A Study on Black and Scholes Option Pricing Model for Selected Companies

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ABSTRACT

The Study on "Black and Scholes option pricing model" is a study that helps to classify the theoretical price of Call option and Put option of the contract. The value derived from the Black and Scholes model guides investor about how much premium the investor has to pay for entering into Call option and Put option Contract. In order to fulfil this study researcher have collected data of top 10 companies based on the market capitalization. Various data's such Stock price, Strike price, Volatility of stock, Risk free interest rate and Time to expiry. Paired Sample T-test, Greeks elements calculations were done for the analysis of data Black and Scholes model,

From the calculation of Black and Scholes model, the value of the premium was derived for 10 different stocks' options and at two different time period. By calculating the value of Call and Put option it was compared with Market value of Call and Put option through Paired Sample T-test and found that in most of case the model was found to be efficient as the calculated value of call and put option was equal to the market value of call and put option. In order to measure the Sensitivity of Call and Put option's Greek Elements calculation was used and found that Greek elements are important factors that clearly states that Delta, Gamma, Theta, Vega and Rho are important tool that -measures the sensitivity of call option and put option prices.

Keywords: Black and Scholes option pricing model, Call option, Put option, Premium, Volatility, Paired sample T-test, Greeks Elements.

I. INTRODUCTION

Black-Scholes model for calculating of an option was introduced in 1973 in a paper entitled, "The Pricing of Options and Corporate Liabilities" published in the Journal of Political Economy. This method developed by famous economists – Fischer Black, Myron Scholes and Robert Merton – is perhaps the most well-known options pricing model. Scholes and Merton were awarded the Nobel Prize in Economics for their work in finding a new method to determine the value of derivatives in the year 1997.B-S model is used to calculate the price of European put and call options. Greek letters in option pricing are commonly used as the sensitivities of an option price relative to changes in the value of either a state variable or a parameter (Hull, 2009).

The Black-Scholes model is used to calculate the theoretical price of European put and call options, ignoring any dividends paid during the option's lifetime. While the original Black-Scholes model did not take into consideration the effects of dividends paid during the life of the option, the model can be adapted to account for dividends by determining the ex-dividend date value of the underlying stock. The model makes certain assumptions, including:

- The options are European and can only be exercised at expiration
- Efficient markets (i.e., market movements cannot be predicted)
- No commissions
- The risk-free rate and volatility of the underlying are known and constant

The Black- Scholes formula takes the following variables into consideration:

- Current underlying price
- Options strike price
- Time until expiration, expressed as a percent of a year
- Implied volatility
- Risk-free interest rates

II. LITERATURE REVIEW

Jerlin Jose and Kanchan (2017) have conducted research on "A study on parameters of option pricing: The Greeks". Their main objective of study was to analyse the effect of Greeks in relation with options and measures the sensitivity of the various Greeks elements. Options have been obtained from the following sector: Finance, Fast Moving Consumable Goods (FMCG) and Power generation and distribution, Top performing company from the above industry have been shortlisted for Greek calculation. The stock and European option data of each company is taken for a period of one month i.e. Jan 2017. 91 days treasury bills rate 6.19% p.a. has been used as risk free rate of return for calculation. Annualized volatility has been used for calculation. From the study they found that Investor should wait for the time to increase in the value of underlying asset in case of HDFC and ITC to make Profit, they can generate in the money in case of Reliance Infrastructure, Investors should calculate sensitivity of the option before making any option trading decisions thus Financial tools like Greeks should be used by investors to manage their portfolio risk and derive expected returns on their investments.

