21.27
	15.4	59.41	57.18	64.34	14.87	12.79	16.03
Jul-14	25.75	71.8	71.51	77.58	21.27	20.92	22.57
	21.85	67.32	67.04	72.99	16.09	15.77	17.33
Aug-14	25.25	76.44	76.31	82.63	18.78	18.56	19.85
	14.85	71.97	71.84	78.03	13.49	13.28	14.46
Spt-14	22.5	79.53	78.82	85.68	27.53	26.72	28.83
	17.65	74.95	74.26	81.06	21.99	21.27	23.65
Oct-14	25.25	78.13	78.94	84.3	19.63	20.46	20.4
	21.65	73.59	74.37	79.69	13.94	14.59	14.96
Nov-14	21.55	81.47	80.65	87.94	23.1	22.16	24.29
	16.1	76.94	76.15	83.33	17.63	16.82	18.98

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	27	90.85	89.63	98.24	25.28	23.96	26.88
	22.1	86.37	85.19	93.6	20.06	18.89	21.61
Jan-15	44	89.83	91.21	97.01	30.59	31.96	32.54
	25.1	85.31	86.64	92.37	25.32	26.54	27.33
Feb-15	42.1	105.72	105.97	114.2	34.3	34.49	36.41
	34.25	101.19	101.44	109.53	28.98	29.13	31.23
Mar-15	33.2	99.42	99.79	107.4	30.38	30.7	21.41
	23.7	90.54	90.9	98.3	20.36	20.58	16.1
Apr-15	35	26.3	29.86	25.17	38.54	41.44	39.72
	27.85	12.96	15.38	13.84	27.3	29.67	29.45
May-15	38.3	27.31	26.04	25.9	36.64	35.59	37.28
	27.2	13.67	12.68	14.57	24.98	24.12	26.89
Jun-15	26.4	18.43	16.16	19.05	29.7	27.72	31.5
	17.6	8.02	6.62	7.72	19.75	18.21	21.12
Jul-15	29.8	19.96	18.17	20.16	32.23	30.74	33.94
	20.1	8.69	7.53	8.83	21.94	20.75	23.65
Aug-15	27.55	17.48	15.58	18.48	33.37	31.7	35.8
	18.75	8.01	6.8	7.14	23.91	22.54	25.53
Spt-15	86.7	44.65	41.38	38.09	55.72	53.09	54.4
	32.4	14.45	12.39	15.43	31.48	29.55	33.96
Oct-15	42	23.73	22.3	23.39	37.89	36.74	39.61
	29.5	11.37	10.33	12.06	27.18	26.22	29.39
Nov-15	28	21.61	18.92	21.93	38.11	36.86	40.32
	18.65	10.25	8.47	10.59	27.88	26.02	30.14
Dec-15	36	28.31	27.34	27.26	43.45	42.69	45.03
	26.2	14.93	14.14	15.93	32.3	31.65	34.82
Jan-16	32.4	28.35	27.86	27.44	40.94	40.56	42.26
	25.6	15.09	14.64	16.1	29.65	29.31	31.94
Feb-16	29.9	21.77	19.02	22.25	36.26	33.91	38.36
	19.95	10.6	8.75	10.92	26.01	24.08	28.07
Mar-16	29.45	16.97	15.39	17.95	31.42	30.03	33.7
	21.4	7.6	6.6	6.62	22	20.88	23.39
Apr-16	33.65	20.83	19.44	21.2	35.06	33.91	37.06
	24	9.66	8.71	9.91	24.82	23.88	26.8

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	30.7	18.28	19	19.02	31.89	32.58	33.97
	21.9	8.09	8.44	7.72	22.07	22.6	23.67
Jun-16	38.6	28.78	26.62	28.15	33.65	31.69	34.01
	27.35	15.78	14.14	16.86	21.63	20.07	23.23
Jul-16	28.7	18.25	18.06	19.34	33.2	33.11	35.62
	19.9	8.78	8.58	8.04	23.71	23.61	25.28
Aug-16	41.45	27.61	28.45	27.91	34.71	35.51	36
	30.35	15.6	16.11	16.62	23.51	24.1	25.3
Spt-16	30.1	20.74	19.59	21.95	36.59	35.6	39.21
	21.05	10.93	10.08	10.65	26.92	26.09	28.84
Oct-16	32.55	19.86	19.73	21.15	33.1	33.06	35.56
	24.25	10.52	10.34	9.85	23.66	23.6	25.07
Nov-16	35.05	24	22.31	24.72	49.34	47.97	52.63
	25.15	12.85	11.61	13.43	39.3	38.1	42.56
Dec-16	33.55	19.09	15.77	19.98	30.28	27.27	32.25
	24.6	9.01	6.93	8.69	20.45	18.1	21.8
Jan-17	30.2	21.89	18.84	22.17	32.11	29.45	33.67
	20.3	10.46	8.46	10.88	21.56	19.47	23.23
Feb-17	34.5	22.17	22.27	22.76	37.35	37.5	39.58
	23.45	11.09	11.07	11.46	27.12	27.23	29.28
Mar-17	29.8	17.92	17.14	19.02	29.55	28.89	31.68
	20.65	8.57	8.01	7.72	20.11	19.57	21.21

Source: Authors compilation

Table 5: Calculated option premiums and market premiums of Bajaj Auto Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	69.35	49.24	53.78	48.79	75.9	79.74	79.27
	52	19.86	22.34	20.22	49.61	52.52	53.45
May-12	306.3	50.37	56.16	48.99	71	75.88	73.24
	51.25	19.76	23.02	20.42	43.82	47.42	47.2
Jun-12	192.4	58.24	53.32	54.75	81.44	77.47	83.12
	160.95	24.6	21.27	26.18	53.1	49.97	57.32
Jul-12	41.3	43.13	18.07	43.35	69.65	46.46	73.22
	22.85	15.66	4.26	14.78	44.28	27.39	47.46
Aug-12	65.2	51.03	43.95	49.49	76.74	70.93	79.54
	38.8	20.16	15.86	20.92	49.84	45.35	53.8
Sep-12	54.5	39.97	33.37	40.97	63.93	58.2	67.59
	31.05	14.33	10.79	12.4	39.28	35.05	41.6
Oct-12	76.45	52.72	51.22	52.45	73.71	72.49	76.55
	49.15	23.06	21.86	23.87	46.76	45.75	50.28
Nov-12	71	58.02	58.26	56.18	81.32	81.58	53.72
	42.8	26.05	25.93	27.61	53.46	53.59	57.69
Dec-12	72.85	55	52.63	54.85	67.2	65.1	69.01
	47.75	25.19	23.42	26.27	39.29	37.65	42.02
Jan-13	87	63.31	61.29	62.6	81.67	79.95	84.01
	56.2	32.03	30.37	34.02	53.32	51.89	57.39
Feb-13	61.05	40.68	37.84	43	71.72	69.3	76.84
	38.8	17.4	15.56	14.42	48.22	46.29	50.81
Mar-13	71	54.79	45.96	55.24	74.65	66.88	77.79
	47.1	25.71	19.97	26.66	47.78	41.82	51.28
Apr-13	72	49.41	46.51	47.91	72.59	70.3	75.11
	49.45	18.13	16.11	18.3	45.37	43.56	48.79
May-13	92.25	62.73	51.5	58.33	82.91	73.78	83.76
	63.95	27.09	19.62	28.72	53.25	46.16	57.28
Jun-13	67	41.8	36.6	42.16	66.23	61.96	69.63
	43.55	14.29	11.32	12.55	40.7	37.49	43.25

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	61.4	45.84	14.39	45.91	71.15	41.71	74.57
	40.95	17.09	2.97	16.3	45.04	23.84	48.17
Aug-13	91.95	53.59	53.9	52.55	61.26	61.57	61.82
	65.65	22.27	22.05	22.94	31.88	31.88	33.79
Spt-13	93.65	54.74	42.83	52.21	86.61	77.26	89.83
	66.6	21.63	14.45	22.6	59.27	51.84	64.01
Oct-13	120.3	61.86	70.96	58.43	92.39	99.51	95.13
	84.2	27.21	33.04	28.81	64.13	69.85	69.14
Nov-13	87.15	49.49	52.56	49.79	77	79.68	80.81
	58.15	20.4	21.84	20.18	50.71	52.7	54.38
Dec-13	78.55	46.95	47.54	47.04	88.46	89.09	93.55
	52.15	18.02	17.96	17.43	62.95	63.41	67.91
Jan-14	100	54.26	52.98	52.49	79.28	78.29	81.93
	59.7	22.03	20.84	22.88	51.62	50.77	55.6
Feb-14	50.85	30.51	26.01	32.25	85.78	81.99	92.4
	28.75	9.34	7.1	2.64	62.97	59.84	67.22
Mar-14	75.65	63.93	54.43	59.55	85.17	77.48	86.2
	45.5	28.24	21.72	29.94	55.56	49.5	59.74
Apr-14	71.6	38.24	34.92	40.11	51.83	48.87	55
	46.5	14.41	12.35	10.74	27.93	25.81	27.56
May-14	99.1	65.16	63.52	61.39	97.59	96.34	100.45
	76.7	30.16	28.68	32.02	69.24	68.16	74.61
Jun-14	90	26.58	58.39	59.26	57.9	82.98	88.25
	61.5	28.17	24.96	29.89	57.54	54.72	61.96
Jul-14	69.9	42.99	15.99	45.07	66.71	39.63	71.04
	48.3	18.31	4.68	15.71	42.37	22.91	44.21
Aug-14	59.95	38.18	31.88	40.05	59.38	53.76	63.25
	38.9	14.37	10.85	10.68	35.52	31.42	36.42
Spt-14	71	43.12	42.99	45.09	67.85	67.94	72.2
	47.35	18.14	17.7	15.72	43.37	43.33	45.47
Oct-14	92.15	65.83	67.09	64.23	95.01	96.13	98.32
	75.85	32.89	33.37	34.87	66.82	67.64	71.97
Nov-14	73.9	49.08	41.08	51.41	78.21	71.12	83.3
	48.35	23.45	18.2	22.05	53.39	47.76	56.6

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	98	70.26	71.21	69.4	96.64	97.53	99.98
	70.4	37.74	38.01	40.03	68.13	68.74	73.27
Jan-15	118.4	60.35	63.14	60.71	83.15	85.67	86.63
	66.75	30.02	31.51	31.34	55.65	57.51	59.75
Feb-15	89.95	67.27	60.34	65.64	86.01	80.07	87.92
	60.3	34.2	29.06	36.27	56.7	51.93	60.9
Mar-15	66.1	35.2	35.1	37.29	54.14	54.25	40.06
	46.25	13.29	12.91	7.93	31.38	31.34	26.09
Apr-15	71.5	39.33	41.8	40.08	61.43	63.64	64.74
	47.95	12.86	13.71	10.18	36.24	37.73	37.99
May-15	84.9	56.33	56.57	168.02	76.69	76.9	183.23
	59.65	22.74	22.44	138.11	47.99	48.05	156.5
Jun-15	79.3	42.86	43.8	44.05	74.49	75.48	79.02
	53.45	16.25	16.34	14.15	49.4	50.08	52.6
Jul-15	72.75	67.52	23.07	64.62	93.08	54.08	95.36
	51.55	32.79	6.97	34.71	63.88	33.81	68.67
Aug-15	86	52.21	49.07	52.67	111.06	108.8	118.05
	59.5	22.73	20.37	22.76	85.6	83.64	92.57
Spt-15	97.1	52.13	39.16	51.55	83.38	72.78	87.24
	68.7	21.35	13.61	21.65	56.58	48.23	60.93
Oct-15	97.4	48.2	38.71	48.4	113.09	105.73	120.44
	61.35	19.02	13.39	18.49	88.04	81.74	95.33
Nov-15	76.65	36.12	32.7	38.18	98.77	96.1	106.37
	52.25	13.74	11.59	8.27	75.47	73.2	80.89
Dec-15	95	68.86	62.72	65	101.79	97.01	104.7
	73.65	33.16	28.49	35.1	72.98	68.98	78.5
Jan-16	82.85	46.93	37.28	48.19	91.84	83.87	97.72
	50.75	19.55	13.74	18.29	66.7	60.16	71.75
Feb-16	95.8	62.73	52.11	59.9	130.64	122.87	137.77
	69.65	28.38	21.16	29.99	104.33	97.54	112.78
Mar-16	106.3	58.33	58.69	56.05	121.84	122.23	128.59
	84.7	24.92	24.69	26.15	95.71	96.02	103.56
Apr-16	90.9	54.17	52.68	56.22	74.07	72.8	78.22
	63.1	27.57	26.39	28.18	48.47	47.41	51.77

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	101.9	70.55	71.33	69.95	141.17	141.94	149.38
	78	39.19	39.54	41.92	115.19	115.84	124.6
Jun-16	87.8	52.78	56.04	55.45	85.04	88.16	90.74
	62.7	27.42	29.4	27.42	60.4	62.87	64.75
Jul-16	96.95	59.37	55.56	61.69	89.86	86.53	95.29
	68	32.38	29.56	33.65	64.29	61.53	69.2
Aug-16	89.35	47.62	49.31	50.77	82.36	84.17	88.57
	65.55	24.72	25.63	22.74	59.04	60.44	62.58
Spt-16	89.95	54.63	56.54	57.88	90.03	92	96.45
	67.05	30.06	31.17	29.85	65.81	67.36	70.43
Oct-16	105.8	66.16	65.88	68.16	97.88	97.76	103.36
	80.7	37.91	37.49	40.13	71.61	71.45	77.27
Nov-16	104.65	80.74	73.16	80.03	109.3	102.74	113.06
	77.1	48.7	42.79	52	80.78	75.23	86.91
Dec-16	90	53.2	45.31	56	80.28	72.98	85.58
	66.7	27.97	22.61	27.97	55.6	49.79	59.36
Jan-17	93.05	65.96	59.96	67.1	102.85	97.71	108.35
	67.5	36.74	32.32	39.06	76.39	72.07	82.55
Feb-17	90	52.16	44.14	55.48	74.15	66.54	79.43
	67.85	28.38	22.9	27.44	50.31	44.35	52.86
Mar-17	104.75	77.68	70.5	77.34	96.22	89.78	98.88
	76.75	46.12	40.58	49.3	67.22	61.92	72.29

Source: Authors compilation

Table 6: Calculated option premiums and market premiums of Bank of Baroda call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	81.45	26.23	20.83	25.82	37.5	32.86	38.88
	19.65	13.66	9.95	14.58	26.45	22.7	28.55
May-12	109.6	15.14	11.93	16.13	31.95	28.9	34.42
	98.15	6.47	4.66	4.89	22.87	20.42	24.28
Jun-12	92.95	27.11	9.46	26.18	41.28	25.26	42.78
	82.2	13.98	3.35	14.93	30.23	17.33	32.62
Jul-12	35.1	22.71	22.93	22.67	47.84	48.08	50.77
	24.2	10.84	10.9	11.42	37.78	37.98	40.95
Aug-12	32.2	18.98	19.07	19.18	31.17	31.3	32.85
	32.75	7.92	7.89	7.93	21.02	21.1	22.66
Sep-12	28	20.11	19.98	19.95	31.76	31.69	33.23
	16.95	8.44	8.28	8.71	21.34	21.26	23.04
Oct-12	38.8	27.49	24.74	26.79	41.94	39.67	43.57
	29	14.55	12.53	15.54	30.94	29.03	33.39
Nov-12	28.15	17.06	14.39	18	32.14	29.72	34.44
	18.15	7.58	5.97	6.75	22.7	20.76	24.24
Dec-12	26.7	16.54	16.2	17.5	30.13	29.89	32.31
	17.9	7.28	7	6.26	20.78	20.57	22.05
Jan-13	44.9	28.44	31.33	27.96	45.47	47.88	47.5
	27.2	15.64	17.67	16.72	34.61	36.64	37.36
Feb-13	34.35	21.93	18.75	22.75	35.6	32.77	37.81
	25.95	11.25	9.1	11.51	25.54	23.23	27.5
Mar-13	30.45	19.37	18.21	19.83	35.52	34.57	37.71
	19.5	8.59	7.81	8.58	25.57	24.79	27.62
Apr-13	26.5	15.99	15.91	16.72	27.66	27.65	29.5
	16.5	6.34	6.21	5.4	18.12	18.09	19.2
May-13	46	25.36	22.75	24.25	34.6	32.43	35.38
	26.3	12.12	10.3	12.94	23.2	21.47	25.02
Jun-13	23.1	20.09	7.84	19.97	33.23	21.93	34.87
	14.65	8.42	2.19	8.66	22.87	14.16	24.71

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	32.9	20.64	21.14	19.79	40.27	40.68	42.35
	24.3	8.09	8.3	8.48	30.03	30.37	32.55
Aug-13	36	21.32	19.36	20.29	42.65	41.17	44.87
	31.1	8.5	7.25	8.98	32.41	31.16	35.13
Spt-13	31.25	9.34	9.11	9.91	35.59	35.45	38.43
	23.45	4.65	4.46	4.26	31.03	30.9	33.7
Oct-13	34.6	10.38	10.84	11	40.06	40.57	43.24
	25	5.53	5.79	5.34	35.48	35.94	38.53
Nov-13	39.05	20.6	17.29	20.5	50.25	47.63	53.52
	32.2	8.88	6.85	9.18	40.45	38.15	43.88
Dec-13	34.9	15.16	15.87	15.84	33.74	34.42	36.14
	25.3	5.63	5.93	4.52	24.35	24.89	26.17
Jan-14	37.45	20.69	22.29	20.44	39.23	40.55	41.39
	27.05	8.79	9.69	9.13	29.03	30.12	31.45
Feb-14	32.6	15.9	15.59	16.01	31.53	31.32	33.44
	23.1	5.3	5.07	4.7	21.77	21.59	23.48
Mar-14	26.8	17.95	16.1	17.62	32.85	31.39	34.82
	17	6.38	5.32	6.31	22.74	21.56	24.77
Apr-14	41.4	25.67	24.86	26.45	44.75	44.07	47.54
	32.8	14.72	14.09	15.68	34.75	34.15	37.65
May-14	59.3	26.39	25.34	27.55	51.65	50.76	55.22
	49.95	15.81	14.99	16.77	41.91	41.11	45.44
Jun-14	39.4	23.35	17.97	24.89	39.89	34.64	42.88
	30.35	13.86	10.08	14.12	30.5	26.09	32.83
Jul-14	44.55	25.57	26.96	26.99	40.48	41.84	43.28
	33.25	15.46	16.44	16.21	30.74	31.86	33.18
Aug-14	40.65	31.23	27.24	32.21	45.9	42.26	48.49
	30.45	19.96	16.9	21.44	35.48	32.37	38.38
Spt-14	38.45	28.28	28.34	29.63	46.43	46.54	49.52
	28.45	17.72	17.71	18.86	36.49	36.57	39.5
Oct-14	46.9	33.36	31.42	34	45.28	43.53	47.39
	36.75	21.61	20.05	23.22	34.45	32.95	37.2
Nov-14	40.1	29.59	28.65	31	42.78	41.94	45.48
	30.05	18.96	18.19	22.23	32.65	31.93	35.29

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	51.8	32.28	33.11	34.16	49.37	50.21	52.8
	41.4	21.94	22.54	23.28	39.45	40.16	42.65
Jan-15	50.7	32.38	34.35	34.16	187.84	189.87	202.68
	40.15	21.91	23.41	23.39	179.5	181.47	194.44
Feb-15	106.75	5.66	5.82	6	36.79	36.98	39.71
	11.55	4.09	4.22	4.38	35.56	35.75	38.49
Mar-15	11.1	5.26	5.24	5.58	34.66	34.67	25.12
	9.55	3.27	3.25	3.42	33.04	33.05	24.36
Apr-15	8.85	14.27	14.88	15.38	30.99	31.64	33.45
	6.45	12.02	12.56	13.05	28.98	29.61	31.44
May-15	8.4	14.98	14.82	16.17	32.82	32.65	35.44
	6.1	12.74	12.6	13.84	30.82	30.66	33.43
Jun-15	7.35	15.21	13.13	16.3	32.13	29.89	34.59
	5.2	12.87	11	13.98	30.08	27.94	32.59
Jul-15	9.5	14.68	14.61	15.54	29.54	29.48	31.68
	6.9	12.2	12.14	13.21	27.44	27.38	29.67
Aug-15	9.45	16.44	15.99	17.64	34.84	34.37	37.53
	7	14.1	13.69	15.31	32.79	32.34	35.52
Spt-15	11.4	15.99	15.78	17.28	35.24	35.02	38.08
	9.2	13.77	13.57	14.96	33.25	33.03	36.07
Oct-15	13.5	17.48	17.44	18.69	36.45	36.41	39.21
	10.7	15.09	15.05	16.36	34.38	34.34	37.21
Nov-15	8.2	13.85	13.75	14.96	30.67	30.58	33.14
	6	11.64	11.56	12.63	28.69	28.6	31.13
Dec-15	13.35	20.41	19.83	21.14	38.41	37.84	40.89
	7.45	15.23	14.74	16.48	34.11	33.58	36.87
Jan-16	6.3	15.65	15.34	16.65	9.58	9.25	9.97
	5.8	13.21	12.94	14.32	6.9	6.63	7.47
Feb-16	7.95	10.95	10.55	11.83	9.23	8.82	9.96
	5.5	8.77	8.42	9.5	7.03	6.69	7.58
Mar-16	11.15	12.74	12.63	13.6	4.92	4.78	4.96
	8.65	10.38	10.28	11.27	2.18	2.08	2.26
Apr-16	9.95	5.8	5.51	5.95	9.16	8.9	9.69
	7.25	3.12	2.92	3.32	6.66	6.45	7.22

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	10.3	6	5.99	6.16	10.33	10.32	10.96
	7.95	3.3	3.28	3.53	7.85	7.84	8.52
Jun-16	9.3	5.97	6.29	5.96	8.62	8.91	8.98
	6.3	3.1	3.31	3.33	6	6.23	6.51
Jul-16	7.95	5.16	5.16	5.43	8.2	8.2	8.75
	5.65	2.73	2.72	2.8	5.82	5.81	6.27
Aug-16	8.5	5.09	5.04	5.34	8.91	8.87	9.52
	6.25	2.64	2.6	2.71	6.53	6.5	7.07
Spt-16	9	6.27	6.43	6.38	9.44	9.59	9.94
	6.4	3.49	3.59	3.75	6.88	7	7.46
Oct-16	9.2	5.94	5.82	6.17	8.99	8.89	9.54
	6.85	3.34	3.25	3.54	6.51	6.43	7.05
Nov-16	7.4	4.95	4.65	5.24	11.76	11.48	12.65
	5.25	2.59	2.38	2.61	9.47	9.22	10.28
Dec-16	10.85	6.26	5.92	6.45	9.79	9.48	10.36
	8.5	3.57	3.32	3.82	7.27	7.01	7.89
Jan-17	7.95	6.21	5.45	6.29	7.79	7.08	8.08
	5.45	3.4	2.87	3.66	5.12	4.58	5.55
Feb-17	9.65	6.13	5.92	6.34	9.69	9.5	10.27
	7.2	3.47	3.32	3.71	7.19	7.04	7.8
Mar-17	9.75	7.17	7.09	7.14	10.38	10.32	10.81
	7	4.18	4.12	4.51	7.71	7.65	8.34

Source: Authors compilation

Table 7 : Calculated option premiums and market premiums of Bharat Heavy Electricals Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	17.1	25.9	25.71	27.51	16.07	15.86	16.66
	12.2	21.06	20.89	22.85	10.76	10.59	11.66
May-12	16.15	23.9	24.49	25.22	22.88	23.47	162.72
	10.55	18.96	19.47	20.56	17.9	18.4	161.25
Jun-12	46.25	21.42	11.82	22.92	50.75	39.47	54.6
	12.65	16.82	8.79	18.27	46.84	36.16	50.75
Jul-12	10.35	21.39	21.08	23	47.83	47.15	51.56
	5.8	16.91	16.64	18.34	43.88	43.57	47.6
Aug-12	13.35	22	22.08	23.17	44.09	44.18	47.2
	7.75	17.06	17.13	18.51	39.92	40.01	43.21
Sep-12	8.3	20.11	18.11	21.56	10.65	8.6	11.24
	4.35	15.58	13.89	16.91	5.92	4.54	6.17
Oct-12	15	24.92	24.14	26.46	14.73	13.89	15.19
	9.95	20.08	19.41	21.8	9.38	8.74	10.15
Nov-12	11.45	22.26	21.82	23.94	12.19	11.74	12.99
	7.25	17.77	17.39	19.28	7.56	7.22	7.97
Dec-12	10.05	22.49	21.25	24.06	17.03	15.77	18.1
	5.75	17.86	16.79	19.4	12.25	11.23	13.26
Jan-13	12.05	23.53	22.89	24.88	13.51	12.79	13.7
	6.6	18.64	18.08	20.23	7.96	7.43	8.61
Feb-13	7.1	22.01	18.02	23.48	12.66	8.61	13.22
	3.85	17.33	13.92	18.83	7.62	4.78	8.18
Mar-13	7.55	17.93	16.81	19.34	8.36	7.25	8.95
	3.85	13.61	12.69	14.68	4.13	3.44	3.85
Apr-13	8.1	5.26	4.12	5.37	8.32	7.31	8.77
	5.75	2.49	1.78	2.57	5.76	4.96	6.21
May-13	9	6.3	5.34	6.23	9.9	9.1	10.35
	6.8	3.22	2.56	2.43	7.23	6.56	7.81
Jun-13	7.3	4.4	3.07	4.67	8.39	7.11	9.01
	5.2	2.08	1.3	1.87	6.05	5.02	4.46

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	8.45	6.37	4.85	6.17	9.29	8	9.6
	5.7	3.15	2.14	3.37	6.53	5.49	7.05
Aug-13	9.8	5.79	5.86	5.61	22.01	22.08	23.59
	8.05	2.64	2.67	2.81	19.74	19.81	21.39
Spt-13	8.2	5.23	4.09	4.83	14.33	13.49	15.22
	6	1.91	1.27	2.03	11.94	11.19	12.95
Oct-13	10.25	5.44	3	5.22	8.37	6.28	8.67
	8.4	2.29	1.79	2.43	5.68	5.16	6.15
Nov-13	9.45	5.29	4.64	5.11	9.23	8.72	9.66
	6.95	2.2	1.79	2.31	6.63	6.21	7.18
Dec-13	10	7.79	8.3	6.95	12.04	12.43	12.31
	5.15	1.56	1.74	1.36	6.84	7.11	7.39
Jan-14	6.2	5.61	2.86	5.59	10.16	7.7	10.71
	4.6	2.64	1.04	2.79	7.59	5.56	8.22
Feb-14	3.35	5.25	3.07	5.29	9.42	7.47	9.96
	2.4	2.41	1.15	2.5	6.89	5.3	7.45
Mar-14	4.05	5.15	2.98	5.19	9.85	7.92	10.43
	2.55	2.31	1.08	2.39	7.33	5.75	7.94
Apr-14	6.35	5.7	1.99	6.11	10.38	6.19	11.19
	4.8	3.43	1	3.45	8.09	4.61	8.71
May-14	9.85	6.06	2.36	6.43	18.28	14.07	19.71
	8.05	3.63	1.17	3.77	16.02	12.17	17.4
Jun-14	16.75	8.07	7.04	8.51	12.16	11.2	12.99
	14.7	5.46	4.65	5.84	9.68	8.84	10.47
Jul-14	17	9.52	9.66	9.77	14.14	14.28	14.92
	15	6.62	6.72	7.11	11.51	11.62	12.43
Aug-14	10.1	8.74	5.81	8.97	12.61	9.85	13.29
	8	5.86	3.62	6.31	9.98	7.61	10.78
Spt-14	10.05	12.17	7.03	11.75	16.13	11.47	16.48
	5.9	5.97	2.81	6.42	10.6	7.08	11.47
Oct-14	11.5	9.07	7.47	9.07	13.34	11.91	13.93
	7.35	3.67	2.77	3.74	8.31	7.25	8.96
Nov-14	12.1	11.35	7.4	11.34	16.22	12.6	16.91
	7.6	5.64	3.18	6.02	11.01	8.2	11.92

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	11.85	10.19	6.28	10.62	15.92	12.13	16.92
	7.8	5.16	2.76	5.29	11.08	8.12	11.94
Jan-15	11.8	7.95	6.68	8.44	12.19	10.96	13.06
	7.55	3.52	2.78	3.12	7.67	6.76	8.03
Feb-15	12.75	9.2	6.26	9.77	15.35	12.44	16.47
	9.2	4.6	2.81	4.44	10.75	8.46	11.49
Mar-15	13.5	8.14	6.66	8.68	51.63	50.07	37.49
	9.65	3.79	2.91	3.36	47.66	46.17	35.59
Apr-15	12.7	7.37	7.03	7.67	12.6	12.3	13.42
	8.05	2.71	2.51	2.29	7.95	7.72	8.44
May-15	11.15	9.2	6.86	9.26	13.83	11.72	14.49
	6.8	3.82	2.51	3.88	8.8	7.23	9.48
Jun-15	10.4	7.14	5.6	7.55	11.85	10.37	12.69
	6.15	2.75	1.96	2.17	7.34	6.26	7.66
Jul-15	10.9	6.72	5.36	7.16	11.8	10.48	12.68
	6.8	2.53	1.85	1.78	7.39	6.42	7.67
Aug-15	15.55	12.24	11.13	11.87	16.39	15.43	16.8
	10.4	6.03	5.28	6.49	10.86	10.1	11.75
Spt-15	13.15	8.59	6.27	8.69	12.9	10.79	13.54
	8.5	3.36	2.14	3.31	7.95	6.41	8.52
Oct-15	13.15	8.06	7.54	7.94	11.67	11.22	12.11
	8.25	2.67	2.39	2.56	6.64	6.31	7.1
Nov-15	14	11	10.23	10.03	13.88	13.23	13.8
	8.9	4.32	3.84	4.65	8.11	7.62	8.77
Dec-15	10.85	8.28	7.71	7.89	10.36	9.86	10.44
	5.9	2.54	2.25	2.51	5.03	4.7	5.35
Jan-16	6.55	4.72	4.33	5.01	8.15	7.79	8.75
	4.45	2.39	2.13	2.32	5.82	5.53	6.24
Feb-16	9.25	5.76	5.26	5.66	10.27	9.86	10.8
	6.5	2.78	2.44	2.97	7.72	7.37	8.37
Mar-16	7.5	2.4	2.4	2.57	5.21	5.22	5.62
	5.3	1.47	1.47	1.5	4.29	4.29	4.64
Apr-16	7.95	3.52	3.74	3.64	5.98	6.18	6.36
	5.7	1.53	1.65	1.49	4.05	4.21	4.36

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	6	3.1	3.05	3.3	7.36	7.33	7.94
	3.9	1.35	1.32	1.15	5.56	5.53	5.99
Jun-16	9.3	4.89	5.08	4.82	7.84	8.01	8.2
	7	2.03	2.14	2.13	5.28	5.41	5.72
Jul-16	7.1	4.25	3.88	4.35	6.98	6.65	7.39
	4.7	1.71	1.5	1.66	4.55	4.3	4.89
Aug-16	7.75	3.85	3.19	4.07	7.21	6.59	7.74
	5.8	1.6	1.24	1.38	4.92	4.44	5.25
Spt-16	6.85	6.12	3.63	5.82	9.39	7.25	9.71
	4.75	2.91	1.4	3.13	6.69	4.97	7.24
Oct-16	9.55	6.22	5.96	5.84	8.67	8.45	8.83
	6.8	2.93	2.75	3.15	5.86	5.69	6.33
Nov-16	8.1	5.73	5.61	5.54	8.6	8.51	8.9
	5.6	2.66	2.57	2.85	5.92	5.85	6.42
Dec-16	6.95	3.94	3.79	4.06	6.6	6.47	7
	4.55	1.5	1.41	1.37	4.21	4.11	4.51
Jan-17	5.1	3.47	3.07	3.63	6.67	6.31	7.14
	2.95	1.54	1.3	1.48	4.79	4.5	5.16
Feb-17	9.3	6.24	5.65	5.91	8.73	8.24	8.93
	6.7	2.99	2.6	3.22	5.95	5.55	6.43
Mar-17	8.25	5.2	5.07	5.26	8.07	7.96	8.49
	5.65	2.45	2.36	2.58	5.53	5.44	5.98

Source: Authors compilation

Table 8: Calculated option premiums and market premiums of Bharti Airtel Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	24.35	20.47	20.77	17.12	24.28	24.52	23.22
	12.1	5.5	5.6	5.86	12.02	12.16	12.99
May-12	17.15	10.97	11.52	10.57	16.68	17.14	17.28
	7.6	4.67	4.97	4.94	11.28	11.63	12.2
Jun-12	27	20.3	11.64	16.73	22.85	15.61	21.27
	14.05	5.14	1.55	5.47	10.12	5.82	10.93
Jul-12	13.35	9.18	9.1	9.2	14.98	14.93	15.75
	4.75	3.6	3.51	3.57	9.89	9.85	10.66
Aug-12	14.7	11.01	9.54	10.6	16.61	15.41	17.2
	5.75	4.7	3.77	4.97	11.2	10.25	12.11
Sep-12	13.2	10.31	8.94	9.56	15.51	14.43	15.91
	7.45	3.72	2.92	3.93	10.05	9.22	10.88
Oct-12	13.85	8.76	8.18	8.6	13.22	12.75	13.76
	8.8	3.04	2.7	2.97	8.04	7.68	8.64
Nov-12	13.65	9.69	9.64	9.3	18.05	18.02	18.94
	8.15	3.56	3.48	3.67	12.93	12.9	14.01
Dec-12	22.5	19.63	17.67	16.6	25.91	24.4	25.61
	10.15	5.05	4.01	5.34	14.41	13.33	15.61
Jan-13	23.75	21.35	30.17	17.38	24.38	31.92	22.8
	4.25	3.47	8.19	3.3	9.32	14.04	9.98
Feb-13	18	12.91	13.07	12.16	18.62	18.75	19.07
	7.2	6.11	6.18	6.53	12.96	13.06	13.98
Mar-13	18.65	14.04	12.62	17.38	19.35	18.22	19.54
	8.75	2.35	1.83	3.3	8.92	8.21	9.39
Apr-13	14.15	7.94	7.55	8.11	14.25	13.94	15.11
	9.1	2.81	2.57	2.46	9.37	9.12	10.03
May-13	18.4	11.93	10.77	11.33	17.52	16.58	18.03
	13.5	5.33	4.54	5.68	11.97	11.21	12.93
Jun-13	12.25	6.99	6.16	7.32	16.42	15.71	17.61
	7.8	2.39	1.96	1.67	11.79	11.21	12.65

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	12.85	6.67	6.04	7	13.27	12.73	14.2
	8.15	2.17	1.84	1.34	8.66	8.24	9.14
Aug-13	21.25	11.28	12.22	11.01	23.76	24.51	25.13
	15.55	5.07	5.63	5.36	18.69	19.33	20.25
Spt 13	21	12.15	11.44	11.3	21.23	20.7	22.09
	14.8	5.29	4.79	5.65	15.88	15.43	17.17
Oct-13	21.4	9.67	11	9.69	17.92	19.02	18.94
	15.7	4	4.77	4.04	12.87	13.77	13.93
Nov-13	18.15	11.8	11.22	11.63	19.6	19.14	20.53
	12.55	5.64	5.21	5.98	14.3	13.91	15.47
Dec-13	17.85	10.95	11.87	10.69	17.36	18.12	18.09
	12.35	4.78	5.32	5.04	12.03	12.63	13.01
Jan-14	18	12.71	13.3	11.98	18.2	18.69	18.64
	12.3	5.93	6.28	6.33	12.54	12.92	13.53
Feb-14	13.85	9.27	8.34	9.31	15.27	14.49	16.06
	8.9	3.69	3.12	3.66	10.17	9.57	10.96
Mar-14	14.55	10.75	10.56	10.22	14.65	14.49	14.94
	8.9	4.32	4.16	4.57	9.05	8.93	9.77
Apr-14	13	8.14	8.1	8.53	12.57	12.56	13.39
	10.4	5.4	5.35	5.74	10	9.98	10.8
May-14	16.2	8.23	7.54	8.69	14.41	13.8	15.43
	13.8	5.58	5.01	5.9	11.91	11.36	12.88
Jun-14	16.15	9.78	9.31	10.08	14.48	14.08	15.3
	13.45	6.82	6.42	7.29	11.79	11.43	12.71
Jul-14	13.6	8.02	7.46	8.46	11.59	11.08	12.36
	11.35	5.37	4.91	5.68	9.04	8.6	9.74
Aug-14	12.25	8.09	6.3	8.64	14.39	12.65	15.48
	9.3	5.62	4.21	5.86	11.98	10.43	12.92
Spt-14	14.6	11.57	11.06	11.74	18.19	17.78	19.16
	9.6	5.87	5.5	6.18	13.01	12.66	14.06
Oct-14	17.75	11.66	12.21	11.99	17.93	18.44	18.94
	12.4	6.14	6.48	6.42	12.79	13.2	13.8
Nov-14	19.5	14.23	13.68	13.99	19.72	19.26	20.38
	12.7	7.87	7.44	8.61	14.12	13.73	15.4

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	14.45	9.44	8.71	9.94	13.62	12.95	14.51
	10.05	4.56	4.07	4.38	8.79	8.28	9.28
Jan-15	16.2	10.12	10.62	10.42	13.28	13.75	13.94
	10.55	4.79	5.07	4.85	8.15	8.48	8.67
Feb-15	16.75	10.13	9.19	10.52	14.54	13.69	15.39
	11.95	4.93	4.3	4.96	9.53	8.87	10.18
Mar-15	15.6	10.74	9.94	10.94	14.82	14.11	10.15
	10.8	5.18	4.63	5.38	9.6	9.05	7.51
Apr-15	21	10.83	11.59	10.69	18.38	19.01	19.29
	14.6	4.77	5.2	4.99	13.13	13.64	14.2
May-15	15.65	8.6	7.94	8.94	15.13	14.57	16.11
	10.65	3.56	3.14	3.24	10.25	9.81	10.95
Jun-15	16.9	10.98	8.71	11.09	17.83	15.89	18.78
	12.3	5.19	3.74	5.39	12.62	11.05	13.62
Jul-15	25.15	12.57	12.27	12.29	19.63	19.4	20.45
	13.8	6.19	5.93	6.59	14.18	13.98	15.32
Aug-15	19.05	13.24	10.92	12.79	21.75	19.88	22.67
	13.65	6.64	5.04	7.09	16.3	14.73	17.6
Spt-15	15.45	7.82	6.92	8.15	14.58	13.81	15.56
	10.85	2.95	2.44	2.45	9.79	9.19	10.44
Oct-15	21.85	10.92	9.41	10.41	16.33	15.11	16.84
	10.55	4.46	3.51	4.71	10.84	9.88	11.72
Nov-15	16.95	12.4	11.37	11.63	17.37	16.54	17.73
	10.75	5.56	4.84	5.93	11.66	10.99	12.57
Dec-15	12.7	7.28	6.6	7.6	13.09	12.51	13.96
	8	2.55	2.18	1.9	8.35	7.91	8.81
Jan-16	9.75	6.22	5.02	6.6	12.04	10.93	12.94
	5.55	2.32	1.69	1.47	7.94	7.09	8.3
Feb-16	16.9	12.31	11.19	11.02	15.99	15.08	15.94
	10.95	5	4.23	5.32	10.01	9.31	10.78
Mar-16	15.35	11.06	7.68	10.43	13.84	10.93	13.92
	10.25	4.46	2.52	4.73	8.02	5.94	8.64
Apr-16	15.4	9.09	7.48	8.99	15.73	14.41	16.53
	10.45	3.35	2.46	3.32	10.61	9.57	11.46

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	14.6	8.22	7.8	8.43	14.69	14.35	15.59
	9.75	3.07	2.81	2.77	9.77	9.5	10.47
Jun-16	12.05	6.52	5.54	6.88	12.71	11.82	13.62
	7.55	2.15	1.66	1.22	8.12	7.46	8.5
Jul-16	16.15	11.8	9.83	11.21	17.07	15.47	17.54
	10.15	5.2	3.94	5.54	11.47	10.21	12.4
Aug-16	11.8	7.19	5.01	7.53	13.42	11.41	14.34
	7.8	2.53	1.48	1.86	8.71	7.21	9.21
Spt-16	13	8.15	7.57	8.29	13.83	13.34	14.61
	8.1	2.91	2.56	2.62	8.86	8.49	9.48
Oct-16	13.15	7.71	6.44	7.79	12.6	11.51	13.27
	8.3	2.49	1.85	2.12	7.63	6.84	8.12
Nov-16	14.55	11.54	10.87	10.62	16.4	15.87	16.69
	9.1	4.64	4.18	4.96	10.72	10.3	11.58
Dec-16	11.2	5.55	4.78	5.86	10.64	9.95	11.41
	6.8	1.98	1.58	1.33	6.95	6.42	7.3
Jan-17	10.7	8.79	6.45	8.57	16.24	14.34	17.08
	6.1	2.97	1.8	2.91	11.15	9.65	12.07
Feb-17	12.4	7.69	6.17	7.82	12.89	11.59	13.62
	7.7	2.54	1.79	2.15	7.97	7	8.48
Mar-17	18.15	9.58	8.88	9.48	15.61	15.04	16.36
	13.4	3.76	3.32	3.82	10.41	9.96	11.24

Source: Authors compilation

Table 9: Calculated option premiums and market premiums of Bharat Petroleum Corporation Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	26.35	13.02	13.38	13.84	24.27	24.68	26.09
	16.9	4.65	4.75	2.45	15.33	15.62	15.72
May-12	26.85	13.83	15.06	14.56	25.7	26.87	27.52
	17.45	4.83	5.37	3.17	16.46	17.31	17.22
Jun-12	84.5	24.29	59.19	22.86	31.3	61.44	31.6
	71.65	10.76	39.84	11.47	19.6	44.72	21.13
Jul-12	25	16.02	17.01	16.81	28.65	29.6	30.62
	16.15	6.46	6.92	5.41	19.14	19.86	20.29
Aug-12	12.55	10.07	10.72	10.09	16.45	17.01	17.29
	8.9	4.3	4.65	4.39	11.27	11.71	12.16
Sep-12	111.75	9.25	9.56	9.31	21.59	21.87	23.01
	8.95	3.67	3.8	3.62	16.7	16.93	18.11
Oct-12	16.1	12.39	11.15	11.78	17.56	16.54	18
	6.65	5.7	4.85	6.08	11.9	11.09	12.84
Nov-12	16	11.83	12.02	11.37	13.88	14.06	13.91
	6.3	5.33	5.41	5.67	7.93	8.04	8.53
Dec-12	13.3	11.43	10.12	11.07	16.15	15.06	16.64
	4.45	5.08	4.21	5.38	10.6	9.75	11.45
Jan-13	20.5	15.45	16.68	13.9	23.29	24.23	23.78
	8.8	3.03	3.47	2.51	12.79	13.44	13.76
Feb-13	17.4	9.35	8.9	9.78	23.6	23.34	25.33
	9.8	4.31	4.04	4.08	18.83	18.6	20.39
Mar-13	17.4	10.59	9.95	10.68	49.82	49.35	53.61
	8.75	4.83	4.38	4.98	45.34	44.89	49.19
Apr-13	16.85	19.49	18.89	20.44	39.63	39.08	42.45
	12.5	14.2	13.7	15.36	34.92	34.41	37.86
May-13	17.15	18.76	18.62	20.04	39.63	39.52	42.71
	11.9	13.89	13.77	14.97	35.07	34.96	38.09
Jun-13	34.25	19.4	18.71	20.35	16.96	16.24	17.64
	12.15	14.12	13.55	15.28	11.54	10.97	12.46

