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OPTION PRICING IN INDIAN OPTIONS MARKET USING BLACK-SCHOLES OPTION PRICING MODEL

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ABSTRACT

As of February, 2019, options contracts (calls and puts) with weekly maturity has been introduced in the NIFTY50 benchmark index in the National Stock Exchange, India after the success in its other indexes of NIFTYBANK and NIFTYIT. We have assessed how this introduction has impacted the pricing of the such derivative contracts. Black Scholes Options Pricing Model was introduced in the 1970s, and since then has been the holy grail in option pricing. Our research determines whether the formula retains its efficiency with a reduced time to maturity, as is the case with the newly introduced weekly options. The study conducted here spans over a period of 3 months starting from 1st March, 2019 to 30th May, 2019. This period also includes a key event in India, i.e., the Lok Sabha election results. In this period, the market tends to behave in an irrational manner in a run up to such events. Thus, our study assesses the impact of the event on the prices of the options (both weekly and monthly expiry). The results illustrate how option pricing using the BSOP model behaves for the options with a weekly maturity. It also identifies any mis-pricing as a result of key external factors.

KEYWORDS- BLACK SCHOLES OPTION PRICING MODEL, PUT OPTION, CALL OPTION, EFFICIENCY, WEEKLY, MONTHLY, NIFTY50

1 Introduction

Derivatives trading was commenced in June 2000 in India after the approval from the Securities Exchange Board of India with its debut in the two nationally recognised exchanges of the country, namely the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) and from then there has been an enormous growth in this sector. In initial times, only index futures based on the stock and other exchanges were approved by SEBI, after which subsequently options contracts were also approved to be traded. In recent times, trading volumes in derivatives are higher than the cash market. Higher volatility, increasing awareness and risk management are some of the major reasons for the growth of derivatives in Indian market.

Due to this, price calculation of the options and proper selection of models has become more important for the traders in this market. There are several models which have been developed with time for a calculation of fair price for option contracts. The Black and Scholes Model being developed in 1973 for option pricing is a highly used and accepted model for pricing. This model of option pricing is based on the fundamental principle that in the future, the price of an underlying asset either decreases or increases when compared to the spot price of the underlying asset. Though several criticisms were made by several authors and researchers and with time several modifications and new models were advised for option pricing like the Cox-Ross-Rubinstein which is also known as Binomial Theory, Monte-Carlo Simulation method, introduction of GARCH volatility etc. Factors like high-risks and involved complexity gave rise to the formation of these other models by these researchers and other economists. Several of these models have resulted in success due to the ability to forecast future volatility but again some are much difficult to implement. But, with respect to globalization, these models have worked efficiently in both developed and developing countries like in India.

The National Stock Exchange (NSE) of India with its benchmark NIFTY50 stock index used to offered index options with monthly maturity i.e., options that expired in the last Thursday of every month. Options trading contributes approximately 80% of the total trading volume in the exchange. The NSE with its NIFTYBANK index, earlier launched weekly maturity options contracts back in the year 2016 which turned out to be a huge success as the no. of contracts traded surged by 98% from the year 2017 where 800,401,601 contracts were traded to 1,587,426,222 contracts in 2018 which along with time became the world's most traded index options. *(Singaravelu, 2019)*

With the success in the NIFYBANK index, NSE also launched weekly options contracts in order to attract more volume of trade in the derivatives market. The weekly contracts were made available to trade from February 11, 2019 with its first expiry on February 14, 2019 followed by February 21 being the second week of such expiry. Such option contracts inherited the existing characteristics where there would be seven consecutive weekly expiry contracts followed by three monthly options contracts, eight half-yearly contracts and three quarterly contracts. When Thursdays are trading holidays, the previous trading day is considered to be the expiry day. Strike intervals for both monthly and weekly contracts remain the same.

In favour of the weekly options contracts with the monthly options contracts, weekly contracts need lesser premium as compared to the monthly contracts due to the lessened time factor. Due to change with maturity both will have different decay and behaviour profile. Again, weekly contracts increase the liquidity which can also be interpreted that there is a significant increase in the volume of trade. *(Technologies, 2019)*

2 Theoretical Background

2.1 Black Scholes Option Pricing Model

The Black Scholes Option Pricing model is a model that helps to calculate the price of an option contract. It considers a several factors like the price of the underlying instrument along with the implied volatility which finally gives us the value of an option. It was developed by three economists namely, Robert Merton, Fischer Black and Myron Scholes in the year of 1973 which later won the Nobel prize in 1997. It makes some assumptions while deriving the option prices:

- The option is European and can only be exercised at expiration.
- No dividends are paid out during the life of the option.
- Markets are efficient (i.e., market movements cannot be predicted).
- There are no transaction costs in buying the option.
- The risk-free rate and volatility of the underlying are known and constant.
- The returns on the underlying are normally distributed.