John Hull and Alan White (2017) has conducted research on "Optimal Delta Hedging for Options". The main objective of study was to determine empirically a model for the minimum variance delta. The data of daily prices for the underlying asset, closing bid and offer quotes for options, and hedge parameters

based on the practitioner Black-Scholes model. We choose to consider options on the S&P 500, S&P 100, the Dow Jones Industrial Average of 30 stocks (DJIA), the individual stocks underlying the DJIA, and five ETFs. The assets underlying three of the ETFs are commodities, gold (GLD), silver (SLV) and oil (USO), Both European and American options on the S&P 100 were included in data set. The period covered by the data we used is January 2, 2004 to August 31, 2015. Using Black and Scholes model they concluded that the negative relation between price and volatility for equities means that the minimum variance delta is always less than the practitioner Black-Scholes delta, Call options on individual stocks and ETFs exhibit the same general behaviour as call options on stock indices, negative relation between asset price and implied volatilities for call option prices. When asset prices rise, implied volatilities decline resulting in an MV delta that is less than the practitioner Black-Scholes delta.

Dr. Benedict valentine Arulanandam, koh wei sin and Muchemi andrew muita (2017) have conducted research on "Relevance of Black-Scholes model on Malaysian KLCI options: an empirical study". The main objective of study was to propose an alternative or appropriate model for option pricing using Option Kuala Lumpur Index (OKLI) in Malaysia and to test the relevance of the current Black Scholes model on option pricing in the Malaysian derivatives market. The secondary data that was used in this research was collected from Bursa Malaysia website (via online) from 2nd of June to 7th of July 2014. Statistical tool for analysis was SPSS and Black and Scholes model. They found that Black Scholes was not so accurate when it comes to pricing options in Malaysian market. The evidence of this was seen after the forecast and transformation process where MAPE was used to check the accuracy of Black Scholes model by comparing it with 4F option pricing model. It was discovered that Black Scholes model has a MAPE of 78.5% while 4F option pricing model has a MAPE of 46.8%.

Arijit Santra and Binay Bhushan Chakrabarti (2017) have conducted research on "Comparison of Black Scholes and Heston Models for Pricing Index Options". Their main objective of study was to the performance of Heston Model and Black-Scholes Model in pricing index options, the two models based on 1074 call option prices of S&P 500 on1st November, 2016. In order to fulfil this study they have used Black and Scholes model and Heston model, from this study they concluded that both Heston Model and Black Scholes Model under-price in-the-money options and over-price out-of-the money options, but the degree of error is different. Black Scholes Model slightly outperforms Heston Model for short

term ITM, DITM and ATM options where Heston Model is unable to capture the high implied volatility. The implied volatility calculated from Heston model prices is found to be less than that calculated from market prices for different combinations of moneyness and time-to-maturity.

Manish Sharma and Dr. Kapil Arora (2015) have conducted research on "Study of Relevance of Black-Scholes Model in Indian Stock Option Market". Their main objective of study was to determine the theoretical prices of stock options using Black Scholes Option Pricing Model (BSOPM). For this study, the ten companies are selected from NIFTY. The one year historical closing price data of these ten companies and the index NIFTY is taken from Nov. 2012 to July 2013 for the period of one year for volatility computation and 780 samples of stock options are taken from 8th July 2013 to 24th July 2013. For the study they have used Black and Scholes pricing model and the paired sample t test is used between the Black Scholes Pricing Model value and the actual market prices of option contracts. From the analysis they concluded that most of the model prices are not near to the actual market prices which show the ineffectiveness of the model. In the given time duration, the Black Scholes model is not very much relevant. Infosys is the only share, in which the differences are not significant between model values and actual values in both call and put options. From paired sample t test we have come to know that out of 30 call option sets, the Null hypothesis is accepted in seven pairs which show that there is no significant difference between model price and actual price. In remaining 23 call option pairs, the null hypothesis is rejected; it shows that there is significant difference between model price and market price.

III. RESEARCH METHODOLOGY

Objective of study

- To determine the theoretical prices of stock options using Black Scholes Option Pricing Model.
- To analyse whether the option value derived from Black and Scholes model is similar or different as compared to market value
- To evaluate the option price sensitivity through Greeks calculation.

Research design: Descriptive research design

Sample size &Data collection

Secondary data is used in this study. It is collected from the nseindia.com website.

- The data of top 10 companies based on its market capitalization is selected from NSE.
- Strike price and spot price of stock is selected from the NSE
- Volatility data is taken from the NSE, which differs from the stock options to options.
- Expiry date is 28th December 2017 and Risk free interest rate is assumed at 6.25%.