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	16.7	19.05	17.98	19.96	16.46	15.34	17.07
	11.75	13.76	12.88	14.88	11.01	10.12	11.88
Aug-13	14.65	14.74	15.44	15.87	36.21	36.94	39.14
	10.5	10.22	10.76	10.79	31.83	32.5	34.59
Spt-13	13.95	12.94	7.29	13.75	18.75	12.94	20.08
	11.3	8.17	4.16	8.67	14.08	9.34	15.23
Oct-13	25.7	18.49	19.4	19.08	19.12	20.02	19.79
	21.05	12.96	13.69	14	13.64	14.38	14.74
Nov-13	16.45	17.93	18.56	18.88	23.71	24.33	25.22
	13	12.77	13.27	13.8	18.75	19.28	20.33
Dec-13	21.35	19.81	20.68	20.3	19.06	19.94	19.44
	11.1	9.67	10.22	10.15	8.85	9.38	9.21
Jan-14	16.15	15.47	16.33	16.58	15.58	16.44	16.17
	11.05	10.79	11.47	11.51	10.9	11.58	11.63
Feb-14	15.4	16.49	15.68	17.61	16.14	15.33	17.23
	10.3	11.68	11.02	12.54	11.33	10.67	12.14
Mar-14	16.3	20.12	19.76	20.99	21.48	21.13	22.5
	11.7	14.72	14.41	15.91	16.16	15.85	17.47
Apr-14	21.75	15.68	15.84	15.86	26.22	26.39	27.66
	18.1	9.67	9.76	10.37	20.97	21.1	22.66
May-14	23.75	11.01	11.31	11.75	22.02	22.35	23.72
	18.75	6.33	6.51	6.26	17.36	17.63	18.71
Jun-14	42.5	13.13	12.88	13.95	30.51	30.33	32.85
	18.95	8.17	7.95	8.46	25.78	25.61	27.94
Jul-14	35	19.11	19.36	19.41	29.73	29.98	31.3
	29.35	13.01	13.18	13.92	24.35	24.56	26.24
Aug-14	26.85	17.73	16.64	18.31	29.3	28.36	31.1
	20.8	11.96	11.06	12.82	24.1	23.26	26.05
Spt-14	20.9	19.08	9.04	20.09	33.76	23.6	36.13
	14.2	9.36	3.57	9.12	24.25	16.2	26.04
Oct-14	39.6	27.65	27.48	26.48	37.29	37.16	38.08
	27.15	14.49	14.36	15.51	25.89	25.82	27.9
Nov-14	27.65	19.47	17.74	20.53	32.06	30.49	34.28
	18.55	9.75	8.59	9.56	22.51	21.24	24.1

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	32.6	20.87	20.85	21.8	34.25	34.28	36.54
	23.5	10.8	10.72	10.91	24.52	24.53	26.38
Jan-15	27.8	18.24	18.03	19.09	30.24	30.09	32.25
	18.45	8.42	8.23	8.12	20.65	20.52	22.1
Feb-15	34.75	22.55	20.01	23.37	30.91	28.58	32.63
	24.65	11.92	10.17	12.4	20.73	18.89	22.26
Mar-15	34.7	19.63	18.79	20.74	34.41	33.69	24.7
	25.65	9.98	9.38	9.77	24.92	24.32	19.62
Apr-15	37	21.38	24.2	21.95	40.26	42.72	42.82
	27.9	10.53	12.34	10.9	30.33	32.38	32.84
May-15	30.55	18.39	18.63	19.45	30.97	31.25	33.17
	22.9	8.88	8.97	8.4	21.5	21.71	22.93
Jun-15	35.7	23.77	22.56	24.48	40.92	39.9	43.44
	25.95	12.79	11.89	13.44	30.81	29.95	33.34
Jul-15	32	19.06	17.95	20.27	35.7	34.72	38.37
	23	9.76	8.99	9.23	26.35	25.53	28.22
Aug-15	38.8	23.18	22.91	24.31	51.57	51.41	55.31
	28.3	12.86	12.6	13.26	41.92	41.77	45.44
Spt-15	37.95	18.42	16.31	19.64	34.04	32.09	36.63
	28.75	9.35	7.96	8.6	24.8	23.2	26.45
Oct-15	36.3	20.34	19.83	21.55	35.5	35.09	38.07
	26.75	10.71	10.31	10.51	25.98	25.63	27.87
Nov-15	33.5	24.81	23.63	25.47	38.55	37.54	40.74
	23.45	13.64	12.75	14.43	28.23	27.38	30.51
Dec-15	29.3	19.48	18.62	20.76	32.56	31.81	34.99
	20.2	10.25	9.63	9.71	23.24	22.61	24.7
Jan-16	34.65	28.68	26.79	28.76	40.25	38.62	41.95
	22.2	16.54	15.1	17.72	29.3	27.94	31.64
Feb-16	29.2	26.62	17.23	27.1	52.43	44	55.72
	21.15	15.05	8.63	16.05	42.3	34.97	45.83
Mar-16	36.25	18.6	16.45	19.58	32.34	30.39	34.59
	26.15	8.89	7.51	8.53	22.78	21.22	24.41
Apr-16	34.15	21.07	21.12	21.97	32.3	35.39	37.59
	24.2	10.72	10.68	10.9	25.4	25.46	27.37

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	41.1	29.99	27.79	29.75	45.88	44.04	47.92
	29.85	17.45	15.76	18.69	34.96	33.38	37.73
Jun-16	38.15	26.44	18.35	27.12	42.44	35.06	44.88
	29.1	15.09	9.5	16.06	32.05	25.9	34.67
Jul-16	37.35	27.88	22.2	28.71	31.43	25.97	32.7
	28.55	16.56	12.44	17.65	20.42	16.24	21.91
Aug-16	25.4	12.74	12.76	13.46	22.93	23	24.58
	19.7	7.64	7.63	7.93	18.03	18.08	19.48
Spt-16	26.25	14.71	13.99	15.24	26.93	26.32	28.68
	21.5	9.1	8.53	9.71	21.83	21.3	23.64
Oct-16	22.85	13.08	13	13.84	31	30.98	33.34
	17.8	7.99	7.89	8.3	26.18	26.16	28.39
Nov-16	27.65	18.23	17.89	18.55	41.3	41.06	44.05
	22.8	12.16	11.85	13.02	36.22	36	39.16
Dec-16	27	17.94	14.13	18.14	54.27	51.07	58.15
	21.9	11.78	8.82	12.61	49.4	46.39	53.44
Jan-17	19.5	15.29	10.42	15.9	26	21.47	27.68
	14.7	9.73	6.12	10.37	20.88	16.95	22.59
Feb-17	20.15	16.11	6.52	16.89	56.67	46.5	61.06
	16.25	10.66	3.69	11.36	51.95	42.35	56.35
Mar-17	17.2	18.04	7.16	18.58	79.75	68.49	85.91
	10.85	7.71	2.18	7.52	70.77	60.37	76.9

Source: Authors compilation

Table 10: Calculated option premiums and market premiums of Cipla Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	13.4	8.24	9.29	8.03	12.44	13.3	12.92
	4.3	2.4	2.87	2.12	7.2	7.8	7.67
May-12	49.05	32.49	32.22	23.17	33.54	33.28	27.97
	5.35	2.65	2.44	2.48	9.25	9.08	9.96
Jun-12	14.45	11.15	9.76	10.13	15.81	14.74	16.06
	3.75	3.99	3.11	4.22	10.08	9.25	10.88
Jul-12	20.3	18.7	19.02	14.99	19.63	19.9	17.3
	6.45	3.15	3.2	3.17	6.06	6.17	6.46
Aug-12	11.5	9.65	8.36	9.21	13.62	12.58	13.98
	2.9	3.28	2.53	3.3	8.1	7.33	8.71
Sep-12	23	19.12	19.6	15.92	21.83	22.21	20.58
	10.25	4	4.13	4.09	9.31	9.51	10.01
Oct-12	14.85	5.96	5.29	6.31	11.05	10.47	11.85
	7.1	3.47	2.95	3.36	8.61	8.1	9.2
Nov-12	21.9	17.5	17.78	14.68	20.2	20.41	19.97
	8.85	3.04	3.06	2.85	8.06	8.16	8.61
Dec-12	22.45	17.82	17.04	15.48	21.27	20.63	20.63
	10.95	3.78	3.31	3.66	9.38	8.95	10.03
Jan-13	25.85	19.46	21.27	16.55	23.36	24.01	22.07
	11.15	4.58	5.43	4.72	10.64	11.04	11.46
Feb-13	21.2	17.58	15.72	15.33	21.72	20.22	21.29
	10.05	3.67	2.77	3.51	10.06	9.08	10.77
Mar-13	17.35	13.24	12.2	12.06	16.68	15.83	16.61
	6.9	3.32	2.75	3.19	8.1	7.52	8.64
Apr-13	14.15	8.85	8.78	8.85	13.88	13.85	14.56
	10.05	3.12	3	2.88	8.68	8.64	9.26
May-13	18.45	13.41	13.09	12.39	19.72	19.48	20.19
	12.95	6.06	5.76	6.41	13.94	13.73	14.99
Jun-13	12.25	5.89	5.7	6.21	10.95	10.83	11.73
	7.8	3.31	3.13	3.22	8.48	8.36	9.08

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	13	7.1	6.03	7.39	11.47	10.55	12.18
	8.25	2.28	1.72	1.41	6.66	6	6.82
Aug-13	15.4	9.61	8.74	9.61	15.44	14.75	16.2
	5.85	3.72	3.15	3.63	10.19	9.64	10.93
Spt-13	18.15	11.1	9.98	10.77	17.21	16.34	17.89
	12.75	4.62	3.85	4.79	11.74	11.03	12.65
Oct-13	19.05	9.34	10.22	9.46	14.97	15.74	15.77
	14.4	3.68	4.11	3.48	9.8	10.37	10.47
Nov-13	16.3	10.58	11.1	10.37	15.13	15.57	15.67
	11.3	4.3	4.52	4.39	9.62	9.93	10.33
Dec-13	12.55	6.64	6.9	6.96	12.28	12.56	13.12
	7.9	3.91	4.06	3.97	9.74	9.98	10.48
Jan-14	14.05	6.17	6.66	6.52	11.44	11.93	12.26
	10.8	3.63	3.93	3.53	8.97	9.39	9.6
Feb-14	13.45	6.52	6.52	6.87	12.77	12.82	13.69
	10.85	3.9	3.84	3.89	10.28	10.32	11.05
Mar-14	11.4	8.62	7.28	8.67	13.96	12.87	14.68
	8.75	5.37	4.3.	5.68	11.2	10.23	12.04
Apr-14	13.05	7.2	5.99	7.49	12.53	11.5	13.35
	10.55	4.36	3.44	4.52	9.94	9.04	10.7
May-14	16.6	8.88	9.76	8.98	13.1	13.86	13.73
	12.8	5.67	6.32	6.01	10.29	10.94	11.05
Jun-14	13.4	8.96	8.36	9	14.2	13.73	14.92
	8.4	3.27	2.87	3.06	9.02	8.65	9.64
Jul-14	21.1	11.48	11.86	11.25	15.12	15.44	15.53
	17.1	5.09	5.25	5.31	9.43	9.65	10.12
Aug-14	16.3	8.41	6.83	8.73	13.61	12.24	14.45
	10.85	3.3	2.39	2.79	8.66	7.63	9.11
Spt-14	22.45	14.53	14.49	14.1	24.72	24.72	25.86
	16.2	7.7	7.58	8.16	19.23	19.21	20.72
Oct-14	26.25	10.65	10.4	11.18	21.88	21.74	23.43
	21.45	5.46	5.21	5.24	16.96	16.83	18.24
Nov-14	26.45	14.57	13.33	14.81	25.71	24.74	27.21
	22.8	8.41	7.42	8.86	20.39	19.53	21.99

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	30.6	20.86	23.11	19.4	29.54	31.3	30.14
	20.1	7.23	8.43	7.52	18.25	19.55	19.68
Jan-15	23.05	11.36	12.41	11.86	20.58	21.56	21.96
	13.3	5.98	6.6	5.92	15.54	16.35	16.69
Feb-15	34	22.14	22.45	20.75	32.7	32.95	33.58
	26.1	8.45	8.48	8.87	21.48	21.65	23.18
Mar-15	28.25	17.05	16.15	16.82	27.33	26.4	18.68
	18.25	5.45	4.84	4.94	16.93	16.39	13.36
Apr-15	34.9	21	23.61	20.21	30.75	32.89	31.75
	25.85	8.32	9.82	8.68	19.79	21.42	21.36
May-15	35.7	20.47	20.93	19.69	32.79	33.18	34.1
	24.65	7.86	8.01	8.15	22.08	22.37	23.87
Jun-15	33	17.63	17.86	17.41	29.94	30.16	31.42
	22.3	6.11	6.13	5.87	19.67	19.82	21.19
Jul-15	34	24.39	23.81	21.96	34.51	34.06	34.95
	22.6	9.8	9.31	10.43	22.94	22.57	24.73
Aug-15	30.45	17.5	15.39	17.62	31.41	29.69	33.19
	20.9	6.45	5.23	6.09	21.33	19.97	22.97
Spt-15	37.6	25.37	24.08	22.99	34.63	33.61	34.93
	27.3	10.78	9.82	11.46	22.87	22.04	24.61
Oct-15	24.75	11.69	10.96	12.33	23.08	22.49	24.75
	14.7	4.7	4.23	3.68	16.02	15.53	17
Nov-15	30.05	18.23	16.12	18.1	29.78	28.05	31.22
	19.95	6.72	5.48	6.57	19.43	18.09	20.91
Dec-15	21.6	12.8	11.41	13.37	21.98	20.79	23.43
	12.55	3.74	3.06	1.84	12.68	11.83	12.98
Jan-16	15.95	14.1	11.97	14.55	23.77	21.95	25.23
	14.7	8.34	6.75	8.79	18.56	16.98	20.03
Feb-16	22.35	12.8	12.36	13.18	22.72	22.38	24.13
	16.95	7.09	6.71	7.41	17.56	17.26	18.96
Mar-16	22.6	11.09	9.79	11.47	21.49	20.41	22.91
	17.1	5.62	4.72	5.71	16.47	15.55	17.79
Apr-16	19.9	11.6	10.8	11.99	18.8	18.12	19.94
	14.35	6.13	5.55	6.36	13.69	13.12	14.77

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	22.35	13.62	13.95	13.78	25.16	25.47	26.65
	16.95	7.65	7.84	8.15	19.96	20.22	21.6
Jun-16	18.9	10.2	11.02	10.62	16.81	17.57	17.89
	14	4.99	5.49	4.99	11.83	12.44	12.71
Jul-16	21.35	14.31	14.39	14.15	18.28	18.36	18.78
	15.45	7.98	7.99	8.53	12.53	12.58	13.49
Aug-16	21.15	13.75	12.63	13.82	20.36	19.42	21.32
	16.45	7.69	6.85	8.2	14.94	14.14	16.13
Spt-16	20.25	14.29	12.12	14.47	20.47	18.56	21.44
	15.3	8.29	6.69	8.85	15.02	13.44	16.21
Oct-16	20.55	9.99	9.99	10.66	15.67	15.7	16.83
	15.4	5.37	5.33	5.03	10.99	10.99	11.57
Nov-16	39.6	13	12.78	13.43	18.62	18.44	19.66
	15.9	7.41	7.2	7.81	13.37	13.21	14.4
Dec-16	20.7	12.77	10.64	13.19	19.35	17.44	20.47
	16.2	7.19	5.68	7.57	14.15	12.57	15.26
Jan-17	25	15.41	13.81	15.37	20.2	18.8	20.89
	16.65	9.12	7.9	9.75	14.51	13.34	15.62
Feb-17	20.05	10.05	10.25	10.71	16.4	16.62	17.62
	15.4	5.41	5.5	5.09	11.7	11.87	12.37
Mar-17	22.25	13.24	12.74	13.68	17.05	16.61	17.92
	13.4	3.88	3.6	2.43	7.62	7.33	7.23

Source: Authors compilation

Table 11: Calculated option premiums and market premiums of Coal India Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	13.7	9.33	8.86	9.61	16.01	15.62	16.99
	5.4	4.1	3.78	4.02	11.06	10.75	11.9
May-12	19.8	14.93	15.84	13.88	20.58	21.33	20.9
	8.2	3.28	3.61	2.7	10.1	10.58	10.71
Jun-12	11.8	7.53	7.13	7.93	9.75	9.38	10.36
	4.1	2.93	2.68	2.34	5.1	4.84	5.02
Jul-12	14.7	11.4	11.7	11.3	14	14.28	14.34
	4.85	5.39	5.55	5.7	8.41	8.6	9.04
Aug-12	18.55	17.19	16.01	15.42	17.96	16.84	16.63
	6.6	4.28	3.68	4.24	5.58	4.97	5.75
Sep-12	17.8	15.09	14.84	14	18.81	18.59	18.77
	6.8	3.35	3.19	2.81	8.04	7.89	8.39
Oct-12	21.3	21.77	21.83	18.36	23.18	23.23	21
	10.6	6.71	6.67	7.17	9.65	9.64	10.38
Nov-12	19.75	18.21	18.46	16.09	17.77	18.04	15.2
	7.1	4.78	4.83	4.9	3.71	3.74	3.66
Dec-12	11.95	11.59	11.05	11.59	11.21	10.66	11.13
	2.85	5.67	5.27	5.99	5.2	4.8	5.47
Jan-13	17.55	16.76	16.53	15.13	16.28	16.05	14.28
	5.45	4.08	3.91	3.95	3.12	2.95	21.77
Feb-13	20.4	19.69	18.99	17.05	22.62	22.02	21.56
	7.15	5.54	5.11	5.86	10.35	9.93	11.16
Mar-13	13.9	16.71	9.94	14.62	19.23	13.41	18.41
	4.8	3.57	1.22	3.43	7.52	4.39	7.98
Apr-13	9.8	4.32	4.11	4.55	10.43	10.31	11.21
	6.7	1.92	1.74	1.5	8.04	7.93	8.61
May-13	13.4	7.21	7.25	7.13	10.7	10.74	11.14
	10	3.87	3.84	4.08	7.87	7.89	8.45
Jun-13	11.1	7.83	6.58	7.64	11.33	10.33	11.73
	8	4.35	3.39	4.59	8.44	7.58	9.05

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	11.85	5.91	5.94	6	9.9	9.95	10.45
	9	2.9	2.86	2.95	7.24	7.28	7.79
Aug-13	11.05	5.42	5.49	5.52	15.32	15.41	16.4
	8.8	2.49	2.48	2.47	12.85	12.93	13.92
Spt 13	9.9	4.41	4.27	4.55	13.08	13.01	14.04
	7.6	1.74	1.61	1.5	10.66	10.6	11.55
Oct-13	14.05	5.51	5.16	5.67	14.63	14.39	15.67
	11.5	2.66	2.38	2.62	12.15	11.94	13.15
Nov-13	10.35	5.41	4.86	5.54	11.78	11.36	12.56
	8.7	2.53	2.13	2.49	9.24	8.88	9.98
Dec-13	9.95	5.07	5.19	5.19	10.98	11.11	11.71
	5.4	2.23	2.24	2.14	8.46	8.57	9.13
Jan-14	10.85	6.05	6.33	6.05	31.27	31.52	33.67
	7.9	2.91	3.03	3	28.98	29.21	31.4
Feb-14	8.75	4.39	4.28	4.52	10.58	10.53	11.32
	6.6	2.12	2	2.08	8.58	8.53	9.28
Mar-14	27.2	5.47	5.51	5.42	11.19	11.24	11.85
	7.55	2.83	2.81	2.98	9.08	9.12	9.81
Apr-14	10.75	6.4	6.22	6.74	11.01	10.87	11.78
	8.2	3.8	3.65	3.92	8.53	8.41	9.2
May-14	13.65	9.04	9.36	9.06	21.31	21.59	22.69
	12.7	5.85	6.08	6.24	18.77	19.03	20.27
Jun-14	19	7.79	7.59	8.26	15.79	15.65	16.97
	16.85	5.2	5.02	5.43	13.35	13.21	14.43
Jul-14	18.15	7.95	8.44	8.44	16.53	17.01	17.77
	16.25	5.37	5.73	5.61	14.09	14.52	15.23
Aug-14	61.45	9.49	8.58	9.76	15.05	14.27	15.93
	11.7	6.49	5.74	6.94	12.38	11.67	13.34
Spt-14	14.5	10.46	10.31	10.59	19.87	19.78	21.07
	9.25	4.81	4.68	4.95	14.83	14.75	16.06
Oct-14	17.4	12.23	12.31	11.84	16.87	16.95	17.34
	12.25	5.81	5.82	6.2	11.27	11.31	12.16
Nov-14	9.95	7.58	5.92	8.05	12.31	10.74	13.21
	6	3.16	2.24	2.41	7.75	6.59	7.98

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	11.3	10.09	8.25	10.24	17.29	15.7	18.27
	6.65	4.51	3.38	4.59	12.21	10.94	13.18
Jan-15	16	12.95	11.9	12.62	18.86	17.99	19.52
	11.05	6.53	5.77	6.97	13.32	12.6	14.38
Feb-15	9.5	7.56	5.97	8.02	11.32	9.81	12.11
	5.5	3.09	2.22	2.37	6.74	5.66	6.83
Mar-15	7	11.02	4.98	11.22	16.27	10.55	11.23
	4.4	5.38	1.85	5.58	11.06	6.69	8.59
Apr-15	15.45	11.98	13.33	11.6	16.19	17.34	16.6
	10.5	5.62	6.49	6	10.58	11.47	11.42
May-15	16.3	13.74	13.98	13.05	16.62	16.84	16.65
	9.95	6.98	7.11	7.45	10.59	10.74	11.38
Jun-15	12.05	8.09	8.24	8.59	11.43	11.59	12.22
	7.3	3.54	3.59	2.99	6.8	6.9	6.92
Jul-15	13.9	8.69	8.03	9.2	16.49	15.91	17.69
	9.75	4.01	3.58	3.6	11.79	11.32	12.59
Aug-15	18	14.33	13.25	14.05	22.39	21.51	23.33
	13	7.9	7.09	8.45	16.91	16.16	18.25
Spt-15	16.8	11.8	10.08	11.54	18.68	17.25	19.47
	11.85	5.58	4.44	5.94	13.31	12.15	14.4
Oct-15	18.2	12.01	11.86	11.27	15.99	15.87	16.2
	12.7	5.3	5.17	5.67	10.24	10.13	11.05
Nov-15	18.2	13.04	12.41	12.09	17.27	16.76	17.43
	10.25	6.08	5.62	6.49	11.41	11	12.29
Dec-15	12.65	10.66	9.71	10.52	15.49	14.69	16.1
	7.2	4.69	4.07	4.92	10.14	9.51	10.95
Jan-16	6.1	8.89	3.55	9.1	14.82	9.64	15.69
	3	3.63	1	3.5	9.85	5.98	10.58
Feb-16	15.4	13.08	10.65	12.11	19	17.05	19.41
	9.45	6.11	4.49	6.52	13.32	11.74	14.36
Mar-16	7.15	6.81	7.57	7.18	13.09	13.8	14.03
	4.5	2.38	2.73	1.58	8.51	9.04	8.95
Apr-16	13.5	10.01	10.12	9.59	14.2	14.3	14.58
	8.3	3.85	3.88	4.04	8.76	8.83	9.48

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	13.85	10.86	10.28	10.19	13.09	12.59	13.04
	8	4.36	3.98	4.64	7.23	6.87	7.81
Jun-16	11.1	5.98	6.44	6.31	9.81	10.26	10.5
	6.55	3.45	3.76	3.54	7.35	7.72	7.92
Jul-16	9.2	5.83	5.97	6.22	10.16	10.32	10.93
	6.8	3.47	3.55	3.45	7.79	7.92	8.35
Aug-16	14	7.89	8.1	8.18	11.66	11.86	12.35
	8.75	5.07	5.2	5.41	9.03	9.19	9.75
Spt-16	10.7	8.18	7.8	8.46	9.95	9.6	10.42
	7.95	5.31	5	5.68	7.2	6.91	7.75
Oct-16	9.5	7.35	6.68	7.68	8.96	8.34	9.47
	7.05	4.63	4.11	4.91	6.33	5.82	6.79
Nov-16	10.95	9.04	8.23	9.12	13.97	13.28	14.67
	8.15	5.94	5.28	6.35	11.24	10.63	12.11
Dec-16	11.25	8.29	7.35	8.41	11.95	11.12	12.53
	8.6	5.26	4.52	5.63	9.22	8.5	9.94
Jan-17	6.9	8.74	4.85	8.74	11.57	7.97	11.99
	3.2	3.25	1.36	3.19	6.37	3.99	6.76
Feb-17	7.35	7.55	3.81	7.84	9.35	5.68	9.84
	5.25	4.76	2.09	5.07	6.67	3.78	7.17
Mar-17	5.3	9.23	3.87	9.31	11.26	6.08	11.63
	4.35	6.11	2.16	6.53	8.36	4.16	8.98

Source: Authors compilation

Table 12: Calculated option premiums and market premiums of Dr. Reddy's Laboratories Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	55	35.59	37.53	36.36	57.52	59.29	60.75
	13.7	10.19	10.7	6.41	32.91	34.06	34.13
May-12	65.75	48.09	47	46.34	63.5	62.62	64.88
	48.85	16.5	15.47	16.4	35.48	34.73	37.87
Jun-12	156.3	62.85	51.12	55.68	74.35	64.63	72.32
	20.95	18.87	12.36	19.74	37.23	30.65	40
Jul-12	72	61.15	62.87	54.54	88.16	89.42	89.45
	43.35	23.24	23.95	24.6	59.14	60.08	63.7
Aug-12	57.85	38.4	37.57	38.07	50.08	49.41	51.64
	30.6	10.6	9.83	8.13	23.82	23.26	24.26
Sep-12	62	44.01	44.79	42.69	67.18	67.85	69.73
	35.15	13.65	13.63	12.75	40.55	40.96	43.43
Oct-12	81.45	58.89	54.8	53.01	66.79	63.22	64.46
	50.4	21.8	18.86	23.06	34.49	31.84	36.95
Nov-12	58.6	38.24	41.76	38.18	54.25	57.27	56.48
	35.65	10.83	12.11	8.23	28.48	30.4	29.51
Dec-12	52.7	39.7	31.66	40	50.1	42.96	51.89
	28.4	12.42	8.35	10.05	23.97	19.39	24.13
Jan-13	65	45.18	46.59	44.39	53.61	54.88	54.45
	40.75	19.46	15.58	14.44	29.95	26.17	26.5
Feb-13	70	62.04	62.96	57.47	76.7	77.44	76.52
	52	26.01	26.17	27.52	46.09	46.51	49.48
Mar-13	58.65	56.66	52.35	52.23	65.31	61.55	63.98
	36.5	21.16	18.15	22.28	33.98	31.21	36.4
Apr-13	46.5	27.29	23.14	28.37	54.47	51.18	58.15
	30.35	15.78	12.52	15.86	44.16	41.24	47.5
May-13	64.5	32.78	31.15	33.69	53.61	52.42	56.75
	56.85	20.36	18.79	21.19	42.72	41.62	45.84
Jun-13	68.25	34.86	31.74	35.78	57.89	55.47	61.28
	62.95	22.27	19.53	23.27	46.96	44.76	50.41

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	72.85	41.43	28.12	41.78	73.5	62.71	77.64
	65.55	27.86	17.11	29.27	62.42	52.64	67
Aug-13	71.05	39.16	43.28	40.05	87.94	91.43	93.8
	83.65	26.24	29.26	27.54	77.42	80.63	83.44
Spt-13	102.3	61.82	46.64	57.82	96.56	85.18	99.73
	77.85	25.34	15.53	26.55	68.23	58.96	73.48
Oct-13	112	39.05	45.09	40.23	84.37	89.46	90.03
	84.4	12.94	15.42	8.97	59.77	63.81	63.87
Nov-13	87.8	46.37	47.7	46.72	83.99	85.23	88.77
	63.7	17.06	17.11	15.46	58.09	58.99	62.28
Dec-13	101.2	57.13	60.45	55.35	86.88	89.51	90.15
	71.05	23.44	24.86	24.08	58.92	60.89	63.35
Jan-14	83.25	45.74	52.41	46.34	67.73	73.37	71.04
	55.7	16.95	20.09	15.08	41.3	45.32	43.5
Feb-14	76.25	39.75	39.23	41.24	80.55	80.48	85.98
	50.05	14.15	13.21	9.98	56	55.84	59.45
Mar-14	100.55	70.67	66.93	67.59	120.95	118.26	126.26
	72.4	34.56	31.22	36.32	93.07	90.7	100.18
Apr-14	93.15	57.97	49.87	59	87.32	80.47	91.84
	64.85	28.64	22.99	29.41	60.68	55.12	65.14
May-14	109	60.48	60.37	61.09	109.59	109.72	115.92
	83.05	30.32	29.81	31.51	83.42	83.47	90.07
Jun-14	65.7	45.23	27.64	47.28	67.62	51.18	71.85
	46.65	19.85	9.92	17.69	42.85	30.73	44.77
Jul-14	74.55	41.91	29.79	44.26	74.94	57.88	80.28
	52.7	18.35	11.33	14.67	51.2	24.47	53.72
Aug-14	64.6	48.72	28.13	51.15	78.79	52.04	84.04
	45.95	23.37	11.12	21.56	54.12	18.5	57.22
Spt-14	89.45	63.29	41.96	64.83	91.56	72.43	96.34
	62.55	33.97	19.59	35.24	64.68	49.34	69.38
Oct-14	120.4	64.8	71.27	66.95	102.67	108.51	108.77
	93.15	36.15	40.35	37.36	76.41	81.2	82.11
Nov-14	91.8	61.2	52.33	63.6	90.34	82.57	95.7
	66.65	33.41	26.95	34.01	64.24	57.85	68.65

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	107.5	60.45	59.61	63.76	111.03	110.71	118.92
	85.25	34.66	33.62	34.17	86.28	85.92	92.49
Jan-15	135	71.54	77.95	72.38	117.42	122.94	123.75
	101.05	40.55	44.82	42.79	90.46	95.1	97.49
Feb-15	135	72.43	72.37	73.52	134.52	134.76	142.57
	92.7	41.65	41.15	43.94	108.16	108.31	116.75
Mar-15	117	69.47	67.42	71.19	112.62	111.13	79.27
	93	39.71	37.78	41.6	86.01	84.65	65.74
Apr-15	125.7	64.06	69.82	67.13	119.62	125	127.87
	100.2	37.18	41	38.15	94.49	99.08	101.9
May-15	133.6	83.86	85.95	83.97	130.95	132.88	137.29
	116.7	51.7	52.94	54.99	103.28	104.87	111.18
Jun-15	133.15	79.05	81.23	80.68	120.54	122.63	126.98
	98.3	48.67	49.96	51.7	93.36	95.07	100.58
Jul-15	108.6	75.45	54.11	77.61	165.32	146.98	176.48
	84.35	45.95	30.22	48.62	139.83	123.33	151.25
Aug-15	127.2	81.39	70.63	84.59	147.44	138.28	157.12
	103.2	52.6	44.04	55.61	121.5	113.32	131.16
Spt-15	175.7	86.09	74.13	89.07	153.1	142.95	162.86
	132.75	56.62	47.02	60.09	126.86	117.77	136.89
Oct-15	173.25	93.35	88.77	95.34	163.47	159.9	173.18
	146.65	62.37	58.36	66.35	136.67	133.41	147.31
Nov-15	130.1	87.09	75.79	90.27	189.16	179.83	200.78
	107.55	57.76	48.62	61.29	163.61	155.06	175.41
Dec-15	986.55	82.61	81.49	81.4	150.39	149.69	158.33
	153.75	49.34	48.14	52.41	123.36	122.7	132.94
Jan-16	108.05	54.96	44.69	57.96	123.68	114.61	132.83
	84.85	29.61	22.53	28.98	99.42	91.5	107.33
Feb-16	95.95	52.99	36.76	56.05	127.74	112.61	137.41
	75	28.28	17.62	27.07	103.76	90.54	112.05
Mar-16	127.7	77.13	71.96	76.56	149.28	145.35	157.78
	109	44.72	40.55	47.57	122.77	119.24	132.53
Apr-16	127	76.89	76.75	79.74	111.74	111.74	118.26
	99.55	48.89	48.62	52.29	85.54	85.48	92.43

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	119.9	84.66	86.47	86.85	134.65	136.4	142.39
	95.6	55.38	56.63	59.4	108.21	109.7	116.94
Jun-16	105.85	71.01	72.15	75	132.37	133.64	141.91
	80.4	45.12	45.82	47.55	107.77	108.85	116.67
Jul-16	111	89.32	69.34	92.73	79.93	59.2	82.16
	85.2	60.87	45.13	65.27	50.57	34.96	53.98
Aug-16	127.5	79.52	79.92	81.76	126.01	126.51	133.34
	105.2	50.66	50.8	54.3	99.75	100.14	107.86
Spt-16	107.15	84.87	81.16	86.76	117.89	114.64	123.74
	76.85	55.29	52.24	59.31	90.69	87.85	97.86
Oct-16	95.75	65.83	61.14	70.07	107.4	103.11	115.31
	71.15	41.23	37.63	42.61	83.22	79.53	89.59
Nov-16	94.75	74.38	65.87	78.83	111.08	103.12	118.85
	70.45	48.74	42.13	51.37	86.2	79.38	92.92
Dec-16	99.65	73.48	58.53	77.43	94.88	80.54	100.87
	77.6	47.21	35.93	49.98	69.32	57.58	74.51
Jan-17	88.1	66.61	57.87	70.71	88.39	80.04	94.46
	63.65	41.6	35.06	43.26	63.74	56.92	68.13
Feb-17	126	86.79	87.3	88.07	88.33	88.84	89.85
	100.5	56.55	56.78	60.61	58.29	58.54	62.52
Mar-17	112	60.63	58.43	64.53	71.46	69.38	76.33
	82.75	36.34	34.61	37.07	47.23	45.54	49.55

Source: Authors compilation

Table 13 : Calculated option premiums and market premiums of Gail (India) Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	16.05	19.01	19.43	16.02	22.01	22.34	20.94
	10.5	4.22	4.33	4.34	9.68	9.86	10.42
May-12	19.25	11.37	12.71	10.57	14.72	15.82	14.82
	8.7	4.47	5.27	4.73	8.85	9.66	9.53
Jun-12	17.7	13.03	11.97	11.71	17.03	16.19	17.02
	10.6	3.08	2.53	2.95	8.58	8	9.2
Jul-12	10.2	8.88	7.32	8.9	14.61	13.32	15.37
	4.5	3.23	2.36	3.06	9.48	8.49	10.17
Aug-12	10	9.14	5.13	9.05	15.2	11.76	15.95
	3.5	3.31	1.34	3.21	10.02	7.41	10.78
Sep-12	22.25	17.67	18.14	14.95	21.2	21.56	20.45
	9.3	3.38	3.49	3.27	9.34	9.54	10.02
Oct-12	13	7.96	7.92	8.24	15.93	15.93	16.99
	5.6	2.92	2.83	2.4	11.08	11.07	11.86
Nov-12	12.9	8.7	8.4	8.8	15.49	15.27	16.38
	4.85	3.2	2.97	2.96	10.45	10.27	11.23
Dec-12	17.25	16.08	15.16	13.93	19.45	18.69	18.91
	6	2.71	2.28	2.24	7.96	7.49	8.42
Jan-13	15.8	14.21	13.81	12.69	19.59	19.27	19.73
	6.2	2.04	1.82	1.01	8.98	8.76	9.45
Feb-13	11.7	7.64	5.84	7.82	11.42	9.84	12.04
	4.7	2.52	1.63	1.98	6.46	5.36	6.72
Mar-13	37.8	14.66	12.94	12.8	20.57	19.27	20.71
	5.3	2.01	1.41	1.12	9.9	9.06	10.54
Apr-13	10.05	6.16	5.02	6.46	11.28	10.28	12.06
	11.45	3.5	2.68	3.55	8.78	7.92	9.45
May-13	11.2	6.47	5.31	6.81	11.75	10.71	12.57
	8.95	3.84	2.98	3.89	9.25	8.36	9.95
Jun-13	10.6	5.72	6.08	6.02	11.84	12.19	12.69
	9.9	3.13	3.34	3.1	9.39	9.69	10.12

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	13.05	7.32	6.07	7.46	11.27	10.2	11.87
	9.05	4.29	3.36	4.54	8.57	7.66	9.23
Aug-13	15.9	7.98	6.26	8.02	15.99	14.6	16.96
	9.5	4.81	3.51	5.11	13.37	12.12	14.44
Spt-13	11.15	8.63	7.06	8.39	12.73	11.44	13.18
	7.35	2.72	1.91	2.56	7.44	6.51	7.96
Oct-13	19.5	9.75	11.28	9.43	13.79	15.06	14.21
	12.25	3.55	4.4	3.6	8.33	9.27	8.96
Nov-13	11.5	6.43	6.6	6.78	11.51	11.7	12.32
	6.7	3.81	3.9	3.86	9.02	9.18	9.7
Dec-13	19.2	11.66	12.51	10.9	16.03	16.72	16.31
	11.1	4.78	5.27	5.07	10.29	10.8	11.09
Jan-14	10.4	5.81	5.92	6.15	10.51	10.66	11.28
	5.5	3.33	3.37	3.24	8.09	8.2	8.65
Feb-14	10.2	11.81	6.38	11.17	17.43	12.94	17.93
	6.1	5.03	1.96	5.33	11.82	8.33	12.76
Mar-14	9.75	6.61	5.96	6.98	13.11	12.56	14.06
	5.7	2.22	1.86	1.15	8.52	8.09	8.87
Apr-14	15.25	7.22	7.11	7.61	12.99	12.93	13.9
	11.05	2.65	2.53	1.81	8.32	8.26	8.67
May-14	26.5	13.33	13.02	12.49	29.08	28.87	30.67
	15.55	6.29	6.01	6.68	23.9	23.71	25.82
Jun-14	19.1	11.81	9.92	11.38	22.86	21.41	24.05
	14.75	5.27	4.03	5.57	17.62	16.39	19.07
Jul-14	22.05	12.35	12.29	12.29	18.66	18.63	19.49
	19.15	6.15	6.04	6.49	13.23	13.19	14.26
Aug-14	13.15	9.51	5.17	9.8	15.99	12	16.96
	8.85	4.15	1.77	4	10.96	7.87	11.75
Spt-14	14.2	7.92	6.46	8.4	14.49	13.15	15.56
	9.8	3.42	2.56	2.6	9.86	8.81	10.31
Oct-14	19.4	9.71	10.11	10.05	17.31	17.69	18.41
	13	4.39	4.57	4.24	12.31	12.61	13.23
Nov-14	23.95	14.9	14.17	14.7	23.54	22.97	24.59
	19.45	8.36	7.76	8.89	18.02	17.52	19.42

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	20.9	13.81	13.01	13.61	24.37	23.76	25.62
	15.5	7.35	6.71	7.81	19.02	18.48	20.53
Jan-15	20.15	12.61	12.35	12.38	19.19	19	19.97
	16.8	6.2	5.96	6.57	13.69	13.53	14.77
Feb-15	15.1	9.07	6.16	9.41	16.1	13.48	17.14
	10.75	3.89	2.24	3.61	11.16	9.1	11.94
Mar-15	17.5	11.41	9.24	11.27	25.5	23.8	17.75
	11.8	5.21	3.81	5.46	20.43	18.96	15.29
Apr-15	24.55	13.35	13.73	12.78	20.55	20.87	21.27
	12.55	6.7	6.92	7.16	15.01	15.27	16.2
May-15	17.35	11.28	11.55	11.15	16.04	16.28	16.65
	12.1	5.24	5.36	5.53	10.62	10.8	11.47
Jun-15	14.4	13.19	8.84	12.75	17.78	14	18.21
	9.95	6.67	3.82	7.12	12.07	9.11	13.02
Jul-15	24.6	13.87	9.11	13.32	19.05	14.95	19.51
	11.2	7.21	4.04	7.7	13.32	10.04	14.34
Aug-15	12	9.75	7.81	9.88	21.12	19.49	22.48
	7.8	4.21	3.05	4.25	16.19	14.81	17.54
Spt-15	15.7	11.79	10.92	10.86	15.15	14.42	15.18
	11.3	4.9	4.32	5.24	9.27	8.72	10
Oct-15	11.95	6.72	4.68	7.02	12.32	10.44	13.15
	7.5	2.15	1.24	1.4	7.67	6.3	8.06
Nov-15	14.6	11.59	8.48	10.91	25.17	22.78	26.55
	8.9	4.96	3.08	5.29	20.08	18.01	21.75
Dec-15	14.9	12.47	6.6	12.05	18.63	13.53	19.28
	10.65	6.02	2.47	6.43	13.12	9.07	14.18
Jan-16	16.05	13.59	10.69	12.87	23.78	21.49	24.81
	11.25	6.79	4.81	7.25	18.39	16.43	19.85
Feb-16	15	12.67	7.27	12.2	19.8	15.21	20.55
	10.95	6.16	2.82	6.58	14.33	10.61	15.49
Mar-16	16.9	8.26	7.64	8.38	15.88	15.38	16.85
	11.75	3	2.64	2.76	10.98	10.58	11.84
Apr-16	20	12.13	12.14	11.93	18.44	18.46	19.2
	12.5	6.05	6.03	6.48	13.08	13.09	14.16

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	14.7	7.68	7.88	8.21	15.73	15.95	16.96
	10.6	3.39	3.49	2.75	11.23	11.4	11.95
Jun-16	23.45	13.89	14.68	13.51	20.44	21.12	21.16
	14.65	7.51	8.05	8.06	14.93	15.48	16.12
Jul-16	17.75	11.43	10.9	11.71	19.02	18.56	20.14
	13	5.94	5.56	6.26	13.95	13.57	15.1
Aug-16	15.5	8.92	8.78	9.45	9.09	8.96	9.64
	11.4	4.25	4.14	3.99	4.43	4.32	4.21
Spt-16	16.45	13.36	10.85	13.11	15.16	12.81	15.27
	11.85	7.13	5.39	7.66	9.27	7.52	9.99
Oct-16	14.9	10.56	9.76	10.87	14.87	14.15	15.67
	10.15	5.23	4.69	5.42	9.78	9.22	10.52
Nov-16	16.95	10.96	10.75	11.49	17.32	17.14	18.46
	12.1	5.88	5.71	6.04	12.4	12.25	13.35
Dec-16	19.2	13.11	12.32	13.21	15.49	14.77	15.95
	13.85	7.24	6.66	7.75	9.91	9.34	10.68
Jan-17	16.4	14.94	10.84	14.79	18.28	14.5	18.7
	12	8.7	5.77	9.33	12.51	9.53	13.48
Feb-17	15.6	11.17	5.69	11.84	13.7	8.19	14.61
	11.95	6.29	2.75	6.39	8.86	4.85	9.32
Mar-17	16.3	13.82	9.1	14.35	29.49	25.08	31.54
	12.05	8.35	5	8.9	24.55	20.64	26.62

