ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 7, Issue 1, pp: (504-509), Month: January - March 2019, Available at: www.researchpublish.com

AN EMPIRICAL STUDY OF OPTION PRICING BY USING BLACK-SCHOLES MODEL FOR SELECT STOCKS OPTIONS FROM INDIAN STOCK OPTION MARKET

[1]Asst.prof. SRIYANK LEVI, [2]Asst. Prof. BR NARASIHA MURTHY,
[3]Asst.prof. SARAH MERLYN

[1]Research Scholar Jain University

[2]Dayanadasagar college arts science and commerce

[3]Lecturer, DSCASC, Bangalore

Abstract: **In this modern world, the finance has become imperative factor for financial eco system to be efficient with that the investment has also equal importance and it's an opportunity for every business and individual, one among them is option. Option pricing is a crucial factor for hedging and speculative activates. Value determination plays a decisive role for an option writer in financial eco system to maintain the balance and stability for the investors. Where Black-Scholes option pricing model is a widely accepted by the investor and research community for check the reliability European options pricing which available in the market. this study is an attempt to test empirically the relevance of B-Scholes options pricing model in Indian Derivative market with specific reference to select metal stock options. Results of the paired sample T-test revealed that there is no significant difference between the expected option prices calculated thorough Black-Scholes Model and market price of options for majority call option contacts but visa versa for put option contacts, in three out of six cases. It can be inferred that model is relevant for metal stocks. So the investor can always employ the B-Scholes model for their investment strategies.**

Keywords: **Finance, Eco system, option, call, put, Black-Scholes, model, investor.**

1. INTRODUCTION

Option pricing and relevance of the price of option is a very important in the one of speculative markets like derivatives markets. Accurate pricing of options eliminates the arbitrage opportunity. Mainly hedgers and speculators are found the derivatives market where their common types investment in derivatives instruments like futures, options, forwards and swaps. Quantum of speculation is more in case of stock market derivatives. Pricing is relevant for both speculators and hedgers. There are two important models for option pricing – Binomial Model and B-Scholes Model. B-Scholes model is widely accepted for European style of option. The present study is an attempt to study the relevance of B-Scholes model in Indian Derivative market with specific reference to select metal stock options in Nifty index.

2. REVIEW OF LITERATURE

Fischer Black and Myron Scholes (1973) the actual options prices deviate in certain systematic ways from the values predicted by the formula. Option buyers pay prices that are a formula. Option writers, however, receive prices that are at about the level of predicted by the formula. There are large transaction costs in the option market, all of which are effectively paid by option buyers. The difference between the price paid by option buyers and the value given by the formula is greater for options on low-risk stocks than the options on high risk stocks.

Gurdip B, Charles C and Zhiwu (1997) regardless of performance yardstick, taking stochastic volatility into account is the first order importance in improving upon the Black-Scholes formula. To rationalize the negative skewness and excess kurtosis implicit on option prices, each model with stochastic volatility requires highly implausible levels of volatility return correlation and volatility variation.

S. Mc Kenzie, D. Gerace and Z. Subedar (2007) the Black Scholes odel is relatively accurate. Comparing the qualitative regression models provides evidence that the Black Scholes model is significant at the 1 per cent level in estimating the probability of an option being exercised. All variables of each regression model exert expected signs of economical significance. The results based on a method of maximum likelihood indicate that the factors of the Black-

Scholes collectively are statistically significant. The qualitative regression models also illustrate the significance of the Black-Scholes model under a logistic distribution is superior to a lognormal distribution. Indicating that the use of a jump-diffusion approach increases the tail properties of the lognormal distribution increases the statistical significance of the Black-Scholes model. The second stage least squares approach to test significance of the qualitative regression models provides significance at the 1% level Lal Dev Pandey and Mihir Das (2013),

GAARCH (1,1) and Black-Scholes model can be used for pricing of index (call and put) and stock (put options) in the Indian stock market. The differences between model and actual prices vary based on time effect. GAARCH and BS Model provides better results for put options and call options with lesser volatility and fewer days to expiry. The results of paired sample T-test show that there is no significant difference between the model and market values.

J. Orlin Grabbe (1983) has explored a set of inequality-equality constraints on rational pricing of foreign currency options, and has developed exact pricing equations for European puts and calls when interest rates are stochastic. The assumption that relevant variables follow diffusion processes allows us to set up a riskless hedge that uses no wealth, and which therefore must have a zero return in equilibrium. The construction of this hedge yields a partial differential equation whose solution is the European call option value. The put option equations are obtained immediately from the call equations through a put-to-call conversion equation that holds for FX options. Finally, it was shown that for sufficiently high values (low values) of the spot rate relative to the exercise price, American calls (puts) will be exercised prior to maturity. Hence (for positive interest rates) American FX options have values strictly greater than European FX options was shown that for sufficiently high values (low values) of the spot rate relative to the exercise price, American calls (puts) will be exercised prior to maturity.

