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OPTION PRICING BY USING BLACK-SCHOLES MODEL: A STUDY WITH SPECIAL REFERENCE TO SELECT BANK STOCKS LISTED IN NSE

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Abstract
Models used to price options account for variables such as current market price, strike price, volatility, interest rate, and time to expiration to theoretically value an option. Some commonly used models to value options are Black-Scholes, binomial option pricing, and Monto carlo simulation. Black-Scholes is a pricing model used to determine the fair price or theoretical value for a call or a put option based on six variables such as volatility, type of option, underlying stock price, time, strike price, and risk-free rate.

Keywords: Option pricing, Black-Scholes Model, Derivative Trading.

Introduction

Today, Derivatives trading is worth $600 trillion – six times more than the total economic output of the entire world. The Indian stock market is one of the most attractive places for the investors all over the world, because of the attractive returns on equities and other instruments. The two main stock exchanges for equity trading in India are the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE). An option is a type of financial derivative that represents a contract between the seller (option writer) and the buyer (option holder), which offers the buyer the right, not the obligation, to execute the contract. The options contract allows the buyer to buy (or sell) a security or other financial asset at an agreed-upon price (strike price) during a certain period or on a specific date. In 1975, Black emphasized that there are some good reasons for the growing popularity of option trading, such as the fact that the brokerage charge for taking position in options can sometimes be lower than the charge for the equivalent position directly in the underlying stocks. Derivative contracts exist on a variety of commodities such as corn, pepper, cotton, wheat, silver, etc. besides commodities. Derivatives contracts also exist on a lot of financial underlying assets like stocks, interest rates, exchange rates, etc. In 1976, Cox and Ross introduced several alternative jump and diffusion processes, and provided solutions for the limiting diffusion cases and for the single-stage forms of the jump processes. The explicit solutions have potential empirical applications and a comparative study of them should give additional insight into the structure of security valuation. Derivative products initially emerged as hedging devices against fluctuations in commodity prices. Financial derivatives came into the spotlight in the post-1970 period due to growing instability in the financial markets. However since their emergence, these products have become popular and by 1990s, they accounted for about two – thirds of total transactions in derivative products. In recent years, the market for financial derivatives has grown tremendously in terms of instruments available, their complexity and also turnover.

Objectives of the study

The study has been done to find out the relevance of Black-Scholes Option pricing model on pricing of call and put options.

Need for the Study

The Black Scholes model is the first and the most widely used model for pricing options. The model and associated call and put option formulae have revolutionized finance theory and practice, and the surviving inventors Merton and Scholes received the Nobel Prize in Economics in 1997 for their contributions. It would, therefore, be interesting to empirically examine the accuracy and statistical significance of Black Scholes model especially with the evidence from India. It is evident from the review of literature that the researchers have tried to explore the statistical and economical significance of the model at different levels, yet there are very few studies in this field in relation to the country which have done the overall empirical investigation of Black Scholes model in the long run. Keeping this consideration in mind, the present study"Option Pricing by Using Black-Scholes Model: A Study with Special Reference to Select Bank Stocks Options".

Options have several advantages over futures and forward contracts.

- Less Risky
- Less Expensive
- More Leverage
- Flexibility

Research Methodology

The study is an applied research as it intends to find the relevance of Black-Scholes Model in Indian Derivative Market. The 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. The Sample comprises of public and private sector banks. In private sector banks five banks are included i.e., ICICI Bank, HDFC Bank, Kotak Mahindra Bank, Axis Bank, and IndusInd Bank. In public sector banks State bank of India, Indian bank, Central Bank of India, Canara bank and Bank of India selected.