Table 14: Calculated option premiums and market premiums of Grasim Industries Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	85	59.94	61.98	61.04	98.36	100.27	103.86
	103.35	30.63	31.63	31.78	72.07	73.57	77.68
May-12	350.1	63.26	65.63	63.32	99.16	101.28	103.97
	314.3	32.36	33.61	34.06	72.13	73.8	77.78
Jun-12	474.5	68.46	66.55	65.57	99.5	98.02	102.51
	99	34.18	32.48	36.31	70.97	69.69	76.41
Jul-12	99.4	70.23	77.18	69.38	107.43	113.24	112.06
	77	37.8	42.47	40.12	79.71	84.51	85.9
Aug-12	111.55	77.78	63.21	75.48	104.02	91.7	106.66
	66.95	43.58	32.73	46.22	74.58	64.4	80.01
Sep-12	78.5	74.67	73.23	74.74	110.33	109.25	115.27
	62.4	42.85	41.38	45.48	82.51	81.51	88.82
Oct-12	102.2	62.4	64.67	65.37	104.2	106.53	111.12
	78.45	35.54	36.76	36.12	78.86	80.72	84.65
Nov-12	120	61.74	67.57	64.95	102.7	108.25	109.7
	61.9	35.48	39.26	35.7	77.61	82.17	83.14
Dec-12	89.1	60.75	63.29	63.91	96.48	99.09	102.96
	73.55	34.57	35.98	34.66	71.34	73.4	76.22
Jan-13	423.45	78.45	89.58	78.52	106.69	116.37	110.82
	88	46.38	54.52	49.27	78.16	86.15	83.97
Feb-13	74.3	55.95	55.68	58.7	81.45	81.43	86.64
	58.85	29.81	29.25	29.45	56.2	56.05	59.58
Mar-13	67.35	63.31	52.65	65.22	90.32	80.9	95.21
	76.3	34.66	27.01	35.97	63.7	56.03	68.3
Apr-13	74.7	45.49	42.76	47.54	78.65	76.56	83.85
	249.5	19.86	17.73	17.18	53.89	52.13	56.96
May-13	94	52.04	51.05	53.76	79.69	79.07	84.32
	76.4	24.31	23.13	23.41	53.76	53.12	57.1
Jun-13	124.65	42.94	41.94	45.15	73.1	72.55	78.1
	67	18.56	17.45	14.79	48.9	48.33	51

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	343.6	45.32	40.44	47.29	73.37	69.31	78.06
	61	19.54	16.21	16.93	48.46	45.22	50.92
Aug-13	404.7	68.35	45.71	66.2	102.26	83.88	105.95
	60	33.97	18.81	35.84	73.83	58.78	79.41
Spt-13	45.4	38.42	16.43	39.94	111.21	90.53	119.42
	56	13.48	3.69	9.58	87.38	69.78	94.38
Oct-13	72	58.73	62.95	58.64	111.5	115	117.87
	126.8	27.44	29.68	28.28	85.21	88.12	92
Nov-13	100	52.37	51.63	53.79	85.85	85.47	90.87
	29.2	24.07	23.05	23.43	59.9	59.48	64.05
Dec-13	84.15	43.54	48.69	45.45	87.41	92.09	13.44
	64.6	18.08	20.57	15.09	62.92	66.66	67.15
Jan-14	96.35	48.87	57.06	50.43	69.26	76.57	73.02
	70	21.45	26.04	20.07	43.27	48.61	45.42
Feb-14	68	46.05	42.98	47.53	89.45	87.17	95.95
	50.9	19.08	16.8	17.18	64.42	62.5	69.55
Mar-14	84.45	64.91	54.73	62.77	91.68	83.46	94.46
	59.65	30.78	23.55	32.42	62.92	56.25	67.64
Apr-14	22.1	52.72	55.74	55.4	82.86	85.85	88.36
	79.2	27.1	29.72	26.1	58.02	60.3	61.59
May-14	196.15	59.85	62.19	61.25	121.93	124.13	129.81
	96.35	30.93	32.13	31.95	96.5	98.36	104.34
Jun-14	103.05	70.65	71.56	72.38	148.42	149.51	158.16
	106.5	40.94	41.2	43.08	122.81	123.74	132.78
Jul-14	252.5	65.09	62.72	68.16	128.14	126.46	137.07
	115	37.97	35.87	38.86	103.05	101.53	111.17
Aug-14	148	63.48	51.76	66.19	109.13	98.89	116.26
	87.15	35.99	27.52	36.89	83.61	74.9	89.95
Spt-14	105	72.31	70.93	74.85	121.65	120.77	129.21
	81.95	43.46	42.02	45.55	95.5	94.66	102.92
Oct-14	94.75	89.93	99.34	90.16	149.19	157.11	156.94
	123.15	57.36	64.42	60.86	121.72	128.68	130.96
Nov-14	99.2	62.27	57.74	65.67	107.95	104.19	115.51
	77.9	36.34	32.73	36.37	83.08	79.8	89.04

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	100.3	61.64	61.78	65.12	107.09	107.62	114.68
	73.1	36.07	35.77	35.82	82.38	82.73	88.18
Jan-15	297.5	75.94	83.46	77.67	129.71	136.29	137.34
	199	45.74	51.03	48.37	103.16	108.82	111.26
Feb-15	131.5	85.16	84.25	87.44	142.06	141.61	150.47
	130	54.84	53.7	58.14	115.31	114.82	124.25
Mar-15	80	90.82	81.18	91.59	149.88	142.04	103.99
	120	58.68	50.75	62.29	122.49	115.48	90.73
Apr-15	102.9	71.96	72.26	75.36	115.97	116.51	123.57
	96.05	44.62	44.54	46.72	90.32	90.7	97.3
May-15	113	76.75	67.28	79.84	123.4	115.12	131.15
	89.95	48.44	41.03	51.2	97.31	90.1	104.95
Jun-15	135.95	87.45	88.19	89.08	128.02	128.85	134.52
	95	56.71	56.97	60.45	100.47	101.1	108.16
Jul-15	355.55	88.09	83.34	88.41	121.81	117.79	126.82
	100	56.13	52.12	59.77	93.39	89.86	100.35
Aug-15	141.15	72.77	62.24	76.47	133.25	123.96	142.53
	81.3	45.81	37.71	47.84	108.06	99.87	116.65
Spt-15	147	90.91	74.53	90.94	118.53	104	122.67
	110	58.57	45.64	62.3	89.46	77.12	95.95
Oct-15	105.3	58.74	45.28	62.47	79.77	66.78	85.39
	80.2	34.58	25	33.83	55.65	45.34	58.22
Nov-15	114	70.13	60.14	73.99	94.16	84.84	100.26
	81.25	43.83	36.18	45.35	68.61	60.89	73.17
Dec-15	116	84.88	78.44	87.32	103.46	97.58	108.11
	102	55.11	49.81	58.68	75.3	70.28	80.8
Jan-16	79	74.56	66.05	78.26	93.5	85.57	99.05
	65	47.36	40.67	49.63	67.18	60.58	71.72
Feb-16	112.95	85.54	62.76	86.34	116.45	96.07	121.39
	84	54.14	36.78	57.7	88.18	70.99	94.8
Mar-16	101	56.43	48.71	60	86.45	79.28	92.7
	472.65	32.38	26.8	31.36	62.44	56.55	65.99
Apr-16	109	51.06	52.05	53.91	93.63	94.94	100.33
	85	26.26	26.44	23.99	69.21	70.19	73.58

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	11.9	76.63	78.17	77.39	116.68	118.18	122.46
	102.6	44.93	45.57	47.48	88.92	90.08	95.65
Jun-16	131.45	62.78	70.49	65.85	108.9	116.04	116.28
	98.05	35.86	40.91	35.94	83.48	89.43	89.48
Jul-16	153.35	88.15	73.43	88.82	125.64	113.14	131.27
	90	55.63	43.88	58.91	97.07	86.26	104.17
Aug-16	161.9	92.13	85.42	92.97	188.98	184.01	200.68
	119.45	59.56	53.78	63.06	162.33	157.76	174.99
Spt-16	148.5	79.78	74.8	81.47	132.1	128.21	139.64
	119.25	48.85	44.58	51.56	104.99	101.51	113.06
Oct-16	165	85.72	85.61	87.43	156.36	156.65	165.79
	135	54.38	53.77	57.52	129.51	129.69	139.59
Nov-16	29.95	15.73	13.87	16.26	49.22	47.81	52.87
	25.15	9.79	8.29	10.27	44.26	42.94	47.92
Dec-16	30	12.47	9.93	13.01	67.37	65.29	72.72
	26	6.95	5.13	7.03	62.71	60.72	68.04
Jan-17	25.8	12.75	9.13	13.34	99.36	96.17	107.39
	19.1	7.28	4.71	7.36	94.9	91.8	102.93
Feb-17	35.75	12.66	10.69	13.34	129.04	127.38	139.55
	31.6	7.43	5.94	7.36	124.72	123.1	135.24
Mar-17	62	26.29	23.4	24.78	221.99	219.95	239.91
	42.9	12.1	10.01	12.82	213.92	211.92	231.12

Source: Authors compilation

Table 15: Calculated option premiums and market premiums of HCL Technologies Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	14.75	12.07	11.52	12.67	20.1	19.63	21.46
	10.5	3.49	3.21	1.56	11.13	10.79	11.21
May-12	25	17.81	17.56	17.57	24.06	23.85	24.83
	12	6.5	6.29	6.46	13.55	13.38	14.48
Jun-12	28	14.63	12.17	14.9	22.87	20.71	24.11
	8.6	4.67	3.49	3.79	13.19	11.67	13.89
Jul-12	26	21.46	20.72	19.85	26.12	25.47	25.91
	15	8.2	7.69	8.74	14.38	13.9	15.52
Aug-12	25	23.18	20.69	21.48	24.3	21.93	23.06
	14.95	9.68	8.08	10.36	11.36	9.77	12.2
Sep-12	18.15	14.05	14.49	14.69	16.42	16.85	17.3
	8.8	4.85	5.01	3.57	7.15	7.37	6.52
Oct-12	29	24.01	20.33	22.68	29.9	26.71	30.04
	18.85	10.81	8.42	11.57	18.21	15.83	19.64
Nov-12	37.4	34.45	33.4	29.92	38.98	38.06	36.94
	13.65	7.74	7.16	7.7	15.12	14.54	16.11
Dec-12	26.25	24.7	21.26	23.93	27.33	24.12	27.19
	14.45	11.99	9.67	12.82	15.29	12.98	16.44
Jan-13	22.8	16.94	16.25	17.58	22.67	22.05	23.92
	13.65	6.99	6.53	6.47	12.88	12.42	13.4
Feb-13	21	19.28	19.21	19.89	25.86	25.83	27.21
	13.8	8.8	8.69	8.78	15.75	15.69	16.71
Mar-13	21.95	16.61	14.46	17.61	23.79	21.77	25.44
	12.9	7.45	6.15	6.5	14.52	13.04	14.94
Apr-13	26.75	17.89	16.46	18.11	29.99	28.85	31.64
	17.25	6.75	5.81	6.28	19.78	18.87	21.17
May-13	29.9	13.37	12.99	13.87	22.3	22.03	23.7
	20.25	3.89	3.59	2.04	12.78	12.56	13.1
Jun-13	29.1	14.7	13.78	15.23	27.63	26.92	29.43
	19.05	4.84	4.26	3.4	17.98	17.41	19.03

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	43.8	23.47	23.47	22.34	33.79	33.8	34.72
	34.2	9.96	9.8	10.51	22.48	22.46	24.23
Aug-13	44.35	16.48	18.01	17.24	38.26	39.68	41.02
	34.5	6.61	7.32	5.41	28.67	29.84	30.82
Spt-13	45.6	16.57	13.58	17.53	44.48	41.88	47.9
	35.65	7.3	5.46	5.7	35.11	32.86	37.78
Oct-13	59.9	25.2	21.64	25.34	49.54	46.74	52.5
	50	12.9	10.35	13.51	39.14	36.7	42.3
Nov-13	36.35	19.15	15.91	20.13	39.3	36.51	42.11
	27.1	9.12	7.01	8.31	29.58	27.24	31.72
Dec-13	37.5	20.73	18.52	21.56	41.93	40.14	44.79
	27.65	10.03	8.48	9.74	31.98	30.45	34.45
Jan-14	54.5	23.24	29.23	24.25	47.88	53.02	51.2
	44.65	12.41	16.47	12.42	37.89	42.33	40.88
Feb-14	47.55	24.22	22.66	25.56	54.79	53.61	59.28
	37.45	13.95	12.68	13.73	45.02	43.96	48.9
Mar-14	56.05	34.73	32.04	35.33	64.26	62.16	68.13
	44.7	22.17	19.9	23.51	53.6	51.7	57.79
Apr-14	49.55	29.49	22.75	31.07	52.01	45.82	55.65
	41.9	18.83	13.74	19.66	41.97	36.56	45.28
May-14	57.25	32.52	31.88	33.98	57.37	56.93	61.21
	52.5	26.56	25.92	28.28	52.08	51.65	56.05
Jun-14	63.35	38.04	32.65	38.59	64.56	60.02	68.2
	40.25	12.23	9.48	10.07	40.02	36.64	42.58
Jul-14	84.4	48.58	47.81	47.19	74.12	73.55	76.95
	58.1	18.25	17.56	18.67	47.55	47.06	51.31
Aug-14	55.9	37.52	27.91	38.62	62.25	53.71	65.98
	33.65	12.68	8.01	10.1	38.04	31.83	40.12
Spt-14	69	55.73	53.01	53.67	74.36	72.09	76.01
	58.1	23.79	21.83	25.14	46.21	44.42	49.81
Oct-14	51.05	40.3	38.23	41.83	75.81	74.16	80.83
	40.2	28.53	26.72	30.42	65.43	63.9	70.63
Nov-14	49.95	34.82	29.61	36.55	57.9	53.23	61.79
	39.95	23.74	19.55	25.14	47.61	43.47	51.36

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	78.8	32.19	29.57	34.16	69.02	66.78	74.23
	43.8	21.88	19.71	22.75	59.25	57.2	64.05
Jan-15	58.5	31.73	25.57	33.55	63.36	57.74	68
	47.9	21.17	16.34	22.14	53.45	48.4	57.76
Feb-15	73.8	40.29	36.28	42.08	64.85	61.35	69.03
	63.2	28.8	25.41	30.67	54.33	51.17	58.58
Mar-15	81.35	51.18	46.74	52.47	197.29	193.84	141.08
	56.8	23.77	20.77	23.95	174.18	170.99	129.79
Apr-15	39.4	42.04	41.9	45.18	96.85	96.76	104.64
	32.1	34.77	34.63	37.61	90.08	89.99	97.79
May-15	42.45	49.62	48.31	51.78	98.51	97.32	105.36
	30.55	38.67	37.53	41.69	88.93	87.81	96.19
Jun-15	37.85	48.25	41.85	51.34	102.91	96.56	110.77
	28.05	38.11	32.6	41.25	93.67	87.69	101.61
Jul-15	47.55	49.67	47.01	52.19	102.76	100.25	110.16
	36.8	38.98	36.66	42.1	93.31	90.94	101.03
Aug-15	46.45	51.95	45.91	54.56	107.85	102.05	115.61
	36.95	41.2	35.96	44.47	98.39	92.92	106.48
Spt-15	41.8	46.6	44.59	49.42	100.92	99	108.52
	31.95	36.33	34.6	39.32	91.66	89.85	99.4
Oct-15	42	45.59	43.5	48.48	100.52	98.51	108.2
	33.25	35.46	33.66	38.39	91.33	89.43	99.09
Nov-15	31.7	42.96	40.88	45.51	93.22	91.24	100.22
	21.25	32.72	30.95	35.41	83.98	82.12	91.1
Dec-15	34.05	43.47	41.93	45.97	93.36	91.91	100.31
	23.75	33.15	31.84	35.88	84.08	82.73	91.19
Jan-16	27.75	38.68	36.15	41.38	84.75	82.26	91.29
	19	28.99	26.88	31.28	75.69	73.38	82.23
Feb-16	26.25	39.47	37.72	42.23	88.54	86.84	95.5
	16.1	29.78	28.31	32.14	105.59	77.92	86.37
Mar-16	29.75	37.15	34.89	39.81	34.13	31.85	36.52
	20.25	27.59	25.72	29.72	24.53	22.67	26.32
Apr-16	28.6	15.21	12.15	16.23	28.25	25.32	30.41
	20.1	6.57	4.84	5.1	19.19	16.91	20.15

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	29.9	20.1	16.7	20.37	30.48	27.48	32.02
	20.75	9.01	6.92	9.24	20.16	17.85	21.72
Jun-16	31.9	25.56	24.74	24.57	42.61	41.98	44.43
	20.35	12.56	11.92	13.44	31.83	31.29	34.42
Jul-16	26.45	14.33	12.83	15.22	22.79	21.4	24.43
	17.95	9.28	8.11	9.66	17.86	16.67	19.23
Aug-16	27.5	15.44	12.07	16.33	23.01	19.8	24.59
	23.25	10.21	7.62	10.77	17.96	15.22	19.35
Spt-16	32.55	19.55	20.11	20.06	25.12	25.65	26.29
	23.25	13.55	13.96	14.5	19.52	19.96	21
Oct-16	25.4	20.7	14.94	21.11	30.02	24.78	31.55
	20.4	14.56	9.92	15.55	24.49	19.88	26.36
Nov-16	25.25	15.75	15.57	16.64	21.18	21.05	22.58
	19.5	10.48	10.31	11.08	16.08	15.95	17.28
Dec-16	26.7	15.75	13.18	16.73	23.57	21.14	25.25
	17.95	6.78	5.29	5.6	14.38	12.61	14.76
Jan-17	24.5	19.9	13.86	20.58	29.11	23.49	30.77
	15.6	9.39	5.75	9.45	19.02	14.78	20.36
Feb-17	23	17.85	14.26	18.81	28.33	24.98	30.26
	14.9	8.23	6.07	7.68	18.76	16.2	19.88
Mar-17	43	28.67	28.39	27.49	37.38	37.16	38.03
	26.85	15.32	15.04	16.36	25.69	25.48	27.64

Source: Authors compilation

Table 16: Calculated option premiums and market premiums of HDFC Bank Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	30.45	54.04	54.75	56.82	110.74	111.47	118.52
	18.45	43.91	44.53	47.47	102.33	103.02	110.56
May-12	15.65	46.32	45.97	50.03	107.62	107.26	116.22
	7.55	37.55	37.24	40.68	99.77	99.43	108.27
Jun-12	20.5	46.58	43.72	49.71	97.09	94.11	104.4
	9.9	37.16	34.68	40.36	88.88	86.07	96.34
Jul-12	18.45	49.36	48.92	53.2	19.17	18.66	20.39
	9.4	40.41	40.02	43.85	10.01	9.65	9.87
Aug-12	19	51.65	52.25	55.62	12.21	12.84	12.58
	8.85	42.61	43.14	46.27	2.93	3.07	0.83
Sep-12	24.85	57.96	58.29	61.62	22.25	22.63	21.34
	13.05	48.22	48.5	52.28	9.53	9.69	10.13
Oct-12	21.5	57.65	57.13	61.82	22.08	21.44	22.87
	10.95	48.31	47.84	52.47	11.61	11.14	12.15
Nov-12	24.4	62.41	61.8	66.29	26.71	25.92	26.24
	12.65	52.57	52.03	56.94	14.35	13.74	15.42
Dec-12	17.5	61.43	59.77	66.23	19.43	17.59	20.58
	8.35	52.36	50.86	56.88	9.94	8.72	9.73
Jan-13	30.15	66.06	67.37	70.22	28.97	30.5	28.79
	16.3	56.23	57.41	60.88	16.81	17.9	18.07
Feb-13	16.3	54.22	54.51	58.62	16.07	16.28	17.2
	8.05	45.42	45.67	49.27	7.54	7.63	6.38
Mar-13	17.05	53.84	52.73	58.1	18.32	17.1	19.52
	8.8	44.91	43.92	48.75	9.27	8.47	8.83
Apr-13	18.6	10.81	9.08	11.09	20.42	19.05	21.7
	14	5.04	3.84	4.9	15.26	14.1	16.4
May-13	26	15.59	14.65	15.26	22.34	21.59	23.13
	19.65	8.61	7.78	9.06	16.51	15.86	17.7
Jun-13	16.95	9.61	6.24	10.09	24.62	21.63	26.45
	13.5	4.58	2.49	3.9	19.77	17.18	21.27

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	24.6	15.68	13.3	15.23	33.39	31.67	35.31
	19.25	8.59	6.73	9.04	28.05	26.5	30.24
Aug-13	30	11.25	11.49	11.53	36.59	36.88	39.28
	19.85	5.41	5.42	5.34	31.7	31.95	34.34
Spt-13	25.8	10.53	7.08	10.77	40.84	38.1	43.91
	21.6	4.73	2.62	4.58	36.04	33.51	39.09
Oct-13	36.6	14.47	16.59	14.01	30.45	32.01	32.18
	35	7.43	8.87	7.82	25.13	26.51	27.11
Nov-13	27	11.56	12.86	11.9	29.2	30.31	31.24
	21.4	5.77	6.51	5.71	24.18	25.17	26.14
Dec-13	24.35	9.59	10.88	10.04	25.47	26.65	27.36
	14.5	4.43	5.11	3.85	20.61	21.63	22.22
Jan-14	27.65	15.8	17.87	15.33	26.87	28.46	28.11
	16.3	3.91	4.66	2.94	16.5	17.65	17.64
Feb-14	21.95	14.38	12.14	14.04	23.16	21.43	24.34
	11.3	3.07	2.07	1.66	12.91	11.68	13.67
Mar-14	18.45	15.76	11.13	15.29	28.05	24.5	29.41
	9.15	3.89	1.92	2.91	17.75	15.08	19.02
Apr-14	30	16.85	19.26	17.59	24.97	27.2	26.52
	24.4	11.22	13.08	11.89	19.71	21.63	21.23
May-14	40	17.44	21.36	18.05	29.51	32.94	31.35
	34.7	11.6	14.7	12.35	24.26	27.31	26.19
Jun-14	32.15	16.38	11.42	17.29	25.46	20.75	27.2
	25.95	11.03	7.21	11.59	20.37	16.3	21.92
Jul-14	14.7	25.95	30.46	25.42	31.89	35.89	32.48
	28.05	13.16	16.27	14.02	20.25	23.31	21.78
Aug-14	25	18.46	17.78	19.28	26.75	26.18	28.39
	19.1	12.77	12.16	13.58	21.44	20.92	23.08
Spt-14	23.55	16.36	17.44	17.37	23.69	24.76	25.35
	13.95	7.27	7.8	5.97	14.43	15.17	14.65
Oct-14	30.05	17.19	19.18	19.23	24.25	26.17	25.92
	22.95	11.96	13.5	12.53	19.18	20.82	20.56
Nov-14	23.8	18.06	20.5	19.14	24.52	26.87	26.19
	18.25	12.78	14.71	13.44	19.41	21.42	20.79

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	30.75	22.15	24.35	23.06	26.32	28.43	27.67
	25.5	16.28	18.07	17.36	20.7	22.5	22.19
Jan-15	33	22.97	25.49	23.74	30.67	33.01	32.29
	29.75	16.93	19	18.04	25.09	27.15	26.94
Feb-15	49	24.48	26.31	25.55	31.09	32.84	32.84
	40.8	18.62	20.12	19.85	25.55	27.08	27.42
Mar-15	39.95	21.98	25.41	23.18	28.22	31.5	20.4
	34.15	16.44	19.29	17.48	22.9	25.77	17.6
Apr-15	70.6	16.49	22.74	17.11	26.66	32	28.3
	29.9	10.57	15.48	11.05	21.31	25.99	22.89
May-15	25.95	13.94	13.56	14.67	23.63	23.4	25.26
	20.4	8.61	8.21	8.61	18.55	18.33	19.82
Jun-15	34.05	21.12	21.38	21.19	30.65	30.92	32.01
	22.7	9.06	9	9.06	19.8	19.95	21.17
Jul-15	24.75	15.95	9.68	16.7	26.02	20.25	27.73
	16.1	6.15	2.91	4.57	16.3	12.07	16.86
Aug-15	33.85	22.71	22.54	22.72	33.89	33.8	35.42
	22.45	10.35	10.02	10.59	22.96	22.84	24.64
Spt-15	32.8	18.94	16.18	19.3	31.52	29.28	33.3
	22.1	7.65	5.91	7.17	21.18	19.4	22.64
Oct-15	37.05	18.09	18.05	18.62	30.36	30.42	32.18
	26.25	7.25	7.03	6.49	20.2	20.2	21.47
Nov-15	38.9	28.87	25.97	27.37	37.97	35.6	38.56
	25.65	14.44	12.19	15.24	25.89	23.94	27.74
Dec-15	37.55	28.47	25.36	26.97	29.69	26.71	28.63
	24.8	14.05	11.68	14.84	15.9	13.61	16.86
Jan-16	24.9	20.29	17.26	20.64	29.18	26.61	30.6
	14.6	8.74	6.76	8.51	18.52	16.53	19.67
Feb-16	29.5	20.59	18.08	20.76	30.8	28.74	32.27
	17.9	8.73	7.05	8.63	20.08	18.46	21.47
Mar-16	27.05	13.43	10.84	14.14	22.37	20.08	23.91
	17.05	4.45	3.11	2.01	13.07	11.43	13.01
Apr-16	31.25	15.54	16.65	16.11	25.77	26.8	27.36
	19.6	5.4	5.78	3.91	15.88	16.6	16.54

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	34.3	22.05	23.03	21.78	27.35	28.22	28.01
	22	9.38	9.78	9.58	15.8	16.34	16.79
Jun-16	27.7	18.58	14.44	19.08	29.83	26.33	31.55
	19.5	7.56	5.09	6.88	19.53	16.82	20.72
Jul-16	30.6	16.87	17.36	17.52	28.74	29.26	30.56
	23.2	10.94	11.2	11.42	23.41	23.85	25.16
Aug-16	28.7	18.86	18.15	19.46	27.64	27.1	29.18
	22.9	12.69	12	13.36	22.08	21.56	23.67
Spt-16	32.85	19.61	21.02	20.15	28.5	29.78	30.02
	24.5	13.32	14.34	14.05	22.87	23.96	24.51
Oct-16	31.9	16.96	18.58	17.75	27.79	29.33	29.62
	27.75	11.26	12.41	11.65	22.52	23.84	24.16
Nov-16	27.65	21.01	18.4	21.36	32.59	30.46	34.31
	21.45	14.46	12.22	15.26	26.95	25.01	28.89
Dec-16	36.7	20.39	19.18	20.64	29.44	28.46	30.82
	25.35	8.63	7.69	8.44	18.68	17.88	19.87
Jan-17	23	18.39	13.92	18.96	30.85	27.05	37.71
	13.95	7.53	4.89	6.76	20.65	17.68	21.94
Feb-17	35.55	23.48	23.71	23.51	33.22	33.46	34.61
	24.15	11.01	10.93	11.31	22.09	22.22	23.66
Mar-17	33.4	25.91	19.84	25.83	35.2	30.02	36.5
	23.1	13.05	8.85	13.63	23.78	19.67	25.49

Source: Authors compilation

Table 17: Calculated option premiums and market premiums of Hero MotoCorp Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	71	43.4	40.57	35.94	62.19	59.62	75.95
	49.3	20.22	18.32	12.58	38.78	36.81	49.45
May-12	90	58.11	45.29	47.15	73.69	61.78	77.12
	41.3	30.27	21.71	23.78	47.14	38.13	50.42
Jun-12	68.9	48.91	33.96	39.66	93.91	80.63	99.9
	47.2	22.05	13.28	16.29	69.19	58.29	74.79
Jul-12	86.65	75.06	56.11	58.11	89.46	72.32	90.3
	57.95	41.93	28.39	34.75	59.33	45.93	63.66
Aug-12	44.65	45.37	16.29	37.45	57.26	27.63	60.81
	28.65	21.13	5.51	14.09	33.13	13.66	33.88
Sep-12	52.4	42.37	22.44	34.8	53.74	34.24	56.79
	34	17.83	7.41	11.44	29.4	16.74	29.95
Oct-12	60.5	56.17	25.49	44.8	78.88	50.16	82.26
	40.3	27.01	9.23	21.43	52.15	30.62	56.19
Nov-12	62.2	48.73	39.65	39.67	66.55	58.24	70.06
	22.35	22.28	16.68	16.31	41.12	34.97	43.66
Dec-12	65.1	52.61	49.38	42.22	70.59	67.75	73.61
	42.65	24.37	22.13	18.85	44.11	41.92	47.28
Jan-13	62.5	68.23	68.72	52.49	83.96	84.42	84.88
	53.2	35.2	35.31	29.12	54.36	54.63	58.48
Feb-13	50.55	41.46	36.85	34.19	56.08	51.82	59.61
	28.7	17.62	14.84	10.83	32.25	29.2	32.99
Mar-13	72.75	64.64	56.2	48.78	85.08	77.98	86.17
	43.65	30.71	24.91	25.41	55.96	50.38	60.29
Apr-13	63	32.39	30.36	33.17	58.6	57.03	62.18
	54.5	20.17	18.44	21.33	48	46.58	51.77
May-13	83.8	35.88	31.31	36.35	69.07	65.45	73.26
	71.2	23.12	19.39	24.51	58.43	55.14	62.99
Jun-13	70	37.62	27.03	38.36	73.79	64.9	78.41
	50.45	25.01	16.65	26.52	63.21	55.13	68.14

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	38.45	27.77	7.69	29.27	55.46	33.86	59.47
	35.05	17.19	3.65	17.43	45.5	26.75	49.01
Aug-13	78.05	40.87	32.89	41.64	76.62	70.04	81.29
	70.95	28.12	21.55	29.8	65.9	59.89	70.96
Spt-13	39.55	65.37	23.32	61.33	126.01	91.61	132.13
	28.2	29.93	6.4	31.73	99.3	69.94	107.23
Oct-13	115	66.69	56.21	62.27	103.36	95.31	106.58
	90.2	30.83	23.51	32.67	75.09	68.4	80.87
Nov-13	71.85	33.73	32.55	35.66	70.53	69.76	75.74
	46.95	11.8	10.87	6.06	47.5	46.83	49.68
Dec-13	67.5	33.78	34.41	35.65	76.31	77.18	81.98
	44.75	11.59	11.55	6.05	53.17	53.8	56.21
Jan-14	95	58.34	60.65	56.5	91.8	93.7	95.47
	66.5	25.61	26.69	26.89	64.39	65.86	69.48
Feb-14	70.35	43.13	37.1	43.89	71.27	66.29	75.26
	46.05	15.91	12.39	14.29	45.93	42.09	48.95
Mar-14	61.75	41.66	35.7	42.64	79.05	74.2	83.99
	37.4	15.12	11.7	13.04	54.26	50.39	58.14
Apr-14	72.9	41.02	33.64	43.44	75.35	68.65	80.84
	48.75	17.95	13.53	14.51	51.92	46.62	54.71
May-14	90	38.29	39.77	40.66	74.5	76.15	80.09
	69.8	16.15	16.7	11.74	51.5	52.73	54.07
Jun-14	109	114.41	112.51	98.71	136.92	135.29	132.48
	80.3	38.41	36.71	40.86	74.54	73.23	80.23
Jul-14	77.65	59.76	26.33	61.62	104.26	72.47	110.73
	53.35	31.67	10.89	32.7	78.64	52.44	84.82
Aug-14	77.4	76.24	30.78	74.81	98.89	57.12	101.47
	54.45	43.15	13.12	45.89	69.61	36.83	74.74
Spt-14	84.75	51.03	39.1	53.97	100.61	89.66	107.98
	58.95	26.52	18.66	25.05	76.57	67.37	82.11
Oct-14	120.55	81.27	85.12	80.55	120.83	124.18	125.91
	101.3	48.56	51.14	51.63	92.75	95.53	99.77
Nov-14	97.45	61.74	57.25	64.76	107.03	103.28	114.28
	74.4	35.18	31.7	35.83	81.94	78.69	88.13

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	109.05	85.68	80.94	85.46	132.11	128.3	138.24
	79.6	53.18	49.19	56.54	104.3	100.92	112.2
Jan-15	119	84.12	89.2	83.94	124.75	129.18	130.24
	91	51.74	55.32	55.02	96.73	100.46	104.03
Feb-15	106	59.1	58.07	61.81	104.18	103.56	111.18
	86.75	32.43	31.39	32.89	79.1	78.5	85.12
Mar-15	85.3	60.41	54.35	62.36	95.35	90.18	67.24
	63.75	32.37	27.93	33.44	69.42	65.11	53.82
Apr-15	86.35	58.23	63.1	59.41	92.18	96.49	97.25
	59.8	29.41	32.39	30.48	65.94	69.39	71.04
May-15	96.6	65.11	60.88	63.96	97.42	94.01	101.3
	74.65	32.98	29.77	35.03	69.73	66.87	75.21
Jun-15	79.6	75.17	49.82	73.47	110.3	88.77	114.35
	52.75	41.87	24.09	44.53	81.98	64.09	88.22
Jul-15	104.25	67.06	63.97	66.33	144	141.77	152.69
	72	35.2	32.72	37.4	118.17	116.17	127.84
Aug-15	95.95	64.48	50.66	65.03	112.25	100.67	118.52
	71.55	34.21	24.63	36.1	85.87	76.04	92.78
Spt-15	115	72.26	70.08	69.35	98.25	96.49	100.55
	81.2	38.02	36.13	40.42	69.05	67.53	74.22
Oct-15	111.2	72.29	63.19	69.03	94.81	87.17	96.43
	76.45	37.74	31.03	40.1	65.15	58.94	69.95
Nov-15	83.3	62	58.89	62.54	96.41	93.9	101.27
	62.95	31.97	29.53	33.61	69.63	67.5	75.1
Dec-15	77.5	46.36	36.69	49.06	77.57	68.64	83.08
	54.35	22.44	16.32	20.13	53.65	46.58	56.6
Jan-16	86	66.94	52.93	67.03	113.94	102.28	119.98
	55.65	35.94	26.09	38.1	87.24	77.33	94.22
Feb-16	77.25	51.05	37.48	53.16	95.5	83.42	101.9
	55.05	24.71	16.19	24.22	70.66	60.7	76.05
Mar-16	94.65	44.51	43.54	47.05	88.87	88.27	95.37
	69.95	20.63	19.74	18.12	65.06	64.51	69.49
Apr-16	84.15	47.87	41.98	50.92	84.26	78.88	90.53
	62.5	24.61	20.63	22.44	60.69	56.29	64.34

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	125	77.63	79.83	76.41	105.08	107.05	108.41
	95.6	44.96	46.34	47.93	76.29	77.85	82.05
Jun-16	92.15	49.52	50.7	52.63	136.13	137.58	146.78
	70.5	25.89	26.42	24.15	112.6	113.86	121.85
Jul-16	92.1	73.77	49.42	74.87	106.95	85.03	112.17
	68.35	43.54	26.16	46.39	79.62	61.47	85.85
Aug-16	95.95	53.1	47.16	56.42	82.37	76.92	88.29
	73.95	29.07	24.86	27.94	58.36	53.92	61.72
Spt-16	90.6	55.72	48.6	59.12	87.94	81.41	94.23
	69.05	31.24	26.17	30.64	63.69	58.32	67.75
Oct-16	115.5	62.74	62.32	66.02	117.69	117.6	126
	92.2	36.57	36.01	37.54	92.85	92.72	100.2
Nov-16	87.75	54.74	50.68	58.21	98.84	95.29	106.21
	66.3	30.76	27.74	29.74	74.91	71.88	80.11
Dec-16	115.45	78.73	64.1	78.12	116.8	104.34	121.72
	88.3	46.54	35.58	49.64	88.84	78.26	95.69
Jan-17	110	77.02	65.33	76.77	113.42	103.46	118.32
	76.15	45.26	36.45	48.29	85.58	77.13	92.21
Feb-17	106.25	60.92	54.67	63.87	96.72	91.2	103.08
	83.6	34.47	29.88	35.39	71.46	66.83	76.79
Mar-17	96.9	66.73	57.95	68.91	123.07	115.59	130.99
	73.75	38.4	31.93	40.43	97.43	90.93	105.36

Source: Authors compilation

Table 18: Calculated option premiums and market premiums of Hindalco Industries Ltd.call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	12.6	10.46	11	8.66	12.84	13.28	12.37
	6.75	3.06	3.36	3.29	6.89	7.2	7.45
May-12	11.95	9.76	10.19	8.04	11.8	12.16	11.31
	5.8	2.49	2.71	2.67	5.89	6.12	6.38
Jun-12	9.7	7.71	7.25	6.77	8.91	8.51	8.54
	4.35	1.54	1.35	1.39	3.3	3.08	3.47
Jul-12	12.05	10.8	10.99	8.67	11.46	11.64	10.13
	5.1	3.07	3.16	3.29	4.66	4.76	5.02
Aug-12	10.05	8.56	8.31	7.31	9.27	9.04	8.52
	3.95	1.91	1.78	1.93	3.18	3.04	3.38
Sep-12	7.55	5.24	5.21	4.97	6.76	6.74	6.84
	2.7	2.13	2.1	2.28	3.99	3.97	4.32
Oct-12	6.15	3.53	3.37	3.74	5.52	5.37	5.91
	2.45	1.37	1.27	1.05	3.29	3.18	3.38
Nov-12	6.3	4.71	4.66	4.68	5.37	5.33	5.46
	2.25	1.93	1.89	1.99	2.69	2.66	2.85
Dec-12	8.2	7.75	7.42	6.8	8.87	8.58	8.46
	2.75	1.56	1.41	1.42	3.22	3.05	3.37
Jan-13	11.65	10.46	15.72	8.66	11.1	16	9.92
	5.65	3.06	6.68	3.29	4.42	7.81	4.77
Feb-13	7.7	5.04	5.1	4.93	6.31	6.37	6.44
	3.4	2.13	2.16	2.24	3.6	3.64	3.88
Mar-13	6.85	5.21	5.05	4.88	6.14	5.99	6.07
	4.1	2.05	1.94	2.19	3.25	3.15	3.51
Apr-13	5.15	2.91	2.71	2.89	4.54	4.38	4.75
	3.7	1.4	1.26	1.48	3.21	3.08	3.47
May-13	5.3	2.9	2.63	2.93	4.7	4.48	4.95
	4.05	1.45	1.26	1.52	3.4	3.22	3.68
Jun-13	5.6	3.62	3.55	3.51	6.26	6.2	6.55
	4.1	1.97	1.9	2.1	4.91	4.86	5.3

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	6.25	3.5	3.4	3.39	5.38	5.3	5.58
	4.75	1.86	1.78	1.99	4	3.93	4.31
Aug-13	7.7	3.14	3.34	3.08	8.56	8.73	9.13
	5	1.57	1.7	1.68	7.34	7.49	7.96
Spt-13	6.75	2.73	2.61	2.82	8.13	8.04	8.73
	5.3	1.38	1.29	1.41	6.95	6.86	7.54
Oct-13	8	3.11	3.37	3.18	6.66	6.88	7.1
	5.9	1.69	1.85	1.78	5.41	5.61	5.86
Nov-13	5.9	2.39	2.53	2.54	7.36	7.51	7.94
	4.55	1.21	1.3	1.13	6.21	6.34	6.73
Dec-13	7.45	4.2	4.33	4.1	6.6	6.71	6.87
	4.85	1.35	1.39	1.29	4.03	4.11	4.34
Jan-14	9.7	8.34	8.56	6.77	9.61	9.78	9.02
	3.9	1.25	1.31	1.14	3.66	3.75	3.91
Feb-14	7	5.51	5.39	4.87	6.7	6.6	6.55
	4.35	1.92	1.83	2.05	3.67	3.59	3.96
Mar-14	4.4	4.47	1.94	4.17	7.37	5.26	7.64
	2.2	1.34	5.67	1.35	4.76	8.1	5.16
Apr-14	6.6	3.7	3.45	3.91	7.41	7.19	7.95
	5.3	2.4	2.21	2.55	6.2	6	6.72
May-14	9.8	3.47	4.28	5.79	7.81	8.52	9.06
	8.55	2.87	2.91	3.07	7.22	7.28	7.83
Jun-14	7.45	3.89	3.38	4.14	7.32	6.84	7.87
	6.6	2.63	2.23	2.78	6.12	5.69	6.62
Jul-14	9	4.43	4.56	4.69	8.81	8.94	9.46
	7.7	3.12	3.21	3.33	7.59	7.7	8.22
Aug-14	13.05	5.53	5.34	5.79	9.65	9.48	10.3
	8.25	4.13	3.95	4.43	8.37	8.21	9.04
Spt-14	8.7	4.95	2.73	5.22	9.11	6.89	9.76
	6.35	2.53	1.19	2.5	6.74	4.94	7.26
Oct-14	9.35	5.17	5.17	5.33	9.86	9.87	10.5
	6.95	2.53	2.51	2.61	7.42	7.42	8.04
Nov-14	9	6.3	5.7	6.29	9.7	9.19	10.16
	6.4	3.33	2.91	3.57	7.07	6.64	7.65

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	9.75	6.78	6.33	6.75	11.38	11.01	11.96
	7	3.75	3.42	4.03	8.76	8.44	9.48
Jan-15	8.5	4.89	5.14	5.06	10	10.23	10.68
	6.05	2.31	2.46	2.34	7.6	7.8	8.23
Feb-15	14.35	6.52	6.62	6.2	10.26	10.35	10.63
	7.15	3.25	3.31	3.48	7.56	7.63	8.17
Mar-15	7.85	3.87	3.72	4.13	7.84	7.72	5.72
	5.65	1.73	1.63	1.41	5.61	5.5	4.48
Apr-15	8.75	5.76	5.99	5.57	8.37	8.57	8.64
	5.9	2.68	2.82	2.87	5.67	5.82	6.14
May-15	7.45	5.16	5.2	5.12	7.99	8.03	8.35
	4.75	2.3	2.31	2.42	5.41	5.44	5.86
Jun-15	7.75	5.89	5.95	5.62	8.41	8.47	8.63
	4.85	2.71	2.74	2.91	5.67	5.71	6.13
Jul-15	5.85	4.01	3.77	4.09	6.37	6.17	6.72
	4.35	2.54	2.36	2.73	5.06	4.88	5.47
Aug-15	4.85	2.63	2.56	2.81	6.02	5.96	6.49
	3.4	1.48	1.42	1.46	4.86	4.81	5.26
Spt-15	5.45	2.97	2.36	2.99	5.41	4.88	5.72
	4.2	1.54	1.13	1.64	4.15	3.7	4.5
Oct-15	4.35	2	1.83	2.11	3.48	3.32	3.72
	3.25	1.23	1.1	1.3	2.74	2.61	2.97
Nov-15	6.5	2.95	2.77	3	4.98	4.82	5.26
	3.5	1.55	1.42	1.65	3.71	3.57	4.02
Dec-15	3.6	1.94	1.84	2.08	3.67	3.58	3.96
	2.55	1.23	1.15	1.26	2.97	2.88	3.21
Jan-16	4.4	3.57	3.44	3.48	5.94	5.83	6.2
	3.15	1.98	1.88	2.13	4.61	4.52	4.98
Feb-16	3.85	1.97	1.86	2.08	1.8	1.69	1.9
	2.65	1.21	1.12	1.27	1.03	1	1.07
Mar-16	5.45	2.91	2.98	2.84	2.95	3.01	2.89
	4	1.39	1.42	1.49	1.44	1.47	1.54
Apr-16	5.55	3.15	3.19	3.2	6.06	6.1	6.44
	4.15	1.74	1.77	1.87	4.82	4.85	5.23

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	5.85	3.19	3.29	3.3	5.63	5.73	5.99
	4.45	1.85	1.92	1.97	4.39	4.47	4.76
Jun-16	6.15	3.44	3.64	3.47	6.68	6.86	7.09
	4.85	1.99	2.13	2.14	5.43	5.58	5.89
Jul-16	7.6	4.45	4.51	4.54	8.37	8.42	8.89
	5.65	2.98	3.02	3.21	7.09	7.14	7.67
Aug-16	7	3.92	3.96	4.14	7.3	7.35	7.83
	5.85	2.62	2.65	2.81	6.08	6.13	6.6
Spt-16	6.45	4.15	3.59	4.43	8.58	8.04	9.25
	4.3	1.96	1.62	1.77	6.33	5.89	6.8
Oct-16	8.6	5.41	5.49	5.53	9.47	9.55	10.04
	5.95	2.72	2.76	2.87	7	7.05	7.59
Nov-16	8.75	6.7	6.61	6.48	11.11	11.04	11.59
	6	3.55	3.48	3.82	8.46	8.4	9.16
Dec-16	10.2	4.78	4.51	5.1	9.8	9.55	10.56
	7.75	2.52	2.34	2.44	7.52	7.31	8.11
Jan-17	6.75	3.9	3.57	4.18	8.4	8.08	9.07
	4.65	1.81	1.61	1.52	6.19	5.93	6.62
Feb-17	10.15	5.17	4.84	5.51	9.33	9.02	10.04
	7.85	2.85	2.62	2.85	7.01	6.75	7.56
Mar-17	8.55	4.92	4.48	5.24	9.55	9.14	10.27
	6.4	2.62	2.32	2.58	7.24	6.9	7.81