Hence (for positive interest rates) American FX options have values strictly greater than European FX options the riskless rate of return one could use as a proxy the T-Bill rate or LIBOR, suitably adjusted to provide an instantaneous rather than annual rate. For the variance rate, standard deviation various possibilities exist for its estimation

Objectives

1. To Understand the historical volatility of the underlying stocks of select of options.

2. To study the relevance of Black-Scholes Option pricing model on pricing of call and put options

Hypothesis

Ho: There is no significant disparity between the model prices and market prices.

Ha: There is a significant disparity between the model prices and market prices.

Research Design

This study is an applied research as it intends to find the relevance of Black-Scholes Model in Indian Derivative Market. Study population constitutes all the stock options traded on NSE. Deliberate Sampling method is applied. Banking stock options are selected, as banking stocks are less volatile. Two actively traded banking stock options are selected. Sample comprises IDBI Bank and Andhra Bank. The historical data has been collected from the NSE website.

Annualized volatility has been computed based on the daily closing prices of the calendar year 2016 (from April 1 2015 to March 31 2016). Interest on 6.9 Government securities 2019 is taken as proxy for risk free rate.

Actual option prices of January, February and March 2016 are used for comparing with the model prices. Pricing is made in one-month advance for two strike prices, one at the ITM and another one OTM.

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Black – Scholes Option Pricing Model

The Black-Scholes model for pricing stock options was developed by Fischer Black, Myron Scholes. It is widely accepted option pricing model. The model takes into account, spot price, variance, and strike price, time to expiry and risk free rate. The formula for computing option price is as under:

Formula

Call Option Premium

$$c = SN(d_1) - Ke^{-rT}N(d_2)$$

$$d_1 = \frac{\ln(\frac{S}{K}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln(\frac{S}{K}) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

Put Option Premium

$$p = X e^{-rt} N(-d2) - S_0 N(-d1)$$

Relevance of Black-Scholes Model

The call and put option price for calculated of select stocks through Black-Scholes Option Pricing Model. The inputs used for the study are:

Annualized volatility computed on the basis of financial year 2015-16 data (Hindalco Industries Ltd – 0.39, SAIL - 0.359 and Tata Steel - 3315), risk free rate is 6.9 Government Securities 2019 (existing rate - 0.809) and rest of the inputs are portrayed in the relevant tables. Paired sample T-test is applied to compare the actual option prices prevailing in the market with the option prices calculated as per Black-Scholes Option Pricing Model.

Table 1.1: Hindalco Industries Ltd Call Option Prices

Observed date (Underlying closing Price in Rs.)	Date of expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (154.75)	January 25, 2016	150	9.75	8.6366
		160	4.75	3.7335
January 25, 2016 (190.75)	February 23, 2016	185	12.25	10.9373
		195	7.1	5.8110
February 23, 2016 (182.1)	March 30, 2016	180	9.65	9.3001
		185	7.35	6.8629

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.2: SPSS Output for Paired Sample T- Test for Hindalco Call Option

Particulars	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	0.9281	0.4121	0.1683	0.4956	1.3606	5.517	5	0.003

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From the above calculation table 1.1 showing the market and B-Sholes model premium for call option of the Hindalco Company. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.2 is less than 0.05. Hence, null Hypothesis is rejected. There is a significant difference between the expected price and actual price of the Hindalco company call options

Table 1.3: Hindalco Industries Ltd Put Option Prices

Observed date (Underlying closing price in Rs.)	Date of Expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (154.75)	January 25, 2016	150	4.3	3.3127
		160	9.2	8.3713
January 25, 2016 (190.75)	February 23, 2016	185	6.2	4.4089
		195	12.1	9.2404
February 23, 2016 (182.1)	March 30, 2016	180	6.85	6.2710
		185	9.35	8.8080

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.4: SPSS Output for Paired Sample T- Test for Hindalco Put Option

Particulars	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	1.2646	0.9034	0.3688	0.3166	2.2126	3.429	5	0.019

From the above calculation table 1.3 showing the market and B-Sholes model premium for put option of Hindalco Company. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.4 is less than 0.05. Hence, null Hypothesis is rejected. There is a significant difference between the expected price and actual price of the Hindalco company put options

Table 1.5: Steel Authority of India Limited Call Option Prices

Observed date (Underlying closing price in Rs.)	Date of Expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (49.4)	January 25, 2016	47.5	2.85	2.8795
		52.5	0.8	0.6417
January 25, 2016 (62.05)	February 23, 2016	60	3.8	3.8121
		65	1.7	1.3110
February 23, 2016 (60.1)	March 30, 2016	57.5	5.2	4.0320
		62.5	1.95	1.5000

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.6: SPSS Output for Paired Sample T- Test for Steel Authority of India Ltd Call option.