Data Analysis Tool

Black and Scholes pricing model was used for valuation of call and put option and Greeks for measuring sensitiveness in price.

Option calculator is used to calculate the Greeks elements.

Paired Sample T-test is performed for comparative analysis.

IV. DATA AND EMPIRICAL RESULTS

- **Company Selection Criteria (Refer Table No.1)**
  The table no.1 is a data that shows the Top 20 companies according to their market capitalization, in order to fulfill objectives **Top 10 companies** are selected on based on the market capitalization. The top 10 companies under study were Reliance Industries, Tata Consultancy Service (TCS), HDFC Bank, ITC, Hindustan Unilever Limited (HUL), Maruti Suzuki, HDFC Corp., SBI, ONGC, Infosys.
- **Data for Black and Scholes Option Pricing Model (Refer Table No.2)**
  The table no.2 is a detailed data that has been used for the calculation of the Black and Scholes Option Pricing Model; the data used for the calculation are Spot price of stocks, Strike price of stock, Time to expiry/365, Risk free interest rate, Volatility of stocks.
- ***Value derived from Black and Scholes Model***
  Reliance Industries- (Refer Table No.3)
  From the table no.3 it is interpreted that at given data, such as Stock price of Reliance is 921, Exercise price or Strike price is 960, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for Reliance stock is 33.69 % at that time the value of Reliance call option premium is Rs 9.79 and the value for the put option premium is Rs 46.66. While at Stock price of 917.30, Exercise price of 900, Risk free rate of return is 6.25%, Time to expire

is 7 days and Volatility is 27.62% at that time the value of Reliance call option premium is Rs 29.94 and value of put option premium is Rs. 6.56.

Tata Consultancy Service- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price of Tata Consultancy service is 2543, Exercise price or Strike price is 2500, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for Reliance stock is 26.24 % at that time the value of Tata Consultancy service call option premium is Rs 77.76 and the value for the put option premium is Rs 29.20. While at Stock price of 2592.65, Exercise price of 2500, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 15.52% at that time the value of Tata Consultancy service call option premium is Rs 96.53 and value of put option premium is Rs. 0.89.

HDFC Bank - (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price of HDFC Bank is 1871, Exercise price or Strike price is 1900, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for Reliance stock is 18.44 % at that time the value of HDFC Bank call option premium is Rs 15.60 and the value for the put option premium is Rs 40.38. While at Stock price of 1697, Exercise price of 1680, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 15.81% at that time the value of HDFC call option premium is Rs 96.53 and value of put option premium is Rs. 0.89.

***ITC*- (Refer Table No.3)**

From the table no.3 it is interpreted that at given data, such as Stock price of ITC is 264.1, Exercise price or Strike price is 260, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for ITC stock is 23.68 % at that time the value of ITC call option premium is Rs 7.37 and the value for the put option premium is Rs 2.70. While at Stock price of 262.05, Exercise price of 260, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 20.13 % at that time the value of ITC call option premium is Rs 4.23 and value of put option premium is Rs. 1.87.

Hindustan Unilever Ltd. - (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price of Hindustan Unilever Ltd. is 1323.3, Exercise price or Strike price is 1320, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for of Hindustan Unilever Ltd. stock is 18.66 % at that time the value of Hindustan Unilever Ltd. call option premium is Rs 21.83 and the value for the put

option premium is Rs 15.60. While at Stock price of 1349.95, Exercise price of 1340, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 16.75 % at that time the value of Hindustan Unilever Ltd. call option premium is Rs 19.06 and value of put option premium is Rs. 7.51.

Maruti Suzuki- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price of Maruti Suzuki is 9150, Exercise price or Strike price is 9100, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for Maruti Suzuki stock is 21.16 % at that time the value of Maruti Suzuki call option premium is Rs 183.01 and the value for the put option premium is Rs 112.78. While at Stock price of 9621, Exercise price of 9600, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 24.03 % at that time the value of Maruti Suzuki call option premium is Rs 144.42 and value of put option premium is Rs. 111.92.