Source: Authors compilation

Table 19 : Calculated option premiums and market premiums of Hindustan Unilever Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	18.4	13.74	13.92	12.77	16.33	16.48	16.17
	7.5	3.98	3.97	3.94	7.57	7.63	8.03
May-12	23	18.55	19.97	16.02	21.14	22.32	20.11
	10.65	4.21	4.81	4.24	8.79	9.48	9.39
Jun-12	24.3	22.45	20.68	18.5	24.42	22.88	22.36
	9.9	6.33	5.2	6.72	10.84	9.8	11.64
Jul-12	15.5	15.63	15.21	14.41	28.33	28.04	29.54
	5.75	3.27	2.99	2.63	18.11	17.87	19.57
Aug-12	30	27.76	27.8	22.26	29.83	29.84	26.86
	2	4.6	4.47	4.59	10.15	10.1	10.86
Sep-12	23.35	19.4	19.6	17.51	23.4	23.56	23
	10.55	5.58	5.56	5.73	11.48	11.54	12.31
Oct-12	16.15	12.41	10.14	12.57	18.48	16.54	19.4
	7.1	6.41	4.83	6.68	13.08	11.5	14.07
Nov-12	14.9	17.39	8.68	16.42	21.97	14.43	22.14
	6.8	4.89	1.41	4.64	10.77	6.13	11.41
Dec-12	25.8	22.34	23.06	19.66	26.29	26.86	25.46
	12.3	7.43	7.73	7.88	13.74	14.11	14.78
Jan-13	28.05	25.88	24.66	21.75	29.84	28.81	28.32
	5.6	4.42	3.78	4.08	11.71	11.07	12.48
Feb-13	14.5	10.47	10.76	10.63	15.31	15.59	16.07
	5.95	4.71	4.81	4.74	10.02	10.21	10.72
Mar-13	19.35	16.64	14.91	15.11	22.42	21.06	22.59
	9.45	3.7	2.87	3.33	11.37	10.44	12.15
Apr-13	13.25	7.81	6.61	8.19	13.97	12.95	14.92
	8.55	2.99	2.29	2.19	9.16	8.37	9.59
May-13	20	10.24	9.8	10.31	14.86	14.51	15.53
	14.75	4.33	3.97	4.31	9.5	9.2	10.14
Jun-13	8.95	10.33	10.09	10.77	15.41	15.25	16.36
	3.5	5.01	4.76	4.77	10.33	10.17	10.9

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	17.05	12.02	4.35	12.25	27.68	20.58	29.53
	13.35	6.08	1.54	6.25	22.62	16.42	24.47
Aug-13	33.25	12.16	13.13	12.61	21.73	22.62	23.13
	28.15	6.53	7.1	6.61	16.59	17.32	17.84
Spt-13	24.7	17.46	11.32	16.75	28.2	23.32	29.33
	16.55	5.12	2.33	4.75	17.63	14.01	18.96
Oct-13	28.05	9.8	10.35	10.32	26.68	27.26	28.7
	18.75	4.8	5.05	4.32	21.88	22.39	23.63
Nov-13	22.25	15.14	14.14	14.87	22.62	21.83	23.52
	11.95	3.88	3.3	2.87	12.29	11.71	12.9
Dec-13	24.15	19.79	20.85	18.16	23.71	24.59	23.42
	13.05	6.03	6.46	6.16	11.72	12.26	12.53
Jan-14	22.45	14.48	16.1	14.15	18.32	19.71	18.71
	17.1	7.7	8.8	8.15	12.34	13.42	13.22
Feb-14	13.6	8.5	7.73	8.98	11.14	10.45	11.87
	9.15	3.81	3.27	2.98	6.4	5.88	6.22
Mar-14	16.6	14.62	12.81	14.15	19.02	17.51	19.43
	10.65	7.7	6.32	8.15	13.06	11.81	14
Apr-14	21.55	17.43	15.94	17.37	20.96	19.62	21.49
	16.3	10.96	9.75	11.66	15.01	13.88	16.07
May-14	20.6	11.24	11.34	11.92	16.15	16.29	17.27
	16.5	6.34	6.35	6.21	11.29	11.38	11.91
Jun-14	16.45	13.13	5.84	13.76	20.84	13.62	22.21
	13.05	7.77	2.87	8.05	15.77	9.83	16.96
Jul-14	31	15.34	17.3	15.76	23.39	25.14	24.7
	24.3	9.45	10.9	10.05	18.05	19.54	19.47
Aug-14	19.85	14.9	12.58	15.64	20.74	18.61	22.05
	14.35	9.48	7.69	9.93	15.56	13.76	16.69
Spt-14	15.35	13.89	12.35	14.77	19.93	18.5	21.35
	8.05	5.31	4.44	3.34	11.01	10.01	10.61
Oct-14	22.25	14.7	13.08	15.59	21.58	20.09	23.08
	15.9	9.56	8.27	9.87	16.58	15.3	17.74
Nov-14	20.55	18.83	15.89	19.27	23.5	20.8	24.51
	15.8	12.72	10.33	13.55	17.8	15.49	19.1

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	23.15	18.2	17.96	18.92	25.35	25.17	26.81
	17.95	12.41	12.15	13.21	19.96	19.78	21.48
Jan-15	20.6	14.05	15.22	14.93	30.14	31.31	32.44
	18.35	9.06	9.89	9.22	25.31	26.35	27.34
Feb-15	33.4	18.69	18.59	19.77	31.19	31.19	33.4
	29.5	13.32	13.17	14.06	26.12	26.1	28.16
Mar-15	34.2	20.72	20.17	21.5	32.28	31.86	22.83
	27.1	14.81	14.3	15.79	26.93	26.53	20.16
Apr-15	53	14.5	17.44	15.34	29.5	32.21	31.68
	26.2	9.31	11.52	9.55	24.57	26.98	26.51
May-15	33.85	14.93	14.15	15.78	23.06	22.4	24.65
	29.55	9.68	9.01	9.99	18	17.42	19.3
Jun-15	28.8	27.58	21.02	26.05	40.42	35.13	41.53
	17.9	13.62	9.14	14.47	28.98	24.65	31.19
Jul-15	30.3	19.31	16.89	19.82	29.11	27.02	30.71
	20.85	8.45	6.9	8.24	18.86	17.24	20.12
Aug-15	24.95	15.84	13.45	16.75	32.93	30.83	35.37
	16.1	6.62	5.21	5.17	23.55	21.85	25.06
Spt-15	34.1	23.52	22.88	23.04	30.94	30.4	31.77
	24.9	10.86	10.31	11.46	19.61	19.16	21.1
Oct-15	34.15	19.7	17.19	19.72	27.48	25.33	28.59
	20.75	8.09	6.53	8.14	16.79	15.18	17.96
Nov-15	21.65	13.3	11.97	14.1	31.45	30.33	33.85
	12.9	4.7	3.96	2.52	22.31	21.4	23.67
Dec-15	31.6	24.29	22.55	23.37	30.3	28.79	30.68
	20.3	11.11	9.85	11.79	18.54	17.37	19.94
Jan-16	34.5	25.14	24.12	24.26	37.03	36.22	38.27
	22	11.94	11.13	12.68	25.83	25.16	27.86
Feb-16	29.6	24.86	21.62	23.79	31.87	29.11	32.33
	18.4	11.48	9.26	12.21	20.14	18.01	21.68
Mar-16	33.7	20.07	19.56	20.3	29.6	29.21	31.03
	23.45	8.68	8.25	8.72	19.1	18.76	20.46
Apr-16	29.75	17.79	16.79	18.19	36.23	35.47	38.57
	20.15	7.05	6.38	6.62	26.31	25.67	28.39

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	31.3	17.86	16.93	18.25	28.37	27.61	29.95
	22.1	7.09	6.46	6.68	18.21	17.62	19.44
Jun-16	17.3	13.47	7.52	14.27	24.7	18.85	26.49
	10.2	4.75	2.04	2.7	15.53	11.29	16
Jul-16	35.45	25.52	25.91	24.33	34.82	35.15	35.57
	23.3	11.99	12.12	12.76	23.25	23.48	25.05
Aug-16	25.4	15.19	15.23	16.02	24.94	25.04	26.65
	16.3	5.91	5.82	4.45	15.51	15.55	16.05
Spt-16	26.05	16.14	17.1	16.86	25.5	26.42	27.13
	15.8	6.33	6.75	5.29	15.79	16.43	16.52
Oct-16	25.85	17.83	16.05	18.22	27.41	25.91	28.9
	17.65	7.07	5.98	6.65	17.23	16.08	18.35
Nov-16	26.05	23.86	18.2	22.73	31.86	27.11	32.46
	15.6	10.51	6.95	11.16	20.31	16.69	21.89
Dec-16	29.2	21.54	18.13	21.01	27.25	24.28	27.8
	17.55	9.04	6.91	9.44	15.88	13.71	17.04
Jan-17	20.25	16.21	13.49	16.7	21.36	18.89	22.43
	16	10.28	8.16	10.91	15.83	13.76	17
Feb-17	24.35	16.37	16.45	16.93	25.29	25.42	26.79
	18.3	10.51	10.5	11.15	19.94	20.03	21.49
Mar-17	23.2	16.86	14.39	17.39	25.29	23.13	26.73
	19	10.92	8.97	11.6	19.88	18	21.41

Source: Authors compilation

Table 20: Calculated option premiums and market premiums of Housing Development Finance Corporation call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	24.95	20.59	20.66	19.97	28.99	29.06	29.87
	13.25	8.12	8.04	8.41	18.01	18.04	19.39
May-12	26.45	21.51	22.43	20.65	29.93	30.71	30.71
	14.2	8.68	9.13	9.09	18.78	19.34	20.25
Jun-12	12.65	13	6.92	13.61	18.86	13	20.04
	5.5	3.97	1.51	2.05	9.62	5.99	9.32
Jul-12	19.85	20.2	17.52	19.54	19.61	16.84	18.75
	8.8	7.74	6.12	7.98	6.87	5.26	6.99
Aug-12	22	20.99	20.3	20.26	28.23	27.67	28.92
	9.6	8.36	7.83	8.71	17.06	16.62	18.36
Sep-12	27.6	23.09	21.19	22.25	28.7	27.06	29.07
	16.45	10.12	8.8	10.7	17.06	15.82	18.34
Oct-12	30.95	22.99	23.14	22.44	29.73	29.89	30.44
	17.8	10.33	10.31	10.89	18.38	18.45	19.76
Nov-12	28.15	25.83	25.01	24.4	32.2	31.5	32.38
	15.6	12.07	11.39	12.85	20.21	19.63	21.72
Dec-12	21.5	16.57	14.39	17.41	24.88	22.93	26.51
	13.2	6.92	5.61	5.85	15.28	13.82	15.82
Jan-13	30.7	23.92	25.37	23.54	30.98	32.26	31.83
	19.2	11.35	12.19	11.98	19.65	20.58	21.13
Feb-13	94.9	25.83	26	24.56	34.12	34.27	34.69
	18.95	12.22	12.21	13	22.44	22.52	24.15
Mar-13	32.15	25.46	22.79	24.29	33.74	31.51	34.35
	18.2	11.97	10.08	12.74	22.11	20.35	23.81
Apr-13	23.35	15.26	13.04	15.74	31.86	30.09	33.99
	13.45	5.07	3.84	3.67	22.12	20.7	23.64
May-13	35.85	21.35	21.06	20.93	34.69	34.5	36.26
	24.45	8.68	8.31	8.86	23.91	23.73	25.77
Jun-13	23.35	19.71	11.15	19.72	36.21	29.03	38.24
	15.6	7.82	3.25	7.65	25.85	20.09	27.87

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	38.2	26.71	23.34	24.93	39.46	36.86	40.5
	26.95	12.16	9.72	12.85	27.93	25.78	30.04
Aug-13	35.35	15.23	16.78	15.65	52.09	53.43	55.98
	24.5	4.95	5.55	3.58	42.65	43.83	46.25
Spt-13	46.5	24.51	22.79	22.24	52.74	51.57	55.46
	34.75	9.61	8.33	10.16	42.29	41.27	45.71
Oct-13	42.85	14	15.51	14.51	29.01	30.34	30.97
	32.25	4.26	4.8	2.44	19.41	20.42	20.58
Nov-13	32.1	23.37	23.67	22.36	40.9	41.16	42.76
	19.35	9.82	9.81	10.29	30.09	30.28	32.49
Dec-13	30.95	14.3	6.89	14.88	34.69	27.84	37.17
	21	4.6	1.46	2.8	25.16	19.64	26.97
Jan-14	31.45	17.02	18.5	17.11	30.33	31.56	32.02
	20.25	5.76	6.36	5.04	20.14	21.07	21.57
Feb-14	27.75	17.33	16.78	17.45	32.74	32.37	34.56
	16.85	6.03	5.55	5.37	22.61	22.28	24.3
Mar-14	30.25	26.22	23.34	24.17	36.56	34.31	37.16
	18	11.44	9.35	12.09	24.78	22.95	26.63
Apr-14	37.2	27.34	25.18	27.19	37.97	36.13	39.42
	25.9	14.9	13.29	15.9	26.88	25.35	28.98
May-14	48.05	26.46	26.24	26.62	40.62	40.48	42.61
	37.2	14.41	14.15	15.33	29.91	29.77	32.3
Jun-14	35	28.09	24.58	27.78	37.21	34.15	38.38
	24.6	15.44	12.87	16.49	25.88	23.39	27.88
Jul-14	34	29.38	20.72	29.46	40.22	32.46	41.83
	24.8	17.01	10.84	18.17	29.09	22.75	31.34
Aug-14	43.3	33.11	29.52	32.79	44.34	41.22	45.8
	29.8	20.17	17.36	21.5	32.86	30.23	35.31
Spt-14	55	32.76	32.46	32.65	43.35	43.12	44.85
	31.65	20.02	19.68	21.36	31.92	31.7	34.32
Oct-14	45.55	32.03	33.86	31.94	41.39	43.05	42.74
	34.05	19.34	20.64	20.65	29.92	31.25	32.17
Nov-14	30.05	25.11	21.84	26.41	35.14	32.12	37.38
	20.1	14.67	12.27	15.12	25.03	22.57	26.76

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	32.3	23.1	22.7	24.58	36.37	36.09	39.04
	22.85	13.51	13.13	13.29	26.82	26.55	28.52
Jan-15	43.3	32.01	31.36	32.41	53.2	52.72	56.12
	32	19.77	19.18	21.12	42.53	42.1	45.91
Feb-15	52.75	26.15	26.85	27.75	48.97	49.76	52.6
	41	16.14	16.56	16.46	39.28	39.94	42.33
Mar-15	56.2	30.72	30.61	32.29	51.03	51.04	36.6
	45.55	19.93	19.74	21	40.89	40.87	31.34
Apr-15	51.05	23.93	28.44	25.37	47.15	51.33	50.64
	40.65	13.96	17.13	14	37.46	41.07	40.38
May-15	40.1	22.57	21.69	23.94	46.9	46.22	50.42
	30.6	12.75	12.04	12.58	37.3	36.7	40.22
Jun-15	64.2	47.44	48.35	43.81	65.8	66.54	66.78
	34.95	14.93	15.2	15.4	38.08	38.57	41.12
Jul-15	37.6	27.5	18.7	28.77	50.49	42.35	53.93
	31.3	16.63	10.31	17.41	40.41	33.36	43.66
Aug-15	36.95	23.99	21.73	25.53	59.49	57.52	64.12
	31.9	18.74	16.75	19.85	54.6	52.73	59.1
Spt-15	45.55	22.39	19.99	23.76	45.7	43.57	49.13
	35.3	12.62	10.89	12.4	36.11	34.27	38.89
Oct-15	50	28.28	26.27	29.02	49.82	48.16	52.86
	39	16.65	15.08	17.66	39.43	37.97	42.62
Nov-15	43.75	32.95	30.81	33.29	56.96	55.23	60.16
	33.35	20.55	18.81	21.93	46.28	44.74	49.95
Dec-15	42.5	28.27	26.22	29.25	45.3	43.56	48.05
	31.9	16.92	15.32	17.89	34.88	33.37	37.64
Jan-16	40.35	34.11	31.8	34.23	52.65	50.73	55.2
	28.95	21.45	19.55	22.87	41.64	39.95	44.85
Feb-16	42.75	33.95	29.99	33.63	53.29	50.01	55.72
	21	11.53	9.36	10.91	32.78	30.34	35.17
Mar-16	46.5	27.33	25.86	27.67	42.91	41.7	45.15
	34.45	15.34	14.19	16.31	32.22	31.18	34.79
Apr-16	43.75	27.39	26.4	27.85	43.32	42.51	45.65
	33.8	15.58	14.78	16.59	32.69	32	35.33

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	41.4	23.69	23.78	24.61	43.54	43.7	46.41
	31.3	12.87	12.84	13.35	33.49	33.61	36.21
Jun-16	48.85	31.19	30.98	31.65	48.57	48.45	51.13
	37.5	19.08	18.82	20.39	37.78	37.65	40.79
Jul-16	31.35	22.58	15.67	23.98	40.34	33.67	43.31
	22.8	12.82	8.12	12.72	30.7	25.13	32.96
Aug-16	48.3	32.43	33.32	33.23	51.47	52.33	54.4
	36.25	20.57	21.16	21.97	40.8	41.52	44.05
Spt-16	41.35	27.07	27.78	28.49	43.01	43.75	41.91
	30.3	16.53	16.96	17.24	32.93	33.52	35.46
Oct-16	44.1	32.04	29.29	32.98	49.45	47.07	52.29
	32.9	20.35	18.17	21.73	38.8	36.72	41.89
Nov-16	38.1	30.87	27.5	31.96	50.27	47.33	53.36
	27	19.45	16.83	20.71	39.82	37.26	43.02
Dec-16	38.7	23.61	19.97	24.97	38.67	35.32	41.39
	28.35	13.53	10.94	13.71	28.85	26.05	30.69
Jan-17	32.15	23.07	20.32	24.49	40.39	37.88	43.34
	21.75	13.24	11.26	13.23	30.71	28.59	32.97
Feb-17	47.3	31.88	28.94	32.76	45.19	42.58	47.58
	37.35	20.15	17.82	21.51	34.36	32.13	37.05
Mar-17	45.05	33.26	30.92	33.92	47.41	45.38	49.77
	33.7	21.21	19.32	22.67	36.44	34.68	39.28

Source: Authors compilation

Table 21: Calculated option premiums and market premiums of ITC Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	11.8	8.63	9.55	7.6	10.38	11.12	10.13
	5.45	1.72	2.08	1.56	4.49	4.93	4.76
May-12	10.9	7.85	8.06	7.22	10.36	10.53	10.44
	5.55	1.55	1.57	1.18	4.86	4.95	5.12
Jun-12	6.3	6.07	3.89	5.86	8.41	6.6	8.65
	2.8	2.71	1.37	2.84	5.55	4.15	5.96
Jul-12	13.9	10.8	11.1	9.29	13.18	13.41	12.85
	7	3.09	3.19	3.25	7.02	7.16	7.56
Aug-12	10.4	7.23	7.16	6.85	9.41	9.35	9.53
	4.9	3.63	3.52	3.83	6.38	6.31	6.83
Sep-12	11.9	9.73	9.77	8.67	12.2	12.22	12.07
	5.45	2.59	2.53	2.63	6.28	6.27	6.74
Oct-12	9.05	5.48	4.9	5.57	9.33	8.87	9.86
	4.25	2.54	2.13	2.55	6.71	6.32	7.21
Nov-12	11.75	8.36	8.83	7.86	12.53	12.89	12.89
	2.95	2.07	2.21	1.82	7.15	7.4	7.66
Dec-12	39.95	40.31	40.52	27.76	40.35	40.56	29.41
	6.85	3.44	3.45	3.61	7.52	7.59	8.1
Jan-13	14.8	11.56	12.12	10.05	13.72	14.16	13.29
	4.2	3.8	4.07	4.02	7.39	7.68	7.93
Feb-13	14	11.76	10.84	10.36	14.57	13.83	14.33
	3.65	4.09	3.44	4.32	8.39	7.83	9.02
Mar-13	15.05	13.31	12.12	11.2	15.4	14.41	14.65
	4.25	2.3	1.72	2.14	6.24	5.63	6.66
Apr-13	8.85	5.92	5.03	6.08	8.43	7.66	8.87
	6.2	3.03	2.4	3.07	5.75	5.13	6.14
May-13	10.75	7.31	7.31	7.29	10.97	10.98	11.46
	9	4.05	4	4.28	8.17	8.17	8.79
Jun-13	13.4	8.36	7.47	8.21	12.37	11.66	12.86
	8.65	4.93	4.2	5.21	9.5	8.88	10.19

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	11.15	7.73	7.19	7.64	11.86	11.44	12.37
	8.2	4.38	3.94	4.63	9.04	8.67	9.72
Aug-13	15.65	7.45	8.36	8	16.17	16.92	17.22
	12.7	4.37	5	4.59	13.58	14.25	14.67
Spt-13	14.35	7.02	5.37	7.01	17.14	15.86	18.26
	12.15	3.8	2.61	4	14.58	13.43	15.77
Oct-13	16.7	6.99	7.55	7.13	13.64	14.13	14.5
	14.4	3.95	4.31	4.13	11.03	11.45	11.9
Nov-13	12.65	6.81	7.43	6.92	13.17	13.69	13.98
	9.85	3.74	4.13	3.91	10.55	11	11.39
Dec-13	10	4.94	5.11	5.2	8.35	8.55	8.93
	5.45	2.45	2.51	2.2	5.91	6.05	6.23
Jan-14	10.75	6.31	7	6.47	9.09	9.36	9.57
	8.1	3.36	3.51	3.46	6.39	6.59	6.84
Feb-14	7.45	4.83	4.13	5.1	8.77	8.17	9.4
	5.15	2.39	1.91	2.09	6.36	5.86	6.72
Mar-14	8.55	6.52	5.76	6.67	9.63	8.99	10.14
	6	3.53	2.95	3.66	6.93	6.39	7.43
Apr-14	11.5	8.23	7.56	8.44	10.64	10.05	11.13
	8.75	5.21	4.66	5.53	7.84	7.33	8.41
May-14	14.35	7.99	7.95	8.17	13.42	13.41	14.21
	11.9	4.96	4.88	5.26	10.76	10.74	11.6
Jun-14	7.75	6.84	3.28	7.15	13.46	10.03	14.39
	6	4.09	1.65	4.24	10.94	7.96	11.81
Jul-14	14.5	8.54	8.49	8.5	11.09	11.05	11.45
	11.8	5.26	5.19	5.59	8.16	8.12	8.75
Aug-14	15.4	8.86	8.25	8.92	12.11	11.59	12.62
	8.25	5.65	5.14	6.01	9.26	8.8	9.94
Spt-14	8.7	6.25	9.14	6.61	9.85	12.47	10.54
	6.1	3.7	5.86	3.7	7.38	9.58	7.86
Oct-14	12.05	7.31	7.77	7.66	10.72	11.16	11.39
	9.25	4.56	4.87	4.75	8.12	8.48	8.7
Nov-14	8.5	6.12	5.48	6.49	9.81	9.24	10.51
	6.15	3.63	3.14	3.58	7.36	6.88	7.83

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	11.2	8.11	8.06	8.35	11.7	11.68	12.33
	8.45	5.13	5.06	5.44	8.98	8.95	9.66
Jan-15	19.8	8.05	8.5	8.32	11.78	12.2	12.44
	10.75	5.11	5.42	5.41	9.08	9.43	9.77
Feb-15	13.65	8.47	8.5	8.68	13.7	13.76	14.49
	10.65	5.43	5.42	5.77	11.01	11.05	11.86
Mar-15	17.25	8.98	8.57	9.22	13.51	13.18	9.46
	12.3	3.63	3.34	3.4	8.43	8.17	6.74
Apr-15	15	10.44	11.46	9.82	14.35	15.17	14.61
	9	3.85	4.41	4.04	8.71	9.31	9.39
May-15	9.55	5.48	5.09	5.82	15.02	14.71	16.19
	5.4	3.05	2.75	2.93	12.65	12.36	13.68
Jun-15	8.95	10.25	6	9.75	14.37	10.8	14.73
	4.6	3.82	1.62	3.97	8.82	6.22	9.51
Jul-15	15.45	6.86	6.6	7.02	12.41	12.21	13.17
	7.7	3.92	3.69	4.13	9.81	9.63	10.59
Aug-15	7.95	5.89	5.23	6.21	13.31	12.76	14.29
	5.45	3.31	2.83	3.32	10.87	10.38	11.75
Spt-15	9.75	6.53	5.97	6.8	11.74	11.26	12.51
	7.65	3.77	3.33	3.91	9.19	8.78	9.91
Oct-15	11.6	7.95	7.55	7.97	12.46	12.14	13.07
	8.75	4.77	4.44	5.08	9.71	9.43	10.47
Nov-15	11.9	8.47	8.11	8.47	13.22	12.93	13.84
	8.95	5.24	4.92	5.57	10.44	10.18	11.24
Dec-15	12	8.41	7.71	8.46	13.73	13.17	14.45
	9.2	5.23	4.67	5.57	11	10.5	11.86
Jan-16	8.15	6.87	6	7.1	11.86	11.12	12.6
	6.05	4.01	3.36	4.21	9.26	8.63	10
Feb-16	7.95	5.32	4.28	5.64	10.71	9.76	11.51
	5.7	2.9	2.19	2.75	8.32	7.5	8.92
Mar-16	14.1	5.29	4.99	5.57	11.77	11.53	12.63
	11.65	2.76	2.53	2.68	9.34	9.14	10.09
Apr-16	9.6	6.02	5.38	6.36	11.3	10.74	12.11
	7.25	3.47	2.99	3.51	8.84	8.35	9.53

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	11.95	8.46	8.07	8.39	13.2	12.9	13.8
	9.7	5.2	4.88	5.54	10.42	10.15	11.22
Jun-16	11.45	12.35	6.63	11.45	17.4	12.64	17.72
	6.8	5.4	2.1	5.76	11.66	7.99	12.57
Jul-16	11.25	8	8.2	7.57	10.21	10.39	10.31
	7.6	3.52	3.62	3.76	6.29	6.41	6.78
Aug-16	8.25	5.58	5.67	5.72	8.98	9.07	9.5
	6.45	3.58	3.62	3.81	7.19	7.26	7.75
Spt-16	7.3	4.34	4.52	4.61	5.87	6.05	6.27
	4.3	2.14	2.23	1.96	3.65	3.78	3.75
Oct-16	7.85	4.69	4.52	4.9	13.22	13.1	14.21
	5.45	2.16	2.04	2.06	10.84	10.73	11.76
Nov-16	8.35	5.89	5.35	5.93	8.25	7.78	8.61
	5.6	2.93	2.55	3.09	5.54	5.17	5.97
Dec-16	8.75	6.19	5.25	6.08	11.26	10.51	11.85
	6.15	3.05	2.41	3.24	8.62	7.98	9.33
Jan-17	7.3	4.89	4	5.08	13.49	12.73	14.48
	5.1	2.28	1.73	2.24	11.09	10.42	12.03
Feb-17	11.8	5.63	5.73	5.78	12.75	12.86	13.62
	9.05	2.84	2.88	2.93	10.27	10.36	11.13
Mar-17	9.95	7.31	6.49	7.15	17.84	17.22	18.97
	7.15	4.04	3.43	4.31	15.3	14.73	16.54

Source: Authors compilation

Table 22 : Calculated option premiums and market premiums of ICICI Bank Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	41.7	25.54	21.86	26.42	39.93	36.61	42.32
	31.6	14.56	11.91	15.38	29.7	26.94	32.09
May-12	31.9	19.29	12.55	20.57	35.76	29.02	38.49
	23.4	10.15	5.9	9.53	26.51	21	28.33
Jun-12	34.55	18.03	15.97	19.19	35.01	33.11	37.66
	25.5	8.89	7.56	8.15	25.76	24.19	27.57
Jul-12	40.7	32.1	27.91	31.77	41.67	37.94	42.91
	29.65	19.39	16.19	20.73	30.22	27.13	32.52
Aug-12	37.35	25.12	24.66	26.23	35.88	35.5	38.06
	26.95	14.5	14.1	15.19	25.72	25.39	27.67
Sep-12	33.65	20.92	21.45	22.25	29.8	30.36	31.93
	23.55	11.46	11.75	11.21	20.34	20.74	21.46
Oct-12	43.95	28.28	27.16	29.59	41.99	41.02	44.64
	38.55	22.49	21.48	24.06	36.66	35.75	39.47
Nov-12	51.25	34.93	36.33	35.31	45.74	47.04	47.59
	39.4	22.68	23.7	24.27	34.52	35.59	37.16
Dec-12	67.05	60.08	58.19	53.21	62.45	60.64	57.11
	36.4	23.96	22.6	25.6	28.16	26.85	30.18
Jan-13	65.9	53.75	21.59	49.6	60.06	61.78	58.2
	35.75	20.59	55.65	21.99	29.51	30.58	31.78
Feb-13	50.65	38.79	39.57	39.03	51.65	52.39	53.69
	25.95	12.83	13.08	11.42	26.61	27.04	27.72
Mar-13	38.7	26.73	24.27	28.18	43.25	41.02	46.22
	18.25	16.37	14.51	17.13	33.33	31.43	35.96
Apr-13	38.4	18.79	17.74	19.89	37.41	36.57	40.16
	33.6	13.44	12.51	14.09	32.41	31.63	34.98
May-13	39	22.15	11.3	23.28	41.82	31.28	44.75
	34.5	16.47	7.67	17.48	36.67	27.02	39.56
Jun-13	47	28.95	28.03	29.23	47.59	46.9	50.14
	37.7	16.61	15.8	17.63	36.85	11.47	39.76

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	44.7	25	22.7	25.57	49.04	47.21	52.16
	34.2	13.38	11.68	13.97	38.82	37.22	41.97
Aug-13	54.05	23.28	23.34	23.52	46.6	46.73	49.47
	43.5	11.45	11.36	11.92	36.38	36.48	39.37
Spt-13	46.85	15.93	17.18	16.69	55.9	57.1	60.21
	36.55	6.28	6.86	5.09	46.64	47.7	50.6
Oct-13	55.85	17.67	18.56	18.59	60.27	61.2	64.94
	45.45	7.91	8.32	6.98	50.94	51.77	55.26
Nov-13	52.25	27.9	28.03	28.27	67.68	67.91	72.24
	42.3	15.75	15.7	16.67	57.62	57.81	62.37
Dec-13	52.25	23.54	25.58	24.32	58.88	60.69	63.05
	41.5	12.38	13.65	12.71	49.04	50.64	53.13
Jan-14	48.95	25.31	26.48	26	54.38	55.48	58.01
	38.2	13.8	14.49	14.39	44.29	45.24	47.93
Feb-14	43.05	21.56	21.43	22.3	43.36	43.36	46.26
	32.35	10.65	10.43	10.7	33.38	33.36	36.05
Mar-14	62.6	51.85	51.19	44.29	69.27	68.73	68.83
	31.05	14.45	13.82	15.28	40.18	39.75	43.44
Apr-14	56.6	32.84	31.58	34.46	56.17	55.66	60.58
	51.5	27.06	25.89	28.92	51.5	50.5	55.5
May-14	82.05	33.88	34.4	35.44	58.35	58.92	62.26
	69.5	22.84	23.17	24.37	48.18	48.67	52.1
Jun-14	48.8	41.85	28.02	43.06	65.96	53.2	69.79
	43.65	29.91	18.76	31.99	55.28	43.88	59.58
Jul-14	61.55	32.86	34.94	34.87	64.59	66.65	69.4
	51.1	22.54	24.12	23.79	54.82	56.67	59.33
Aug-14	58.05	41.52	38.14	43.08	64.1	61.11	67.98
	47.9	29.89	27.04	32	53.5	50.81	57.71
Spt-14	76.95	67.38	62.33	64.01	80.75	76.28	80.74
	48.25	33.98	30.31	36.33	50.74	47.25	54.57
Oct-14	61.35	43.06	44.8	44.4	54.54	56.21	57.21
	49.9	31.16	32.53	33.33	43.39	44.81	46.65
Nov-14	50.4	39.29	36.86	41.62	57.97	55.77	61.99
	40.6	28.67	26.59	30.54	47.81	45.83	51.57

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	65.5	46.72	46.77	48.89	49.04	49.1	378.11
	55.7	35.31	35.27	37.81	37.76	37.74	370.14
Jan-15	13.8	8.2	8.79	8.71	69.43	70.08	74.96
	12.6	7.1	7.64	7.6	68.62	69.27	74.17
Feb-15	16.9	8.27	8.15	8.8	71	70.95	76.67
	15.15	6.2	6.08	6.58	69.38	69.34	75.08
Mar-15	14.8	7.46	7.14	7.96	189.22	188.88	141.57
	12.5	5	4.74	5.19	188.14	187.8	141.15
Apr-15	16.8	28.72	29.74	30.8	63.75	64.83	68.66
	13.45	26.31	27.28	28.47	61.69	62.75	66.67
May-15	13.95	29.84	29.7	32.03	66.61	66.47	71.77
	11.15	27.44	27.31	29.7	64.56	64.42	69.78
Jun-15	13.05	30.31	27.61	32.31	65.47	62.63	70.38
	8.3	25.48	23.06	27.64	61.36	58.64	66.4
Jul-15	12	27.09	26.41	29.21	62.25	61.52	67.18
	7.5	22.6	21.99	24.55	58.28	57.58	63.21
Aug-15	12.7	26.64	26.72	28.69	60.78	60.87	65.57
	8.15	22.12	22.18	24.02	56.8	56.88	61.59
Spt-15	14.25	25.7	25.14	27.59	57.33	56.73	61.77
	9.15	21.1	20.6	22.93	53.31	52.74	57.79
Oct-15	16.75	26.65	26.17	28.23	56.32	55.84	60.42
	11.45	21.73	21.31	23.56	52.18	51.72	56.45
Nov-15	14.55	26.81	26.7	28.52	42.45	42.33	45.52
	8.9	21.98	21.88	23.86	38.02	37.91	41.22
Dec-15	9.3	22.79	21.9	24.65	10.29	9.39	11.08
	5.25	18.45	17.67	19.98	6.01	5.38	5.97
Jan-16	9.35	23.62	22.96	25.38	11.53	10.84	12.21
	6.9	21.25	20.64	23.05	8.93	8.34	9.66
Feb-16	7.8	19.48	17.79	21.05	9.87	8.23	10.63
	5.6	17.23	15.67	18.72	7.55	6.19	8.11
Mar-16	13.5	17.96	18	19.09	13.23	13.27	13.9
	10.65	15.49	15.53	16.76	10.61	10.64	11.46
Apr-16	11.95	6.81	6.35	6.95	13.3	12.92	14.14
	9.4	3.94	3.6	4.21	10.77	10.43	11.67

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	11.4	5.91	5.83	6.18	12.56	12.51	13.46
	9	3.3	3.23	3.44	10.13	10.08	10.98
Jun-16	9.3	6.8	5.98	6.97	11.87	11.15	12.59
	5.35	2.05	1.66	1.49	7.15	6.63	7.57
Jul-16	9.8	5.04	5.15	5.38	10.77	10.9	11.61
	5.65	2.06	2.11	1.54	7.62	7.72	8.11
Aug-16	14.55	7.02	7.07	7.26	12.23	12.29	13.01
	9.7	2.31	2.31	1.78	7.53	7.56	7.97
Spt-16	12.25	8.34	8.44	8.2	12.87	12.97	13.41
	6.9	2.8	2.83	2.72	7.78	7.85	8.37
Oct-16	12.15	6.34	6.33	6.62	13.13	13.14	14.06
	9.4	3.68	3.66	3.88	10.68	10.68	11.58
Nov-16	13.5	6.65	6.38	6.99	12.81	12.59	13.72
	11.05	4.04	3.83	4.25	10.36	10.16	11.22
Dec-16	11.6	5.3	4.95	5.67	11.08	10.76	11.95
	9.25	3	2.75	2.93	8.76	8.48	9.44
Jan-17	8.7	5.31	4.76	5.67	6.32	5.78	6.77
	6.5	2.99	2.6	2.93	3.99	3.58	4.1
Feb-17	14.65	6.64	6.61	6.96	11.6	11.59	12.4
	12.3	4.01	3.97	4.22	9.12	9.1	9.86
Mar-17	16	11.65	11.44	10.86	15.46	15.29	15.62
	10.3	5.02	4.86	5.39	9.74	9.61	10.53

Source: Authors compilation

Table 23: Calculated option premiums and market premiums of Kotak Mahindra Bank Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	18.8	14.15	13.21	14.66	25.64	24.86	27.3
	11	4.65	4.14	3.45	16.21	15.61	17.16
May-12	19	13.52	11.12	14.23	26	23.82	27.85
	9.5	4.62	3.44	3.02	16.83	15.18	17.71
Jun-12	19.2	12.66	10.41	13.32	23.29	21.24	24.93
	17.25	3.95	2.9	2.11	14.21	12.72	14.74
Jul-12	23.2	19.87	19.11	19.56	30.19	29.56	31.43
	14.5	8.08	7.54	8.35	19.66	19.16	21.23
Aug-12	74.25	16.71	16.88	16.67	24.96	25.12	26.07
	13.05	5.79	5.81	5.46	14.79	14.89	15.79
Sep-12	29	20.91	20.93	20.18	29.5	29.53	30.35
	15.3	8.52	8.45	8.97	18.59	18.6	20.08
Oct-12	24.5	18.42	14	18.77	26.82	22.85	28.18
	15	7.69	5.17	7.56	16.66	13.74	17.79
Nov-12	27.65	22.28	22.89	21.53	28.59	29.14	29.11
	15.8	9.72	10.03	10.32	17.31	17.68	18.66
Dec-12	22.6	20	17.59	20.19	25.28	23.1	26.21
	12.75	8.79	7.28	8.98	14.64	13.06	15.6
Jan-13	24.35	19.98	19.94	20.05	22.16	22.12	22.59
	13.9	8.63	8.52	8.84	11.13	11.05	11.7
Feb-13	21.2	21.35	20.86	21.27	22.45	21.98	22.58
	14.05	9.62	9.24	10.06	10.94	10.57	11.54
Mar-13	25.3	22.91	20.15	22.32	25.35	22.77	25.31
	14.3	10.46	8.65	11.11	13.5	11.69	14.47
Apr-13	20.95	11.22	9.36	11.77	18.33	16.7	19.55
	12.85	5.98	4.66	5.83	13.31	11.96	14.18
May-13	21.35	12.62	9.61	13.21	22.79	20.13	24.33
	17.6	7.18	5.03	7.26	17.72	15.45	19.05
Jun-13	23	13.82	10.64	14.47	33.92	31.19	36.39
	19.95	8.31	5.95	8.52	28.95	26.48	31.31

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	24.15	12.42	9.39	13.03	39.83	37.22	42.88
	21.75	7.08	4.92	7.09	35.02	32.61	37.95
Aug-13	31.25	17.19	13.3	16.95	35.82	32.8	37.92
	25.05	10.41	7.41	11.01	30.51	27.77	32.89
Spt-13	26.65	24.97	6.6	22.36	55.63	41.12	58.55
	19.35	9.89	1.09	10.47	45.3	32.66	48.96
Oct-13	29.55	12.23	13.33	12.78	34.13	35.15	36.66
	28.1	6.79	7.48	6.84	29.24	30.17	31.67
Nov-13	33.5	17.09	19.73	17.21	33.83	35.96	35.87
	22	5.94	7.23	5.32	23.8	25.51	25.64
Dec-13	37	23.72	25.02	22.27	35.67	36.68	36.71
	25.5	9.83	10.05	10.38	24.41	25.19	26.33
Jan-14	23.1	11.39	10.84	12.04	27.7	27.33	29.81
	13.75	6.43	5.96	6.1	22.89	22.55	24.67
Feb-14	29	22.7	22.17	20.8	34.04	33.64	34.86
	20.15	8.44	7.96	8.91	22.76	22.43	24.57
Mar-14	18.8	13.34	10.96	13.79	28.68	26.72	30.63
	11.5	3.76	2.65	1.9	19.18	17.65	20.38
Apr-14	35.4	22.97	23.65	23.2	33.75	34.39	35.36
	26.75	11.39	11.76	11.96	23.18	23.66	25
May-14	45.4	21.38	21.85	22.07	34.7	35.17	36.79
	35.6	10.61	10.83	10.84	24.61	24.97	26.51
Jun-14	28.9	22.66	18.25	23.45	40.47	36.57	43.07
	20	11.83	8.87	12.21	30.45	27.19	32.9
Jul-14	32.4	20.92	17.6	21.9	34.21	31.21	36.46
	23.85	10.67	8.47	10.66	24.35	21.92	26.13
Aug-14	64	21.67	21	22.78	36.15	35.62	38.61
	23.6	11.51	10.97	11.54	26.35	25.89	28.28
Spt-14	34.05	25.74	15.72	26.89	37.34	27.75	39.63
	23.55	14.99	8.1	15.65	27.1	19.37	29.13
Oct-14	33.05	23.07	24.31	24.36	45.84	47.08	49.18
	23.7	12.99	13.77	13.12	36.17	37.22	39.05
Nov-14	38.9	33.99	32.62	34.18	47.92	46.77	50
	28.25	21.48	20.33	22.94	36.77	35.76	39.59

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	43.3	25.55	24.13	27.13	41.92	40.68	44.95
	33.65	15.61	14.49	15.89	32.2	31.12	34.55
Jan-15	39	26.88	28.23	28.52	44.13	45.49	47.31
	36.1	21.47	22.59	22.9	39.03	40.27	42.11
Feb-15	46.7	27.78	27.41	29.53	44.7	44.47	47.95
	34.3	17.78	17.4	18.29	34.93	34.7	37.51
Mar-15	68	52.64	50.53	49.84	70.17	68.42	45.29
	42.9	20.57	19.11	21.74	42.12	40.77	32.2
Apr-15	65.85	33.75	39.46	33.56	53.73	58.46	56.28
	45.75	20.69	25.04	22	42.66	46.77	41.91
May-15	58.8	34.1	30.04	34.04	54.04	50.7	56.66
	48.3	21.14	17.91	22.48	42.98	40.05	46.27
Jun-15	52.55	35.38	35.34	35.38	55.6	55.65	58.29
	40.5	22.41	22.24	23.82	44.5	44.51	47.88
Jul-15	40.4	22.67	16.43	24.07	128.84	122.83	139.33
	30.7	12.96	8.65	12.51	119.82	114.08	130.12
Aug-15	24.35	14.67	14.22	15.16	69.14	68.86	74.52
	19.8	8.89	8.49	9.38	64.51	64.25	69.93
Spt-15	15.05	15.31	12.55	15.51	66.24	64.04	71.26
	21.95	9.16	7.07	9.74	61.56	59.47	66.68
Oct-15	25	11.09	10.61	11.73	62.49	62.18	67.54
	21	6.12	5.73	5.96	57.98	57.6	62.96
Nov-15	24.05	16.08	13.14	16.32	69.53	67.19	74.81
	19.2	9.91	7.66	10.55	64.85	62.61	70.23
Dec-15	33.45	24.86	22.61	22.93	75.94	74.39	80.9
	21.8	10.69	9.12	11.37	66.27	64.85	71.73
Jan-16	21.5	16.42	13.29	16.78	72.76	70.22	78.34
	14.35	10.34	7.93	11	68.09	65.65	73.74
Feb-16	20.1	13.31	11.09	13.91	67.02	65.14	72.32
	14.95	7.85	6.21	8.14	62.43	60.64	67.73
Mar-16	29.8	13.64	12.74	13.98	61.63	60.98	66.37
	20	7.79	7.08	8.2	56.99	56.37	61.79
Apr-16	30.7	32.86	31.73	34.73	69.45	68.38	74.6
	22.55	27.53	26.5	29.69	64.72	63.69	70.02