(Black & Scholes, 1973)

In mathematical notation:

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

$$d_1 = \frac{\ln\left(S/K\right) + \left(r + s^2/2\right)t}{s \cdot \sqrt{t}}$$

$$d_2 = d_1 - s \cdot \sqrt{t}$$

C = Call premium
S = Current stock price
t = Time until option exercise
K = Option striking price
r = Risk-free interest rate
N = Cumulative standard normal distribution
e = Exponential term

s = St. Deviation
ln = Natural Log

2.2 Operational Definitions *(investopedia.com)*

- **Derivatives:**

  A derivative is a financial security with a value that is reliant upon or derived from, an underlying asset or group of assets—a benchmark. The derivative itself is a contract between two or more parties, and the derivative derives its price from fluctuations in the underlying asset.

- **Options:**

  An options contract is an agreement between two parties to facilitate a potential transaction on the underlying security at a preset price, referred to as the strike price, prior to the expiration date.

- **Call Option:**

  Call options are financial contracts that give the option buyer the right, but not the obligation, to buy a stock, bond, commodity or other asset or instrument at a specified price within a specific time period.

- **Put Option:**

  A put option is a contract giving the owner the right, but not the obligation, to sell a specified amount of an underlying security at a pre-determined price within a specified time frame.

- **NIFTY50 Index:**

  The NIFTY 50 index, National Stock Exchange of India's benchmark broad based stock market index for the Indian equity market. Full form of NIFTY is National Index Fifty. It represents the weighted average of 50 Indian company stocks in 13 sectors.

- **Index Option:**

  An index option is a financial derivative that gives the holder the right, but not the obligation, to buy or sell the value of an underlying index, such as the NIFTY50, at the stated exercise price on or before the expiration date of the option. No actual stocks are bought or sold; index options are always cash-settled, and are typically European-style options.

3 Literature Review

Options and derivatives have been placed in the limelight of financial use since the inception of the benchmark option pricing model in 1973 which has also given birth to several areas of studies and research in the present times. Many people studied and researched the validation of such models, by comparing or modifying, leading to single objective. In this section, we will go through some past studies conducted by these researchers which is relevant to our subject. It was believed that if options are correctly priced in the market, it should not be possible to make sure profits by creating portfolios of long and short positions in options and their underlying stocks. Thus, by this idea, a theoretical valuation formula for options was derived. This formula can also be used to derive the discount that should be applied to a corporate bond because of the possibility of default. Later, this formula was named as the Black-Scholes Model. For derivation purpose, seven assumptions were made by the authors. The study was mainly aimed at finding any deviation between calculated prices and actual prices. Other findings also highlighted the factors behind these differences *(Black & Scholes, 1973)*.Later this model was used to study its significance in Indian stock markets and also the difference between the calculated prices and the actual prices. It was said that the calculated fair values are no way near to the actual values thus the ineffectiveness of the model. It is partially relevant and can be made effective by considering all other constraints of the model. *(Sharma & Arora, 2015)*. Several investigations were conducted by methods of empirical studies to choose the best model on calculating option prices by making a comparison between three different models, depending on many previous studies which presented large investigations about the outperforming of models on pricing of options. It was concluded that the effect is variable depending on the different type of moneyness, viz., In-the-money, At-the-money and Out-of-the money and the descriptive statistics elucidates all models are overpriced than the current prices in all categories especially in In-the money category