HDFC Corporation- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price HDFC Corp. is 1718, Exercise price or Strike price is 1700, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for HDFC Corp. stock is 17.36 % at that time the value of HDFC Corp. call option premium is Rs 34.87 and the value for the put option premium is Rs 13.09. While at Stock price of 1697, Exercise price of 1680, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 15.81 % at that time the value of HDFC Corp. call option premium is Rs 26.16 and value of put option premium is Rs. 7.14.

State Bank of India- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price SBI is 312.35, Exercise price or Strike price is 310, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for SBI stock is 36.19 % at that time the value of SBI call option premium is Rs 10.07 and the value for the put option premium is Rs 7.03.While at Stock price of 316.3, Exercise price of 315, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 27.48 % at that time the value of SBI call option premium is Rs 5.67 and value of put option premium is Rs. 4.

Infosys- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price Infosys is 1019, Exercise price or Strike price is 100, the Risk free return is

6.25%, Time to expiry is 13 days and Volatility for Infosys stock is 17.68 % at that time the value of Infosys call option premium is Rs 26.62 and the value for the put option premium is Rs 5.40. While at Stock price of 1021.5, Exercise price of 1020, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 20.93 % at that time the value of Infosys call option premium is Rs 13.21 and value of put option premium is Rs. 10.48.

Oil and Gas Commission- (Refer Table No.3)

From the table no.3 it is interpreted that at given data, such as Stock price ONGC is 183.15, Exercise price or Strike price is 182.5, the Risk free return is 6.25%, Time to expiry is 13 days and Volatility for ONGC stock is 27.4 % at that time the value of ONGC call option premium is Rs 4.32 and the value for the put option premium is Rs 3.26. While at Stock price of 187.95, Exercise price of 187.5, Risk free rate of return is 6.25%, Time to expire is 7 days and Volatility is 22.42 % at that time the value of ONGC call option premium is Rs 2.68 and value of put option premium is Rs. 2.

Paired Sample T-test for call option (Refer Table 4)

H0= Calculated value of call option is equal to the Market value of call option

H1= Calculated value of call option is not equal to the Market value of call option

From the table no.4, it can be interpreted that the P value of test is 0.04 which is less than 0.05, so here null is rejected and alternative is accepted and it can be said that calculated value of call option is not equal to the Market value of call option. But at Strike price 2, the P value of test is 0.06 which is more than 0.05, so here null is accepted and alternative is rejected and it can be said that calculated value of call option is equal to the Market value of call option.

- **Paired Sample T-test for put option (Refer Table 5)**

  H0= Calculated value of call option is equal to the Market value of put option

  H1= Calculated value of call option is not equal to the Market value of put option

  From the table no.5, it can be interpreted that the P value of test is 0.14 which is more than 0.05, so here null is accepted and alternative is rejected and it can be said that calculated value of put option is equal to the Market value of put option and at Strike price 2, the P value of test is 0.18 which is more than 0.05, so here null is accepted and alternative is rejected and it can

be said that calculated value of put option is equal to the Market value of put option.

- *Analysis of Greeks For Call Option at Strike Price 1 and Strike Price 2*
  (Refer Table 6)

  Delta, the most popular options Greek, measures an option's price sensitivity relative to changes in the price of the underlying asset, and is the number of points that an option's price is expected to move for each one-point change in the underlying. Delta is typically shown as a numerical value between 0.0 and 1.0 for call options and 0.0 and -1.0 for put options. In other words, options Delta will always be positive for calls and negative for puts.

  Vega, measures an option's sensitivity to changes in the volatility of the underlying, and represents the amount that an option's price changes in response to a 1% change in volatility of the underlying market.

  Gamma, measures the sensitivity of Delta in response to price changes in the underlying instrument and indicates how Delta will change relative to each one-point price change in the underlying. Gamma is used to determine how stable an option's Delta is: Higher Gamma values indicate that Delta could change dramatically in response to even small movements in the underlying's price.