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	28.65	32.84	32.67	34.97	70.08	69.95	75.45
	22.95	27.68	27.52	29.93	65.4	65.27	70.85
Jun-16	24.25	31.42	32.01	33.76	46.6	47.21	50.25
	19.7	26.52	27.05	28.72	41.85	42.41	45.42
Jul-16	24	32.3	32.46	34.66	23.01	23.16	24.56
	19.15	27.36	27.5	29.63	17.93	18.03	19.32
Aug-16	21.1	32.76	31.97	35.16	21.72	20.87	23.14
	16.2	27.81	27.09	30.12	16.59	15.86	17.85
Spt-16	21.1	32.07	32.11	34.55	19.39	19.39	20.78
	16.3	27.26	27.29	29.51	14.48	14.46	15.44
Oct-16	26.75	35.17	34.6	37.51	24.06	23.43	25.35
	20.7	30.03	29.5	32.47	18.62	18.06	20.06
Nov-16	20.55	38.16	36.68	40.55	27.51	25.91	28.84
	16.85	32.91	31.54	35.51	21.92	20.52	23.57
Dec-16	24.05	31.6	29.83	33.98	21.64	19.81	23.15
	19.2	26.73	25.13	28.94	16.65	15.09	17.89
Jan-17	22	34.35	32.47	36.37	28.56	26.62	30
	16.25	29.04	27.34	31.33	23.07	21.35	24.84
Feb-17	24.65	34.45	32.55	36.88	21.67	19.64	22.93
	19.8	29.41	27.69	31.84	16.35	14.63	17.59
Mar-17	22.8	32.72	32.34	35.26	17.11	16.65	18.3
	17.9	27.92	27.57	30.22	12.19	11.8	12.85

Source: Authors compilation

Table 24: Calculated option premiums and market premiums of Larsen & Turbo Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	65.2	33.15	33.74	34.81	61.3	61.95	65.58
	40.75	10.96	11.11	7.09	38.47	38.91	40.33
May-12	67.85	38.62	39.45	39.03	64.83	65.62	68.39
	42.1	12.86	13.13	11.31	40.4	40.95	43.2
Jun-12	65.95	47.87	41.4	45.21	70.98	65.7	72.98
	41.1	16.8	13.2	17.49	44.23	40.26	47.85
Jul-12	84	62.83	63.14	58.35	88.25	88.52	89.8
	54.2	28.63	28.66	30.63	59.85	60.02	64.57
Aug-12	50.15	40.33	29.68	41.05	56.9	47.2	59.65
	27.9	14.6	9.21	13.33	32.07	25.41	33.76
Sep-12	73.45	57.92	56.86	54.38	79.56	78.71	80.96
	44.9	24.92	24.06	26.66	51.39	50.69	55.54
Oct-12	81	65.54	61.83	62.33	90.33	87.25	92.29
	56.55	32.34	29.63	34.61	61.93	59.42	66.8
Nov-12	56.15	41.81	39.07	44.1	49.68	47.08	52.72
	32.3	18.35	16.61	16.38	26.15	24.34	25.84
Dec-12	58.5	46.27	45.48	47.93	56.78	56.09	59.61
	33.8	20.67	20.03	20.21	31.67	31.1	32.99
Jan-13	63.6	46.6	48.88	47.97	58.95	61.11	61.76
	38.25	20.51	21.72	20.25	33.58	35.03	35.32
Feb-13	68.35	54.15	53.81	53.43	75.92	75.69	78.64
	40.4	24.37	23.97	25.71	49.04	48.8	52.95
Mar-13	48.85	30.13	26.56	32.16	54.28	50.94	58.42
	29.25	10.19	8.41	4.44	32.62	30.21	32.84
Apr-13	65.2	36.54	33.15	36.85	70.04	67.35	74.22
	48.25	23.8	21.01	25.32	59.45	56.99	64.1
May-13	59.9	27.55	26.18	29.24	73.2	72.17	78.89
	54.6	22.16	20.88	23.48	68.3	67.31	73.89
Jun-13	53	25.03	23.78	26.57	48.58	47.59	52.21
	42.7	15.13	14.1	15.05	38.91	38.02	41.83

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	51.85	29.47	24.25	30.82	112.41	107.96	121.12
	41.9	18.42	14.43	19.3	102.98	98.76	111.66
Aug-13	36.85	18.35	12.3	19.1	41.35	35.92	44.27
	31.65	10.91	6.6	11.4	34.7	29.85	37.56
Spt-13	33.7	15.48	8.82	16.14	44.44	38.23	47.75
	26.45	8.32	4.02	8.45	38.02	32.41	41.23
Oct-13	50.8	25	24.95	24.36	49.95	49.97	52.71
	39.75	12.08	11.93	12.83	39.55	39.55	42.79
Nov-13	39.45	18.53	18.59	19.6	57.75	57.96	62.25
	29.95	8.93	8.85	8.07	48.41	48.59	52.46
Dec-13	42.5	21.95	20.48	22.95	60.35	59.22	64.84
	31.95	11.43	10.34	11.42	50.74	49.71	55
Jan-14	51.4	30.77	32.46	30.46	106.12	107.52	113.72
	40.55	17.79	18.92	18.93	96.54	97.85	104.45
Feb-14	36.5	20.87	18.37	21.8	47.73	45.65	51.15
	26.45	10.42	8.71	10.27	38	36.18	41.1
Mar-14	34.9	25.45	19.93	26.27	80.16	75.52	86.1
	25.15	14.14	10.25	14.74	70.54	66.27	76.5
Apr-14	54.35	42.41	39.66	45.06	87.3	84.76	93.89
	44.5	32.05	29.7	34.46	77.69	75.32	84.23
May-14	75.7	45.22	43.48	47.94	90.09	88.53	96.79
	66.7	34.69	33.17	37.34	80.38	78.93	87.1
Jun-14	68.75	48.5	47.84	51.79	53.44	52.71	57.06
	58.5	38.32	37.71	41.2	43.25	42.66	46.61
Jul-14	77.55	53.08	53.84	56.6	78.25	79.07	83.99
	61.85	42.74	43.36	46.01	68.31	69.05	73.91
Aug-14	53.35	48.02	40.12	51.06	52.43	44.6	55.86
	43.8	37.59	30.82	40.47	42.11	35.29	45.4
Spt-14	62.45	62.37	59.4	64.37	77.57	74.84	81.37
	36.75	35.54	33.38	37.89	51.77	49.6	55.84
Oct-14	73.7	58.58	60.66	60.45	70.02	72.04	73.24
	46.6	32.03	33.39	33.97	44.25	45.72	47.56
Nov-14	60.1	51.71	47.61	55.24	63.29	59.29	67.84
	37.65	28.92	26.06	28.76	40.37	37.35	42.06

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	75.25	71.88	72.14	72.68	80.51	80.78	82.61
	45.8	42.91	43.01	46.21	52.55	52.69	56.72
Jan-15	54.95	49.5	50.69	52.53	59.15	60.34	63.06
	47.5	38.95	39.93	41.94	48.84	49.87	52.74
Feb-15	75.7	50.4	49.4	54.07	62.43	61.49	67.15
	65.5	40.54	39.63	43.48	52.68	51.81	56.83
Mar-15	89	62.44	63.32	65.66	76.26	77.15	80.84
	78.5	51.28	52.03	55.07	65.53	66.33	70.56
Apr-15	70	41.17	44.23	42.25	71.28	74.02	75.6
	58.2	28.99	31.4	30.93	60.63	63.09	65.36
May-15	71.5	34.86	35.77	36.54	77.68	78.65	83.3
	61.2	23.74	24.36	25.21	67.69	68.57	73.27
Jun-15	66.15	32.37	33.07	34.28	60.56	61.36	64.98
	41.9	10.9	11.05	5.96	37.92	38.46	39.24
Jul-15	75.15	52.03	47.93	51.56	73.54	70.08	76.34
	48.8	22.39	19.7	23.25	46.68	43.99	50.27
Aug-15	87.05	60.21	56.38	57.74	74.33	71.01	75.04
	59.4	27.6	24.88	29.43	45.06	42.5	48.54
Spt-15	67.75	39.23	27.81	40.34	59.33	48.96	62.66
	44.85	14.04	8.36	12.03	34.8	27.5	36.54
Oct-15	79.3	45.83	44.45	44.46	67.09	65.99	69.38
	53.5	16.08	15.12	16.15	40.53	39.67	43.62
Nov-15	56.3	31.88	28.52	33.17	55.21	52.31	58.8
	33.6	9.18	7.58	4.85	32	29.93	33.05
Dec-15	52.2	33.87	30.11	34.69	56.36	53.15	59.66
	29.65	9.73	7.94	6.38	32.48	30.19	33.93
Jan-16	29	28.74	26.23	29.95	47.3	45.13	50.34
	31.3	17.66	15.71	18.63	37.02	35.14	39.96
Feb-16	46.8	20.79	19.2	22.08	37.83	36.44	40.63
	37.35	11.21	10.06	10.75	28.3	27.12	30.27
Mar-16	59.25	26.52	25.41	27.35	53.45	52.59	56.99
	49	15.2	14.3	16.02	43.34	42.58	46.92
Apr-16	49.95	32.81	29.92	32.94	45.56	43.05	47.47
	38.8	20.32	18.04	21.72	34.36	32.21	37

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	43.85	24.41	24.17	25.79	81.66	81.6	88.05
	39.1	18.88	18.63	20.17	76.84	76.78	83.24
Jun-16	71.7	41.66	44.14	41.26	60.53	62.69	62.95
	44.75	13.97	15.09	13.19	34.75	36.24	37.08
Jul-16	76.7	56.48	54.54	52.48	73.82	72.22	74.35
	47.15	22.86	21.46	24.41	44.88	43.63	48.46
Aug-16	65.9	32.23	22.23	33.8	51.2	41.78	54.58
	44.85	10.03	5.7	5.73	28.26	21.97	28.54
Spt-16	62.1	42.61	44.77	41.67	64.1	65.94	66.58
	33.95	14.07	15.03	13.6	38.12	39.42	40.94
Oct-16	51.15	32.82	30.48	33.89	45.76	43.69	48.25
	40.6	21.22	19.33	22.66	34.97	33.18	37.7
Nov-16	45	26.07	23.48	27.78	59.43	57.11	64.05
	36.5	16.33	14.35	16.55	49.88	47.79	53.95
Dec-16	47.75	30.17	26.04	31.36	44.54	40.81	47.2
	37	18.95	15.78	20.13	34.04	30.86	36.72
Jan-17	36.65	28.79	25.2	30.06	54.5	51.36	58.22
	26.45	17.82	15.09	18.83	44.4	41.63	48.04
Feb-17	60.45	37.51	35.64	37.8	49.42	47.78	51.36
	49.65	24.9	23.34	26.58	37.98	36.55	40.8
Mar-17	44.4	28.8	27.48	30.4	42.67	41.51	45.54
	34.7	18.3	17.23	19.17	32.55	31.54	35

Source: Authors compilation

Table 25: Calculated option premiums and market premiums of Lupin Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	13.45	15.19	15.32	14.82	23.49	23.62	24.44
	9.3	3.97	3.92	3.16	13.24	13.31	14.06
May-12	26.1	22.15	24.26	19.74	27.35	29.07	26.94
	19.95	7.62	8.81	8.08	15.23	16.45	16.41
Jun-12	23.95	13.63	6.73	13.7	20.31	14.07	21.26
	16.45	3.43	1.03	2.04	10.44	6.52	10.7
Jul-12	49.6	21.65	22.66	19.41	26.57	27.39	26.17
	37.8	7.33	7.81	7.75	14.49	15.04	15.61
Aug-12	22	13.43	13.11	13.63	20.28	20.04	21.31
	10.6	3.48	3.24	1.97	10.53	10.34	10.74
Sep-12	28.85	18.96	18.7	18.03	24.97	24.76	25.38
	18.5	6.32	6.05	6.37	13.79	13.61	14.78
Oct-12	24.05	21.36	19.69	19.74	27.97	26.61	28.16
	20.5	7.68	6.6	8.09	16.37	15.35	17.65
Nov-12	22.85	13.25	12.93	13.48	20.9	20.66	22.02
	12.5	3.41	3.17	1.82	11.22	11.03	11.51
Dec-12	22.25	17.26	15.95	16.77	23.9	22.82	24.6
	11.8	5.42	4.65	5.11	13.18	12.4	14.03
Jan-13	24	19.57	20.14	18.62	24.32	24.81	24.51
	14.9	6.81	7.01	6.97	12.87	13.16	13.77
Feb-13	23.35	16.7	15.92	16.46	23.14	22.49	23.93
	12.5	5.28	4.77	4.8	12.6	12.12	13.31
Mar-13	26.1	20.64	18.29	19.23	25.65	23.68	25.66
	13.5	7.26	5.83	7.58	13.95	12.53	14.99
Apr-13	14	9.94	9.67	10.46	17.98	17.81	19.23
	12.7	4.9	4.63	4.45	13.07	12.92	13.89
May-13	24	13.43	12.82	13.77	25.79	25.36	27.42
	19.35	7.47	6.93	7.75	20.59	20.2	22.21
Jun-13	2.7	15.95	16.89	16.08	29.18	30	30.87
	24.15	9.53	10.14	10.07	23.81	24.52	25.67

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	30	12.37	10.69	13.01	23.48	22.07	25.13
	15.05	7.09	5.82	6.99	18.48	17.26	19.83
Aug-13	30.8	15.63	14.84	16.19	40.76	40.23	43.68
	36	9.74	9.03	10.18	35.73	35.24	38.65
Spt-13	36	23.41	26.06	22.1	36.17	38.21	37.37
	37.75	9.58	11.13	10.08	25	26.62	26.97
Oct-13	50	21.95	25.7	21.37	32.99	36	34.24
	38.3	9.05	11.28	9.35	21.97	24.31	23.66
Nov-13	45.05	14.28	16.08	14.99	23.88	25.56	25.48
	23.2	4.96	5.71	2.97	14.42	15.59	14.7
Dec-13	34.55	23.87	26.51	22.82	32.13	33.69	32.81
	27.05	10.27	11.83	10.8	20.53	21.46	22.07
Jan-14	35	17.22	19.46	22.14	32.02	33.96	38.23
	27.45	11.13	12.79	16.13	26.74	28.46	32.99
Feb-14	32.85	14.12	13.53	14.84	26.95	26.55	28.84
	27.9	8.7	8.15	8.82	21.9	21.52	23.55
Mar-14	31.9	18.07	17.62	18.73	34.65	34.38	36.94
	27.5	12.09	11.61	12.72	29.41	29.15	31.7
Apr-14	37.35	20.58	20.93	21.3	32.46	32.84	34.41
	32.3	14.57	14.77	15.48	27.07	27.39	29.13
May-14	42	18.22	20.46	19.24	31.96	34.08	34.22
	36.6	12.8	14.55	13.42	26.87	28.77	28.96
Jun-14	41.75	26.58	26.38	26.15	32.4	33.98	33.04
	31.65	13.69	13.4	14.53	20.64	22.41	22.16
Jul-14	49.75	23	26.37	23.76	27.72	30.88	29.02
	40.75	11.89	14.07	12.14	17.01	19.31	17.94
Aug-14	42.85	23.05	21.95	24.16	34.78	33.86	37
	33.55	12.51	11.61	12.54	24.66	23.88	26.3
Spt-14	47.3	28.01	28.55	28.99	40.82	41.39	43.15
	37.55	16.57	16.82	17.37	30.2	30.63	32.46
Oct-14	59	36.24	51.09	36.25	49.02	61.78	50.89
	54.9	23.19	35.28	4.62	37.47	48.5	40.19
Nov-14	49.7	28.81	28.43	29.95	42.94	42.7	45.52
	40.9	17.5	17.07	18.33	32.41	32.16	34.84

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	52.85	25.42	11.87	26.97	41.02	27.25	43.96
	43.85	15.46	6.14	15.34	31.23	19.86	33.27
Jan-15	76	28.1	30.99	29.42	42.35	45.05	45.04
	35.7	17.14	19.15	17.79	32	34.24	34.34
Feb-15	58.75	30.09	29.42	31.68	45.89	45.41	48.95
	49.9	19.31	18.65	20.05	35.64	35.19	38.24
Mar-15	59.3	40.59	35.91	41.51	60.52	56.51	42.21
	48.25	28.12	24.19	29.89	49.44	45.86	36.79
Apr-15	100.9	31.31	38.06	32.93	59.52	65.57	63.71
	67.5	25.47	31.41	27	54.28	60	58.45
May-15	71.7	35.9	37.68	36.73	56.85	58.48	60.03
	61.55	23.47	24.69	24.87	45.9	47.3	49.38
Jun-15	57.2	50.02	27.44	47.93	78.52	60	81.46
	37.4	17.94	6.7	18.28	51.42	37.38	55.48
Jul-15	76.05	57.05	42.3	53.01	85.5	74.02	87.78
	49.8	22.13	13.37	23.36	57.34	48.33	61.89
Aug-15	79.35	59.83	54.41	53.8	86.35	82.23	87.73
	51.3	22.78	19.06	24.15	57.47	54.18	61.96
Spt-15	110	74.31	70.08	64.72	103.57	100.35	104.13
	61.85	9.94	8.12	5.42	49.64	47.5	52.83
Oct-15	93.9	53.31	43.7	51.55	109.85	102.64	115.97
	69.05	21.17	15.28	21.9	83.96	77.84	90.91
Nov-15	79.8	47.82	42.36	46.82	82.72	78.5	86.75
	54.1	17.34	14	17.17	56.49	53.11	60.96
Dec-15	69.45	34.39	32.56	35.43	70.64	69.29	75.31
	44.55	9.93	8.79	5.77	46.63	45.55	49.57
Jan-16	76.25	60.21	52.24	55.23	91.57	85.52	93.94
	48	24.13	18.83	25.58	63.25	58.36	68.23
Feb-16	67.9	31.63	28.78	32.7	68.29	66.08	72.95
	44.95	8.21	6.77	3.05	44.68	42.95	47.32
Mar-16	85	43.49	43.12	42.44	127.2	127.09	135.81
	61.05	13.72	13.17	12.78	102.97	102.85	111.76
Apr-16	75	38.41	38.61	39.86	62.02	62.28	65.89
	49.65	14.37	14.36	12.49	38.22	38.37	40.45

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	63.65	36.63	36.04	38.78	65.67	65.23	70.43
	41.35	14.43	14	11.41	42.8	42.43	45.1
Jun-16	79.85	49.04	52.1	48.54	77.94	80.57	81.54
	52.95	20.38	22.09	21.17	52.12	54.15	56.41
Jul-16	46.4	33.01	26.18	35.2	59.25	52.66	63.73
	26.45	12.22	8.8	7.82	37.11	32.29	38.31
Aug-16	94.5	60.91	62.06	59.5	91.12	92.14	94.58
	67.5	29.98	30.61	32.13	64.06	64.85	69.33
Spt-16	59.8	37.63	39	39.38	58.59	59.92	62.38
	35.5	14.31	14.93	12.01	35.13	36.05	36.75
Oct-16	70.1	53.68	50.78	52.04	73.01	70.54	74.93
	43.4	23.2	21.29	24.67	45.65	43.75	49.37
Nov-16	81	55.3	55.48	53.23	123.27	115.23	121.39
	50.45	24.22	24.19	25.86	98.31	89.92	97.35
Dec-16	55.6	35.47	28.59	37.41	59.22	52.77	63.34
	34.7	13.17	9.66	10.04	36.31	31.63	37.85
Jan-17	66.2	54.22	48.63	52.44	73.91	69.13	75.82
	38	23.54	20	25.06	46.48	42.84	50.27
Feb-17	83.05	58.41	59.3	55.48	75.88	76.66	76.87
	50.4	26.21	26.65	28.11	47.4	47.95	51.23
Mar-17	57.3	37.92	35.81	39.43	51.92	50.02	54.9
	34.4	14.11	12.9	12.06	28.14	26.81	28.9

Source: Authors compilation

Table 26: Calculated option premiums and market premiums of Mahindra & Mahindra Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	23.65	14.2	12.51	15.13	27.85	26.3	29.98
	15.05	5.72	4.76	3.93	18.87	17.66	19.78
May-12	33.05	22.39	22.83	22.37	34.05	34.45	35.62
	22.35	10.62	10.82	11.17	23.48	23.79	25.37
Jun-12	43.75	24.52	8.65	24.03	35.19	20.42	6.44
	35.45	12.03	2.9	12.83	24.21	12.88	26.16
Jul-12	19.75	18.6	11.23	19.23	16.69	9.09	17.07
	11.65	8.24	4.12	8.03	6.18	2.5	5.51
Aug-12	23.55	18.13	7.4	18.83	24.27	13.63	15.62
	13.7	7.96	2.36	7.62	14.34	7.11	15.03
Sep-12	26.4	17.16	17.78	18.14	21.22	21.84	22.57
	16.15	7.76	8.05	6.93	11.78	12.16	11.79
Oct-12	31.4	20.12	11.37	21.18	28.89	20.32	30.77
	21.05	10.19	4.86	9.98	19.12	12.69	20.25
Nov-12	26.8	18.22	17.13	19.4	24.06	23.05	25.76
	17.9	9.08	8.32	8.2	14.81	14.03	15.05
Dec-12	30.9	23.18	22.39	24.24	29.37	28.67	31.05
	20.7	12.68	12.06	13.03	19.15	18.57	20.35
Jan-13	31	21.26	22.5	22.41	26.06	27.28	27.67
	20.55	11.27	12.02	11.21	16.18	17.03	16.88
Feb-13	32.25	21.41	21.8	22.43	31.14	31.55	33.1
	23.35	11.15	11.32	11.22	21.19	21.49	22.61
Mar-13	29.8	22.05	19.27	23.01	27.77	25.17	29.31
	18.7	11.58	9.66	11.8	17.57	15.59	18.61
Apr-13	35.55	24.86	21.64	23.51	34	31.41	34.69
	23.45	10.85	8.6	11.46	22.33	20.27	24.02
May-13	37.05	19.5	18.53	19.58	33.03	32.31	34.8
	26.85	7.75	7	7.53	22.6	22	24.28
Jun-13	38.8	19.01	15.66	19.45	47.07	44.44	50.31
	28.7	7.89	5.81	7.41	37.2	34.92	40.24

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	34.8	21.24	9.56	21.34	43.88	33.74	46.56
	26.3	9.24	2.87	9.29	33.63	25.14	36.35
Aug-13	48.8	23.5	23.79	22.73	43.16	43.42	45.32
	38.05	10.21	10.2	10.68	32.48	32.68	35.09
Spt-13	32.95	13.45	8.72	14.02	35.17	31.04	37.74
	24.1	4.05	1.99	1.98	25.75	22.38	27.62
Oct-13	41.1	14.82	17.53	15.41	34.14	36.47	36.55
	32.25	5	6.23	3.36	24.55	26.43	26.29
Nov-13	38.5	16.86	17.75	17.45	35.08	35.94	37.45
	28.55	6.46	6.77	5.4	25.26	25.93	27.09
Dec-13	35.45	17.11	19.15	17.73	35.93	37.73	38.37
	25	6.7	7.67	5.68	26.11	27.56	28.01
Jan-14	34.2	18.72	19.54	19.21	37.86	38.63	40.31
	24.05	7.72	8.01	7.16	27.83	28.45	29.96
Feb-14	33.95	19.84	18.16	19.86	36.29	35.02	38.33
	23.5	7.95	6.79	7.81	25.93	24.87	27.95
Mar-14	33	24.27	20.43	23.75	43.03	40.07	45.18
	22.3	11.18	8.54	11.7	32.29	29.79	34.86
Apr-14	40.15	22.64	21.22	15.67	39.07	37.91	41.53
	31.1	11.7	10.65	9.63	28.94	27.95	31.19
May-14	52.55	26.08	27.25	17.8	51.41	52.5	54.75
	42.8	14.62	15.33	11.76	41.25	42.18	44.62
Jun-14	51	32.25	25.38	21.49	51.59	45.65	54.37
	44.7	19.98	14.76	15.45	40.81	35.66	44.01
Jul-14	44.1	22.99	15.64	16.75	40.88	33.92	43.78
	40.05	17.47	11.31	13.73	35.76	29.37	38.58
Aug-14	51	30.24	24.62	20.25	49.04	44.2	51.76
	37.1	18.17	13.95	14.21	38.37	34.19	41.4
Spt-14	45.5	27.43	25.73	20.11	46.85	45.41	50.19
	23.85	7.22	6.37	5	24.96	23.95	24.01
Oct-14	52	33.62	34.36	23.02	55.64	56.39	58.98
	42.55	21.77	22.21	16.98	45.05	45.68	48.61
Nov-14	44.05	27.4	23.21	19.65	45.19	41.44	48.24
	34.9	16.7	13.55	13.61	35.08	31.86	37.76

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	37.7	26.23	22.91	19.14	47.7	44.76	51.12
	28.2	15.92	13.41	13.1	37.83	35.27	40.74
Jan-15	47.5	32.45	32.55	21.7	51.89	52.06	36.04
	38.35	20.23	20.18	15.66	41.12	41.24	30.78
Feb-15	48	25.98	25.66	18.75	43.49	43.32	46.48
	34.75	15.49	15.14	12.71	33.49	33.31	36.01
Mar-15	46.4	23.54	22.13	17.57	45.53	44.36	33.43
	36.7	13.82	12.71	11.53	35.95	34.91	28.18
Apr-15	44.85	25.85	28.72	26.9	45.7	48.3	48.69
	35.55	14.86	16.83	15.5	35.54	37.75	38.39
May-15	38.7	22.4	20.23	23.74	60.24	58.39	64.89
	29.15	12.52	10.94	12.34	50.74	49.07	54.96
Jun-15	48	33.55	26.82	33.66	55.17	49.47	58.03
	37.6	20.88	15.72	22.26	44.3	39.32	47.76
Jul-15	37.8	25.12	15.44	26.53	45.75	36.42	49.03
	28.9	14.86	8.15	15.13	35.9	27.96	38.67
Aug-15	42.6	25.85	20.83	27.35	41.81	37.14	44.74
	32.9	15.63	11.94	15.95	31.9	27.96	34.22
Spt-15	54.6	30.24	28.48	30.84	51.67	50.24	54.68
	45.85	18.27	16.84	19.45	41.1	39.84	44.4
Oct-15	41.1	22.21	17.47	23.58	47.24	42.83	50.81
	31.3	12.47	9.19	12.18	37.67	33.86	40.6
Nov-15	39	22.72	20.95	24.01	55.3	53.82	59.47
	31	12.66	11.34	12.61	45.69	44.37	49.45
Dec-15	47.6	30.38	25.93	31.45	54.35	50.51	57.84
	37.5	18.91	15.5	20.05	44.02	40.63	47.57
Jan-16	35	25.2	22.28	26.53	46.86	44.3	50.17
	26.9	14.75	12.58	15.13	36.95	34.73	39.86
Feb-16	43.1	29.75	22.37	30.43	50.66	44.2	53.64
	33.65	17.9	12.48	19.03	40.13	34.55	43.35
Mar-16	54.95	27.56	23.1	28.55	47.72	43.82	50.74
	39.35	16.28	12.98	17.15	37.42	34.06	40.42
Apr-16	49.5	30.24	29	30.67	49.25	48.24	51.93
	38.35	18.19	17.18	19.44	38.57	37.69	41.67

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	53.55	29.69	29.91	30.8	51.93	52.21	55.27
	42	18.42	18.5	19.57	41.64	41.87	45.02
Jun-16	60.45	31.54	32.08	32.39	51.26	51.81	54.27
	48.45	19.82	20.14	21.17	40.7	41.15	43.97
Jul-16	40.1	27.16	20.47	28.84	37.37	30.91	39.96
	30.95	17.08	12.14	17.61	27.46	22.17	29.3
Aug-16	49.9	29.39	30.21	30.95	46.8	47.64	49.97
	39.2	18.76	19.29	19.73	36.67	37.37	39.54
Spt-16	43.55	27.53	27.61	29.11	44.32	44.5	47.43
	33.75	17.21	17.18	17.89	34.36	34.48	36.99
Oct-16	42.35	27.7	24.95	29.23	42.6	40.1	45.5
	33	17.26	15.14	18.01	32.54	30.41	35.02
Nov-16	43.95	29.91	27.72	30.92	50.86	48.99	54.03
	33.1	18.5	16.77	19.69	40.48	38.84	43.76
Dec-16	48.95	28.37	26.14	29.02	42.79	40.86	45.1
	36.9	16.71	14.99	17.8	32.14	30.5	34.71
Jan-17	33.35	23.29	19.8	24.58	42.83	39.67	45.89
	23.85	13.15	10.69	13.35	33.04	30.36	35.63
Feb-17	48.75	28.83	27.56	29.75	43.1	42.02	45.56
	37.6	17.42	16.39	18.52	32.54	31.61	35.13
Mar-17	41.5	30.97	27.62	31.74	40.54	37.51	42.46
	32.55	19.21	16.62	20.51	29.55	27.02	31.83

Source: Authors compilation

Table 27 : Calculated option premiums and market premiums of Maruti Suzuki India Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	47.2	25.65	20.71	27.29	48.35	43.72	52
	28.1	15.87	12.21	15.94	38.74	34.71	41.67
May-12	67.3	47.94	42.95	46.09	74.14	70.14	76.86
	42.7	17.29	14.35	17.72	47.6	44.51	51.42
Jun-12	59	36.95	30.76	35.59	60.31	55.34	62.81
	34.25	9.08	6.44	7.23	35.11	31.57	37.57
Jul-12	50.75	34.72	28.69	34.6	57.63	52.59	60.54
	29	8.98	6.39	6.23	33.16	29.6	35.07
Aug-12	24.1	28.94	19.74	29.6	125.42	117.34	135
	44.8	6.3	3.23	1.24	103.45	96.33	112.41
Sep-12	63	53.29	50.54	47.43	68.72	66.49	68.26
	33.95	17.91	16.12	19.06	39.43	37.76	42.59
Oct-12	50.9	25.7	13.52	27.35	46.08	33.68	49.52
	30.05	15.91	7.37	16	36.45	25.9	39.13
Nov-12	57.3	35.38	36.35	36.22	51.3	52.24	53.99
	31.7	10.8	11.06	7.85	27.09	27.64	27.75
Dec-12	56.05	43	41.47	43	55.92	54.61	57.86
	30.85	15.39	14.36	14.64	29.77	28.8	31.32
Jan-13	47.65	28.4	29.1	30.23	45.34	46.13	48.66
	25.85	8.58	8.71	1.86	23.87	24.32	22.3
Feb-13	52.25	35.98	31.11	37.69	57.91	53.55	61.72
	29.05	12.77	10.18	9.33	34.46	31.3	35.63
Mar-13	55.65	42.54	32.11	42.33	58.9	49.74	61.13
	31.45	14.75	9.44	13.96	32.93	26.6	34.94
Apr-13	50.4	25.54	20.89	26.98	44.56	40.32	47.73
	39.6	15.27	11.86	15.54	34.69	31.06	37.3
May-13	74.05	38.39	36.54	39.86	65.16	63.66	69.3
	62.3	26.68	25.05	28.41	54.63	53.26	58.93
Jun-13	60.65	32.45	32.02	34.23	53.5	53.25	57.2
	67.3	21.72	21.26	22.79	43.36	43.11	46.71

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	64.1	39.07	32.02	39.87	60.67	54.54	63.97
	53.05	26.69	20.97	28.43	49.75	44.3	53.54
Aug-13	62.8	34.62	29.94	35.39	54.43	50.41	57.45
	55	22.47	18.74	23.95	43.64	40.11	47.04
Spt-13	84	54.55	46.41	48.95	75.42	69.02	76.04
	53.55	19.13	14.3	20.34	46.8	41.96	50.56
Oct-13	78.8	35.54	39.65	36.11	47.61	51.32	49.73
	50.85	10.41	12.14	7.5	22.99	25.26	23.06
Nov-13	79.95	54.25	57.13	52.3	86.55	88.91	90
	54.95	22.53	24.06	23.69	59.7	61.55	64.55
Dec-13	74.3	47.38	50.92	47.35	83.28	86.29	87.78
	48.25	18.79	20.62	18.74	57.77	60.13	62.38
Jan-14	79.25	48.28	53.77	48.63	107.91	112.45	114.85
	52.9	20.3	23.1	20.03	83.21	87.05	90.17
Feb-14	84.35	54.33	53.44	52.36	80.78	80.11	83.52
	56.3	22.57	21.76	23.75	53.49	52.92	57.78
Mar-14	79	55.76	53.18	53.02	84.74	82.72	87.5
	51.9	23.06	21.2	24.41	57.33	55.69	61.97
Apr-14	92.05	57.85	59.13	37.57	87.35	88.55	91.47
	65.85	28.36	28.97	22.78	60.83	61.73	65.67
May-14	92.85	41.92	40.54	30.48	71.28	70.18	76.37
	68.9	18.68	17.66	15.69	47.84	46.93	50.44
Jun-14	93.25	57.74	57.34	39.71	100.27	100.11	106.62
	70.5	30.51	30	24.93	75.07	74.87	81.04
Jul-14	84.25	50.8	39.48	37.34	95.36	84.71	102.43
	62.25	26.92	19.44	22.55	71.65	62.78	76.76
Aug-14	85.65	73.23	57.67	48.51	108.1	94.33	113.49
	63.25	43.26	31.85	33.73	81.1	69.56	87.5
Spt-14	94.05	64.54	63.24	46.44	101.86	100.88	108.82
	68.75	38.67	37.47	31.65	76.96	76.06	82.68
Oct-14	121.85	83.09	84.13	55.72	122.4	123.48	128.81
	96.5	53.1	53.63	40.94	95.31	96.17	102.75
Nov-14	121.4	88.26	85.32	59.88	119.31	116.79	125.35
	93.6	58.55	55.97	45.1	91.85	89.6	98.88

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	105.8	94.49	85.79	62.66	124.05	116.3	129.37
	80	63.51	56.34	47.88	95.74	89.01	102.86
Jan-15	124.75	85.44	91.14	58.6	116.95	122.29	81.68
	99.1	56.33	60.57	43.81	89.88	94.35	68.15
Feb-15	161.65	100.94	98.13	67.41	126.92	124.48	132.23
	102.8	70.04	67.49	52.63	98.31	96.08	105.48
Mar-15	103.7	73.16	68.57	54.08	101.43	97.24	74.45
	78.85	48.04	44.28	39.3	76.73	73.12	60.74
Apr-15	103.7	58.95	68.59	61.94	96.33	105.2	102.81
	78.45	32.66	39.05	32.34	71.15	78.41	75.97
May-15	113.8	59.69	61.68	62.87	102.19	104.36	109.26
	91	33.71	34.67	33.27	77.22	78.94	82.56
Jun-15	115.55	78.58	79.24	79.85	112.36	113.13	117.8
	87.25	47.48	47.52	50.25	84.51	85.03	90.83
Jul-15	113.2	71.95	57.03	74.94	127.06	114.11	135.39
	89.7	43.63	32.41	45.33	101.18	89.91	109
Aug-15	114.45	83.37	65.62	85.8	117.36	101.59	123.57
	88.35	53.17	39.34	56.2	89.77	76.31	96.38
Spt-15	148.75	65.09	62.47	68.7	100.96	98.93	107.86
	125.8	39.08	36.74	39.1	75.81	73.97	80.72
Oct-15	161.25	89.59	79.02	91.82	154.19	145.53	163.39
	138.05	58.71	50.02	62.22	127.29	119.51	137.12
Nov-15	151.6	97.41	87.33	98.01	182.97	175.11	193.64
	125.35	64.59	56.12	68.41	155.97	148.78	167.9
Dec-15	160	85.99	83.29	88.83	136.36	134.35	144.46
	128.4	56.05	53.47	59.23	109.43	107.56	117.76
Jan-16	119.3	92.6	79.94	94.73	144.64	133.96	152.64
	91.25	61.43	51.04	65.14	117.16	107.68	125.99
Feb-16	131.55	90.21	74.46	90.67	157.69	144.9	166.37
	105.05	57.61	45.04	61.07	130.41	118.97	140.38
Mar-16	146.6	55.49	55.59	58.32	120.35	120.88	129.07
	121	29.54	29.18	28.73	95.77	96.17	103.21
Apr-16	133.4	75.17	71.6	78.47	159.79	156.97	171.04
	107.55	47.42	44.47	50.14	134.67	132.11	145.79

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	145	90.55	92.32	91.88	190.47	192.21	202.66
	118.95	59.54	60.68	63.55	164.5	166.06	177.68
Jun-16	153.15	97.43	94.06	99.16	158.77	156.09	167.6
	125.65	66.4	63.42	70.83	131.61	129.17	141.78
Jul-16	118.9	77.58	64.93	81.81	158.04	146.71	169.54
	94.2	50.89	41.04	53.48	133.14	122.95	144.03
Aug-16	151.7	82.69	77.75	87.78	169.98	165.83	182.77
	127.55	56.8	142.73	59.45	145.35	222.94	157.17
Spt-16	140.55	93.29	76.31	98.19	150.76	135.21	160.99
	116.55	65.74	51.95	69.86	124.94	111.08	134.81
Oct-16	178.2	106.32	106.78	111.58	178.13	178.93	190.14
	154.25	78.03	78.14	83.25	152.07	152.73	164.11
Nov-16	168.95	112.13	104.72	117.92	243.52	237.41	261.25
	142.25	83.97	77.49	89.59	218.22	212.48	235.96
Dec-16	159.55	94.17	79.95	98.89	156.3	143.49	166.84
	143.8	66.3	54.67	70.56	130.41	118.93	140.77
Jan-17	163.5	99	83.87	104.42	148.32	134.36	158.29
	137.55	71.56	59.01	76.09	122.32	109.9	131.82
Feb-17	179.45	106.6	98.29	112.81	175.23	167.88	187.62
	156.85	79.46	72.28	84.48	149.61	142.89	161.41
Mar-17	167.65	98.87	95.41	105.28	154.18	151.3	165.5
	145.9	73.14	70.02	76.95	129.19	126.52	139

Source: Authors compilation

Table 28: Calculated option premiums and market premiums of NTPC Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	7.45	4.59	5.16	4.52	6.95	7.42	7.24
	2.95	1.65	1.95	1.62	4.31	4.67	4.63
May-12	6.75	3.96	4.42	4.01	6.22	6.62	6.55
	2.2	1.32	1.53	1.12	3.72	4	3.94
Jun-12	7.9	6.29	5.51	5.57	7.79	7.16	7.67
	2.7	1.52	1.13	1.51	3.73	3.31	4.01
Jul-12	11.9	10.53	10.95	8.35	11.24	11.6	10.01
	4.7	2.4	2.6	2.55	4.39	4.6	4.72
Aug-12	6.4	4.84	4.55	4.64	6.6	6.36	6.75
	1.8	1.71	1.53	1.74	3.84	3.66	4.12
Sep-12	10.15	9.26	8.9	7.69	10.4	10.08	9.71
	3.75	1.86	1.65	1.89	4.13	3.93	4.44
Oct-12	10.6	9.31	8.66	7.72	10.15	9.59	9.32
	4.8	1.89	1.55	1.92	3.73	3.38	3.99
Nov-12	10.8	10.27	10.43	8.32	10.73	10.87	9.43
	4.3	2.38	2.42	2.52	3.74	3.79	4.01
Dec-12	5.55	4.33	3.72	4.31	5.69	5.16	5.88
	1.65	1.51	1.17	1.42	3.04	2.68	3.2
Jan-13	7.65	7.83	6.68	6.67	8.76	7.77	8.22
	2.35	2.46	1.78	2.62	4.18	3.52	4.5
Feb-13	6.8	8.12	5.29	6.85	8.95	6.52	8.31
	2.1	2.63	1.13	2.8	4.26	2.71	4.57
Mar-13	3.5	2.57	2.19	2.73	3.82	3.47	4.09
	1.2	1.58	1.29	1.57	2.84	2.55	3.01
Apr-13	3.8	2.64	3.07	2.7	4.37	4.74	4.62
	3	1.2	1.46	1.17	3.07	3.36	3.28
May-13	6.5	3.85	3.66	3.72	5.9	5.76	6.13
	4.2	2.08	1.91	2.2	4.47	4.34	4.8
Jun-13	5	3.29	3.11	3.29	5.76	5.62	6.07
	3.45	1.68	1.52	1.76	4.41	4.29	4.75

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	5.05	2.82	2.84	2.86	4.72	4.74	4.98
	3.9	1.32	1.3	1.33	3.39	3.41	3.64
Aug-13	5.95	2.64	2.94	2.7	7.55	7.8	8.09
	4.35	1.19	1.35	1.17	6.32	6.54	6.84
Spt-13	5.05	3.16	2.79	3.08	6.45	6.18	6.81
	3.4	1.48	1.21	1.55	5.13	4.89	5.54
Oct-13	6.25	3.04	2.55	3.06	6.09	5.72	6.46
	5.25	1.49	1.14	1.53	4.79	4.47	5.17
Nov-13	5.95	2.85	3.21	2.9	5.8	6.09	6.16
	4.85	1.35	1.56	1.37	4.51	4.75	4.86
Dec-13	6.4	3.63	3.99	3.52	5.72	6	5.96
	3.7	1.61	1.82	1.69	4.06	4.28	4.37
Jan-14	5.7	3.51	3.72	3.38	5.22	5.39	5.4
	3.45	1.48	1.58	1.54	3.54	3.66	3.81
Feb-14	4.2	2.74	2.3	2.73	9.2	8.89	9.86
	2	1.44	1.11	1.51	8.22	7.93	8.9
Mar-14	5.65	3.34	3.38	3.11	5.44	5.47	5.63
	3.05	1.22	1.2	1.27	3.79	3.8	4.09
Apr-14	4.7	2.94	2.91	2.06	4.89	4.87	5.2
	3.5	1.61	1.57	1.32	3.63	3.61	3.91
May-14	6.2	2.93	3.25	2.03	5.39	5.67	5.75
	4.25	1.58	1.79	1.3	4.14	4.38	4.47
Jun-14	8.45	3.44	2.8	2.5	6.74	6.15	7.23
	7.6	2.16	1.68	1.76	5.52	5	5.96
Jul-14	8.45	4.41	4.68	2.9	7.02	7.26	7.39
	6.6	2.85	3.06	2.16	5.66	5.87	6.11
Aug-14	4.35	3.2	2.13	2.29	5.39	4.37	5.76
	3.25	1.9	1.14	1.55	4.15	3.29	4.47
Spt-14	7.35	6.08	6.15	3.44	7.74	7.8	7.73
	4.2	2.58	2.61	1.96	4.78	4.81	5.14
Oct-14	5.3	3.89	3.97	2.59	5.81	5.89	6.11
	4.3	2.39	2.44	1.85	4.46	4.53	4.81
Nov-14	4.2	3.01	2.65	2.23	5.85	5.53	6.3
	3.1	1.8	1.53	1.49	4.66	4.38	5.02