because of the high level of fluctuation, that leads to the conclusion that investors use option contracts for speculation purposes and also other regression analysis focus to examine the best model in predicting the current prices, where the estimation shows that the Monte Carlo Simulation method is out-performing when the volatility is lower, and the Binomial model is performing in Out-of-the money category *(Bendob & Bentouir, 2019)*. In the case of Black-Scholes model for option pricing, by using GARCH volatility, it was observed that pricing efficiency improved significantly and among all other option pricing models used in studies on the use of GARCH volatility in the pricing equations, it was found that Blacks model is more efficient followed by Black-Scholes model and Binomial option pricing model *(Coelho & Reddy, 2018)*. Attempts were made to study the efficiency of the theoretical prices of the options based mainly on the BSOP model in order to portray the importance of these theoretical prices behind the influences in decision making of traders and speculators. It was also said that differences in calculated and theoretical prices arise due to several transaction prices where buyers pay a price and option writers receive a different price. Descriptive Statistics says that out-of-the-money and deep out-of-the-money options exhibits a relatively higher fluctuation as indicated by the values of its coefficient of variation and the results of the regression analysis highlights that R-squared value is quite larger for at-the-money options, in-the-money options and deep-in-the-money options. Very low value of R-square can be observed for deep out-of-the-money options. So, it was inferred that the Black-Scholes model performs well in predicting the market price of the call options except in the case of options which belong to out-of-the-money and deep out-of-the-money categories *(Sudhakar & Srikanth, 2016)*. As per Black-Scholes model is concerned net open interest of stock option was a very significant variable in determining the future spot price of an underlying stock. In a developing country like India, there is extremely limited participation of institutional investors in the Indian stock derivative market because of regulatory restrictions; as such investors are allowed to use derivative securities mainly for hedging and arbitrage purposes only *(Srivastava, Yadav, & Jain, 2008)*. Many researchers modified the Black-Scholes Model for research purposes. It was done by adding some more and new variables on the basis of an assumption related to risk-free interest rate and a process to calculate the new risk-free interest rate was made on the basis of the modified variable. This included three types of risk factors in the existing Black-Scholes model which replaces the risk free interest rate variable and was observed that it had a better and a powerful outcome which reduces the differences with the theoretical prices significantly *(Khan, Gupta, & Siraj, 2013)*. Lastly, several Causality Relationships between Equity Price in Cash Market and its underlying Call and Put

Options in Derivatives Market, Equity Volume Traded in Cash Market and its underlying Call and Put Options in Derivatives Market were studied in order to facilitate Implied Volatility, Open interest and Trading volume in Indian derivatives markets which made it possible to develop strategies for buying of call and put options *(Sharma & Arora, 2012)*.

4 Research Design

4.1 Research Gap

Past Studies made on this subject had a focus on determining the efficiency of the Black Scholes Option Pricing model on several financial options that have been traded on the basis of selected companies (e.g.: TCS, Reliance etc.) or a particular market sector (e.g.: Banking, FMCG etc.) on a chosen index (e.g.: NSE, NYSE etc.). Our focus is to study the NIFTY50 option that has a strike price equivalent to the Nifty index points with a weekly maturity of every Thursday which has been implied in Indian Futures & Options Market from February 2019, on which no studies have been conducted yet. A comparative analysis of the impact on the weekly and monthly option maturity to date is non-existent.

4.2 Research Questions

- What is the impact on pricing from the change of maturity date?
- Are the previous models efficient enough to determine prices of such options?
- If calculated, what will be the difference from the actual prices with the calculated prices?
- What is the reason for such differences, if any?
- How is the pricing affected by external events?

4.3 Objectives

- To study the impact of the impact on pricing from the change of maturity date.
- To determine the efficiency of the BSOP model on the NIFTY50 options of weekly maturity post February, 2019.
- To determine the difference in empirically calculated prices and the actual prevailing market prices.
- To analyse the reason for these differences, if any.
- To study the effect of external events on option pricing.

4.4 Hypothesis

- Hypothesis 1:
  Reduced time to expiry of weekly NIFTY50 Options does not cause a significant divergence from theoretical price as computed using BSOP.

- Hypothesis 2:
  Monthly Call prices, weekly and monthly Put prices violate the theoretical price due to excessive demand from market participants in a run up to key events, but not weekly Call prices.

4.5 Scope

Our scope is confined to the study of NIFTY50 options only traded in NSE, India as our objective is to study the impact of change in the maturity date which has only been applied to NIFTY50 options. Moreover, Indian derivative markets use European options as it is less volatile as compared to the American options. So, we inherently need to depend on these European options for the research.

4.6 Limitations

Limitations comprises of the low availability of data as it has only been a few months that such options have come into existence. Moreover, there exists minute difference between the strike price and the underlying price of NIFTY50 options, which is difficult to eliminate without compromising the objective of the study. The market sentiments also influence the prices of options which are difficult to capture.