Literature Review

Upputuri, S., Prasad, M. S. V., & Sri, S. (2021) the word risk is a distinctive characteristic of the most fabulous commodity markets. Fluctuations in the prices of farming and non-agricultural products are produced, over time, by demand-supply dynamics. The latest two decades have observed a many-fold improvement in international trade and business volume due to the barrage of globalization and liberalization sweeping across the world. It has managed to rapid and random fluctuations in financial assets costs, interest rates, and exchange rates, consequently showing the corporate world an unwieldy financial risk. In the present highly unpredictable industry scenario, the importance of risk management is much greater than ever before. The emergence of the derivatives market is an ingenious feat of financial engineering that provides a reasonable and less costly solution to risk embedded in the underlying asset's price unpredictability. India's experience with the equity derivatives market has been extremely positive over the years. The study conducted an attempt to analyze the derivative market over the years, and an analysis and a comparative study of the NSE and BSE attempted representatives of percentage analysis, trend, and CAGR.

Prabakaran S. (2020) pointed out in his research study that there has been a continuing economic and political discussion on whether financial markets used to secure risk traditionally hedged within other channels in recent years. These debate discussions include altering equity-linked life insurance contracts, funded pension schemes, and insurance derivatives. To modify these financial products to

cater to the needs of the different financial markets, both actuaries and finance experts will have to get to make out better the field of other experts. The research study suggests that combining all the mathematical finance and insurance mathematics methods shoul prove indispensable.

It necessitates a substitute way of insurance that resulted in an increasing number of insurance products entering into the financial market that contains an economic component of some nature. This approach provides derivation and formulation of alternative pricing formula of the Black - Scholes option that completely avoids the ambiguous, ironic, and controversial Black-Scholes assumptions concerning continuous delta hedging trading, zero transaction costs, risk fewer arbitrage opportunities, and infinite continuous divisibility of invested size. The author feels that to precisely derive the fair pricing formula of the Black-Scholes option, one should assume that, on average, the fundamental has a float equal to the risk-free rate. To account for other substances, the researcher resort to the insurance option fair pricing with the same natural assumptions.

Golbabai, A., & Nikan, O. (2020) attempted to review the pricing double barrier options in the case change in underlying price is reflected in a fractal transmission system. It is well stated that due to the appearance of enormous fantasy influence in the divided derivatives, approximating financial options concerning their inherited properties can be well described and stated. As a result, comparatively stable and efficient numerical procedures must be found while allowing incomplete differential equations. The foremost aim of the paper is to attain the estimated answer of the time-fractional BS model of order $0<\alpha\leq 10<\alpha\leq 1$ overriding European options based on the moving least-squares method. In the suggested process, initially, the mentioned equation is discredited in the sense of time based on restricted difference format of order $O(\delta t2-\alpha)O(\delta t2-\alpha)$ and then estimated by the MLS loom in the space variable. Additionally, the immovability and convergence of the advised scheme are discussed in detail during the paper. Numerical verification and comparisons exhibit that the recommended technique is exact and efficient.

Shah P. (2019) stated that price volatility participates a severe role in option pricing. With the help of drive pointers of functional analysis, one can understand the foreseen high volume of price volatility. It manages to a very high amount of development in option prices. The authorstates that Commodity Channel Index (CCI) is one of the essential technical investigation tools that help assess drive and a hint of future volatility in prices. The present investigation proposed recognizing the significant increase in option price with a minimum level of risk using CCI. The historical data of NSE's NIFTY index was also examined based on the stipulated rules of CCI in exhibiting strong force and consequently formulating a long position in correspondence to the Money option agreements. The writer also asserts that the risk portion and return of practicing this trading device in NIFTY selection were calculated using Return, Strike Rate, Maximum Loss Zone, Average increase to Average Loss Ratio, and its importance.

Varma (2003) has studied volatility, using data for a short period of time from June 2001 to February 2002, on Nifty Future and options prices under the Black-Scholes model. He suggests that the volatility is severely mispriced because of the imperfection of the Indian market and market is learning and the impact of learning effects can be seen over a long period of time.