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	4.2	2.92	2.85	2.15	5.85	5.8	6.29
	3	1.7	1.64	1.41	4.66	4.61	5.02
Jan-15	5.4	3.85	3.9	2.58	5.15	5.2	3.54
	4	2.36	2.39	1.84	3.78	3.81	2.86
Feb-15	5.6	3.51	3.12	2.45	4.85	4.49	5.13
	4.1	2.13	1.83	1.71	3.54	3.24	3.8
Mar-15	3.75	3.67	1.93	2.61	8.75	7.05	6.29
	3.15	2.32	1.07	1.87	7.53	6	5.66
Apr-15	5.1	3.01	3.36	3.18	5.21	5.53	5.57
	3.95	1.73	1.97	1.76	3.98	4.25	4.28
May-15	5.8	4.29	4.07	4.3	6.02	5.84	6.27
	4.45	2.7	2.53	2.88	4.61	4.45	4.96
Jun-15	5.25	3.46	3.57	3.54	4.91	5.01	5.16
	2.9	1.36	1.41	1.28	2.89	2.96	3.05
Jul-15	3.95	2.63	2.31	2.8	4.35	4.05	4.67
	2.65	1.44	1.21	1.38	3.16	2.91	3.36
Aug-15	3.6	2.5	2.42	2.66	5.62	5.56	6.05
	2.55	1.33	1.27	1.25	4.45	4.39	4.79
Spt-15	4.9	3.23	2.6	3.27	5.97	5.43	6.32
	3.5	1.76	1.32	1.86	4.68	4.22	5.06
Oct-15	5	2.78	2.73	2.89	4.5	4.46	4.78
	3.75	1.45	1.4	1.48	3.24	3.2	3.48
Nov-15	4.5	2.6	2.44	2.76	4.19	4.05	4.49
	3	1.39	1.27	1.35	2.99	2.87	3.18
Dec-15	4.4	2.54	2.53	2.7	4.19	4.19	4.5
	2.65	1.35	1.33	1.29	3	3	3.19
Jan-16	1.4	3.9	3.19	3.95	7.09	6.49	7.51
	2.95	2.37	1.84	2.53	5.78	5.25	6.24
Feb-16	5.15	4.19	2.94	4.16	7.35	6.29	7.74
	3.9	2.58	1.64	2.75	6.01	5.07	6.48
Mar-16	5.6	3.19	3.17	3.24	4.55	4.54	4.77
	4.4	1.73	1.7	1.83	3.21	3.2	3.47
Apr-16	5.5	3.76	3.64	3.65	5.47	5.38	5.66
	3.75	2.09	2	2.23	4.05	3.97	4.36

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	4.45	3.42	3.27	3.45	5.46	5.34	5.74
	3.55	1.9	1.78	2.03	4.12	4.01	4.45
Jun-16	4.65	2.35	2.44	2.49	4.76	4.86	5.12
	3.55	1.18	1.23	1.08	3.58	3.67	3.83
Jul-16	5.85	3.66	3.4	3.72	5.44	5.22	5.72
	4.5	2.16	1.96	2.3	4.09	3.9	4.41
Aug-16	5.8	3.09	3.03	3.24	5.49	5.45	5.86
	4.15	1.76	1.71	1.82	4.23	4.2	4.57
Spt-16	4	2.81	2.01	2.97	5.06	4.29	5.42
	2.9	1.57	1.02	1.56	3.84	3.2	4.12
Oct-16	6.05	2.71	2.75	2.86	4.06	4.1	4.33
	3.7	1.45	1.47	1.44	2.83	2.86	3.01
Nov-16	5.4	3.94	3.87	3.93	7.14	6.92	7.35
	3.9	2.35	2.28	2.51	5.8	5.58	6.08
Dec-16	6	3.56	2.9	3.66	5.17	4.58	5.45
	4.75	2.11	1.63	2.24	3.83	3.34	4.13
Jan-17	4	4.13	2.94	4.14	6.26	5.21	6.55
	3.35	2.55	1.66	2.72	4.88	3.98	5.26
Feb-17	6.6	4.51	3.43	4.51	6.72	5.79	7.02
	4.25	1.7	1.12	1.67	4.13	3.45	4.42
Mar-17	5	2.93	2.53	3.1	4.89	4.52	5.24
	3.75	1.68	1.39	1.69	3.67	3.36	3.93

Source: Authors compilation

Table 29: Calculated option premiums and market premiums of Oil and Natural Gas Corporation Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	13.8	10.8	10.66	9.86	14.28	14.17	14.35
	4.05	3.89	3.75	4.12	8.49	8.4	9.17
May-12	10.9	6.28	6.9	6.45	10.44	10.99	11.06
	3.1	3.43	3.84	3.58	7.85	8.31	8.47
Jun-12	11.95	8.65	8.07	8.18	11.98	11.51	12.23
	6.65	2.52	2.19	2.44	6.57	6.23	7.04
Jul-12	11.6	8.25	8.16	8.16	12.98	12.89	13.54
	6.25	2.65	2.56	2.43	7.87	7.78	8.38
Aug-12	13.25	10.26	10.14	9.57	13.59	13.5	13.74
	8.3	3.66	3.54	3.84	7.91	7.82	8.53
Sep-12	17.95	17.81	15.48	14.33	19.78	17.81	18.2
	5.85	2.91	1.95	2.86	7.26	6.14	7.79
Oct-12	8.85	5.49	2.66	5.79	8.79	5.98	9.4
	2.8	2.98	1.19	2.92	6.34	4.1	6.76
Nov-12	17.6	16.56	17.1	13.56	17.92	18.38	16.28
	5.2	2.4	2.55	2.09	5.44	5.66	5.69
Dec-12	9.4	8	7.09	7.84	10.83	10.05	11.16
	4.7	2.37	1.9	2.11	5.59	5.06	5.88
Jan-13	10.55	8.67	8.62	8.35	12.04	12.01	12.37
	5.2	2.71	2.63	2.61	6.68	6.65	7.15
Feb-13	20	14.99	14.85	13.27	20.02	19.91	20.02
	9.65	2.48	2.36	1.8	9.22	9.13	9.78
Mar-13	18.5	17.25	13.3	14.5	20.01	16.76	19.01
	8.15	3.16	1.66	3.02	8.04	6.16	8.6
Apr-13	14.8	11.54	10.56	10.51	16.07	15.3	16.28
	9.4	4.39	3.73	4.65	10.29	9.69	11.1
May-13	13.7	7.99	7.78	8.02	11.95	11.79	12.51
	8.75	2.55	2.38	2.16	6.85	6.72	7.22
Jun-13	13.3	10.98	9.63	10.29	18.22	17.2	18.91
	8.6	4.2	3.35	4.43	12.8	11.97	13.84

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	13.65	6.05	5.17	6.36	14.14	13.4	15.18
	9.5	3.42	2.77	3.43	11.7	11.03	12.64
Aug-13	15	7.28	8	7.35	23.29	23.88	24.97
	9.45	2.07	2.35	1.49	18.6	19.11	20.19
Spt-13	20.75	11.1	10.07	9.66	20.24	21.73	21
	14.6	3.58	2.92	3.8	14.92	16.64	16.14
Oct-13	17.25	7.43	8.7	7.31	11.1	12.15	11.55
	12.5	1.93	2.47	1.45	6	6.71	6.3
Nov-13	15.65	10.37	10.96	9.54	16.07	16.52	16.53
	10.05	3.52	3.79	3.68	10.58	10.92	11.44
Dec-13	12.75	11.64	7.22	10.49	18.19	14.82	18.66
	7.8	4.36	1.92	4.63	12.6	9.93	13.61
Jan-14	11.35	6.03	6.28	6.24	10.6	10.85	11.27
	6.55	3.23	3.37	3.31	8.04	8.24	8.66
Feb-14	12.2	8.34	7.81	8.01	12.15	11.72	12.52
	6.95	2.36	2.05	2.15	6.83	6.52	7.3
Mar-14	6.45	5.56	2.85	5.82	13.02	10.44	13.96
	3.25	2.91	1.22	2.89	10.57	8.33	11.43
Apr-14	17	13.2	12.17	12.54	15.72	14.8	15.7
	11.65	6.51	5.76	6.96	9.7	8.99	10.43
May-14	15.7	7.2	7.17	7.63	18.07	18.08	19.46
	14	4.65	4.61	4.84	15.68	15.69	17
Jun-14	33.9	21.38	21.36	18.51	32.21	32.19	32.69
	16.75	6.86	6.78	7.34	21.17	21.14	22.91
Jul-14	21	9.21	9.68	9.77	13.42	13.89	14.36
	18.65	6.59	6.95	6.98	10.89	11.3	11.73
Aug-14	29.8	8.79	7.79	9.31	16.71	15.82	17.94
	10.85	6.15	5.34	6.51	14.24	13.43	15.4
Spt-14	28.55	23.48	18.97	20.65	31.45	27.87	31.39
	16.25	8.87	6.15	9.48	19.78	17.05	21.33
Oct-14	15.85	9.73	9.5	10.27	17.91	17.74	19.19
	11.55	4.85	4.66	4.68	13.13	12.98	14.1
Nov-14	15.15	11.55	10.55	11.84	16.11	15.22	16.94
	10.4	5.99	5.28	6.26	10.89	10.18	11.71

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	18.35	14.1	13.38	13.65	21.16	20.58	21.92
	12.55	7.54	6.99	8.06	15.62	15.13	16.85
Jan-15	15.45	9.87	10.39	10.11	14.82	15.3	15.62
	10.5	4.49	4.77	4.52	9.75	10.11	10.46
Feb-15	13.3	8.06	7.98	8.53	14.42	14.38	15.46
	8.8	3.47	3.39	2.95	9.77	9.73	10.34
Mar-15	13.95	9.68	7.78	9.84	12.41	10.66	12.92
	9.35	4.22	3.09	4.26	7.19	5.95	7.64
Apr-15	13.75	9.27	9.98	9.35	14.26	14.88	14.98
	8.4	3.8	4.18	3.81	9.18	9.64	9.87
May-15	15.6	12.19	11.4	11.75	17.24	16.58	17.73
	10.15	5.8	5.24	6.2	11.68	11.15	12.62
Jun-15	16.5	13.39	12.65	12.61	17.58	16.96	17.79
	10.45	6.61	6.06	7.07	11.75	11.24	12.65
Jul-15	10.7	8.27	7.71	8.56	13.1	12.62	13.89
	6.3	3.3	2.96	3.02	8.25	7.88	8.76
Aug-15	12.45	7.14	6.74	7.41	12.88	12.54	13.72
	7.9	2.42	2.19	1.86	8.18	7.92	8.68
Spt-15	9.6	7.2	6.27	7.3	11.41	10.61	12.02
	7.15	2.21	1.76	1.76	6.57	6	6.93
Oct-15	7.4	4.62	4.33	4.93	8.99	8.74	9.68
	5.6	2.37	2.17	2.16	6.69	6.47	7.14
Nov-15	8.65	6.15	3.39	6.43	10.48	7.8	11.17
	6.25	3.51	1.67	3.66	7.98	5.75	8.62
Dec-15	11.95	5	4.72	5.32	9.25	9.01	9.94
	7.15	2.66	2.46	2.55	6.9	6.7	7.4
Jan-16	7.2	6.41	4.92	6.64	11.03	9.68	11.73
	4.95	3.67	2.62	3.87	8.5	7.35	9.19
Feb-16	8.55	5.31	4.5	5.6	10.36	9.63	11.11
	6.45	2.82	2.27	2.82	7.96	7.33	8.59
Mar-16	8.45	4.99	2.76	5.26	9.73	7.53	10.44
	6.3	2.55	1.2	2.49	7.34	5.53	7.91
Apr-16	9.8	6.65	6.76	6.66	10.72	10.83	11.26
	7.25	3.66	3.73	3.93	8.08	8.17	8.75

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	9.5	5.78	6.01	6	9.96	10.18	10.6
	7.1	3.12	3.27	3.27	7.46	7.64	8.07
Jun-16	9.95	6.18	6.59	6.31	10.23	10.6	10.82
	7.3	3.37	3.64	3.58	7.67	7.97	8.3
Jul-16	9.6	7.81	7.79	7.67	12.2	12.19	12.72
	5.8	2.4	2.36	2.21	7.18	7.17	7.7
Aug-16	7.85	4.57	4.55	4.88	7.15	7.15	7.69
	5.8	2.34	2.32	2.15	4.87	4.86	5.11
Spt-16	7.65	6.95	4.92	7.09	10.61	8.75	11.18
	5.5	4.07	2.64	4.36	7.98	6.44	8.63
Oct-16	9.2	6.21	5.72	6.53	10.47	10.03	11.19
	6.85	3.64	3.29	3.8	8.01	7.63	8.65
Nov-16	8.05	6.97	4.52	7.33	10.54	8.16	11.24
	6.1	4.35	2.59	4.6	8.03	6.05	8.67
Dec-16	10.55	7.12	6.57	7.43	9.11	8.6	9.63
	8.55	4.41	3.99	4.7	6.5	6.08	7.01
Jan-17	6.3	4.7	4.28	4.94	5.66	5.26	5.99
	4.8	2.93	2.61	3.12	3.93	3.61	4.22
Feb-17	7.15	4.85	3.83	5.12	6.08	5.1	6.47
	6.35	3.93	3.03	4.21	5.2	4.31	5.6
Mar-17	9.5	7.03	6.74	6.84	11.15	10.91	11.61
	6.65	3.83	3.6	4.11	8.44	8.23	9.11

Source: Authors compilation

Table 30: Calculated option premiums and market premiums of Power Grid Corporation of India Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	9.6	8.85	9.14	6.57	9.12	9.38	7.68
	2.55	1.15	1.26	1.18	2.7	2.83	2.91
May-12	10	8.94	9.43	6.63	9.19	9.64	7.68
	2.45	1.2	1.43	1.25	2.69	2.93	2.89
Jun-12	5.85	4.42	4.29	3.81	5.28	5.17	5.11
	1.1	1.34	1.23	1.41	2.77	2.69	2.99
Jul-12	5.65	4.43	4.47	3.9	5.34	5.37	5.22
	1	1.43	1.42	1.51	2.86	2.87	3.08
Aug-12	5.8	5.18	4.93	4.39	6.19	5.99	5.97
	1.05	1.34	1.17	1.4	3.1	2.95	3.34
Sep-12	9.85	10.21	10.08	7.52	10.46	10.33	8.67
	2.9	1.46	1.35	1.54	3.12	3.03	3.36
Oct-12	4.05	2.09	1.6	2.19	3.44	3	3.66
	1.05	1.5	1.09	1.59	2.91	2.51	3.13
Nov-12	5.75	4.7	4.98	4.09	5.74	5.96	5.61
	1.2	1.09	1.2	1.09	2.75	2.89	2.96
Dec-12	8.95	8.67	8.84	6.57	9.04	9.19	7.8
	2.15	2.34	1.76	1.79	3.3	3.38	3.55
Jan-13	5.7	14.19	4.75	9.86	14.21	5.44	10.37
	1.2	1.4	1.59	1.48	2.63	2.83	2.82
Feb-13	3	6.16	10.48	4.91	6.83	10.67	9.08
	1	1.26	4.59	1.32	2.89	5.65	5.91
Mar-13	8.5	8.65	8.19	6.45	8.83	8.41	7.31
	2.2	1.57	1.28	1.66	2.81	2.54	3.01
Apr-13	4.1	1.8	1.63	1.86	2.91	2.78	3.09
	2.85	1.2	1.06	1.26	2.38	2.26	2.55
May-13	3.1	1.73	1.71	1.81	2.92	3.02	3.23
	1.95	1.16	1.13	1.2	2.4	2.49	2.69
Jun-13	3.4	2.11	1.97	2.16	4.5	4.4	4.79
	1.9	1.2	1.08	1.25	3.72	3.63	4.02

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	3.9	2.45	2.24	2.44	3.33	3.16	3.45
	2.5	1.17	1.01	1.22	2.2	2.06	2.35
Aug-13	4.75	2.08	2.37	2.12	4.49	4.74	4.78
	3	1.16	1.36	1.21	3.72	3.93	4.01
Spt-13	3.1	1.46	1.53	1.54	3.09	3.17	3.32
	2.15	1.17	1.22	1.23	2.84	2.91	3.05
Oct-13	5.25	2.41	2.8	2.35	3.61	3.93	3.74
	3.3	1.36	1.65	1.43	2.75	3.02	2.95
Nov-13	2.65	1.63	1.5	1.69	3.64	3.55	3.9
	1.5	1.31	1.2	1.39	3.38	3.29	3.64
Dec-13	1.65	1.39	2.25	1.47	2.59	3.32	2.78
	1	1.11	1.87	1.16	2.33	3.02	2.51
Jan-14	4.35	3.13	3.42	2.88	4.03	4.27	4.05
	2.95	1.28	1.46	1.35	2.52	2.69	2.7
Feb-14	2.1	1.66	2.01	1.72	2.2	2.52	2.32
	1.1	1.06	1.33	1.11	1.65	1.91	1.76
Mar-14	2.4	2.81	3	2.61	4.62	4.76	4.79
	1	1.05	1.14	1.09	3.24	3.35	3.5
Apr-14	4.5	3.51	3.28	2.11	3.97	3.76	3.92
	3.05	1.76	1.58	1.33	2.38	2.21	2.55
May-14	3.85	2.06	2	1.48	4.34	4.3	4.64
	2.8	1.24	1.18	1.01	3.58	3.55	3.87
Jun-14	6.15	3.37	3.33	2.15	4.06	4.02	4.13
	5.65	1.76	1.71	1.37	2.58	2.54	2.76
Jul-14	7.15	3.27	3.55	2.19	4.55	4.81	4.76
	6	1.77	1.95	1.41	3.19	3.38	3.42
Aug-14	7.65	3.72	3.29	2.34	4.83	4.46	4.95
	4	2.05	1.72	1.56	3.36	3.06	3.6
Spt-14	3.8	3.84	2.42	2.4	4.34	3.03	4.35
	1.75	2.15	1.15	1.63	2.77	1.78	2.96
Oct-14	5.1	3.6	3.67	2.34	4.9	4.96	5.08
	3.5	2	2.03	1.56	3.48	3.52	3.74
Nov-14	4.1	2.91	2.41	2.07	5.14	4.7	5.48
	2.9	1.57	1.21	1.3	3.88	3.51	4.17

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	3.2	2.49	2.21	1.85	4.5	4.25	4.83
	2.15	1.27	1.07	1.07	3.3	3.09	3.51
Jan-15	4.6	3.68	3.01	2.37	5.41	4.85	3.67
	3.35	2.06	1.57	1.59	4.01	3.54	3
Feb-15	4.3	2.76	2.88	2.01	4.76	4.88	5.08
	4.2	1.47	1.54	1.23	3.52	3.61	3.77
Mar-15	6.25	3.99	3.16	2.62	5.75	5.04	3.94
	4.8	2.39	1.77	1.84	4.35	3.75	3.26
Apr-15	13.4	3.74	4.4	3.68	4.04	4.66	4.04
	4.55	2.09	2.56	2.22	2.46	2.92	2.62
May-15	4.4	3.29	3.11	3.32	4.49	4.35	4.68
	3.75	1.76	1.62	1.85	3.11	2.98	3.34
Jun-15	4.45	2.97	2.73	3.05	4.47	4.27	4.72
	3.35	1.54	1.36	1.58	3.15	2.99	3.38
Jul-15	9.65	3.18	2.82	3.21	4.49	4.18	4.69
	2.95	1.66	1.39	1.74	3.11	2.86	3.35
Aug-15	4.2	3.51	2.7	3.49	4.84	4.14	5.02
	2.8	1.91	1.33	2.02	3.42	2.86	3.68
Spt-15	2.55	2.17	1.9	2.29	5.11	4.88	5.49
	1.9	1.39	1.18	1.42	4.37	4.16	4.72
Oct-15	5.1	3.15	2.73	3.12	4.57	4.21	4.75
	3.55	1.57	1.27	1.66	3.18	2.89	3.43
Nov-15	5.25	2.78	2.65	2.83	3.69	3.57	3.85
	3.15	1.34	1.23	1.37	2.34	2.24	2.49
Dec-15	4.1	2.68	2.43	2.76	3.93	3.72	4.15
	2.45	1.3	1.12	1.3	2.63	2.46	2.81
Jan-16	3.9	2.79	2.57	2.89	5.63	5.46	6
	2.35	1.41	1.24	1.42	4.37	4.22	4.72
Feb-16	3.75	2.48	2.28	2.62	4.86	4.69	5.21
	2.85	1.24	1.09	1.15	3.65	3.5	3.91
Mar-16	4.65	2.78	2.46	2.85	3.93	3.65	4.14
	4.25	1.37	1.14	1.39	2.61	2.39	2.79
Apr-16	4.75	2.47	2.53	2.57	3.78	3.84	4
	3.25	1.15	1.16	1.11	2.51	2.55	2.67

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	3.95	2.61	2.82	2.7	4.72	4.91	5.03
	3.2	1.26	1.37	1.25	3.46	3.61	3.72
Jun-16	5	2.68	2.89	2.79	4.86	5.05	5.18
	3.65	1.34	1.45	1.33	3.6	3.76	3.88
Jul-16	4.45	2.45	2.21	2.6	5.5	5.3	5.92
	3.35	1.25	1.08	1.14	4.31	4.13	4.63
Aug-16	5.6	3.13	2.47	3.26	5.56	4.97	5.92
	4.6	1.75	1.27	1.8	4.28	3.78	4.61
Spt-16	4.5	3.07	2.37	3.21	5.26	4.64	5.61
	3.45	1.72	1.23	1.76	3.99	3.47	4.3
Oct-16	5	3.51	3.09	3.59	5.57	5.22	5.88
	4.05	2.02	1.7	2.13	4.23	3.93	4.56
Nov-16	4.9	3.07	2.62	3.2	6.6	6.23	7.07
	3.5	1.7	1.37	1.74	5.35	5.02	5.79
Dec-16	7.85	5.26	4.41	4.99	7.19	6.49	7.34
	5.2	1.99	1.48	2.08	4.36	3.84	4.7
Jan-17	6.4	5.07	4.06	4.83	7.23	6.41	7.42
	3.55	1.85	1.27	1.91	4.45	3.84	4.8
Feb-17	8.9	6.19	5.97	5.76	7.8	7.62	7.81
	6.05	2.68	2.5	2.85	4.79	4.64	5.15
Mar-17	6.95	4.6	4.49	4.53	6.85	6.77	7.13
	4.7	1.65	1.56	1.62	4.19	4.12	4.5

Source: Authors compilation

Table 31: Calculated option premiums and market premiums of Reliance Industries Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	34.15	21.69	21.9	22.06	30.48	30.7	31.94
	23.55	10.46	10.51	10.86	20	20.15	21.51
May-12	22.15	16.08	12.56	17.06	20.31	16.91	21.67
	13.5	7.01	4.99	5.85	11.12	8.83	10.91
Jun-12	24.3	16.9	15.29	17.66	23.12	21.65	24.5
	14.8	7.11	6.13	6.46	13.44	12.37	13.94
Jul-12	32.7	26.71	27.41	25.84	28.3	28.97	27.84
	20.25	13.69	14.1	14.64	15.74	16.16	16.87
Aug-12	17.4	15.08	14.06	16.04	16.98	16	18.12
	8.65	6.32	5.69	4.84	8.11	7.46	7.15
Sep-12	26.85	19.24	19.73	20.04	31.63	32.13	33.66
	16.65	9.03	9.26	8.84	21.81	22.19	23.37
Oct-12	37.55	28.02	22.15	27.61	40.49	31.36	37.59
	27	15.35	11.2	16.41	29.42	21.02	27.12
Nov-12	35.35	28.64	28.87	27.77	32.43	32.66	32.44
	21.3	15.51	15.59	16.57	20.2	20.32	21.68
Dec-12	28.95	24.67	25.41	24.72	28.75	29.45	29.45
	17.95	12.72	13.14	13.52	17.41	17.89	18.69
Jan-13	27.45	17.06	19.12	18.19	25.56	27.57	27.43
	18.3	8.15	9.36	6.98	16.42	17.91	16.9
Feb-13	33.4	26.78	27.48	27.04	35.71	36.37	37.18
	22.85	14.86	15.27	15.84	24.74	25.24	26.67
Mar-13	29.4	22.71	20.29	23.23	27.01	24.76	28.08
	20.2	11.53	9.87	12.03	16.25	14.57	17.32
Apr-13	36.85	25.24	24.24	23.15	32.96	33.49	34.67
	25.55	10.46	9.61	11.05	22.41	21.75	24.09
May-13	27.95	20.09	13.87	19.52	33.9	28.98	35.45
	17.7	7.4	3.99	7.42	23.23	19.34	25.05
Jun-13	28.75	15.69	15.28	16.04	30.31	30.06	32.21
	19	5.14	4.75	3.94	20.42	20.2	21.79

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	29.55	14	11.27	14.65	28.43	26.12	30.42
	20.3	4.6	3.19	2.55	18.94	17.15	19.92
Aug-13	37.1	19.64	21.42	19.64	43	44.44	45.68
	26.9	7.73	8.58	7.54	32.86	34.07	35.54
Spt-13	39.1	22.04	17.33	21.33	42.65	39.11	44.9
	28.85	8.93	6.01	9.23	32.13	29.14	34.74
Oct-13	49.8	26.94	30.47	24.77	40.63	43.29	41.68
	37.15	12.01	14.34	12.68	29.12	31.28	31.31
Nov-13	33.05	18.49	20.12	18.76	31.89	33.28	33.7
	22.1	7.17	7.91	6.66	21.61	22.67	23.14
Dec-13	35.6	21.51	22.69	20.92	37.62	38.57	39.43
	24.3	8.61	9.14	8.82	26.94	27.69	29.09
Jan-14	40.4	26.49	29.51	24.73	38.68	41	39.65
	27.85	11.95	13.88	12.63	27.1	28.97	29.15
Feb-14	28.95	19.61	18.46	19.35	28.9	27.99	30.05
	18.25	7.37	6.52	7.25	18.07	17.34	19.34
Mar-14	31.85	26.53	25	24.2	39.57	38.42	40.48
	19.6	11.46	10.24	12.1	28.01	27.04	30.13
Apr-14	39.6	26.76	24.71	16.94	36.78	35.06	38
	29.15	13.9	12.34	10.83	25.47	24.05	27.43
May-14	45.55	21.67	17.77	14.95	38.93	35.57	41.39
	36.6	10.69	8.1	8.84	28.82	26.03	31.07
Jun-14	40.2	21.4	20.72	15.39	36.95	36.45	39.47
	31.05	11.12	10.54	9.28	27.08	26.63	29.01
Jul-14	44.65	25.39	26.94	16.96	39.5	40.89	41.58
	33.65	13.52	14.47	10.85	28.86	29.97	31.11
Aug-14	38.35	27.84	27.64	17.78	36.77	36.63	37.91
	27.25	15.02	14.74	11.67	25.33	25.17	27.25
Spt-14	38.25	26.84	27.31	17.6	38.43	38.89	40.12
	27.4	14.54	14.74	11.49	27.44	27.77	29.56
Oct-14	37.8	24.9	27.54	16.28	35.44	37.74	36.96
	27.05	12.73	14.43	10.17	24.5	26.32	26.39
Nov-14	25.8	17.79	15.89	13.28	28.55	26.84	30.6
	16.7	8.52	7.25	7.17	19.15	17.8	19.95

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	35.2	24.69	24.86	16.54	36.02	36.21	37.8
	24.55	12.93	12.91	10.43	25.3	25.42	27.23
Jan-15	32.5	21.07	22.62	14.35	33.35	34.75	23.36
	21.95	9.96	10.83	8.24	23.06	24.15	18.02
Feb-15	40.1	26.07	26.76	16.66	37.61	38.23	39.08
	28.6	13.42	13.76	10.54	26.52	26.99	28.59
Mar-15	38.55	25.35	25.7	15.97	34.53	34.85	23.02
	27.8	12.54	12.64	9.85	23.23	23.45	17.62
Apr-15	36.45	20.41	24.58	20.22	31.55	34.98	32.96
	24.75	8.39	10.88	8.55	20.89	23.56	22.49
May-15	25.65	21.01	13.22	21.09	34.48	27.75	36.26
	17.05	9.24	4.72	100.27	23.98	18.66	112.94
Jun-15	36	25.42	26.14	24.39	37.16	37.76	38.32
	23.6	11.98	12.33	12.72	25.86	26.32	27.88
Jul-15	32.7	15.97	13.47	16.92	29.4	27.16	31.55
	24.45	6.84	5.33	5.25	20.05	18.27	21.02
Aug-15	28.55	16.67	15.53	17.61	31.5	30.56	33.77
	19.45	7.25	6.46	50.47	22	21.24	66.04
Spt-15	37.85	21.8	20.02	21.63	34.98	33.55	36.64
	27.2	9.62	8.38	9.96	24.31	23.15	26.23
Oct-15	37	22.67	21.58	22.08	31.91	31.02	32.93
	25.65	9.92	9.09	10.41	20.75	20.04	22.36
Nov-15	29.25	19.58	17.53	20.13	33.78	32.08	35.83
	19.25	8.69	7.33	8.46	23.65	22.27	25.39
Dec-15	39.75	28.44	27.78	27.28	38.68	38.15	39.58
	28.3	14.69	14.07	15.6	26.98	26.52	29
Jan-16	34.4	26.07	25.14	25.71	43.98	43.29	46.13
	24.45	13.25	12.47	14.04	33.18	32.58	35.82
Feb-16	38.05	26.39	22.71	26.07	44.49	41.54	46.68
	27	13.59	10.95	14.4	33.69	31.18	36.37
Mar-16	41.65	21.45	21.34	21.72	38.27	38.25	40.48
	30	9.86	9.64	10.05	27.94	27.89	30.15
Apr-16	39.65	26.96	26.3	27.13	40.75	40.23	42.72
	28.65	14.9	14.34	15.89	29.97	29.51	32.37

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	30.7	18.47	19.37	19.57	32.3	33.2	34.63
	21.5	8.99	9.47	8.33	22.8	23.5	24.28
Jun-16	35.8	26.17	25.92	26.17	49.81	49.66	52.68
	24.9	14	13.74	14.93	39.41	39.28	42.67
Jul-16	26.75	18.76	18.78	19.82	25.7	25.76	27.4
	21.55	13.37	13.34	14.2	20.51	20.55	22.07
Aug-16	28.8	20.34	20.9	21.4	27.96	28.52	29.74
	24.25	14.79	15.2	15.78	22.67	23.15	24.42
Spt-16	31	22.44	22.49	23.33	30.35	30.44	32.07
	25.7	16.56	16.55	17.71	24.87	24.93	26.76
Oct-16	34.3	20.8	19.53	21.99	31.98	30.86	34.19
	29.35	15.37	14.26	16.37	26.83	25.81	28.94
Nov-16	26.85	21.06	19.6	22.16	28.33	27	30.12
	21.85	15.5	14.24	16.54	23.02	21.83	24.78
Dec-16	32.55	25.77	22.25	25.96	30.08	26.81	30.93
	22.65	13.83	11.34	14.72	18.73	16.24	20.11
Jan-17	25.95	20.01	16.86	21.24	38.24	35.34	41.08
	17.45	10.44	8.33	10	28.72	26.29	30.82
Feb-17	30.25	20.64	19.84	21.7	31.18	30.5	33.24
	21.05	10.57	9.97	10.46	21.33	20.77	22.73
Mar-17	48.5	33.42	28.18	33.38	47.57	40.97	47.32
	39.4	20.74	16.7	22.14	34.23	30.34	36.83

Source: Authors compilation

Table 32: Calculated option premiums and market premiums of Sun Pharmaceutical Industries Ltd. call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	35.2	16.11	17.69	15.75	24.03	25.34	24.94
	13.5	4.67	5.34	4.09	13.62	14.53	14.49
May-12	16	23.79	23.03	21.39	30.38	29.75	30.22
	17.4	9.15	8.54	9.72	18.34	17.84	19.74
Jun-12	22	15.41	14.44	15.21	23.96	23.18	25.01
	14	4.34	3.79	3.55	13.76	13.18	14.59
Jul-12	29	21.74	21.91	20.31	26.16	26.29	26.02
	17.3	8.21	8.18	8.65	14.19	14.24	15.24
Aug-12	24.55	18.98	18.12	18.3	25.81	25.12	26.46
	13.65	6.61	6.02	6.63	14.82	14.28	15.88
Sep-12	20.05	16.46	16.96	16.57	17.92	18.41	18.27
	12.9	5.55	5.68	4.9	7.21	7.4	6.95
Oct-12	28.75	22.36	9.19	21.21	25.6	13.51	25.37
	17.65	9.05	2.3	9.54	13.43	5.76	14.38
Nov-12	43	30.21	30.66	26.42	34.39	34.76	32.84
	12.9	4.56	4.55	3.09	11.28	11.4	11.41
Dec-12	21.25	18.15	17.65	18.14	26.22	25.83	27.34
	11.45	6.72	6.32	6.47	15.71	15.39	16.75
Jan-13	33.05	26.23	27.58	24.28	32.09	33.22	31.91
	20.05	11.88	12.67	12.62	19.78	20.6	21.22
Feb-13	32	26.32	26.58	24.17	29.39	29.61	31.56
	19.8	11.79	11.83	12.51	16.34	16.44	20.87
Mar-13	29.7	26.91	24.88	25.24	31.12	29.33	30.73
	20.45	12.78	11.26	13.57	18.5	17.11	19.81
Apr-13	27	20.03	20.37	19.3	32.96	33.24	34.36
	16.05	7	6.96	6.96	22.16	22.35	23.87
May-13	41.35	24.57	24.55	23.45	68.28	68.34	72.71
	29.4	10.61	10.35	11.12	58.23	58.27	63.02
Jun-13	42.05	16.65	16.9	17.3	42.49	42.87	45.55
	32.6	6.35	6.25	4.96	32.78	33.08	35.31

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	47.75	21.59	17.66	21.43	44.93	41.97	47.6
	37.45	9.04	6.49	9.1	34.56	32.04	37.35
Aug-13	54.9	27.46	24.13	26.47	125.04	122.8	134.3
	44.6	13.43	10.9	14.14	115.7	113.56	125.23
Spt-13	25.7	7.76	5.14	8.11	25.19	22.94	27.1
	21.85	2.87	1.51	1.94	20.45	18.48	22.1
Oct-13	34.5	15.09	16.07	14.42	36.48	37.2	38.69
	30.95	7.84	8.44	8.25	31.27	31.93	33.75
Nov-13	24.7	11.19	12.35	11.39	42.49	43.46	45.67
	21	5.24	5.88	5.22	37.68	38.58	40.85
Dec-13	28.45	16.72	18.07	15.49	27.12	46.9	48.86
	16.9	3.74	4.17	3.16	16.47	36.99	39.28
Jan-14	22.25	11.82	12.91	11.82	24.35	25.23	25.82
	19.25	5.52	6.12	5.65	19.13	19.89	20.67
Feb-14	26.5	14.13	13.54	13.69	139.58	139.23	150.25
	20.65	7.15	7	7.52	135.67	135.31	146.46
Mar-14	19.5	11.78	9.89	12.02	24.37	22.9	25.93
	14.8	5.8	4.45	5.85	19.21	17.93	20.73
Apr-14	23.4	24.47	24.87	26.19	55.65	56.07	60.02
	18.35	19.53	19.86	21.1	51.08	51.48	55.43
May-14	27	26.22	26.99	28.15	56.47	57.97	61.73
	21.6	21.34	22	23.05	51.89	53.36	57.1
Jun-14	18.8	25.06	22.26	26.96	54.28	51.45	58.66
	14.55	20.28	17.84	21.87	49.74	47.06	54.01
Jul-14	28.95	27.2	27.88	29.25	21.14	21.81	22.67
	24.05	22.38	22.97	24.16	16.27	16.82	17.42
Aug-14	35.25	35.82	33.23	38.01	28.88	26.18	30.39
	26.2	30.53	28.17	32.92	23.37	20.98	25.13
Spt-14	28	35.32	34.52	37.93	26.8	25.94	28.66
	22.7	30.37	29.63	32.84	21.73	20.97	23.39
Oct-14	36.85	36.14	37.14	38.54	26.82	27.84	28.36
	32.2	30.97	31.87	33.45	21.41	22.28	23.04
Nov-14	28.75	37.06	34.79	39.62	28.78	26.44	30.6
	23.45	31.95	29.88	34.53	23.51	21.43	25.33

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	47	45.01	45.13	46.66	36.95	37.06	37.49
	32.1	33.86	33.94	36.47	25.08	25.13	26.93
Jan-15	29.95	38.85	39.57	41.06	30.96	31.7	32.36
	18.5	28.56	29.14	30.87	20.3	20.83	21.81
Feb-15	38.6	46.93	44.25	49.07	43.48	40.76	45.23
	27.6	36.04	33.74	38.88	32.4	30.09	34.92
Mar-15	36.35	46.07	45.6	47.96	40.2	39.7	26.6
	27.1	35.04	34.62	37.77	28.75	28.31	21.3
Apr-15	47.3	24.03	28.11	24.46	58.66	62.02	62.66
	37.7	12.41	15.14	12.97	48.72	51.7	52.8
May-15	38.25	20.66	21.44	21.35	36.52	37.28	38.83
	28.6	9.87	10.26	9.86	26.46	27.06	28.5
Jun-15	39.5	19.89	19.95	20.73	35.78	35.92	38.16
	29.55	9.48	9.41	9.24	25.88	25.97	27.81
Jul-15	32.75	18.98	16.83	19.6	47.15	45.42	50.49
	23.1	8.38	7.01	8.11	37.46	35.95	40.58
Aug-15	29.15	15.19	13.63	16.04	35.08	33.76	37.7
	20.1	5.99	5.07	4.55	25.74	24.64	27.58
Spt-15	43	18.8	14.98	19.51	41.03	37.74	43.88
	33.1	8.39	6.07	8.02	31.28	28.5	33.79
Oct-15	31.4	15.01	13.34	15.92	37.28	35.83	40.14
	22.95	6.09	5.1	4.44	28.04	26.83	30.06
Nov-15	33.95	20.93	18.57	21.34	45.43	43.54	48.42
	24.25	9.7	8.14	9.86	35.46	33.83	38.41
Dec-15	36.8	26.53	24.81	24.59	54.32	53.09	57.07
	26	12.32	11.05	13.1	43.82	42.74	47.04
Jan-16	31.35	24.15	21.54	23.47	49.23	47.24	51.97
	20.8	11.29	9.49	11.98	38.86	37.13	42.07
Feb-16	36.15	23.08	19.49	23	40.39	37.47	42.55
	25.15	10.97	8.59	11.51	29.91	26.47	32.34
Mar-16	40.7	22.3	22.09	22.38	37.66	37.54	39.66
	30.2	10.46	10.21	10.89	27.2	27.08	29.39
Apr-16	34.6	26.65	25.33	26.74	43.74	42.63	46.01
	23.95	14.79	13.81	15.87	33.25	32.31	36.01

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	30.5	24	23.22	24.59	37.72	37.05	39.85
	20.6	12.94	12.35	13.72	27.47	26.91	29.73
Jun-16	36.3	20.32	21.6	21.45	35.6	36.84	38.13
	26.75	10.58	11.38	10.58	26.04	27.04	28.04
Jul-16	27.4	18.08	18.59	19.18	25.16	25.67	26.89
	18.4	8.78	9.05	8.31	15.79	16.15	16.51
Aug-16	33.85	23.51	22.57	24.28	29.23	28.36	30.66
	24.75	12.73	12.03	13.41	18.81	18.13	20.19
Spt-16	32.15	25.57	25.86	25.46	29.71	29.99	30.31
	21.1	13.6	13.75	14.59	18.35	18.53	19.79
Oct-16	24.8	17.27	16.06	18.36	20.78	19.61	22.18
	20.3	12.14	11.15	12.92	15.72	14.73	16.88
Nov-16	24.15	17.69	17.14	18.75	25.49	25	27.26
	19.8	12.48	12	13.32	20.45	20.01	22.09
Dec-16	26.95	17.51	15.08	18.49	25.71	23.42	27.45
	22.45	12.21	10.26	13.06	20.64	18.64	22.3
Jan-17	26.05	19.45	17.83	19.76	23.54	22.04	24.41
	16.3	8.66	7.65	8.89	13.11	12.05	13.93
Feb-17	21.8	13.87	14.27	14.84	22.47	22.89	24.19
	17.15	9.08	9.36	9.4	17.71	18.06	19.06
Mar-17	33.3	23.43	23.06	23.19	28.67	28.36	29.34
	22.8	11.52	11.23	12.32	17.54	17.28	18.93

Source: Authors compilation

Table 33 : Calculated option premiums and market premiums of State Bank of India call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	124.35	74.7	76.81	73.6	119.64	121.49	125.07
	95.6	42.9	44.27	45.9	92.58	94.14	99.92
May-12	104.1	60.84	57.26	62.72	111.75	108.76	118.89
	79.25	33.28	30.63	35.01	86.66	84.08	93.82
Jun-12	94.9	60.64	46.88	62.02	109.49	97.36	116.18
	70.95	32.49	23.18	34.31	84.17	73.89	91.14
Jul-12	87.35	76.17	98.18	74.73	116.3	134.56	121.05
	67.2	43.99	60.84	47.02	88.81	104.47	95.76
Aug-12	107.55	67.77	60.14	67.09	108.04	101.64	113.05
	80.1	36.79	31.28	39.38	81.27	75.87	87.85
Sep-12	90.75	63.09	63.57	62.7	101.42	101.91	106.28
	63.4	32.76	32.9	34.99	74.94	75.32	81.08
Oct-12	108.3	73.43	75.68	73.71	112.97	115.02	118.43
	81.2	42.97	44.45	46.01	86.09	87.79	92.99
Nov-12	100.3	60.44	58.3	62.62	94.83	93.04	100.58
	75.6	33.32	31.65	34.91	69.43	67.9	74.94
Dec-12	82.8	58.44	54.46	60.86	91.29	87.8	97
	58.75	31.93	29.03	33.15	66.17	63.26	71.3
Jan-13	102.25	68.73	68.67	70.74	96.28	96.34	101.39
	76.2	40.45	40.21	43.03	69.88	69.86	75.39
Feb-13	96.35	58.7	54.39	61.99	90.3	86.4	96.48
	73.75	33.54	30.36	34.28	65.8	62.56	70.58
Mar-13	92.3	68.29	63.9	68.58	91.9	88.05	95.53
	65.55	38.22	34.91	40.88	64.45	61.28	69.55
Apr-13	96.5	64.63	63.07	63.15	95.2	93.98	98.72
	67.9	32.39	31.02	34.47	67.47	66.4	72.78
May-13	93.25	65.88	36.63	65.39	101.89	76.17	106.5
	71.05	34.54	15.65	36.71	74.7	53.71	80.63
Jun-13	105.55	68.72	66.28	65.84	95.19	93.22	97.57
	78	34.89	32.89	37.16	66.43	64.76	71.52

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	71.35	37.24	36.52	39.43	73.41	72.98	78.83
	48.35	14.78	14.15	10.75	50.29	49.9	53.06
Aug-13	98.15	41.02	39.72	42.41	70.48	69.49	74.89
	73.15	15.69	14.73	13.72	46.05	45.24	49.02
Spt-13	84.1	39.25	30.3	39.83	90.46	83.03	96.46
	60.55	13.1	8.65	11.15	66.38	60.28	71.76
Oct-13	112.85	57.66	57.24	54.63	98.25	97.99	102.34
	86.1	24.44	23.89	25.95	71.43	71.18	77.26
Nov-13	102.3	52.52	51.52	52.46	99.17	98.5	104.84
	75.85	23.08	22.18	23.78	73.6	73.01	79.65
Dec-13	88.65	44.78	47.7	45.85	83.42	86.03	88.61
	63.8	18.12	19.54	17.16	58.64	60.69	63.13
Jan-14	74.75	44.37	44.04	45.28	84.48	84.36	89.73
	50.35	17.56	17.1	16.59	59.72	59.58	64.35
Feb-14	66.05	42.83	32.38	42.74	70.18	61.36	73.7
	44.35	14.96	9.57	14.05	44.73	38.1	48.01
Mar-14	59.4	50.08	36.72	48.31	77.49	66.5	80.4
	35.55	19	11.6	19.62	50.72	42.29	54.79
Apr-14	77.35	38.56	37.6	41.02	76.4	75.7	82.17
	68.7	28.23	27.33	29.74	66.57	65.92	71.96
May-14	112.25	44.07	29.25	46.73	129.32	114.93	139.41
	103.75	33.35	21.04	35.45	119.7	106.01	129.67
Jun-14	106	51.34	50.02	54.63	98.65	97.68	106.09
	94.25	40.77	39.52	43.35	88.7	87.77	95.84
Jul-14	49.3	63.22	65.49	66.07	108.32	110.57	115.5
	111.7	51.4	53.3	54.8	97.74	99.83	105.22
Aug-14	102.8	58.2	54.28	60.85	87.06	83.61	92.53
	95.4	46.46	42.91	49.57	76.29	73.08	82.05
Spt-14	83.2	51.8	27.95	55.02	101.28	77.2	108.86
	61.2	27.91	12.85	26.82	77.59	57.52	83.32
Oct-14	111.5	77.38	76.19	76.84	106.6	105.65	110.5
	83.9	45.56	44.41	48.64	78.4	77.54	84.41
Nov-14	96.9	54.82	50.51	58.31	87.07	83.18	93.42
	74.35	30.91	27.74	30.11	63.24	60.01	67.19