5 Data Description

In the following analysis we are trying to analyse the differences between the actual option prices in the market with the theoretically calculated prices with the help of Black Scholes Option Pricing model. We segregated our study in two parts where we calculate prices of Call and Put options with weekly maturity as well as Call and Put options with monthly maturity. The period of our analysis is confined to a period of three months i.e., from 1st March, 2019

to 30th May, 2019. This period consists of three monthly maturity dates and thirteen weekly maturity dates. Every Thursday is an expiry/ maturity date for the weekly options contracts and every last Thursday of the month is the expiry/ maturity date for the monthly option contracts. This period is selected as first weekly options in India was traded on 14th February, 2019. In order to make an equivalent comparative study between monthly and weekly maturity dates, this period has been selected. In this study, we used at-the-money options with respect to the closing NIFTY50 levels for every trading day.

In order to suffice the variables of Black Scholes Option Pricing model we used:

- **Closing NIFTY50 level** of each trading day as the underlier stock price.
- **Nearest Strike price** in the multiples of 50 in which Futures and Options are traded in the Index.
- Time until expiration is calculated as

$$\frac{\text{(Number of days left to expiry)}}{365}$$

- Risk-Free interest in India is considered to be **6.78%.**
- The volatility level is considered to be the **Implied volatility** level of the particular option contract of the very particular date based on the specific Strike Price.
- Actual prices, Settlement Prices are derived from the official **National Stock Exchange of India (NSE)** website with respect to specific date, maturity date and strike price.

6 Data Analysis

Using our theoretical price and actual price of the options, we calculated the difference between the two and came to a conclusion that if the difference exceeds 1 or -1, it would indicate that the pricing is inefficient and if it is within the range from 1 to -1, it would be considered that the pricing is comparatively efficient as it is not possible to tap the exact value due to several other factors.

We calculated this difference for both Call and Put options with weekly and monthly expiry. This calculation as mentioned above is for a period of three months, starting 1st March 2019 to 30th May 2019. The difference is derived by subtracting the actual market prices from the theoretically derived prices from the Black Scholes Option Pricing Model.

During this period we test our first hypothesis that the transition from monthly to weekly options does not cause a divergence of actual prices from the theoretical prices.

In case of call options:

TABLE 1: CALL OPTIONS

WEEKLY CALL OPTIONS					MONTHLY OPTIONS		
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**		**Theoretical BSOP Price**	**Closing Price**	**Difference**
01-Mar-19	84.07	83.5	-0.57		206.40	206.4	0.00
05-Mar-19	41.30	41.3	0.00		166.11	166.4	0.29
06-Mar-19	25.09	25.1	0.01		165.76	165.7	-0.06
07-Mar-19	0	5.95	0		160.19	160.25	0.06
08-Mar-19	55.26	55.25	-0.01		143.30	142.35	-0.95
11-Mar-19	55.75	55.75	0.00		150.27	150.35	0.08
12-Mar-19	45.96	45.95	-0.01		138.80	138.4	-0.40
13-Mar-19	20.91	20.9	-0.01		125.64	125.4	-0.24
14-Mar-19	0	0.8	0		125.93	125.65	-0.28
15-Mar-19	64.92	64.7	-0.22		120.08	119.95	-0.13
18-Mar-19	61.17	61.15	-0.02		131.62	132.1	0.48
19-Mar-19	24.04	24.05	0.01		101.98	102.1	0.12
20-Mar-19	0	19.5	0		111.36	111.35	-0.01
22-Mar-19	80.58	80.6	0.02		80.52	80.6	0.08
25-Mar-19	67.98	68	0.02		67.82	68	0.18
26-Mar-19	52.09	52.1	0.01		51.99	52.1	0.11
27-Mar-19	34.29	34.3	0.01		34.22	34.3	0.08
28-Mar-19	0	9.9	-		0	9.9	-
WEEKLY CALL OPTIONS					MONTHLY OPTIONS		
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**		**Theoretical BSOP Price**	**Closing Price**	**Difference**
29-Mar-19	100.47	100.45	-0.02		233.54	234.3	0.76
01-Apr-19	84.59	84.6	0.01		222.11	222.9	0.79
02-Apr-19	64.35	64.35	0.00		209.97	209.95	-0.02
03-Apr-19	43.90	43.9	0.00		207.02	207.55	0.53
04-Apr-19	0	1.25	-		194.14	194.25	0.11
05-Apr-19	83.97	83.95	-0.02		202.88	203.4	0.52
08-Apr-19	64.58	64.6	0.02		176.98	177.25	0.27
09-Apr-19	64.60	64.6	0.00		180.68	180.65	-0.03
10-Apr-19	33.60	33.6	0.00		155.41	155.2	-0.21
11-Apr-19	0	1.5	-		151.39	151.4	0.01
12-Apr-19	74.23	74.25	0.02		123.21	122.9	-0.31
15-Apr-19	43.66	43.65	-0.01		100.28	100	-0.28
16-Apr-19	25.21	25.2	-0.01		85.41	85.45	0.04
18-Apr-19	0	6.1	-		73.03	72.55	-0.48
22-Apr-19	66.71	66.7	-0.01		66.71	66.7	-0.01
23-Apr-19	38.34	38.05	-0.29		38.34	38.05	-0.29
24-Apr-19	21.06	21.05	-0.01		21.25	21.05	-0.20
25-Apr-19	0	4.35	-		0	4.35	-
26-Apr-19	41.14	41.15	0.01		336.20	336.8	0.60
30-Apr-19	26.95	26.95	0.00		311.56	312.15	0.59