  Theta, measures the time decay of an option – the theoretical dollar amount that an option loses every day as time passes, assuming the price and volatility of the underlying remain the same.

  Rho measures the sensitivity of option price in respect to changes in interest rate.

  From the table no.6, it can be interpreted that the highest Delta is of Infosys at Strike price 1 i.e. 0.961 and at Strike price 2 the highest Delta is of Tata Consultancy Service i.e. 0.741. The lowest Delta is of Reliance i.e. 0.279 at Strike price 1 and lowest Delta at Strike price 2 is of Infosys i.e. 0.542.

  The highest Gamma is of ITC at Strike price 1 i.e. 0.301 and highest Gamma at Strike price 2 is of ONGC i.e. 0.068. The lowest Gamma is of Maruti Suzuki both at Strike price 1 and Strike price 2 i.e. 0.001 and 0.001.

  The highest Vega is of Maruti Suzuki at both Strike price 1 and Strike price 2 i.e. 6.735 and 5.278. The lowest Vega is of ONGC at both the Strike price 1 and Strike price 2 i.e. 0.137 and 0.103.

The highest Theta is of Maruti Suzuki at both Strike price 1 and Strike price 2 i.e. -6.365 and -9.936 and the lowest Theta is of ONGC at both Strike price 1 and Strike price 2 i.e. -0.161 and -0.182.

The highest Rho is of Maruti Suzuki at both the Strike price 1 and 2 i.e. 1.839 and 0.982. The lowest Rho is of ONGC at both the Strike price 1 and Strike price 2 i.e. 0.035 and 0.019.

- **Analysis of Greeks For Put Option at Strike Price 1 and Strike Price 2**

From (Table 7), it can be interpreted that the highest Delta is of Reliance at Strike price 1 i.e. -0.721 and highest Delta is of Infosys at Strike price 2 i.e. -0.458. The lowest Delta is of Infosys i.e. is -0.259 at Strike price 1 and lowest Delta is of Tata i.e. -0.039 at Strike price 2.

The highest Gamma is of ONGC both at Strike price 1 and Strike price 2 i.e. 0.042 and 0.068 and the lowest Gamma is of Maruti Suzuki both at Strike price 1 and Strike price 2 i.e. 0.001 and 0.001.

The highest Vega is of Maruti Suzuki at both the Strike price 1 and Strike price 2 i.e. 6.735 and 5.278. The lowest Vega is of ONGC at both the Strike price 1 and Strike price 2 i.e. 0.137 and 0.103.

The highest Theta is of Maruti Suzuki at both Strike Price 1 and Strike price 2 i.e. -4.81 and -8.295. The lowest Theta is of ONGC at both the Strike price 1 and Strike price 2 i.e. -0.129 and -0.15.

The highest Rho is of Maruti Suzuki both at Strike price 1 and Strike price 2 i.e. -1.395 and -0.857. The lowest Rho is of ITC i.e. -0.019 at Strike price 1 and ONGC at Strike price 2 i.e. -0.017.

V. FINDINGS AND RECOMMENDATIONS

***From Black and Scholes option pricing model it was found that*:**

- The value of Reliance call option premium was Rs 9.79 at Strike price 1 and Rs.24.94 at Strike price 2. The value of Reliance Put option premium was Rs. 46.66 at Strike price 1 and Rs. 6.56 at Strike price 2.
- The value of Tata Consultancy Service call option premium was Rs 77.76 at Strike price 1 and Rs.96.53 at Strike price 2. The value of Tata Consultancy Service Put option premium was Rs. 29.20 at Strike price 1 and Rs. 0.89 at Strike price 2.
- The value of HDFC Bank call option premium was Rs 15.60 at Strike price 1 and Rs.26.16 at Strike price 2. The value of HDFC Bank Put option premium was Rs. 40.38 at Strike price 1 and Rs. 7.14 at Strike price 2.