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	13.75	7.14	7.23	7.54	16.9	17.02	18.16
	11.4	4.52	4.56	4.72	14.47	14.58	15.68
Jan-15	15.1	7.65	8.37	7.95	41.23	41.9	44.47
	12.3	4.84	5.36	5.13	39.02	39.66	42.28
Feb-15	19	8.53	8.72	8.71	39.46	39.65	42.48
	15.95	5.52	5.63	5.89	37.19	37.38	40.26
Mar-15	16.35	9.02	8.51	9.06	63.87	63.48	45.96
	14	5.85	5.42	6.24	61.84	61.45	45.04
Apr-15	14.05	32.76	33.49	35.25	75.72	76.53	81.4
	11.1	30.49	31.19	33.03	73.9	74.71	79.65
May-15	12.3	33.69	33.4	36.34	104.56	104.23	111.97
	9.85	31.45	31.18	34.12	103	102.67	110.46
Jun-15	15.8	36.65	36.74	39.13	159.56	159.69	168.01
	10.4	32.01	34.35	34.69	157.37	158.59	166
Jul-15	9.35	31.39	30.68	33.95	92.13	91.29	98.88
	7.1	29.21	28.53	31.73	90.51	89.68	97.31
Aug-15	10.9	31.9	31.64	34.5	75.28	75	81.09
	8.75	29.71	29.47	32.28	73.49	73.21	79.33
Spt-15	14.05	31.2	31.05	33.54	68.08	67.92	73.2
	11.8	28.91	28.77	31.32	66.22	66.07	71.41
Oct-15	13.1	30.31	30	32.55	12.03	11.68	12.6
	10.6	28.02	27.71	30.33	9.32	9.02	10.06
Nov-15	11.15	28.91	28.64	31.18	9.77	9.48	10.39
	8.85	26.68	26.42	28.95	7.26	7.01	7.83
Dec-15	11.05	31.64	30.87	33.97	10.24	9.38	10.55
	8.4	29.34	28.61	31.75	7.37	6.66	7.93
Jan-16	8.3	28.17	27.87	30.33	12.77	12.47	13.61
	5.85	25.91	25.63	28.11	10.27	10	11.13
Feb-16	11.7	23.52	23.35	25.15	13.38	13.19	14.05
	9.05	21.19	21.02	22.92	10.76	10.59	11.62
Mar-16	10.5	18.81	18.53	20.3	8.85	8.58	9.51
	8.2	16.63	16.38	18.08	6.55	6.32	7.05
Apr-16	10.25	4.5	4.55	4.79	9.42	9.48	10.14
	7.95	2.21	2.22	2.07	7.11	7.15	7.65

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	10.95	6.52	6.04	6.46	11.04	10.64	11.6
	8.45	3.48	3.14	3.74	8.42	8.08	9.11
Jun-16	9.2	4.65	3.23	4.93	8.72	7.34	9.37
	7.65	2.3	1.43	2.21	6.38	5.26	6.86
Jul-16	12.3	7.54	7.18	7.48	10.31	10	10.68
	9.5	4.43	4.15	4.76	7.53	7.26	8.12
Aug-16	11.35	7.59	6.41	7.59	12.24	11.22	12.86
	8.9	4.54	3.66	4.87	9.58	8.7	10.35
Spt-16	10.2	6.13	6.32	6.46	10.16	10.35	10.86
	7.75	3.58	3.71	3.74	7.7	7.86	8.32
Oct-16	10.1	6.02	5.39	6.37	9.05	8.46	9.67
	7.65	3.53	3.08	3.65	6.61	6.13	7.1
Nov-16	10.85	7.23	6.59	7.48	15.85	15.3	16.94
	8.3	4.45	3.96	4.76	13.38	12.87	14.5
Dec-16	12.05	6.05	5.83	6.43	10.38	10.19	11.15
	9.7	3.61	3.43	3.71	7.98	7.82	8.61
Jan-17	8.2	5.4	4.4	5.78	8.41	7.43	9.04
	6.05	3.1	2.41	3.06	6.08	5.29	6.47
Feb-17	11.05	6.45	5.27	6.82	8.73	7.6	9.31
	8.8	3.92	3.07	4.1	6.25	5.34	6.71
Mar-17	10.75	7.6	7.3	7.84	11.55	11.29	12.22
	8.3	4.78	4.54	5.12	8.95	8.72	9.68

Source: Authors compilation

Table 34: Calculated option premiums and market premiums of Tata Motors Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	14.9	26.97	27.07	28.85	26.24	26.33	28.06
	9.4	22.29	22.37	24.21	21.54	21.62	23.39
May-12	17.55	34.13	31.31	35.88	77.63	74.71	83.1
	7.4	24.48	22.19	26.59	69.78	67.04	75.53
Jun-12	15.75	22.14	22.15	23.66	48.5	48.52	52.17
	11.1	17.51	17.51	19.02	44.52	44.53	48.25
Jul-12	9.65	22.69	20.3	24.41	49.93	47.34	53.83
	5.8	18.21	16.14	19.76	45.98	43.52	49.87
Aug-12	11.2	20.26	20.05	21.75	12.31	12.09	13.1
	6.6	15.77	15.6	17.11	7.67	7.51	8.14
Sep-12	12.15	22.88	22.55	24.48	13.42	13.07	14.15
	7.25	18.26	17.98	19.84	8.53	8.26	9.15
Oct-12	15.85	27.47	22.92	29.18	16.05	11.33	16.56
	10.65	22.62	18.62	24.54	10.65	7.07	11.52
Nov-12	12.3	23.92	24.06	25.79	12.79	12.93	13.72
	7.7	19.49	19.61	21.15	8.27	8.36	8.7
Dec-12	12.35	25.92	26.19	27.84	14.1	14.37	14.97
	7.5	21.36	21.59	23.2	9.29	9.48	9.95
Jan-13	17.85	32.52	32.03	34.42	20.36	19.84	20.94
	7.95	23.16	22.77	25.13	10.35	10	10.94
Feb-13	14.75	25.78	27.82	27.8	13.53	15.62	14.5
	7.65	17.49	19.08	18.51	5.63	6.8	4.45
Mar-13	15.75	29.75	29.06	31.58	17.59	16.84	18.13
	6.95	20.6	20.06	22.29	7.94	7.48	8.07
Apr-13	14.6	9.34	8.91	9.29	14.91	14.56	15.62
	9.4	3.72	3.44	3.77	9.81	9.53	10.59
May-13	16.6	10.54	10.2	10.46	15.72	15.44	16.39
	11.35	4.71	4.46	4.94	10.46	10.24	11.31
Jun-13	15.05	8.86	8.73	9.21	14.89	14.79	15.84
	10.15	3.85	3.74	3.68	10.05	9.96	10.77

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	13.05	6.94	6.54	7.35	11.68	11.32	12.51
	8.35	2.57	2.33	1.83	7.15	6.88	7.39
Aug-13	19.5	13.21	11.72	12.33	18.51	17.29	18.85
	13.55	6.37	5.34	6.81	12.81	11.83	13.81
Spt-13	20.75	12.82	12.77	12.16	18.03	17.99	18.45
	15.15	6.2	6.13	6.64	12.4	12.36	13.38
Oct-13	17.85	7.56	7.92	8.07	13.84	14.21	14.9
	13.3	3.29	3.47	2.55	9.36	9.64	9.8
Nov-13	20.25	11.23	11.76	11.6	19.13	19.62	20.32
	15.05	5.85	6.17	6.08	14.13	14.53	15.27
Dec-13	22.4	14.34	15.28	14.2	22.17	22.98	23.16
	16.85	8.1	8.75	8.68	16.77	17.44	18.11
Jan-14	15	9.29	9.47	9.81	17.59	17.8	18.87
	10.25	4.51	4.6	4.29	12.88	13.04	13.83
Feb-14	19.6	14	13.43	13.51	19.38	18.91	19.9
	14.8	7.47	7.03	7.99	13.73	13.33	14.8
Mar-14	18.3	13.49	12.25	13.66	21.17	20.1	22.28
	12.95	7.62	6.71	8.14	15.91	2.99	17.21
Apr-14	19.05	12.95	12.49	8.32	20.49	20.13	21.49
	13.85	6.91	6.55	5.41	15.18	14.87	16.41
May-14	23.7	10.77	11.43	7.55	19.14	19.76	20.44
	18.55	5.62	6.02	4.64	14.24	14.75	15.35
Jun-14	19.5	11.76	11.54	7.94	17.73	17.56	18.73
	14.5	6.22	6.03	5.04	12.58	12.43	13.56
Jul-14	17.5	10.41	9.34	7.43	16.59	15.62	17.73
	13.25	5.44	4.7	4.52	11.74	10.95	12.55
Aug-14	22.7	15.73	15.11	9.77	19.63	19.08	20.03
	13.45	4.71	4.35	3.96	9.16	8.79	9.52
Spt-14	23.7	17.26	17.17	11.02	27.06	27.01	28.33
	13.4	6.23	6.11	5.21	16.91	16.86	18.17
Oct-14	20.7	11.32	12	8.29	22.08	22.77	23.74
	15.75	6.49	6.92	5.39	17.33	17.91	18.67
Nov-14	20.8	14.74	12.94	10.06	21.74	20.13	22.99
	15.95	9.07	7.7	7.15	16.49	15.12	17.8

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	18.85	13.21	12.69	9.34	21.19	20.75	22.6
	14.15	7.94	7.52	6.43	16.18	15.8	17.44
Jan-15	20.95	13.25	13.55	9.07	21.09	21.39	14.8
	15.5	7.7	7.88	6.16	15.95	16.19	12.2
Feb-15	27.7	15.3	14.92	10.63	24	23.69	25.51
	23.35	9.76	9.42	7.72	18.85	18.57	20.35
Mar-15	24.85	15.1	15.15	10.47	25.01	25.1	17.7
	20.2	9.55	9.54	7.56	19.9	19.96	15.11
Apr-15	22.45	13.16	12.93	13.57	22.77	22.61	24.18
	17.5	7.52	7.31	7.93	17.63	17.49	19.06
May-15	21.45	10.43	10.77	11.03	26.52	26.88	28.53
	17.05	5.54	5.72	5.45	21.82	22.13	23.63
Jun-15	17.5	9.86	9.56	10.42	18.28	18.05	19.61
	10.7	3.44	3.24	2.14	11.58	11.4	12.06
Jul-15	20.7	13	11.1	12.91	21.18	19.6	22.21
	15.55	6.82	5.49	7.27	15.84	14.51	17.12
Aug-15	17.25	9.45	8.59	9.74	19.26	18.55	20.55
	12.75	4.18	3.63	4.1	14.37	13.77	15.53
Spt-15	14.85	6.32	4.3	6.73	13.84	11.86	14.92
	10.5	2.22	1.28	1.1	9.39	7.87	9.85
Oct-15	19.75	8.5	8.17	8.44	17.37	17.13	18.4
	14.6	2.94	2.73	2.8	12.43	12.23	13.46
Nov-15	19.3	10.21	7.99	10.38	19.96	18.07	21.2
	14.6	4.65	3.29	4.74	14.96	13.38	16.19
Dec-15	20.5	12.69	10.6	12.54	21.67	19.94	22.75
	15.25	6.48	5.04	6.91	16.36	14.91	17.7
Jan-16	15.15	8.54	8.09	8.99	18.76	18.4	20.14
	10.55	3.76	3.45	3.36	14.04	13.73	15.12
Feb-16	19.35	10.78	9.62	10.53	22.37	21.47	23.65
	14.25	4.65	3.9	4.89	17.3	16.53	18.75
Mar-16	18.75	6.64	6.71	6.96	18.48	18.58	19.87
	13.7	2.15	2.15	1.33	13.9	13.98	15
Apr-16	22.25	14.92	14.97	14.66	22.03	22.09	22.88
	16.75	8.66	8.67	9.29	16.56	16.61	17.88

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	22.55	14.62	14.75	14.68	23.92	24.05	25.16
	17.35	8.65	8.73	9.31	18.67	18.78	20.2
Jun-16	22.45	10.49	3.19	11.19	20.71	12.39	22.29
	17.7	5.84	1.38	5.82	16.06	9.16	17.34
Jul-16	23.75	15.4	15.77	15.67	24.84	25.18	26.21
	18.4	9.58	9.84	10.31	19.61	19.9	21.23
Aug-16	25	13.5	13.58	14.28	23.6	23.7	25.29
	20.2	8.45	8.48	8.91	18.74	18.82	20.29
Spt-16	22.15	13.84	13.55	14.59	23.54	23.3	25.19
	17.85	8.7	8.46	9.22	18.63	18.42	20.18
Oct-16	23.95	15.21	14.22	15.96	35.61	34.74	38.23
	18.8	9.9	9.12	10.59	30.78	29.99	33.41
Nov-16	26.15	16.59	15.27	17.17	27.18	26	28.86
	20.7	10.97	9.92	11.8	22.03	20.99	23.86
Dec-16	30.25	18.39	18.01	17.92	26.05	25.72	26.89
	19.6	6.95	6.7	7.19	15.6	15.36	16.85
Jan-17	23.2	18.55	16.89	18.23	26.84	25.41	27.83
	12.65	7.25	6.28	7.49	16.48	15.42	17.81
Feb-17	24.45	13.69	13.97	14.58	22.64	22.94	24.32
	15.95	5.27	5.39	3.84	13.8	14	14.22
Mar-17	27.9	22.7	21.17	20.99	28.32	27.01	28.21
	16.6	9.53	8.54	10.25	16.72	15.75	18.09

Source: Authors compilation

Table 35: Calculated option premiums and market premiums of Tata Consultancy Services Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	59.75	34.07	35.54	34.1	131.97	133.26	141.71
	34.25	8.74	9.18	5.75	109.54	110.68	119.06
May-12	42.3	24.99	22.79	26.42	34.83	32.81	37.15
	21.55	14.8	13.12	15.08	24.86	23.19	26.46
Jun-12	42.55	39.31	22.61	38.51	54.96	40.22	56.78
	20.4	11.52	4.61	10.16	29.12	19.54	30.77
Jul-12	64.05	42.36	41.34	41.19	55.51	54.67	56.82
	37.7	13.46	12.73	12.84	28.81	28.17	30.55
Aug-12	47.85	39.85	35.95	38.92	54.41	51.11	56.03
	22.6	11.78	9.77	10.57	28.34	26.09	29.93
Sep-12	63.95	56.54	56.2	51.76	74.45	74.18	74.79
	37.25	21.96	21.52	23.41	45.4	45.14	49.01
Oct-12	77.7	57.68	36.34	52.02	68.75	50.46	67.27
	50.35	22.18	10.34	23.67	38.08	25.46	41.01
Nov-12	41.35	34.26	31.34	35.06	43.79	41.15	45.75
	18.45	9.96	8.49	6.71	19.63	17.98	18.96
Dec-12	39.45	33.36	32.62	34.3	46.72	46.11	49.16
	16.75	9.56	9.04	5.94	22.92	22.46	22.75
Jan-13	53.9	34.91	32.5	35.35	43.09	40.92	44.66
	29.8	9.88	8.64	7	18.42	17.07	17.77
Feb-13	62.85	60.31	58.57	54.32	68	66.44	65.36
	28.5	24.34	23	25.96	36.01	34.81	38.68
Mar-13	37.15	29.34	25.4	31.17	37.62	33.86	40.2
	16.65	9.03	7.16	2.82	16.38	14.16	13.06
Apr-13	50.4	28.79	26.48	30.1	44.71	42.76	47.55
	47.3	22.81	20.7	24.2	39.28	37.46	42.18
May-13	43.2	27.49	19.5	28.44	42.17	35.01	44.65
	33.75	15.97	10.25	16.63	31.59	25.61	33.94
Jun-13	40.95	35.83	22.82	35.97	57.93	46.77	60.89
	30.6	22.79	12.92	24.16	46.87	37.1	50.41

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	65.75	35.91	21.04	36.12	59.61	46.73	62.76
	56.85	22.93	11.76	24.32	48.63	37.31	52.32
Aug-13	47.9	37.23	18.97	38.26	73.43	56.88	78.18
	38.1	24.95	11.07	26.45	62.94	47.98	67.89
Spt-13	66.75	40.36	14.83	41.82	66.14	41.23	70.22
	61.1	28.32	8.77	30.02	55.39	33.37	59.61
Oct-13	107.6	35.72	34.67	37.38	78.57	77.92	84.18
	107	29.69	28.65	31.48	73.38	72.75	79.05
Nov-13	69	44.33	38.56	45.49	68.5	63.6	72.34
	55.85	31.77	26.84	33.69	57.43	53	61.68
Dec-13	64.45	34.27	36.45	36.11	59.63	61.81	63.79
	39.9	11.77	12.51	6.6	36.42	37.92	37.22
Jan-14	88.7	40.68	42.65	42.45	84.92	86.87	90.84
	63.75	15.86	16.58	12.94	60.81	62.34	65.09
Feb-14	86.45	63.84	61.45	61.73	91.22	89.33	94.07
	57.3	30.43	28.41	32.22	62.84	61.24	67.68
Mar-14	69.2	52.77	45.67	53.29	95.01	89.31	100.47
	43.65	23.52	18.83	23.78	69.17	64.44	74.63
Apr-14	75.2	38.19	35.3	40.5	70.72	68.26	75.92
	52.8	15.78	13.93	11.65	47.61	45.65	49.83
May-14	80.95	41.86	43.26	44.24	77	78.53	82.54
	56.9	18.38	18.92	15.4	53.4	54.53	59.23
Jun-14	80.35	65.5	53.32	63.87	94.76	84.6	98.05
	54.05	32.93	24.53	35.03	66.76	58.51	74.97
Jul-14	118.5	75.89	77.43	73.42	107.36	104.56	110.6
	90.05	41.95	39.1	44.58	78.61	76.2	84.49
Aug-14	76.65	54.21	50.02	56.49	88	84.45	93.6
	52.35	27.64	24.6	27.65	62.82	59.87	67.34
Spt-14	81.5	68.76	62.91	68.84	103.98	99.13	108.8
	54.05	37.67	33.22	40	76.68	72.58	82.69
Oct-14	105	68.95	71.23	69.77	106.56	108.67	112.01
	83	38.63	39.94	40.93	79.63	81.32	85.88
Nov-14	64.25	50.48	43.43	53.26	87.2	80.92	93.32
	41.35	25.69	20.91	24.42	62.92	57.77	67.11

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	95.25	74.78	74.8	74.2	109.09	109.22	113.55
	66.05	42.61	42.28	45.35	81.13	81.16	87.36
Jan-15	89.15	46.97	47.58	49.7	69.47	70.24	74.24
	64.45	22.96	23.05	20.86	45.51	45.98	47.4
Feb-15	98.15	64.19	64.98	64.87	104.63	105.46	110.22
	62.25	34.16	34.38	36.03	78.11	78.73	84.32
Mar-15	86.35	54.2	53.23	56.88	110.18	109.63	79.38
	59.75	28.38	27.41	28.04	85.71	85.19	66.46
Apr-15	97.5	48.34	57.32	50.28	96.72	104.53	103.31
	71.25	22.16	27.54	21.12	72.05	78.52	77.58
May-15	85.6	59.39	55.09	59.5	100.77	97.37	106.11
	59.85	29	25.82	30.34	74.29	71.41	80.23
Jun-15	63.05	46.94	33.36	49.24	78.9	66.45	84.2
	40.45	21.78	13.58	20.08	54.37	44.59	57.76
Jul-15	104.9	69.42	58.79	67.91	119	110.58	124.71
	78.35	36.46	28.77	38.75	91.83	84.61	99.1
Aug-15	65.45	45.68	42.07	47.86	79.99	76.99	85.39
	41.1	20.54	18.07	18.69	55.52	53.07	59.11
Spt-15	91.05	53.21	49.88	54.74	90.89	88.22	96.4
	65.5	25.48	23.02	25.58	65.32	63.08	70.27
Oct-15	104	70.13	54.63	68.45	91.25	77.88	93.47
	76.25	36.96	26.04	39.29	62.01	51.36	66.64
Nov-15	84.45	69.92	66.27	67.69	94.2	91.19	96.58
	54.7	36.25	33.32	38.53	65.11	62.58	70.01
Dec-15	62.25	38.7	37.31	40/93	63.98	62.92	68.5
	39.7	15.8	14.73	11.77	40.59	39.71	41.84
Jan-16	72.05	47.87	42.69	49.59	68.05	63.5	71.89
	47.35	21.38	17.98	20.43	42.59	39.11	44.93
Feb-16	69.95	65.44	53.67	63.69	85.91	75.85	87.99
	42.2	32.52	24.38	34.53	56.93	49	61.23
Mar-16	72.9	40.87	41.19	42.74	61.87	62.32	65.77
	47.45	16.3	16.16	13.58	37.56	37.78	38.96
Apr-16	77.95	34.91	33.5	36.81	65.29	64.28	69.94
	54.1	12.28	11.23	7.15	41.9	41.05	43.45

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	78.5	58.03	50.17	56.7	85.23	78.84	88.37
	50.15	25.82	20.53	27.04	57.41	52.31	61.85
Jun-16	64.7	48.89	34.86	49.6	82.87	71.54	87.52
	40.7	20.41	12.29	19.94	56.98	48.16	61.22
Jul-16	72.1	33.71	26.71	35.66	67.19	60.9	72.14
	50.6	11.87	8.26	6.01	44.12	39.31	45.76
Aug-16	72.45	47.14	46.75	48.27	80.77	80.64	85.56
	46.25	19.61	18.99	18.61	55.25	55.06	59.19
Spt-16	81.4	49.95	53.04	50.29	84.01	86.68	88.52
	55.6	20.8	22.27	20.64	57.87	59.93	62.27
Oct-16	80.7	53.14	40.75	52.44	101.11	91.34	106.68
	55.4	22.22	14.72	22.78	74.97	66.85	81.08
Nov-16	81.1	67.19	58.24	62.6	91.25	84.08	92.61
	53.15	31.09	24.73	32.95	61.55	55.78	66.14
Dec-16	60.8	30.75	23.11	32.54	60.36	53.38	64.82
	40.45	9.68	6.15	2.89	37.67	32.53	38.37
Jan-17	66.65	41.28	28.56	42.48	78.72	67.76	83.76
	43.8	15.14	8.57	12.82	53.94	45.35	57.71
Feb-17	63.45	36.07	30.92	37.77	77.93	73.65	83.49
	40.25	12.44	9.63	8.12	54.14	50.71	57.59
Mar-17	80.05	60.92	50.68	58.63	94.24	86.14	97.75
	53.95	27.44	20.59	28.98	66.38	59.78	71.6

Source: Authors compilation

Table 36: Calculated option premiums and market premiums of Tata Power Company Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	5.65	12.58	12.66	13.57	28.93	29.02	31.12
	3.4	10.45	10.52	11.35	27.17	27.26	29.37
May-12	6.45	14.23	14.24	15.14	70.5	70.52	73.36
	4.4	11.91	11.92	12.93	69.68	69.7	72.62
Jun-12	6.6	12.66	11.97	13.5	28.3	27.55	30.32
	3.3	10.38	9.77	11.28	26.51	25.78	28.6
Jul-12	6.3	14.85	14.06	15.72	30.59	29.75	32.71
	3.45	12.47	11.76	13.5	28.71	27.9	30.94
Aug-12	8.05	13.66	13.68	14.41	27.39	27.41	29.27
	3.7	11.27	11.28	12.2	25.49	25.51	27.48
Sep-12	8	14.13	14.04	14.95	6.5	6.38	6.32
	3.95	11.76	11.67	12.73	3.48	3.39	3.75
Oct-12	6.15	13.77	12.39	14.79	5.07	3.67	5.29
	4.05	11.57	10.34	12.57	2.62	1.74	2.72
Nov-12	7	14.88	14.8	15.74	6.18	6.06	5.78
	4.2	12.5	12.42	13.53	2.91	2.82	3.13
Dec-12	5.05	14.28	14.12	15.28	4.72	4.52	4.71
	2.45	12.02	11.88	13.06	1.98	1.86	2.05
Jan-13	6.3	15.17	15.34	16.11	5.83	6.05	5.56
	3.3	12.82	12.98	13.89	2.69	2.82	2.9
Feb-13	4.95	13.38	13.52	14.34	4.31	4.46	4.37
	1.4	9.24	9.35	9.9	1.39	1.45	1.18
Mar-13	4.55	12.81	12.52	13.72	4.65	4.33	4.76
	2	10.58	10.32	11.5	2.1	1.9	2.16
Apr-13	3.95	2.21	2.1	2.28	3.22	3.13	3.4
	3.25	1.11	1.02	1.13	2.18	1.89	2.07
May-13	8.3	3.31	3.32	3.12	4.4	4.41	4.47
	3.4	1.58	1.57	1.68	2.94	2.94	3.16
Jun-13	13.05	2.87	2.67	2.76	3.84	3.67	3.92
	2.3	1.25	1.11	1.32	2.42	2.29	2.61

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	3.95	2.36	2.12	2.36	3.79	3.71	3.98
	2.6	1.69	1.48	1.78	2.73	2.66	2.94
Aug-13	4.5	2.52	2.75	2.5	6.69	6.87	7.14
	3.05	1.03	1.16	1.05	5.47	5.63	5.93
Spt-13	4.25	1.94	1.93	1.96	4.72	4.67	5.04
	3.35	1.04	1.03	1.1	3.97	3.92	4.3
Oct-13	6.6	2.55	2.92	2.47	4.05	4.35	4.22
	4.55	1.24	1.49	1.32	2.96	3.2	3.19
Nov-13	5.55	3.26	3.52	2.98	4.13	4.35	4.13
	2.5	1.18	1.33	1.25	2.37	2.52	2.55
Dec-13	3.25	2.8	3.03	264	5.24	5.42	5.49
	2.9	1.13	1.26	1.2	3.93	4.08	4.26
Jan-14	5.4	3.07	3.15	2.91	4.91	4.98	5.1
	4.15	1.38	1.42	1.47	3.54	3.59	3.83
Feb-14	3.6	2.28	2.13	2.22	5.01	4.9	5.31
	2.4	1.27	1.15	1.35	4.24	4.14	4.57
Mar-14	4.05	2.24	2.26	2.22	4.36	4.37	4.6
	2.75	1.27	1.28	1.36	3.57	3.58	3.85
Apr-14	4.35	2.91	2.92	1.9	4.89	4.9	5.16
	3.35	1.79	1.79	1.37	3.91	3.92	4.23
May-14	4.35	2.19	2.31	1.55	4.86	4.97	5.21
	4.65	1.21	1.28	1	3.93	4.02	4.25
Jun-14	6.15	3.12	3.14	2.11	5.52	5.55	5.87
	5.5	1.75	1.75	1.4	4.26	4.28	4.61
Jul-14	5.1	3.12	2.45	2.11	5.18	4.58	5.5
	4.4	1.75	1.28	1.4	3.92	3.41	4.24
Aug-14	8.2	3.77	3.78	2.31	5.52	5.53	5.72
	3.05	1.23	1.22	1.02	3.21	3.21	3.44
Spt-14	3.65	2.15	2.05	1.57	4.02	3.93	4.32
	1.75	1.2	1.13	1	3.08	3	3.31
Oct-14	4.5	3.04	3.18	1.93	4.63	4.74	4.83
	3.25	1.54	1.63	1.21	3.3	3.39	3.57
Nov-14	3.65	2.94	2.67	1.96	4.7	4.47	4.96
	2.55	1.55	1.36	1.25	3.42	3.23	3.7

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	3.45	2.38	2.12	1.7	4.38	4.14	4.69
	2.3	1.18	1.01	1	3.2	3	3.43
Jan-15	3.95	2.53	2.74	1.69	4.18	4.37	4.42
	2.75	1.4	1.55	1.12	3.16	3.31	3.42
Feb-15	4.15	2.33	2.31	1.66	4.2	4.2	4.5
	3.1	1.33	1.31	1.09	3.24	3.23	3.49
Mar-15	5.1	3.47	3.25	2.12	4.88	4.69	5.02
	3.75	1.86	1.7	1.41	3.48	3.33	3.75
Apr-15	18.4	3.21	3.62	3.01	4.18	4.53	4.22
	3.25	1.52	1.8	1.63	2.73	3	2.94
May-15	4.05	3.17	3.19	3	4.42	4.44	4.51
	2.55	1.52	1.52	1.63	3	3.02	3.24
Jun-15	4	2.93	3.04	2.8	3.85	3.95	3.91
	2.45	1.33	1.4	1.43	2.43	2.51	2.63
Jul-15	2.95	2.4	2.5	2.4	3.66	3.76	3.84
	1.75	1	1.06	1.03	2.38	2.45	2.57
Aug-15	3.45	2.02	2	2.06	3.53	3.53	3.75
	2	1.16	1.14	1.23	2.77	2.76	2.99
Spt-15	3.35	1.94	1.85	1.95	3.04	2.97	3.19
	2.05	1.1	1.04	1.18	2.3	2.24	2.48
Oct-15	2.7	1.67	1.42	1.75	2.74	2.52	2.92
	1.55	1.32	1.11	1.42	2.43	2.22	2.62
Nov-15	4.5	2.3	2.25	2.29	3.18	3.14	3.31
	2.35	1.37	1.32	1.46	2.35	2.31	2.53
Dec-15	3.65	2.18	2.18	2.18	2.99	3	3.11
	1.8	1.02	1.01	1.07	1.93	1.93	2.08
Jan-16	3.1	2.37	2.25	2.35	3.44	3.34	3.58
	1.9	1.42	1.32	1.52	2.61	2.52	2.81
Feb-16	2.65	1.32	1.46	1.41	2.14	2.14	2.3
	1.55	1.06	1.18	1.13	1.89	1.89	2.04
Mar-16	4	1.26	1.41	1.34	2.28	2.43	2.45
	1.75	1.1	1.24	1.18	2.13	2.27	2.3
Apr-16	2.7	1.3	1.24	1.38	2.66	2.61	2.86
	1.65	1.13	1.07	1.21	2.51	2.46	2.71

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	3.15	1.58	1.65	1.65	2.73	2.8	2.91
	2	1.03	1.08	1.09	2.22	2.28	2.4
Jun-16	3.75	1.38	1.56	1.47	2.4	2.57	2.58
	1.95	1.11	1.27	1.19	2.15	2.31	2.32
Jul-16	3.2	2.6	2.6	2.47	3.48	3.48	3.55
	1.9	1.02	1.01	1.08	2.09	2.08	2.25
Aug-16	4	2.68	2.65	2.51	3.74	3.71	3.81
	2.4	1.05	1.02	1.12	2.34	2.32	2.53
Spt-16	2.35	1.83	1.56	1.89	2.65	2.41	2.8
	1.45	1.25	1.03	1.33	2.12	1.9	2.28
Oct-16	2.75	1.6	2.09	1.69	2.81	3.25	2.61
	1.7	1.07	1.45	1.13	2.31	2.7	2.09
Nov-16	3.7	1.91	1.95	1.97	2.99	3.03	3.16
	2.15	1.32	1.35	1.41	2.45	2.49	2.65
Dec-16	3.05	1.3	1.28	1.39	2.12	2.1	2.28
	2	1.04	1.02	1.11	1.87	1.85	2.02
Jan-17	2.8	1.93	1.72	1.98	3.02	2.84	3.19
	1.7	1.33	1.15	1.42	2.48	2.32	2.68
Feb-17	3.55	2.09	2.05	2.13	3	2.97	3.15
	2.45	1.21	1.18	1.3	2.19	2.17	2.37
Mar-17	3.45	1.62	1.64	1.72	2.39	2.41	2.56
	2.1	1.35	1.36	1.44	2.13	2.15	2.3

Source: Authors compilation

Table 37: Calculated option premiums and market premiums of Tata Steel Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	25.45	18.37	15.55	18.02	27.6	25.2	28.69
	15.75	6.93	5.36	7.07	17.26	15.46	18.63
May-12	18.9	11.23	9.22	11.96	20.13	18.21	21.64
	10.05	3.35	2.49	1	11.54	10.22	11.51
Jun-12	22.4	21.85	13.56	19.58	26.43	19.3	25.88
	12.55	8.04	3.66	8.62	14.49	9.64	15.66
Jul-12	10.75	10.95	4.78	11.64	17.4	10.98	18.66
	4.7	6.16	2.23	6.16	12.65	7.55	13.54
Aug-12	28.8	22.94	23.05	20.29	26.84	26.93	25.91
	15.3	8.71	8.72	9.34	14.51	14.55	15.64
Sep-12	17.25	9.08	9.12	9.64	16.47	16.53	17.68
	8.7	4.45	4.44	4.17	11.82	11.86	12.64
Oct-12	17.55	9.71	7.09	10.34	13.71	11.15	14.7
	9.8	5.09	3.42	4.86	9.06	7.12	9.49
Nov-12	27.8	23.52	23.58	20.67	24.5	24.55	22.32
	15.15	9.08	9.06	9.71	10.85	10.85	11.64
Dec-12	16.25	12.64	11.79	12.88	15.17	14.39	15.75
	7.65	3.31	2.93	1.93	5.81	5.37	5.21
Jan-13	19.95	15.17	15.64	15.21	18.38	18.83	18.92
	9.75	4.84	5.03	4.26	8.31	8.56	8.43
Feb-13	15.2	9.68	9.8	10.31	15.4	15.55	16.54
	7.45	5.07	5.13	4.83	10.75	10.86	11.4
Mar-13	14.05	8.45	8.36	8.98	12.83	12.77	13.75
	6.35	3.93	3.85	3.5	8.23	8.18	8.59
Apr-13	15.55	8.47	7.94	8.44	12.98	12.55	13.57
	10.6	2.87	2.54	2.65	7.83	7.5	8.35
May-13	14.95	8.58	7.94	8.47	14.19	13.69	14.87
	9.85	2.85	2.48	2.67	9.06	8.67	9.73
Jun-13	13.1	6.06	5.75	6.32	12.78	12.54	13.67
	8.35	3.34	3.1	3.42	10.29	10.08	11.13

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	10.25	7.12	2.56	7.15	12.41	8.18	13.09
	7.15	4	1.07	4.25	9.75	6.16	10.53
Aug-13	12.5	6.36	6.6	6.24	18.41	18.61	19.66
	11.05	3.15	3.28	3.34	15.96	16.14	17.29
Spt-13	21.8	7.31	7.41	7.3	18.72	18.82	19.97
	18.2	4.14	4.18	4.4	16.21	16.3	17.53
Oct-13	20.25	6.41	7.31	6.61	16.92	17.68	18.13
	15.95	3.57	4.18	3.72	14.46	15.15	15.67
Nov-13	17.3	6.43	6.91	6.77	18.94	15.72	16.39
	14.3	3.81	4.12	3.88	16.54	13.22	13.86
Dec-13	17.95	7.2	7.92	7.63	12.85	13.54	13.78
	13.1	2.75	3.08	1.83	8.24	8.75	8.53
Jan-14	17.1	10.5	10.77	10.65	27.09	27.35	28.95
	12.2	4.78	4.88	4.85	22.19	22.41	24.06
Feb-14	19.1	10.13	9.93	9.98	19.32	19.19	20.38
	13.6	4.09	3.91	4.18	14.19	14.07	15.35
Mar-14	16.35	8.3	8.13	8.45	17.6	17.5	18.74
	11.4	2.99	2.84	2.65	12.71	12.62	13.72
Apr-14	17.05	9.96	9.47	7.2	14.17	13.72	15.17
	12.55	5.25	4.9	4.37	9.46	9.1	9.99
May-14	27.75	14.38	14.83	9.52	23.86	24.28	25.24
	22.6	8.62	8.93	6.7	18.69	19.05	20.23
Jun-14	22.05	14.34	12.37	9.87	21.5	19.7	22.83
	17.7	8.91	7.43	7.05	16.4	14.87	17.72
Jul-14	22.4	17.82	12.26	11.72	25.82	20.7	27.11
	18.2	11.83	7.55	8.9	20.41	16.01	22.02
Aug-14	25.5	18.4	17.53	12.21	28.02	27.27	29.54
	21.35	12.46	11.74	9.39	22.68	22.01	24.48
Spt-14	21.1	14.88	14.96	10.46	24.51	24.61	26.18
	11.6	5.77	5.76	4.82	15.29	15.35	16.05
Oct-14	21	13.79	14.43	9.62	23.15	23.76	24.7
	15.85	8.5	8.95	6.8	18.17	18.69	19.65
Nov-14	22.8	17.91	16.17	11.52	25.67	24.15	26.81
	12.8	7.09	6.08	5.88	15.52	14.39	16.64

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	17.8	13.23	12.29	9.35	21.45	20.6	22.93
	13.15	8.08	7.37	6.53	16.53	15.8	17.85
Jan-15	21.45	14.64	15.02	9.4	20.91	21.26	21.82
	16.6	8.61	8.86	6.58	15.49	15.77	16.73
Feb-15	18.1	9.59	9.67	7.06	16.39	16.49	17.63
	13.45	5.07	5.09	4.24	11.79	11.87	12.55
Mar-15	16.6	8.75	8.86	6.41	13.79	13.92	14.81
	12.2	4.28	4.32	3.59	9.24	9.33	9.69
Apr-15	16.75	9.34	10.45	9.39	15.1	16.05	15.88
	11.25	3.79	4.41	3.8	10.01	10.74	10.79
May-15	15.75	7.98	8.29	8.43	15.01	15.41	16.18
	11.1	3.35	3.49	2.84	10.34	10.66	11.1
Jun-15	17.3	12.11	12.25	11.56	17.6	17.73	18.11
	11.45	5.59	5.64	5.98	12.05	12.14	13.02
Jul-15	12.4	11.74	5.46	11.03	15.78	10.29	16.01
	8.15	5.09	1.63	5.44	10.07	6.02	10.88
Aug-15	14.95	9.5	9.33	8.98	22.58	22.46	23.9
	9.75	3.28	3.14	3.39	17.67	17.57	19.19
Spt-15	15.6	10.94	9.08	9.75	17.52	16.11	17.98
	11.1	3.89	2.81	4.16	12.08	10.96	13.08
Oct-15	16.25	10.94	9.31	9.51	15.32	14.06	15.38
	10.55	3.67	2.72	3.92	9.62	8.66	10.4
Nov-15	14.95	9.26	8.93	8.8	14.65	14.39	15.18
	10.4	3.14	2.93	3.22	9.39	9.19	10.16
Dec-15	10.2	5.22	4.62	5.5	11.26	10.73	12.08
	6.1	2.72	2.31	2.7	8.86	8.4	9.58
Jan-16	12.8	10.07	8.43	9.47	17.77	16.48	18.52
	7.5	3.69	2.76	3.89	12.55	11.51	13.6
Feb-16	17.1	11.88	10.36	10.6	20.41	19.28	21.1
	11.35	4.69	3.73	5.01	15.03	14.09	16.25
Mar-16	19.4	10.8	10.31	9.87	18.85	18.49	19.56
	13.95	4.02	3.7	4.29	13.55	13.25	14.68
Apr-16	19.05	12.79	12.29	12.74	21.35	20.94	22.44
	13.8	6.9	6.54	7.43	16.19	15.83	17.55

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	16.35	9.47	9.6	10.11	18.21	18.35	19.61
	11.7	4.96	5.03	4.8	13.64	13.75	14.68
Jun-16	20.25	14.37	14.58	14.04	22.59	22.78	23.53
	14.35	8.12	8.26	8.73	17.23	17.39	18.63
Jul-16	13.45	13.27	7.66	13.21	22.1	16.98	23.21
	9.15	7.33	3.62	7.9	16.91	12.62	18.32
Aug-16	19.7	11.9	11.84	12.32	19.28	19.24	20.47
	14.9	6.6	6.55	7.01	14.31	14.27	15.51
Spt-16	21.35	15.17	15.71	15.05	23	23.48	24
	16.25	9.05	9.44	9.73	17.63	18.03	19.05
Oct-16	18.15	11.88	12.09	12.41	19.84	20.06	21.16
	13.1	6.74	6.87	7.1	14.95	15.13	16.19
Nov-16	18.55	13.39	12.5	13.9	23.34	22.55	24.85
	13.4	8.03	7.37	8.59	18.37	17.69	19.92
Dec-16	22.45	15.61	14.04	15.74	21.22	19.8	22.11
	17.35	9.69	8.49	10.43	15.79	14.6	17.07
Jan-17	14	10.57	9.39	11.28	17.45	16.31	18.76
	9.5	5.96	5.14	5.97	12.82	11.88	13.75
Feb-17	25.55	17.42	16.49	17.68	24.9	24.06	26.09
	20.2	11.5	10.74	12.37	19.51	18.79	21.07
Mar-17	17.95	12.47	12.04	13.36	19.77	19.37	21.29
	13.45	7.83	7.49	8.05	15.12	14.77	16.25

Table 38: Calculated option premiums and market premiums of UltraTech Cement Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	25	33.73	18.59	34.46	54.81	41.14	57.91
	5.65	9.11	3.39	5.17	30.62	21.44	31.64
May-12	150.5	35.28	20.82	35.31	62.79	50.42	66.24
	123.6	9.14	3.66	6.02	38.17	29.29	40.54
Jun-12	131.45	34.13	11.68	34.6	57.61	36.35	60.82
	102.9	8.98	1.54	5.31	33.25	18.94	34.79
Jul-12	50.5	35.12	22.49	35.63	64.19	53.3	67.99
	44.35	9.73	4.58	6.34	39.84	31.89	42.24
Aug-12	30.9	47.79	34.34	46.15	67.52	56.3	69.52
	21.25	16.79	9.69	16.86	40.22	32.1	43.19
Sep-12	57.45	59.15	53.11	54.72	76.71	71.77	77.13
	43.45	23.97	19.89	25.43	47.11	43.32	50.72
Oct-12	73.85	43.09	23.77	44.15	64.96	47.27	68.49
	30.05	16.48	6.81	14.86	39.65	27	41.87
Nov-12	85	64.04	64.49	60.86	77.44	77.82	77.64
	51.55	29.74	29.66	31.58	47.07	47.22	50.53
Dec-12	71.15	60.39	63.87	57.49	73.56	76.56	73.9
	53.65	26.62	28.56	28.2	43.6	45.7	46.83
Jan-13	69.2	45.88	42.43	46.5	67.11	64.23	70.37
	40.05	18.05	15.78	17.21	41.15	38.93	43.74
Feb-13	106.3	56.01	66.8	53.58	70.44	79.61	71.28
	79.45	23.11	29.83	24.29	41.3	48.03	44.37
Mar-13	191.45	55.78	38.76	53.74	71.13	56.43	72.32
	43.15	23.32	13.27	24.45	42.3	31.65	45.44
Apr-13	52.6	36.71	18.71	37.47	63.02	47.02	66.69
	31.4	10.84	3.54	7.23	38.28	26.87	40.21
May-13	65	32.71	31.7	34.04	58.94	58.28	62.81
	36	9.28	8.43	3.8	35.23	34.67	36.23
Jun-13	131	46.76	44.29	45.62	94.27	92.53	99.53
	48.05	15.93	14.14	15.38	68.6	67.13	74.18