The above table depicts the call option prices from the date of 1st March to 30th April, 2019. As from the data it can be interpreted that the model works efficiently throughout the time with an acceptable level of difference within the specified range.

In case of Put Options:

TABLE 2: PUT OPTIONS

WEEKLY PUT OPTIONS					MONTHLY PUT OPTIONS		
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**		**Theoretical BSOP Price**	**Closing Price**	**Difference**
01-Mar-19	58.98	58.9	-0.08		143.26	142.65	-0.61
05-Mar-19	49.48	49.4	-0.08		139.42	138.95	-0.47
06-Mar-19	31.68	31.6	-0.08		133.76	133.6	-0.16
07-Mar-19	0	0.3	-		119.41	119.3	-0.11
08-Mar-19	68.89	68.45	-0.44		120.01	119.25	-0.76
11-Mar-19	42.80	42.65	-0.15		105.57	105.5	-0.07
12-Mar-19	39.40	39.3	-0.10		106.87	106.75	-0.12
WEEKLY PUT OPTIONS					MONTHLY PUT OPTIONS		
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**		**Theoretical BSOP Price**	**Closing Price**	**Difference**
13-Mar-19	34.70	34.65	-0.05		111.49	110.9	-0.59
14-Mar-19	0	4.4	-		96.15	95.4	-0.75
15-Mar-19	64.13	64.2	0.07		101.86	101.65	-0.21
18-Mar-19	36.90	36.75	-0.15		86.18	86.25	0.07
19-Mar-19	32.38	32.4	0.02		82.95	82.7	-0.25
20-Mar-19	0	0.15	-		56.54	56.4	-0.14
22-Mar-19	58.54	58.5	-0.04		58.54	58.5	-0.04
25-Mar-19	47.42	47.45	0.03		47.42	47.45	0.03
26-Mar-19	40.87	40.75	-0.12		40.87	40.75	-0.12
27-Mar-19	29.40	29.45	0.05		29.40	29.45	0.05
28-Mar-19	0	1.65	-		0	1.65	-
29-Mar-19	71.25	70.8	-0.45		156.56	156.85	0.29
01-Apr-19	45.43	45.4	-0.03		137.04	136.35	-0.69
02-Apr-19	45.94	45.95	0.01		134.16	134.05	-0.11
03-Apr-19	28.25	28.1	-0.15		132.71	131.9	-0.81
04-Apr-19	0	3	-		116.85	116.9	0.05
05-Apr-19	48.00	47.5	-0.50		97.61	97.25	-0.36
08-Apr-19	46.72	46.5	-0.22		103.23	102.65	-0.58
09-Apr-19	30.50	30.2	-0.30		89.66	89.35	-0.31
10-Apr-19	30.16	30	-0.16		101.44	101.05	-0.39
11-Apr-19	0	3.45	-		84.01	83.45	-0.56
12-Apr-19	49.84	49.25	-0.59		84.20	83.7	-0.50

15-Apr-19	43.03	42.85	-0.18			76.66	75.95	-0.71
16-Apr-19	30.91	30.6	-0.31			67.49	66.95	-0.54
18-Apr-19	0	0.7	-			51.09	50.65	-0.44
22-Apr-19	47.77	47.45	-0.32			47.77	47.45	-0.32
23-Apr-19	52.69	52.65	-0.04			52.69	52.65	-0.04
24-Apr-19	33.43	33.4	-0.03			33.43	33.4	-0.03
25-Apr-19	0	6.75	-			0	6.75	-
26-Apr-19	50.43	49.9	-0.53			274.60	274.6	0.00
30-Apr-19	34.49	34.35	-0.14			270.80	272.1	1.30

The above table depicts the put option prices from the date of 1st March to 30th April, 2019. As from the data it can be interpreted that the model works efficiently throughout the time with an acceptable level of difference within the specified range.