- The value of ITC option premium was Rs 7.37 at Strike price 1 and Rs.4.23 at Strike price 2. The value of ITC Put option premium was Rs. 2.70 at Strike price 1 and Rs. 1.87 at Strike price 2.
- The value of HUL call option premium was Rs 21.83 at Strike price 1 and Rs.19.06 at Strike price 2. The value of HUL Put option premium was Rs. 15.60 at Strike price 1 and Rs. 7.51 at Strike price 2.
- The value of Maruti Suzuki call option premium was Rs 183.01 at Strike price 1 and Rs.144.42 at Strike price 2. The value of Maruti Suzuki Put option premium was Rs. 112.78 at Strike price 1 and Rs. 111.92 at Strike price 2.
- The value of HDFC Corporation call option premium was Rs 34.87 at Strike price 1 and Rs. 26.16 at Strike price 2. The value of HDFC Corporation Put option premium was Rs. 13.09 at Strike price 1 and Rs. 7.14 at Strike price 2.
- The value of SBI call option premium was Rs 10.07 at Strike price 1 and Rs. 5.67 at Strike price 2. The value of HDFC Corporation Put option premium was Rs. 7.03 at Strike price 1 and Rs. 4.00 at Strike price 2.
- The value of Infosys call option premium was Rs 26.62 at Strike price 1 and Rs. 13.21 at Strike price 2. The value of Infosys Put option premium was Rs. 5.40 at Strike price 1 and Rs. 10.48 at Strike price 2.
- The value of ONGC call option premium was Rs 4.32 at Strike price 1 and Rs. 2.68 at Strike price 2. The value of ONGC Put option premium was Rs. 3.26 at Strike price 1 and Rs. 2.00 at Strike price 2.
- From Paired Sample T-test it was found that:
- From Paired sample T-test for call option it was found that at Strike price 1, the calculated value of call option is not equal to the market value of call option because the p value (0.04) was less than the 0.05 but at Strike price 2 it was found that the calculated value of call option was equal to the market value of call option because the p value was (0.06) was more than the 0.05.
- From the Paired sample T-test for put option it was found that at Strike price 1, the calculated value of put option was equal to the market value of put option because the p value (0.14) which was more than the 0.05. At the same time at Strike price 2, the calculated value of put option was equal to the market value of put option because the p value (0.18) which was more than 0.05.

From Greeks calculation it was found that:

- From the analysis, it was found that Infosys at Strike price 1 and Tata Consultancy Services at Strike price 2 has the highest Delta that states that

both the stock has highest impact on the call option price as the asset's price changes.

- ITC at Strike price 1 and ONGC at Strike price 2 was having the highest Gamma that states that this both stock has highest movement of Delta when the asset price gets change.
- Maruti Suzuki has the highest Vega at both Strike price that states change in Volatility of Stock has highest impact on Maruti Suzuki's stock option.
- Maruti Suzuki has the highest Theta at both the Strike price that clearly states, as the time passes Maruti Suzuki will highly lose its call option price as compared to other Stock option.
- Maruti Suzuki has highest Rho at both the Strike price that means change in interest rate has highest impact on Maruti Suzuki call option price as compared to other stock option.
- From the analysis, the value of Delta, Gamma, Vega, Theta and Rho for put option are as under:
- From the analysis, it was found that Reliance at Strike price 1 and Infosys at Strike price 2 has the highest Delta that states that both the stock has highest impact on the put option price as the asset's price changes as compared to the other stock option.
- Highest Gamma is of ONGC at both the Strike price that states the ONGC has highest movement of Delta when the asset's price changes.
- Maruti Suzuki at both the Strike price has the highest Vega that means change in Volatility has highest impact on Maruti Suzuki put option price as compared to other stock option.
- Maruti Suzuki has the highest Theta at both the Strike price that clearly states, as the time passes Maruti Suzuki will highly lose its put option price as compared to other Stock option.
- Maruti Suzuki has highest Rho at both the Strike price that means change in interest rate has highest impact on Maruti Suzuki put option price as compared to other stock option.