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	67.6	45.72	21.88	44.81	70.78	56.9	80.53
	40.55	15.37	4.53	14.57	44.14	35.49	54.44
Aug-13	76.3	36.57	38.04	37.34	60.37	61.75	63.8
	59.95	10.78	11.02	7.1	35.6	36.49	37.15
Spt-13	54	38.82	25.16	37.41	90.52	80.21	95.96
	39	9.38	4.02	7.17	65.79	57.39	71.24
Oct-13	99.3	46.68	36.56	45.29	77.81	69.91	81.28
	56.7	15.57	10.06	15.06	51.31	45.18	55.26
Nov-13	67.2	36.23	31	37.34	80.68	76.56	86.16
	43.15	11.14	8.36	7.1	56.53	53.21	60.49
Dec-13	65.5	32.31	33.29	33.67	71.2	72.3	76.212
	40.95	9.11	9.12	3.43	47.64	48.42	50.33
Jan-14	66.6	38.97	43.9	38.99	67.41	71.44	71
	43.25	11.34	13.32	8.75	42.09	45.04	44.81
Feb-14	52	31.45	22.93	32.43	73.14	66.08	78.18
	25	7.77	4.35	2.19	49.47	43.98	52.65
Mar-14	74.3	55.23	39.63	51.62	81.96	69.81	84.17
	39.35	20.48	11.5	21.38	53.8	44.4	58.01
Apr-14	86	34.48	44.89	69.46	68.79	81.01	101.49
	64.45	38.33	29.41	40.92	70.08	61.5	75.42
May-14	63.8	57.33	63.05	58.13	106.31	111	112.52
	78.5	28.23	31.67	29.59	80.65	84.57	87.26
Jun-14	118.15	64.7	60.04	65.62	94.91	90.97	99.52
	87	34.98	31.46	37.07	68.03	64.73	73.35
Jul-14	36.4	78.28	73.08	77.67	120.32	116.07	125.63
	102.4	46.01	41.86	49.13	92.69	89	99.85
Aug-14	80.1	59.14	46.04	61.34	93.2	81.45	98.82
	60	31.68	22.76	32.79	67.57	57.96	72.72
Spt-14	98	77.34	71.76	77.25	110.69	106	115.26
	68.95	45.6	41.17	48.7	82.76	78.74	89.12
Oct-14	103.1	79.21	82.42	78.72	106.87	109.75	110.57
	88.75	47	49.14	50.18	78.31	80.61	84.2
Nov-14	95	79.36	74.33	78.19	116.72	112.59	121.25
	72.25	46.54	42.5	49.64	88.61	85.04	95.35

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	255.85	67.95	68.48	68.81	103.27	103.87	108.43
	66.45	37.86	37.95	40.26	76.39	76.82	82.42
Jan-15	102.2	50.11	51.59	53.29	137.54	139.29	148.5
	60.95	26.35	27.07	24.75	114.14	115.67	123.72
Feb-15	132.95	83.84	83.31	85.3	130.71	130.45	137.63
	96.35	53.13	52.42	56.76	103.61	103.32	111.68
Mar-15	114.25	73.81	66.81	76.71	121.56	115.55	128.48
	93.3	45.49	40.01	48.16	95.62	90.39	102.72
Apr-15	107.8	52.7	57.61	56.1	99.43	104.27	106.94
	84.5	29.09	32.24	27.91	75.79	79.81	81.2
May-15	101.55	55.16	62.09	58.34	99.33	105.84	106.47
	82.65	30.32	34.9	30.14	75.1	80.52	80.7
Jun-15	110.95	70.09	72.46	72.73	123.48	125.79	131.45
	85.35	42.14	43.65	44.54	97.92	99.87	105.85
Jul-15	95	62.33	47.17	65.56	108.27	94.23	115.75
	72.6	36.27	25.57	37.37	83.43	71.55	89.94
Aug-15	129.1	89.39	82.3	89.59	149	143.19	156.79
	87	57.59	51.82	61.4	121.89	116.7	131.33
Spt-15	135	84.18	75.93	84.26	134.68	127.79	141.37
	110.45	52.54	45.99	56.07	107.41	101.37	115.77
Oct-15	140	60.65	59.34	63.44	103.95	102.98	110.88
	95.6	34.13	32.98	35.25	78.9	78.03	85.1
Nov-15	121	75.67	62.69	77.07	113	101.58	118.85
	77	45.8	36.05	48.88	86.04	76.35	92.85
Dec-15	95.8	71.21	66.04	73.08	108.28	103.84	114.3
	77.15	42.33	38.21	44.89	81.8	78	88.29
Jan-16	72	66.52	56.78	69.02	106.05	97.39	112.58
	50.7	38.8	31.66	40.83	80.29	72.98	86.64
Feb-16	79.05	77.63	49.1	78.42	108.09	82.09	112.88
	51.7	47.02	26.44	50.23	80.42	58.94	86.66
Mar-16	136	63.61	51.29	66.26	104.09	92.99	110.75
	76	36.46	27.7	38.07	78.67	69.34	84.86
Apr-16	106	54.87	55.16	58.31	108.24	108.81	116.39
	81.2	30.73	30.69	29.98	84.31	84.75	90.65

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	102.4	58.73	60.48	61.96	105.56	107.4	113.05
	77.05	33.21	34.19	33.63	80.95	82.45	87.16
Jun-16	125	84.66	90.35	84.36	125.19	130.14	130.62
	91.15	52.55	56.72	56.03	97.2	101.41	104.62
Jul-16	124	70.9	64.74	73.74	115.45	110.12	122.74
	92.5	43.02	38.25	45.41	89.59	84.98	96.71
Aug-16	113.7	71.97	73.1	75.55	118.09	119.38	126.02
	88.65	45	45.6	47.22	92.64	93.67	99.91
Spt-16	117.85	64.6	66.95	68.69	119.81	122.33	128.77
	92.7	39.88	41.37	40.36	95.56	97.69	102.85
Oct-16	140	64.31	63.65	68.46	117.85	117.56	126.71
	92.1	39.84	39.11	40.13	93.7	93.4	100.73
Nov-16	117.2	85.49	75.64	88.41	139.89	131.34	148.46
	88.1	56.33	48.44	60.08	113.48	105.91	122.5
Dec-16	127	87.88	66.18	88.25	130.68	111.71	136.74
	106.35	56.18	39.5	59.92	102.84	86.47	110.7
Jan-17	83.05	53.64	33.91	57.14	138.73	119.04	149.65
	61.1	30.08	17.01	28.81	115.19	97.78	124.58
Feb-17	112.4	83.13	75.78	85.25	122.16	115.77	128.72
	104.15	53.33	47.43	56.92	95.03	89.48	102.46
Mar-17	156.5	84.55	82.64	86.65	124.87	123.36	131.57
	109.05	54.63	52.89	58.32	97.71	96.33	105.33

Source: Authors compilation

Table 39: Calculated option premiums and market premiums of Wipro Ltd. call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	14.75	7.82	6.73	8.31	23.22	22.26	25.05
	6.65	3.37	2.72	2.56	18.63	17.79	20.11
May-12	19.05	10.9	11.99	10.94	17.99	18.92	18.93
	9.15	5.01	5.66	5.19	12.76	13.5	13.78
Jun-12	11.1	7.96	4.66	8.39	13.32	10.14	14.24
	4.5	3.25	1.53	2.64	8.59	6.23	8.99
Jul-12	25.7	32.5	23.56	24.68	35.15	35.81	31.35
	12.65	6.99	7.37	7.44	14.8	15.2	15.93
Aug-12	19.8	16.99	16.65	14.54	19.47	19.17	18.5
	8.95	3.24	3.02	3.05	7.51	7.31	7.97
Sep-12	13.25	7.97	7.83	8.29	12.84	12.75	13.65
	5.05	3.03	2.9	2.54	7.99	7.91	8.41
Oct-12	14.65	7.33	4.25	7.75	12.05	9.06	12.9
	6.55	2.8	1.29	2	7.42	5.28	7.62
Nov-12	58.05	18.54	18.05	15.52	20.73	20.19	19.19
	9.65	3.94	3.63	4.03	8.2	7.76	8.63
Dec-12	18.5	16.67	16.06	14.98	19.46	18.93	18.91
	7.5	3.75	3.39	3.49	7.86	7.51	8.28
Jan-13	16.6	15.62	12.5	14.27	19.95	17.37	19.92
	7	3.3	2.06	2.78	8.98	7.4	9.48
Feb-13	16.35	12.26	12.34	12.01	16.36	16.44	16.82
	7.05	5.9	5.9	6.26	10.7	10.75	11.53
Mar-13	12.7	8.44	7.27	8.88	14.42	13.39	15.42
	4.8	3.63	2.92	3.13	9.64	8.84	10.19
Apr-13	16.8	7.63	7.51	8.04	28.63	28.61	30.89
	9	2.99	2.86	2.18	24.03	24	26.06
May-13	12.45	5.5	4.72	5.83	9.87	9.18	10.59
	8	3.05	2.48	2.9	7.45	6.86	7.94
Jun-13	14.1	10.78	6.38	10.15	14.88	11.23	15.17
	9.95	4.09	1.75	4.29	9.21	6.53	9.93

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	20.8	12.19	11.45	11.31	18.35	17.78	18.84
	13.95	5.13	4.59	5.45	12.71	12.24	13.71
Aug-13	22.7	7.42	8.06	7.75	17.03	17.62	18.24
	17.95	2.62	2.89	1.89	12.29	12.76	13.17
Spt-13	27.5	10.14	10.17	10.47	19.91	19.99	21.22
	22.6	4.72	4.66	4.62	14.91	14.97	16.08
Oct-13	31	11.58	12.32	11.66	24.14	24.77	25.64
	24.3	5.59	6.01	5.8	19.04	19.57	20.6
Nov-13	19.25	9.43	9.39	9.84	16.01	16.03	17.06
	13.6	4.28	4.19	3.98	11.06	11.06	11.79
Dec-13	16.15	8.15	9.05	8.61	20.07	20.93	21.59
	11.2	3.47	3.93	2.76	15.37	16.09	16.51
Jan-14	22.15	12.29	10.77	12.59	19.42	18.13	20.51
	17.2	6.49	5.39	6.73	14.15	13.08	15.23
Feb-14	20.65	12.57	12.21	12.91	26.08	25.84	27.79
	15.3	6.79	6.45	7.05	21	20.78	22.7
Mar-14	22.9	14.46	13.91	14.58	23.9	27.79	25.18
	16.85	8.23	7.75	8.72	18.51	22.59	19.97
Apr-14	22.95	11.65	11.53	8.44	36.01	35.99	38.8
	18.1	6.58	6.45	5.45	31.3	31.27	33.95
May-14	26	15.86	16.75	10.12	22.53	23.31	23.4
	22.3	9.43	10.05	7.14	16.9	17.55	18.19
Jun-14	22.6	13.46	11.92	9.02	17.89	16.51	18.71
	17.6	7.6	6.47	6.04	12.44	11.32	13.38
Jul-14	24.55	14.02	11.27	9.51	23.01	20.6	24.37
	20.05	8.22	6.21	6.53	17.78	15.73	19.21
Aug-14	19.45	13.87	12.4	9.39	18.96	17.65	19.91
	14.55	8.06	6.95	6.4	13.57	12.49	14.6
Spt-14	17.6	14.32	13.11	9.77	20.6	19.54	21.72
	12.7	8.55	7.61	6.78	15.27	14.37	16.45
Oct-14	27.3	16.62	15.4	10.91	25.16	24.14	26.39
	22.25	10.39	9.4	7.92	19.68	18.79	21.2
Nov-14	18.6	12.89	12.59	9.09	16.73	16.47	17.7
	13.75	7.5	7.24	6.11	11.53	11.31	12.31

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	18.85	14.65	13.78	10.03	19.44	18.67	20.44
	13.7	8.9	8.19	7.05	14.04	13.38	15.1
Jan-15	21.3	15.04	14.01	9.97	20.73	19.84	21.67
	16.1	8.98	8.17	6.98	15.21	14.46	16.39
Feb-15	24.3	15.53	15.56	10.55	21.31	21.36	22.39
	18.4	9.66	9.62	7.57	15.87	15.9	17.09
Mar-15	22.1	14.96	14.97	10.56	22.46	22.51	23.88
	17.5	9.45	9.4	7.57	17.28	17.31	18.61
Apr-15	52	10.9	12.96	11.46	23.45	25.29	25.15
	20.15	5.75	7.09	5.64	18.56	20.14	20.02
May-15	18.9	9.18	9.28	9.69	15.35	15.49	16.43
	14.45	4.34	4.33	3.87	10.54	10.63	11.12
Jun-15	16.55	9.84	10.1	10.36	17.01	17.31	18.19
	11.25	4.84	4.94	4.53	12.13	12.35	12.92
Jul-15	21	14.56	9.36	14.35	21.98	17.55	22.89
	15.75	8.02	4.42	8.53	16.39	12.71	17.66
Aug-15	21.05	15.64	14.44	15.24	23.61	22.65	24.51
	15.25	8.87	7.91	9.41	17.95	17.12	19.3
Spt-15	20.45	11.07	9.53	11.49	18.83	17.51	20.03
	15.5	5.64	4.58	5.67	13.75	12.66	14.78
Oct-15	24.05	11.11	9.81	11.6	18.68	17.56	19.9
	18.4	5.8	4.88	5.78	13.64	12.71	14.63
Nov-15	17.85	10.73	10.12	11.21	17.68	17.18	18.83
	12.1	5.46	4.99	5.39	12.65	12.23	13.54
Dec-15	22	15.72	15.41	15.3	17	16.71	16.88
	15.05	8.93	8.62	9.47	10.55	10.28	11.25
Jan-16	14.05	12.91	9.42	13.03	17.37	14.26	18.09
	10.7	6.85	4.46	7.21	11.82	9.37	12.7
Feb-16	14.1	10.54	8.71	11.01	17.22	15.6	18.34
	9.25	5.29	4.07	5.19	12.2	10.89	13.04
Mar-16	17.65	8.63	9.17	9.14	13.73	14.28	14.7
	13.3	3.96	4.22	3.31	9	9.4	9.34
Apr-16	18.5	9.1	7.99	9.53	23.46	22.56	25.2
	13.95	4.05	3.33	3.66	18.64	17.85	20.15

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	16.5	10.45	9.73	10.71	18.51	17.94	19.63
	12.3	4.84	4.32	4.84	13.38	12.9	14.41
Jun-16	17	11.07	12.15	11.19	18.27	19.19	19.25
	11.8	5.18	5.81	5.32	13	13.73	14.01
Jul-16	17.5	13.88	11.7	13.44	18.16	16.32	18.57
	13.6	7.13	5.57	7.57	12.28	10.8	13.19
Aug-16	16.3	10.82	11.39	10.98	14.69	15.22	15.35
	10.7	5.02	5.32	5.11	9.3	9.67	9.93
Spt-16	21	13.94	14.66	13.08	16.61	17.22	16.51
	10.35	2.48	2.64	1.34	5.82	6.1	5.63
Oct-16	17.8	12.95	11.53	12.3	19.8	18.69	20.46
	11.85	6.05	5.04	6.43	14.16	13.24	15.27
Nov-16	12.9	7.7	6.81	8.03	12.2	11.44	12.97
	7.6	2.82	2.3	2.16	7.35	6.78	7.62
Dec-16	14.6	9.54	7.78	9.62	14.15	12.64	14.82
	10	3.84	2.79	3.75	8.89	7.75	9.49
Jan-17	14.7	9.45	7.42	9.59	12.91	11.11	13.49
	9.4	3.84	2.65	3.72	7.63	6.33	8.08
Feb-17	14.9	10.13	7.81	10.1	12.97	10.92	13.39
	9.8	4.19	2.81	4.23	7.46	5.99	7.93
Mar-17	17.6	13.73	11.88	12.93	17.72	16.18	17.9
	12.6	6.65	5.32	7.06	11.7	10.47	12.56

Source: Authors compilation

Table 40 : Calculated option premiums and market premiums of NIFTY 50 call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	203.15	143.24	142.81	136.47	201.43	201.14	206.59
	139.2	71.75	70.34	75.76	142.73	142.26	153.21
May-12	176.2	137.88	123.66	131.91	184.93	173.34	188.85
	115.75	67.42	56.58	71.2	125.64	116.14	134.82
Jun-12	142.7	95.46	60.4	96.99	155.79	125.69	164.34
	90.3	38.45	19.08	36.29	103.85	80.66	110.95
Jul-12	157.75	129.52	113.75	126.11	189.69	177.09	196.46
	97.8	62.17	50.61	65.41	132.98	122.59	143.04
Aug-12	172.8	144.49	133.48	136.18	148.73	138.04	142.1
	109.8	71.55	62.71	75.47	78.24	69.69	82.81
Sep-12	145.35	113.47	109.39	113.43	131.35	127.69	134.28
	86.4	51.54	47.83	52.72	73.1	69.92	77.08
Oct-12	107.1	82.1	71.96	86.51	122.36	113.48	130.51
	60.6	34.73	28.09	25.8	74.62	67.84	74.98
Nov-12	152.3	123.19	118.26	122.96	82.22	78.36	87.17
	49.85	22.73	19.67	1.55	42.04	39.12	29.87
Dec-12	148.85	137.93	127.24	135.59	171.85	162.66	175.7
	87.45	71.07	62.49	74.89	112.2	104.61	120.07
Jan-13	121.3	88.08	89.26	92.61	89.04	90.24	93.67
	69.95	38.99	38.63	31.91	39.96	39.65	33.17
Feb-13	169.3	154.61	149.49	148.92	160.5	155.52	156.59
	102.45	83.61	78.71	88.22	91.96	87.32	97.37
Mar-13	95.4	92.62	72.2	96.71	119.59	100.82	126.39
	49.3	40.9	28.21	36	68.95	55.46	69.73
Apr-13	93.1	63.04	48.34	65.3	110.83	99.09	117.85
	45.9	34.24	22.81	31.46	84.61	74.46	89.49
May-13	142.9	117.5	94.37	112.5	148.46	129.64	150.6
	85.8	44.6	28.46	44.82	87.5	73.14	92.97
Jun-13	161.7	131.44	105.22	123.57	156.74	134.93	156.39
	103.2	54.15	34.97	55.89	92.34	75.56	98.16

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	123.85	92.59	58.71	92.39	160.94	134.98	169.42
	72.95	30.1	12.1	24.71	107.72	87.43	114.73
Aug-13	189.55	130.76	127.48	122.65	243.64	241.32	255.1
	127	53.26	48.65	54.97	188.46	186.32	202.98
Spt-13	151.35	72.99	35.29	74.53	232.48	202.84	249.33
	124	40.7	14.46	40.69	207.19	179.64	223.87
Oct-13	212.75	85.39	94.71	86.2	189.15	196.45	201.19
	185.3	50.91	56.73	52.36	162.37	168.94	174.71
Nov-13	146	71.3	73.53	73.78	169.02	171.9	180.83
	116.85	41.56	41.58	39.94	143.28	145.75	153.94
Dec-13	178.55	83.5	85.71	85.14	156.02	158.29	165.44
	150.1	50.34	50.48	51.3	128.71	130.55	138
Jan-14	147.15	75.97	83.64	78.32	146.11	152.93	155.48
	118.05	45.01	49.23	44.48	119.46	125.3	127.84
Feb-14	134.5	92.94	74.81	93.26	144.91	130.86	151.94
	104.9	57.42	41.96	59.42	115.95	103.42	123.85
Mar-14	106.2	85.18	59.59	86.81	128.76	107.89	135.44
	77.55	51.87	31.46	52.98	100.24	82.08	106.77
Apr-14	154	117.82	104.95	120.17	151.38	140.24	157.92
	124.45	84.63	73.07	88.95	121.51	111.39	129.38
May-14	281.15	109.64	104.04	113.15	158.47	154.09	167.2
	256.55	78.04	72.56	81.92	130.23	126.09	139.23
Jun-14	136.7	113.47	80.2	117.51	160.46	130.94	169.42
	111	82.24	54.31	86.29	132.24	105.88	141.25
Jul-14	177.2	103.19	88.84	108.11	143.95	131.4	152.82
	151.15	74.33	61.77	76.89	116.86	105.52	124.28
Aug-14	129.65	100.53	77.25	105.52	146.84	125.91	156.27
	104.25	72.34	52.73	74.3	120.28	101.59	127.91
Spt-14	144.7	122.24	109.09	127.01	168.48	157.25	177.99
	114.6	91.29	79.34	95.78	140.21	129.86	149.6
Oct-14	165.1	115.63	117.04	120.67	158.32	160.19	167.62
	137.2	85.6	85.91	89.45	130.5	131.83	139.08
Nov-14	134.65	122.4	100.84	127.6	161.13	141.85	170.24
	106.05	92.01	73.04	96.37	132.87	115.42	141.47

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	154.5	136.61	126.06	141.25	178.41	169.38	187.59
	125.4	104.67	94.71	110.03	149.24	140.77	158.93
Jan-15	177.1	107.14	113.51	112.51	129.15	135.6	136.69
	147.95	78.97	83.42	81.29	101.88	106.97	107.09
Feb-15	215.9	120.16	117.55	125.94	168.65	167.05	179.12
	190	91.02	87.92	94.72	141.4	139.63	150.6
Mar-15	237.8	144.28	129.07	148.72	199.25	186.39	209.72
	208.95	111.8	97.75	117.5	170.22	158.23	181.5
Apr-15	218.75	116.43	195.17	118.53	175.71	239.75	184.75
	186.75	82.19	151.71	85.64	146.67	205.14	156.48
May-15	180.75	109.39	140.73	112.21	182.69	208.12	193.35
	151.15	76.34	102.91	79.32	154.69	177.83	165.49
Jun-15	176.6	111.68	130.78	114.44	185.42	201.02	196.13
	147.05	78.42	94.52	81.55	157.31	171.5	168.27
Jul-15	168.45	86.86	86.83	112.19	161.84	161.83	190.65
	140.85	87.57	87.6	79.3	162.19	162.21	162.71
Aug-15	162.35	88.35	84.83	115	187.56	186.55	219.17
	132.5	89.25	89.55	82.11	187.94	188.71	191.81
Spt-15	199.55	85.32	99.58	88.87	183.26	195.21	196.07
	170.9	56.37	67.73	55.97	157.4	168.3	168.85
Oct-15	228.45	114.09	138.05	115.39	205.11	223.71	216.86
	198.45	79.15	99.51	82.5	177.06	194.16	189.67
Nov-15	163.35	95.24	116.38	98.68	181.87	199.18	193.77
	136.45	64.33	81.66	65.78	155.1	170.87	166.3
Dec-15	184.6	113.32	136.77	115.02	187.3	206.02	197.56
	156.9	78.81	98.7	82.13	158.84	175.89	169.88
Jan-16	132.1	92.39	105.81	95.84	183.06	194.13	195.28
	105.3	61.86	72.71	62.95	156.54	166.61	167.93
Feb-16	132	88.44	91.58	91.7	191.54	194.13	204.65
	105	57.95	60.44	58.81	165.32	167.68	177.69
Mar-16	199.7	94.33	113.99	96.51	180.28	195.75	191.47
	172.2	61.46	77.47	63.62	153.06	167.13	164.33
Apr-16	157.05	99.41	90.58	104.27	172.59	165.52	184.28
	130.15	70.72	62.88	73.71	146.3	139.77	157.14

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	181.65	125.67	122.31	128.44	207.54	205.29	219.39
	150.75	92.86	89.32	97.88	179.55	177.36	192.49
Jun-16	558.65	148.16	24.85	155.33	258.73	122.77	276.23
	508.9	92.63	10.64	94.21	207.04	92.05	222.02
Jul-16	159.75	116.55	99.26	121.31	180.08	165.34	191.14
	131.45	86.13	71.05	90.75	152.62	139.14	163.66
Aug-16	178.35	126.98	122.23	131.38	163.37	159.43	171.73
	149.15	95.54	90.8	100.82	134.34	130.54	143.34
Spt-16	169.95	115.63	114.02	120.81	165.35	164.48	175.4
	139.8	85.81	83.76	90.25	137.81	136.8	147.45
Oct-16	172	108.83	92.78	114.33	165.1	151.09	175.89
	144.25	80.2	66.27	83.77	138.39	125.65	148.12
Nov-16	164.85	126.64	109.4	131.07	209.49	195.25	222.35
	135.05	95.24	79.99	100.51	181.96	168.77	195.27
Dec-16	161.45	104.94	80.47	110.05	145.17	122.86	154.15
	134.05	76.05	55.53	79.49	117.99	98.21	125.94
Jan-17	139.1	119.87	87.26	124.08	161.55	132.41	170.22
	109.7	88.63	61.03	93.52	132.97	106.74	142.11
Feb-17	179.6	128.89	111.82	133.1	173.87	158.96	182.99
	151	97.17	82.01	102.54	145.03	131.43	154.92
Mar-17	166.55	135.61	110.25	139.62	171.17	148.32	179.27
	136.8	103.4	81.14	109.06	141.56	120.92	150.83

Source: Authors compilation

Table 41: Calculated option premiums and market premiums of Nifty Bank Index call options

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Blacks Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	342.05	187.18	176.1	198.49	318.54	309.2	341.59
	289.75	134.45	124.79	141.02	268.28	259.72	288.96
May-12	301.75	207.69	160.01	217.95	378.57	335.49	404.71
	247.95	151.02	111.62	160.48	327.02	287.67	352.93
Jun-12	306.45	204.34	130.78	212.32	368.88	301.57	393.04
	255.75	145.42	86.41	154.85	316.52	255.52	341.45
Jul-12	281.7	206.09	164.17	216.92	347.19	309.02	371.03
	231.7	150.28	115.47	159.44	295.5	260.92	318.61
Aug-12	311.65	202.52	196.9	213.12	235.22	230.12	248.97
	262.15	146.74	141.43	155.64	180.92	176.14	193.34
Sep-12	320.75	231.87	236.69	239.02	289.35	294.18	303.13
	257.05	170.58	173.95	181.54	232.11	236.02	248.64
Oct-12	316.3	235.6	218.23	247.09	354.86	339.75	377.73
	257.9	178.11	162.76	189.62	301.61	287.73	324.58
Nov-12	304.3	207.92	202.38	220.69	282.81	278.29	302.35
	253.95	155.07	149.78	163.21	231.55	227.24	247.99
Dec-12	294.55	249.17	219.57	261.44	290.26	262.11	306.6
	243.1	191.54	165.66	203.97	234.54	209.44	251.05
Jan-13	333.5	253.94	265.69	266.61	296.1	316.42	322.44
	278	196.39	205.81	209.14	240.44	259.36	267.2
Feb-13	261.55	225.56	216.76	239.56	306.29	298.68	327.57
	209.45	172.63	164.49	182.08	254.94	247.85	273.17
Mar-13	252.35	226.75	198.37	239.02	324.87	298.97	346.26
	196.2	170.89	146.45	181.55	272.1	248.69	292.56
Apr-13	275.75	170.14	149.76	178.04	341.99	325.86	365.84
	219.35	112.99	95.72	116.44	290.51	275.74	312.74
May-13	328.55	189.93	116.73	198.45	359.78	294.31	384.27
	282.15	131.5	73.35	136.85	307.51	248.23	330.79
Jun-13	338.85	217.75	160.65	223.82	407.29	359.98	432.9
	290.9	154	106.5	162.22	353.35	309.9	379.95

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	298.7	167.45	128.3	175.65	499.56	467.11	537.47
	250.3	111.39	80.03	114.05	450.11	419.68	486.79
Aug-13	442.9	183.92	176.66	188.85	535.13	531.03	573.73
	387.45	121.11	113.9	127.25	484.68	480.75	523.76
Spt-13	418.55	154.02	119.14	158.85	618.62	591.53	665.88
	369.25	93.64	66.81	97.25	570.31	544.54	617.65
Oct-13	560.95	201.62	217.43	202.07	580.57	593.44	620.84
	500.95	133.46	144.96	140.47	529.6	541.71	571.48
Nov-13	428.75	174.86	184.69	182.83	529.89	540.18	569.81
	375.95	117.23	123.55	121.23	480.25	489.86	519.41
Dec-13	473.65	185.26	208.89	191.67	468.54	488.99	501.82
	412.85	124.16	141.78	130.07	417.43	436.39	450.75
Jan-14	410.65	193.25	208.43	199.56	429.07	442.83	458.34
	356.25	131.38	142.22	137.96	376.97	389.55	406.49
Feb-14	322	162.14	136.83	168.68	345.22	325.05	369.08
	271.7	103.49	82.92	107.08	293.7	275.32	316.67
Mar-14	277.6	187.49	144.57	192.77	402.65	368.14	429.46
	225.9	124.82	90.02	131.17	350.19	318.45	377.52
Apr-14	458.75	274.39	264.66	289.18	443.12	435.23	473.44
	402.35	217.83	208.75	232.4	390.83	383.36	421.14
May-14	729.85	267.63	268.78	283.37	485.86	488.26	521.09
	668.05	212.66	213.05	226.59	434.93	437.04	469.43
Jun-14	453.45	336.69	250.08	352.41	526.43	446.36	560.43
	408.5	277.52	200.46	295.63	472.67	397.77	508.07
Jul-14	608.5	339.77	363.67	355.84	418.53	441.67	442.47
	561.4	280.72	301.57	299.06	362.41	383.36	388.1
Aug-14	421.05	303.46	285.22	321.93	572.26	556.88	614.56
	372.5	248.76	232.03	265.15	521.61	506.97	563.06
Spt-14	384.1	311.64	299.61	331.32	491.23	481.2	526.88
	333.1	257.83	246.52	274.55	440.08	430.52	474.11
Oct-14	392.55	300.78	300.68	319.97	389.38	390.14	416.53
	333.4	247.39	246.69	263.19	337.51	337.89	362.24
Nov-14	415.4	349.94	333.87	370.52	510.96	497.02	546.13
	355.65	294.05	278.97	313.75	458.25	445	492.95

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	496.25	359.37	366.82	382.12	383.74	391.4	408.72
	440.4	305.21	311.35	325.35	330.07	336.55	352.65
Jan-15	562.65	385.81	417.31	408.02	534.55	565.27	570.38
	502.9	329.22	357.36	351.25	481.05	509.64	516.83
Feb-15	702.5	402.3	403.73	426.42	560.68	563.35	599.14
	657.45	346.43	347.11	369.65	507.64	509.89	545.56
Mar-15	691.7	405.97	408.46	428.34	568.51	572.08	605.96
	632.3	348.47	350.12	371.57	514.57	517.68	552.55
Apr-15	596.1	279.55	448.33	293.49	487.5	631.54	520.74
	546.85	220.94	372.49	233.6	434.48	569.66	467.21
May-15	478.3	259.43	322.45	274.18	482	538.4	516.9
	429.95	204.31	259.56	214.29	430.7	483.43	463.47
Jun-15	503.05	274.53	301.82	289.44	509.1	866.88	545.33
	452.2	217.76	241.68	229.55	457.15	480.08	492.05
Jul-15	472	254.85	255.58	314.31	483.68	483.6	558.01
	427.95	256.52	255.49	254.42	484.48	483.57	504.68
Aug-15	470.5	261.51	256.52	294.66	668.71	670.22	735.27
	417.5	259.89	262.84	234.76	668.18	672.44	683.87
Spt-15	545.9	247.75	286.88	261.51	568.5	602.93	610.94
	501.75	192	225.89	201.61	517.94	550.46	559.01
Oct-15	596	239.25	294.05	252.88	488.32	537.01	524.36
	547.1	184.54	231.97	192.98	437.59	483.17	471.57
Nov-15	479.7	276.06	318.19	289.1	497.3	534.03	531.05
	425.7	216.65	253.6	229.2	444.23	478.57	477.87
Dec-15	495.1	286.87	324.06	299.2	465.03	497.69	494.69
	437.35	226.07	258.8	239.3	410.61	440.96	440.82
Jan-16	369.05	262.06	300.16	275.31	525.5	558.68	562.82
	318.4	203.96	237.14	215.41	473.56	504.73	510.28
Feb-16	390.55	230.48	239.59	242.8	505.34	513.42	542.4
	346.1	174.08	181.81	182.9	454.42	461.99	490.3
Mar-16	518.55	251.19	292.83	258.58	483.07	517.48	514.11
	458.15	187.81	223.72	198.68	429.42	461.52	461.95
Apr-16	493.95	282.82	267.45	295.77	484.53	472.08	516.72
	437.45	223.48	209.34	237.81	431.19	419.43	464.14

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	484.6	304.71	296.44	317.1	547.29	541.42	583.33
	429.3	243.85	235.81	259.14	493.76	488.11	531.2
Jun-16	398.4	264.05	191.59	280.06	467.16	398.76	501.29
	358.3	209.73	147	222.09	416.04	352.47	448.44
Jul-16	435.95	315.99	287.63	330.25	496.36	471.9	528.11
	390.45	256.05	230.27	272.29	442.03	419.06	474.92
Aug-16	450.9	309.86	295.03	326.51	438.65	425.95	467.31
	397.55	252.36	238.47	268.55	384.64	372.64	413.07
Spt-16	476.45	340.01	340.45	354.99	498.43	499.98	529.06
	413.85	279.55	279.16	297.03	443.19	444.39	475.36
Oct-16	537.2	334.94	331.83	350.57	515.13	513.62	548.11
	483.2	275.17	271.62	292.6	460.67	459.03	494.73
Nov-16	440.75	320.39	285.94	337.54	562.43	532.56	601.71
	380.55	262.7	231.44	279.58	509.84	481.58	549.08
Dec-16	501.05	276.06	251.05	292.98	406.44	383.9	435.1
	445.1	221.91	199.36	235.02	354.56	333.61	380.92
Jan-17	408.35	313.43	254.27	328.34	455.54	401.56	484.18
	346.3	254.14	201.5	270.38	400.83	350.77	430.33
Feb-17	458.05	294.28	270.72	312.3	451.48	430.63	483.63
	407.95	239.87	218.38	254.34	399.65	380.09	429.76
Mar-17	431.85	310.33	274.19	329.17	447.15	414.01	478.35
	379.6	255.47	222.76	271.2	394.75	363.82	424.03

Source: Authors compilation

Table 42: Calculated option premiums and market premiums of Nifty IT call options.

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Apr-12	244.1	116.74	144.68	123.14	344.05	368	370.49
	212.2	65.53	85.61	64.82	296.2	318.04	320.96
May-12	992.4	122.69	123.8	127.29	199.98	200.97	212.39
	15.05	67.12	67.89	68.97	148.45	149.27	159.63
Jun-12	680.65	98.78	87.76	104.7	163.05	152.56	174.75
	602.1	50.97	43.89	46.38	115.23	106.87	121.36
Jul-12	468.45	128.8	141.72	133.33	173.44	185.16	182.79
	427.8	72.32	81.62	75.01	120.13	129.55	128.42
Aug-12	717.5	131.37	145.36	133.3	165.07	177.7	171.51
	642.2	71.28	81.31	74.98	109.06	119	116.8
Sep-12	319.7	146.73	170.75	148.25	174.37	196.37	179.9
	261.75	84.82	102.91	89.93	116.32	133.92	124.55
Oct-12	80.35	112.09	110.27	118.33	185.91	184.23	198.86
	64.85	61.51	60.27	60.01	136.68	135.3	145.71
Nov-12	409.05	114.48	131.6	120.05	178.17	193.56	189.77
	347.95	61.9	73.86	61.73	127.76	140.34	136.36
Dec-12	384	143.34	173.47	146.28	205.07	231.27	215.36
	327	83.27	105.99	87.96	150.49	172.43	161.88
Jan-13	349.25	126.94	152.21	131.38	162.55	185.65	170.89
	293.4	70.55	88.87	73.06	108.88	127.21	116.01
Feb-13	90	143.96	163.28	148.65	216.92	233.89	229.37
	60.05	85.94	100.47	90.33	163.68	178.05	183.83
Mar-13	4.65	127.65	120.94	134.64	152.09	145.61	161.39
	240	75.62	70.8	76.32	100.88	95.88	105.29
Apr-13	281.95	145.21	97.22	147.32	224.43	183.24	236.05
	247.95	82.59	48.31	86.54	169.51	134.89	182.18
May-13	1352.75	134.11	96.67	133.16	194.84	163.49	202.81
	1258.3	68.96	43.17	72.38	138.53	113	148.85
Jun-13	976.95	140.23	114.68	140.2	266.59	246.68	281.88
	460	75.6	56.75	79.42	213.29	195.84	230.12

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Jul-13	240	115.43	75.58	119.58	187.68	152.36	199.15
	431.85	59.24	33.14	58.8	135.75	107	145.14
Aug-13	66.65	149.68	96.01	152.44	412.14	368.27	441.1
	55.6	87.44	48.81	91.66	361.79	321.38	391.32
Spt-13	19.3	173.5	67.88	174.95	240.63	143.46	251.03
	19.45	108.14	33.06	114.17	183.08	102.45	196.17
Oct-13	427.6	159.09	123.93	162.1	221.89	191.36	232.52
	389.5	96.36	69.36	101.32	165.59	139.81	177.46
Nov-13	352.85	191.85	170.04	191.59	300.89	283.48	315.25
	315.6	124.03	105.61	130.8	244.2	228.61	261.91
Dec-13	232.1	137.38	132.84	144.01	224.7	221.61	239.55
	202.7	82.54	77.99	83.22	173.2	170.27	185.14
Jan-14	271.9	187.35	176.69	190.77	271.74	263.17	285.28
	241.2	123.14	113.43	129.99	215.16	207.36	230.66
Feb-14	61.9	177.45	149.85	183.24	293.25	270.24	311
	50.2	116.55	93.91	122.46	239.3	218.77	257.24
Mar-14	385	170.16	120.71	177.43	265.71	221.54	282.32
	105.95	112.01	73.33	116.65	212.37	173.86	227.71
Apr-14	978	192.49	187.64	197.59	286.15	282.56	301.7
	901.85	130.48	125.59	138.26	230.79	227.37	247.9
May-14	1257.2	192.24	174.79	197.38	299.97	285.51	316.92
	1169.85	130.28	115.37	138.05	245.16	232.15	263.56
Jun-14	751.75	184.4	154.08	189.57	268.79	242.44	283.33
	688.45	122.99	98.31	130.24	213.51	190.39	229.31
Jul-14	312.7	164.9	136.3	173.7	248.67	222.85	265.24
	277.7	110.43	87.44	114.37	196.94	174.41	210.78
Aug-14	253	192.49	168.9	200.2	260.25	239.24	274.94
	230.25	133.32	113.46	140.87	205.18	186.66	219.86
Spt-14	170.8	169.86	144.26	179.6	249.17	225.88	266.19
	150.25	116.88	95.85	120.28	198.1	177.65	211.29
Oct-14	233.9	196.57	166.32	206.13	314.59	288.04	335.28
	206.3	139.48	114.12	146.81	261.9	238	281.52
Nov-14	214.4	201.64	167.37	211.29	292.36	261.58	310.73
	184.2	144.17	115.46	151.97	238.77	211.36	256.11

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
Dec-14	251.25	247.88	208.11	254.29	362.91	328.51	382.29
	219.05	184.18	149.79	194.96	306.48	275.19	328.36
Jan-15	784.45	194.18	205.09	203.69	286.5	297.3	304.8
	729.85	137.26	145.18	144.37	233.33	242.54	250.31
Feb-15	675.65	199.01	193.67	209.59	289.58	285.66	308.6
	618.95	143.31	137.92	150.27	236.93	233.11	253.83
Mar-15	118.65	229.28	210.48	239.55	317.22	300.84	336.18
	113.1	170.26	153.5	180.22	262.35	247.4	281.21
Apr-15	594.1	197.94	308.11	203.61	309.15	401.11	326.8
	543.35	135.09	228.64	142.26	253.77	336.51	272.29
May-15	1624.9	204.61	246.59	207.2	768.26	799.38	825.35
	1534.65	138.35	173.18	145.85	719	748.89	777.16
Jun-15	855.1	197.59	192.24	202.32	315.44	310.87	333.2
	788.6	133.75	129.44	140.96	259.96	255.9	279.04
Jul-15	431.25	142.95	141.72	191.78	263.71	263.33	317.74
	388.4	144.61	145.49	130.43	264.57	265.25	263.49
Aug-15	594.5	142.83	139.64	214.3	187.7	185.35	258.35
	235.8	148.59	148.63	152.94	192.05	192.28	200.77
Spt-15	423.55	207.19	238.91	210.6	340.17	366.31	358.94
	330	141.54	167.82	149.24	284.41	307.98	305.24
Oct-15	421.1	177.73	192.17	185.05	371.83	384.01	397.48
	381.1	118.65	130.18	123.7	319.95	331.07	344.92
Nov-15	783.05	204.96	246.85	208.4	327.98	362.61	345.73
	733	139.46	174.25	147.05	271.98	303.1	291.79
Dec-15	1239.9	156.79	196.74	164.22	271.99	306.62	290.24
	1166.15	100.52	131.97	102.86	220.03	250.58	235.99
Jan-16	810.7	192.46	211.8	196.79	294.97	311.41	310.93
	740.75	128.53	144.21	135.44	239.04	253.58	256.41
Feb-16	440.7	166.8	185.08	173.88	282.93	298.79	301.22
	393.55	108.52	122.91	112.52	230.04	244.05	247
Mar-16	1059	175.46	96.24	180.13	284.25	211.88	300.67
	975.5	113.07	54.75	118.78	229.52	166.75	246.57
Apr-16	365.55	199.87	190.47	201.74	310.84	1148.23	326.54
	314.35	133.64	124.88	141.15	254.26	1050.83	272.76

Month and Year	Market Premium (Rs.)	Historical Volatility			GARCH Volatility		
		BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)	BS Model Premium (Rs.)	Black's Model Premium (Rs.)	Binomial Model Premium (Rs.)
May-16	298.9	201.06	188.02	202.73	331.78	321.74	349.41
	267.75	134.6	122.92	142.14	275.84	266.66	296.18
Jun-16	558.65	152.34	124.02	159.94	290.17	265.95	310.46
	508.9	97.1	74.82	99.36	239	217.41	257.12
Jul-16	753.25	201.51	155.07	202.77	302.56	263.59	316.94
	692	134.68	96.95	142.18	245.31	210.82	262.91
Aug-16	823.2	141.45	127.53	148.82	240.11	228.58	256.6
	755.95	87.61	76.19	88.23	189.06	178.87	202.27
Spt-16	959.3	142.79	149.14	149.7	230.67	237.22	245.86
	887.5	87.56	91.13	89.11	178.78	184.08	191.3
Oct-16	1026.65	187.64	141.45	188.68	273.4	234.25	285.82
	950.45	121.23	84.58	128.09	215.96	181.87	231.51
Nov-16	943.1	153.64	136.57	158.93	241.98	227.8	256.39
	866.9	94.3	80.44	98.35	188.18	175.77	202.08
Dec-16	520.8	132.69	102.2	139.49	239.9	213.04	256.57
	460.2	79.05	56.42	78.91	189.19	165.95	202.78
Jan-17	308.6	194.05	143.57	194.27	270.44	227.25	281.46
	266.8	126.64	86.42	133.68	211.91	174.47	226.78
Feb-17	288.1	178.7	151.49	180.92	275.82	253.35	289.91
	253.2	113.88	91.78	120.33	219.73	199.93	235.99
Mar-17	300.15	134.88	110.66	142.16	254.61	233.64	272.79
	263.6	82.23	63.67	81.57	204.42	186.01	219.17

Source: Authors compilation

APPENDIX-II

Publication of Research Paper:

i) Felcy R. Coelho and Y V Reddy (2017), Applicability of Black-Scholes and Black's Option Pricing Models in Indian Derivatives Market, The IUP Journal of Financial Risk Management, Vol XIV , No. 2, June 2017, pp.61-69.

ii) Felcy R. Coelho and Y V Reddy (2018), Pricing of Stock Options using Black-Scholes, Black's and Binomial Option Pricing Models, Management Today: An International Journal of Management Studies, Vol 8,No.1, January –March 2018, pp.103-108.