In the case of monthly options:

TABLE 3: MONTHLY OPTIONS

MONTHLY CALL OPTIONS					MONTHLY PUT OPTIONS		
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**		**Theoretical BSOP Price**	**Closing Price**	**Difference**
02-May-19	305.33	306.45	1.12		292.87	293.55	0.68
03-May-19	343.25	344.4	1.15		280.03	281.35	1.32
06-May-19	360.49	362.65	2.16		307.10	308.05	0.95
07-May-19	350.28	352.15	1.87		312.52	314.3	1.78
08-May-19	349.32	350.8	1.48		195.19	195.15	-0.04
09-May-19	318.06	320.05	1.99		285.18	286.95	1.77
10-May-19	303.01	304.55	1.54		300.08	301.8	1.72
13-May-19	321.68	323	1.32		253.87	255	1.13
14-May-19	319.22	320.7	1.48		287.23	288.3	1.07
15-May-19	314.80	317	2.20		295.66	297.2	1.54
16-May-19	310.88	312.95	2.07		272.81	274.5	1.69
17-May-19	299.75	301.6	1.85		274.52	276.15	1.63
20-May-19	248.47	250.1	1.63		239.64	241	1.36
21-May-19	273.89	275.9	2.01		262.80	264.45	1.65
22-May-19	293.74	295.4	1.66		263.45	265.35	1.90
23-May-19	**149.06**	**149.85**	**0.79**		**112.11**	**112.15**	**0.04**
24-May-19	95.75	95.6	-0.15		74.53	74.4	-0.13
27-May-19	56.73	56.5	-0.23		84.34	84.45	0.11
28-May-19	55.05	55.2	0.15		59.96	60	0.04
29-May-19	42.69	42.85	0.16		30.37	30.3	-0.07
30-May-19	0	2	0		0	5.05	0

If we observe the above data for the month of May, it can be said that the pricing difference exceeds our stipulated range of 1 to -1 for both the Calls and the Put Options. Moreover, this difference exists from 2nd May, 2019 till 22nd May, 2019. However, again interestingly, the same difference ceases to exist post the declaration of the election results i.e., after 23rd May, 2019.

In the case of Weekly Call Options:

TABLE 4: WEEKLY CALL OPTIONS

WEEKLY CALL OPTIONS			
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**
03-May-19	79.18	79.2	0.02
06-May-19	71.54	71.55	0.01
07-May-19	54.06	54.05	-0.01
08-May-19	51.46	51.45	-0.01
09-May-19	0	3.4	0
10-May-19	93.85	93.85	0.00
13-May-19	84.46	84.45	-0.01
WEEKLY CALL OPTIONS			
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**
14-May-19	72.01	72	-0.01
15-May-19	42.00	42	0.00
16-May-19	0	1	0
17-May-19	251.49	251.5	0.01
20-May-19	203.45	203.45	0.00
21-May-19	207.39	207.4	0.01
22-May-19	209.00	209	0.00
23-May-19	**0**	**6.65**	**-**
24-May-19	95.63	95.6	-0.03
27-May-19	56.52	56.5	-0.02
28-May-19	55.19	55.2	0.01
29-May-19	42.86	42.85	-0.01
30-May-19	0	2	0

Even in the case of weekly call options, through observation and derivation of the values it can be said that call options go at par with the prices of the actual market prices of weekly call options and the theoretically derived prices from the Black Scholes Option Pricing Model of the weekly call options and remains within the range which makes the model efficient even at the week of a run up event.