Nagendran, R., & Venkateswar, S. (2014) mentioned in their research paper that Derivatives trading was initiated in India in 2001, and the trade price of derivatives was approximately three times that of cash market trade worths. Nevertheless, 20% of the options were offered by the NSEthat is traded on

an active basis. It is possibly due to the need for education to the investor regarding options and their pricing methodology. It is opined that a research study on option pricing in India will enable the investors to be aware of the mechanism that is available for option pricing and its use considered as an instrument to prevaricate risks. This particular empirical research paper employs beyond 95,000 call options to examine the validity of the (BS) model in Indian Stock Optionspricing. The research results demonstrated the robustness of the BS model in pricing stock options in India and that pricing is an additional pick-up by integrating volatility into the model.

Black and Scholes Model

Black-Scholes is a pricing model used to determine the fair price or theoretical value for a call or a put option based on six variables such as volatility, type of option, underlying stock price, time, strike price and risk-free rate. The quantum of speculation is more in case of stock market derivatives, and hence proper pricing of options eliminates the opportunity for any arbitrage. There are two important models for option pricing – Binomial Model and Black-Scholes Model. The model is used to determine the price of a European call option, which simply means that the option can only be exercised on the expiration date.

Option pricing and relevance of the price of option is very important in one of speculative markets like derivatives markets. Accurate pricing of options eliminates the arbitrage opportunity. Mainly hedgers and speculators are found in 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 Black-Scholes Model. The Black-Scholes Model is widely accepted for European style of option.

Black-Scholes model in pricing stock options in India and that is further improved by incorporating implied volatility into the model.

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**

Description: Black-Scholes pricing model is largely used by option traders who buy options that are priced under the formula calculated value, and sell options that are priced higher than the Black-Scholes calculated value (1).

The formula for computing option price is as under (2):

Call Option Premium C = SN(d1) - Xe- rt N(d2)

Put Option Premium P = Xe–rT N (–d2) – S0 N (-d1)

d1 = [Ln (S / X) + (r + s2 / 2) X t] --- s Öt d2 = [Ln (S / X) + (r - s 2 / 2) X t] ---- s Ö

Here,

C = price of a call option

P = price of a put option

S = price of the underlying asset

X = strike price of the option
r = rate of interest
t = time to expiration
s = volatility of the underlying
N represents a standard normal distribution with mean = 0 and standard deviation = 1

- **Put Option Premium**

$p=Xe^{-rt}N(-d2) – S_o N(-d1)$

Data Analysis

The analysis aims to calculate the option price through the Black-Scholes model. The essential variables used in the Black-Scholes model include: Price of the underlying asset (S) is a current market price of the asset. The strike price (K) is a price at which an option can be exercised.Time until expiration (T) is the time among calculation and an option's exercise date

Null hypothesis

There is no significant difference between BS model values and actual market values of select public and private sector banks

Procedure

Table,Paired t-test for BS model values and actual market values of select public and private sector banks

Bank	Model	Mean	SD	t	p
ICICI Bank	Average Fair Price	2.301	19.924	-1.204	0.031*
	Average Actual Price	2.457	19.874		
HDFC Bank	Average Fair Price	2.854	18.247	-2.104	0.038*
	Average Actual Price	2.248	18.201		
Kotak Mahindra Bank	Average Fair Price	2.658	20.140	-3.004	0.004**
	Average Actual Price	2.487	19.247		
Axis Bank	Average Fair Price	2.108	19.924	-4.253	0.021*
	Average Actual Price	2.221	18.364		
IndusInd Bank	Average Fair Price	2.308	18.201	-3.247	0.201
	Average Actual Price	2.451	20.147		
State Bank of India	Average Fair Price	2.284	21.254	-3.257	0.011*
	Average Actual Price	2.257	16.574		
Indian Bank	Average Fair Price	2.248	17.568	-2.354	0.302
	Average Actual Price	2.159	18.240		
Central Bank of India	Average Fair Price	2.001	17.350	-2.147	0.127
	Average Actual Price	2.124	19.104		