VI. CONCLUSION

From the study of **"Black and Scholes option pricing model"** it was concluded that the model helps to determine the theoretical price of call option premium and put option premium. By using the following data such as Spot price of the stock option, Strike price of the option, Risk free return, Time to expiry and Volatility of Stock. Here in this study, by taking two different Strikes price of a stock and calculated the value of call option and put option. From the paired sample T-test it was concluded that in most of case the model was found to be efficient as the calculated value of call and put option was equal to the market value of call and put option. From the calculation of

Greeks it was concluded that the Greek elements are an important factors that clearly states that Delta, Gamma, Theta, Vega and Rho are important tool that measures the sensitivity of call option and put option prices.

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Table 1 - Company Selection Criteria

Company Name	Market Cap. (Rs. crs)	Company Name	Market Cap. (Rs. crs)
Reliance	5,87,052.44	Maruti Suzuki	2,77,309.50
TCS	4,90,239.48	HDFC	2,75,332.69
HDFC Bank	4,85,779.63	SBI	2,72,556.99
ITC	3,23,475.05	ONGC	2,34,848.20
HUL	2,84,953.60	Infosys	2,33,856.88

Table -2 Data used for Black and Scholes Option Pricing Model

Name	Reliance Indus.		TCS		HDFC- Bank Ltd	
Stock price	921	917.3	2543	2592.65	1871	1697
Exercise	960	900	2500	2500	1900	1680
RF	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Time to expiry	0.0356	0.0192	0.0356	0.0192	0.0356	0.0192
Volatility	0.3369	0.2762	0.2624	0.1552	0.1844	0.1581
Name	ITC		HUL		Maruti Suz.Ltd.	
Stock price	264.1	262.05	1323.3	1349.95	9150	9621
Exercise	260	260	1320	1340	9100	9600
RF	0.0625	0.0625	0.1	0.1	0.0625	0.0625
Time to expiry	0.0356	0.0192	0.0356	0.0192	0.0356	0.0192
Volatility	0.2368	0.2013	0.18661	0.1675	0.2116	0.2403
Name	HDFC CORP.		SBI		Infosys	
Stock price	1718	1697	312.35	316.3	1019	1021.5
Exercise	1700	1680	310	315	1000	1020
RF	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Time to expiry	0.0356	0.0192	0.0356	0.0192	0.0356	0.0356
Volatility	0.1736	0.1581	0.3619	0.2748	0.1768	0.2093
Name	ONGC					
Stock price	183.15	187.95				
Exercise	182.5	187.5				
RF	0.1	0.1				
Time to expiry	0.0356	0.0356				
Volatility	0.274	0.2242				

Table 3 - Value Derived From the Calculation of Black and Scholes Model

Name of Company	Value of call @ Strike price 1	Value of call @ Strike price 2	Value of put @ Strike price 1	Value of put @ Strike price 2
Reliance	9.79	24.94	46.66	6.56
Tata Consul.	77.76	96.53	29.2	0.89
HDFC- Bank	15.6	26.16	40.38	7.14
ITC	7.37	4.23	2.7	1.87
HUL	21.83	19.06	15.6	7.51
Maruti Suzuki	183.01	144.42	112.78	111.92
HDFC CORP.	34.87	26.16	13.09	7.14
SBI	10.07	5.67	7.03	4
Infosys	26.62	13.21	5.4	10.48
ONGC	4.32	2.68	3.26	2

Table 4 Output of Paired Sample T-test for Call option @ Strike Price 1 and Strike Price 2

	Cal. value of call @ Strike price 1	Market value of call @ Strike price	Calculated value of call @ Strike price 2	Market value of call @ Strike price 2
Mean	39.124	42.525	36.306	38.255
Variance	3016.342493	3509.298472	2175.514182	2467.514139
Observations	10	10	10	10
Pearson Correlation	0.998346662		0.999285277	
Mean Difference	0		0	
Df	9		9	
t Stat	-1.98336223		-1.74303339	
P(T<=t) one-tail	0.039316394		0.057650079	
t Critical one-tail	1.833112933		1.833112933	
P(T<=t) two-tail	0.078632788		0.115300158	
t Critical two-tail	2.262157163		2.262157163	