In the case of Weekly Put Options:

TABLE 4: WEEKLY CALL OPTIONS

WEEKLY PUT OPTIONS			
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**
03-May-19	43.33	42.75	-0.58
06-May-19	50.10	50.15	0.05
07-May-19	193.54	193.9	0.36
08-May-19	27.73	27.65	-0.08
09-May-19	0	4.4	-
10-May-19	99.54	99.4	-0.14
13-May-19	76.02	76.3	0.28
14-May-19	55.23	55.3	0.07
15-May-19	38.24	38.2	-0.04
16-May-19	0	10.75	-
17-May-19	237.93	239.6	1.67
20-May-19	202.43	203.85	1.42
21-May-19	190.32	191.55	1.23
22-May-19	180.56	182	1.44
23-May-19	0	7.1	-
24-May-19	74.53	74.4	-0.13
27-May-19	84.34	84.45	0.11
28-May-19	59.96	60	0.04
WEEKLY PUT OPTIONS			
Date	**Theoretical BSOP Price**	**Closing Price**	**Difference**
29-May-19	30.37	30.3	-0.07
30-May-19	0	5.05	-

Here, in the case of weekly put options, it can be observed through the above data that the values of the put options go at par with the prices of the actual market prices of weekly put options and the theoretically derived prices from the Black Scholes Option Pricing Model of the weekly put options and remains within the range. However, in the week of the elections result, the difference is significantly more and exceeds the range of 1. Thus, the Black

Scholes model becomes inefficient when it comes to the pricing of put options at the time of a run up event.

Thus, on the basis of an overall analysis of the above data during the month of the elections, we observe that the difference between theoretical and actual prices in the monthly option contracts move out of the range of 1 and -1. Generally, the actual market prices are higher than the calculated theoretical prices. Thus, difference can't be completely neglected. When it comes to the case of weekly prices, call and put options holds up with the Black Scholes Model for the entire month except that the Put options shows inefficiency as the difference moves out of the specified range in the week of the election results and so it indicates that the option pricing using Black Scholes Option Pricing Model tends to be inefficient. This is the case for both weekly and monthly call and put options except weekly call option. This shows that the Black Scholes pricing model becomes inefficient when it comes to derive prices in a run up to key events, i.e., increased demand and volatility in the market.

7 Conclusion

On the basis of our study that is conducted on the time period of 1st March, 2019 to 30th May, 2019 we conclude that:

7.1 General Pricing of Nifty50 Index Options

5.1.1 The prices derived from the usage of Black Scholes Option Pricing model is not much different from the prevailing actual market prices.

5.1.2 Based as an extension of the available literature it can be said that, studies on this subject is based on individual discretion for the selection of the specified variable.

5.1.3 It can be concluded that consideration of Implied volatility in place of historical volatility or the IndiaVIX in the Black Scholes formula, gives more efficient results than past researches.

5.1.4 Black Scholes Option Pricing Model works efficiently when it comes to calculate prices of options contracts with monthly maturity when the time variable is comparatively high.

5.1.5 Black Scholes Option Pricing Model also works efficiently and predicts close values when it comes to calculate option prices with lower time variable, i.e., with weekly maturity.

5.1.6 Thus, it can also be said that in normal circumstances, introduction of weekly expiry options doesn't alter the efficiency of the Black Scholes Option Pricing Model even for a developing country like India.

7.2 Alternate Conclusion

Black Scholes Option Pricing Model works on certain assumptions made on behalf of the entire market. But when these assumptions fail to satisfy, the model accordingly fails to work efficiently and thus cannot show relevant prices. It lags behind with certain gaps.

In a volatile and dynamic world of finance, factors changes in fraction of seconds. It is very hard to work on a predefined environment and hence with predefined variables. Factors change and it is very normal. There are many factors that the Black Scholes Option Pricing Model fails to tap. For example, dividends are not considered while calculating option prices. But dividend is a normal and natural part of stocks and companies. Similarly, it doesn't or consider other factors like market demand and supply and market sentiments like a run up event in the economy of the specific country.

On the basis of our study, we observe that when markets behave normally, Black Scholes Option Pricing Model works efficiently and thus predicts relatable price which can be used by trader while making his/her trading decisions. Thus, prices calculated in the period of 1st March to 30th April, 2019, prices are quite similar to actual market prices. But when there are events which have an indirect impact to the economy, market works with certain undefinable anomaly. In this case, May 2019 witnessed the Lok Sabha Elections in India which did have an indirect impact on the economy based on the discretion of every individual.

In our observation, there were several anomalies created in the market in the month of May, 2019. On a general basis, call option prices rise when the market moves in a bullish trend. In other words, people bet on the upside of the market and vice versa for put options i.e., put option prices rise when markets are on a bearish trend. But in our study, for the month of May, at times there were situations when the prices of the put options as well as for the call options were rising on bullish trend. This signified that people were investing heavily on both the possibilities of the market. Again, the average volatility in the market i.e., IndiaVIX was

on an all-time high which supports the above fact. Such acts created an anomaly which lead to differences between the theoretically derived prices and the actual market prices. Again, the differences settled once the election results were declared on 23rd May, 2019. Thus, that confirms our anticipation. Though our study, was based on at-the-money options, it might vary depending on the moneyness of the option.