Canara Bank	Average Fair Price	2.248	19.354	-1.04	0.149
	Average Actual Price	2.571	19.428		
Bank of India	Average Fair Price	2.687	19.124	-1.852	0.159
	Average Actual Price	2.247	19.459		

The above Table exhibits the results of Paired t-test for BS model values and actual market values of select public and private sector banks.The t & p-value for an average fair price and the actual price of ICICI bank is -1.204&0.031. The study results indicate that the p-value is <0.05. Therefore the study concluded a significant difference between the actual price and average fair price of ICICI bank through the BS model. The t & p-value for an average fair price and the actual price of HDFC bank is -2.104&0.038. The study results indicate that the p-value is <0.05. Therefore the study concluded a significant difference between the actual price and average fair price of HDFC Bank through the BS model.

The t & p-value for an average fair price and the actual price of Kotak Mahindra bank is --3.004&0.004. The study results indicate that the p-value is <0.05. Therefore the study concluded a significant difference between the actual price and average fair price of Kotak Mahindra Bank through the BS model.

The t & p-value for an average fair price and the actual price of Axis bank are -4.253 &0.021. The study results indicate that the p-value is <0.05. Therefore the study concluded a significant difference between the actual price and average fair price of Axis bank through the BS model.

The t & p-value for an average fair price and the actual price of Inducing is -3.247&0.201. The study results indicate that the p-value is >0.05. Therefore the study concluded no significant difference between the actual price and average fair price of Axis bank through the BS model.

The t & p-value for an average fair price and the actual price of State Bank of India is -3.257 &0.011. The study results indicate that the p-value is <0.05. Therefore the study concluded a significant difference between the actual price and average fair price of the State Bank of India through the BS model.

The t & p-value for an average fair price and the actual price of Indian Bank is -2.354&0.302. The study results indicate that the p-value is >0.05. Therefore the study concluded that there is no significant difference between the actual price and average fair price of Indian Bank through the BS model The t & p-value for an average fair price and the actual price of Indian Bank is -2.354&0.302. The study results indicate that the p-value is >0.05. Therefore the study concluded that there is no significant difference between the actual price and average fair price of Indian Bank through the BS modelThe t & p-value for an average fair price and the actual price of the Central Bank of India is -2.147 &0.127. The study results indicate that the p-value is >0.05. Therefore the study concluded that there is no significant difference between the actual price and average fair price of the Central bank through the BS model

The t & p-value for an average fair price and the actual price of Canara Bank of India is -1.04 &0.149. The study results indicate that the p-value is >0.05. Therefore the study concluded that there is no

significant difference between the actual price and average fair price of Canara bank through the BS model

The t & p-value for an average fair price and the actual price of Bank of India is -1.852 &0.159. The study results indicate that the p-value is >0.05. Therefore the study concluded that there is no significant difference between the actual price and average fair price of the bank of India through the BS model.

Directions for Future Study

The current research considered the banks stocks from NSE, the study have the opportunity to extend as further study for considering the some other sectors like insurance, manufacturing, and other's stocks. In addition, the study executed on BS Black-Scholes Model on various assumptions. The study has the opportunity to continue for other assumption of this model by adding various new variables

Conclusion

The study focuses on measuring the Option Pricing by Using Black-Scholes Model: A Study with Special Reference to Select Bank Stocks Listed in NSE. The study used the top five private sector banks and top-ranking five public sector banks. The private sector banks include ICICI bank, HDFC bank, Kotak Mahindra Bank, Axis Bank, and IndusInd bank.

The public sector banks SBI, Indian Bank, Central bank of India, Canara Bank, and Bank of India. It is observed from the study results; the ICICI bank's strength in rising net cash flow and cash from operating activity constantly. The study also points out that the earning per share of ICICI bank steadily.

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