Table 5 Output of Paired Sample T-test for Put option @ Strike Price 1 and Strike Price 2

	Calculated value of put @ Strike price 1	Actual value of put @ Strike price 1	Calculated value of put @ Strike price 2	Actual value of put @ Strike price 2
Mean	27.61	25.58	15.951	13.305
Variance	1140.861556	859.78678	1146.361632	623.46611
Observations	10	10	10	10
Pearson Correlation	0.994824599		0.999057428	
Mean Difference	0		0	
Df	9		9	
t Stat	1.170184863		0.932002802	
P(T<=t) one-tail	0.135989788		0.187830151	
t Critical one-tail	1.833112933		1.833112933	

P(T<=t) two-tail	0.271979577		0.375660303	
t Critical two-tail	2.262157163		2.262157163	

Table 6 Cal. of Greeks Elements for Call Option at Strike Price 1 and Strike Price 2

	Name of Co.	Delta	Gamma	Vega	Theta	Rho
Strike price 1	Reliance	0.279	0.006	0.584	-0.799	0.088
	Tata	0.661	0.003	1.757	-2.048	0.571
	HDFC Bank	0.359	0.006	1.32	-1.049	0.234
	ITC	0.664	0.301	0.182	-0.194	0.06
	HUL	0.56	0.008	0.985	-0.83	0.256
	Maruti	0.584	0.001	6.735	-6.365	1.839
	HDFC Corp	0.658	0.007	1.191	-0.983	0.39
	SBI	0.57	0.018	0.231	-0.351	0.06
	Infosys	0.741	0.01	0.622	-0.548	0.26
	ONGC	0.555	0.042	0.137	-0.161	0.035
Strike price 2	Reliance	0.708	0.01	0.436	-0.967	0.12
	Tata	0.961	0.002	0.305	-0.748	0.459
	HDFC Bank	0.7	0.009	0.817	-1.121	0.223
	ITC	0.633	0.052	0.137	-0.224	0.031
	HUL	0.649	0.012	0.693	-0.976	0.164
	Maruti	0.547	0.001	5.278	-9.936	0.982
	HDFC Corp	0.7	0.009	0.817	-1.121	0.223
	SBI	0.563	0.033	0.173	-0.368	0.033
	Infosys	0.542	0.013	0.561	-0.932	0.104
	ONGC	0.552	0.068	0.103	-0.182	0.019

Table 7 Calculation of Greeks Elements for Put Option at Strike Price 1 and Strike Price 2

	Name of Co.	Delta	Gamma	Vega	Theta	Rho
Strike price 1	Reliance	-0.721	0.006	0.584	-0.635	-0.253
	Tata	-0.339	0.003	1.757	-1.621	-0.318
	HDFC Bank	-0.641	0.006	1.32	-0.724	-0.441
	ITC	-0.336	0.031	0.182	-0.15	-0.019
	HUL	-0.44	0.008	0.985	-0.605	-0.213
	Maruti	-0.416	0.001	6.735	-4.81	-1.395
	HDFC Corp	-0.342	0.007	1.191	-0.692	-0.214
	SBI	-0.43	0.018	0.231	-0.298	-0.05
	Infosys	-0.259	0.01	0.622	-0.377	-0.096
	ONGC	-0.445	0.042	0.137	-0.129	-0.03
Strike price 2	Reliance	-0.292	0.01	0.436	-0.813	-0.053
	Tata	-0.039	0.002	0.305	-0.32	-0.02
	HDFC Bank	-0.3	0.009	0.817	-0.834	-0.099
	ITC	-0.367	0.052	0.137	-0.18	-0.019
	HUL	-0.351	0.012	0.693	-0.747	-0.092
	Maruti	-0.453	0.001	5.278	-8.295	-0.857

	HDFC Corp	-0.3	0.009	0.817	-0.834	-0.099
	SBI	-0.437	0.033	0.173	-0.314	-0.027
	Infosys	-0.458	0.013	0.561	-0.757	-0.092
	ONGC	-0.448	0.068	0.103	-0.15	-0.017

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