Another conclusion can also be derived that in this market moves, there were many speculators who were only participating to book timely rewards by exercising several strategies in the live market.

Put options had a higher difference than call options which can also be interpreted as there were more participants in the markets who believed a bullish rally in the market and thus had a higher demand for calls. Such demand and supplies are not considered by the Black Scholes Option Pricing model, thus showing its inefficiency.

On an overall basis, as an extension of the literature available it can be said that the Black Scholes Option Pricing model is much inefficient when it comes to today's dynamic world as there are a lot of factors to be taken into consideration when predicting such prices and is needed to be considered. Though, changing of maturity date from monthly to weekly in Indian markets didn't have much of an impact on the pricing efficiency as in both the cases, in normal market conditions it worked efficiently and in the other condition it failed. Though call prices were predicted efficiently though that can also be explained with other reasons such as demand and supply.

8 Suggestions

In this study, we made an attempt to test the Black Scholes Option Pricing model in Indian markets where option contracts with shorter maturity of every week was introduced on 14th Feb, 2019. We tested the efficiency of the model on the new maturity dates along with a comparison with the similar monthly maturity options contracts considering at-the-money option contracts. Along with that we tapped a time period when there was a run up event causing an economic impact, thus effecting the trading behaviour of the market. Based on our findings and above conclusions we would recommend that other approaches to test the efficiency of the model would be beneficial with different corrections in the variables used or even needed by making twitches in the formula itself. Further study can be recommended on such event which causes economic effect so that it can be confirmed that such anomaly is truly not considered by the Black Scholes Option Pricing model or is it an-one-time event.

There are scopes of making studies on different moneyness of options to truly test the efficiency of the model even after changes in the maturity date. Studies can be made for a longer term as our study is based on a period of three months. The trader/ investor sentiments can be tested and monitored by way of collecting primary data and using them to facilitate a study. Again, our research was confined only to the NIFTY50 index. More studies can be made on other indexes like NIFTYBANK or the NIFTYIT of the same exchange. Different exchanges can also be attempted. Lastly, studies can also be made on the volatility factor of the option pricing model with several corrections or newer ideas can be facilitated in order to have a strong price predictor in the world of derivatives.

References

[1] Bendob, A., & Bentouir, N. Options Pricing by Monte Carlo Simulation, Binomial Tree and BMS Model: A comparative study. *Journal of Banking and Financial Economics, 1(11)*, 2019, 79-95.

[2] Black, F., & Scholes, M. The Pricing of Options & Corporate LiabilitieS. *Chicago Journals, 81(3)*, 1973, 1-19.

[3] Coelho, F. R., & Reddy, D. Y. Pricing of Options in Indian Derivatives market- An Emperical Study. *University of Goa,* Taleigao, Goa, 2018, 1-312

[4] Khan, M. U., Gupta, A., & Siraj, S. Empirical Testing of Modified Black-Scholes Option Pricing Model. *International Journal of Economics and Financial Issues, 3(1)*, 2013, 87-98.

[5] Sharma, M., & Arora, D. An Analytical Study of Price Discovery of Equity Options in India. *JK Lakshmipat University*, 2012, 1-12.

[6] Sharma, M., & Arora, K. Study of Relevance of Black-Scholes Model in Indian Stock Option Market. *International Journal of Advanced Research and Innovative Ideas in Education, 1(4)*, 2015, 324-334.

[7] Singaravelu, K. *Nifty 50 Weekly Options Makes A Stellar Start.Mumbai: Bloomberg Quint, 2019*

[8] Srivastava, S., Yadav, S. S., & Jain, P. K. Significance of Non-Price Variables in Price Discovery: An Empirical Study of Stock Option Market in India. *Vikalpa, 33(2),* 2008, 15-23.

[9] Sudhakar, A., & Srikanth, P. Analysis of The Efficacy of Black-scholes Model - An Empirical Evidence from Call Options on Nifty-50 Index Pacific. *Pacific Business Review International, 9(5),* 2016, 94-102.

[10] Technologies, R. *Everything You Need to Know About The New Nifty Weekly Contract.Mumbai: Medium,* 2019