Particulars	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	0.3539	0.4455	0.1819	-0.1136	0.8215	1.946	5	0.109

From the above calculation table 1.5 showing the market and B-Sholes model premium for call option of Steel Authority of India Limited. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.6 is greater than 0.05. Hence, null Hypothesis is accepted. There is no significant difference between the expected price and actual price of the Steel Authority of India Limited call options

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Table 1.7: Steel Authority of India Limited Put Option Prices

Observed date (Underlying closing price in Rs.)	Date of Expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (49.4)	January 25, 2016	47.5	1.4	0.7978
		52.5	4	3.5409
January 25, 2016 (62.05)	February 23, 2016	60	1.95	1.0597
		65	5.25	3.5375
February 23, 2016 (60.1)	March 30, 2016	57.5	1.45	1.1352
		62.5	3.7	3.5774

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.8: SPSS Output for Paired Sample T- Test for Steel Authority of India Ltd. Put Option.

Particulars	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	0.6836	0.5673	0.2316	0.0883	1.2789	2.952	5	0.032

From the above calculation table 1.7 showing the market and B-Sholes model premium for put option of Steel Authority of India Limited. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.8 is less than 0.05. Hence, null Hypothesis is accepted. There is a significant difference between the expected price and actual price of the Steel Authority of India Limited put options

Table 1.9: Tata Steel Call Option Prices

Observed date (Underlying closing price in Rs.)	Date of Expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (392.35)	January 25, 2016	390	14.7	14.145
		400	10.25	9.5034
January 25, 2016 (469.5)	February 23, 2016	450	31.1	28.0552
		470	19.85	16.0710
February 23, 2016 (485.75)	March 30, 2016	480	20.7	21.8593
		490	15.95	16.7710

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.10: SPSS Output for Paired Sample T- Test for Tata Steel Call Option

Particulars	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	1.0176	2.0090	0.8202	-1.0907	3.1259	1.24	5	0.27

From the above calculation table 1.9 showing the market and B-Sholes model premium for call option of Tata Steel company. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.10 is greater than 0.05. Hence, null Hypothesis is accepted. There is no significant difference between the expected price and actual price of the Tata Steel company put options

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Table 1.11: Tata Steel Put Option Prices

Observed date (Underlying closing Price in Rs.)	Date of Expiration	Strike price (Rs.)	Market premium (Rs.)	Model Premium* (Rs.)
December 29, 2016 (392.35)	January 25, 2016	390	11.45	10.3424
		400	16.6	15.6230
January 25, 2016 (469.5)	February 23, 2016	450	9.75	6.6617
		470	18.4	14.5934
February 23, 2016 (485.75)	March 30, 2016	480	14.3	13.6317
		490	18.95	18.4918

***** *Expected Premium is calculated through Black-Scholes Option Pricing Model.*

Table 1.12: SPSS Output for Paired Sample T- Test for TATA Steel Put Option

Particulars	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the difference				
				Lower	Upper			
Pair 1 Market Premium Model Premium	1.6843	1.4031	0.5728	0.2118	3.1568	2.94	5	0.032

From the above calculation table 1.11 showing the market and B-Sholes model premium for put option of Tata Steel company. Through our analysis we have found from employing Paired Sample T- Test at 95% Confidence Interval, the result shows that p value of SPSS output as shown in Table 1.12 is less than 0.05. Hence, null Hypothesis is accepted. There is a significant difference between the expected price and actual price of the Tata Steel company put options

3. CONCLUSION

The paper is an effort to understand the Pricing of an option which is very important for the participants buyers and sellers of the option contract. B-Scholes option pricing model is applied for metal stocks in this study. The Paired sample T-test results indicate that this model can be applied for metal stock options. However, in majority of put option out of six cases, there is a difference between expected price and market price of the option. Options may be under- priced or overpriced in the market. Hence, it is advised to find expected option price through BSOP Model can be computed before entering into an option contract.

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