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# Option Premium and Option Pricing Models – An Overview

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## Abstract:

Derivative is a contract or financial instrument whose value is derived from an underlying asset. Options are highly leveraged financial instruments that allow speculators to participate in the stock market without owning stock and allow shareholders to hedge against unwanted risk. Options can be bought or sold. The maximum loss associated to holder of an option is initial investment with unlimited profit. On the other hand the writer of an option can expose unlimited losses with limited profit. Option prices are set so that in-the-money contracts are more valuable than out-of-the-money contracts, and the far series are more valuable than the near series. The current stock price, exercise price, expiration date, volatility of stock price, risk free interest rate and dividend are factors that also must be considered in determining the price of an option. The present study attempts to know the option price concept and models of option premium.

Keywords: Option Premium, Block-Scholes Model, Binomial Option Pricing Model

## Introduction:

In an option contract, the holder of option has to buy the right from the writer of option by paying a price upfront for the same. This price is known as the option premium, which is non-refundable, non-adjustable, one-time, upfront payment to be made by option holder to the option writer. The option contract locks up the price at which the asset may be purchased or sold on or before a specific date in future. Naturally, the option value may increase or decrease or may remain unchanged in value during the expiration period. It is just like a contingent claim to holder of the option contract. Depending upon the spot price on maturity date, the holder of an option decides to exercise or not.

## Review of Literature:

**Andrea Angeli, Cornelius Bonz and Christer Peterson (2010)** this study examines whether the performance of Black and Scholes model to price stock index options is influenced by general conditions of the financial markets. For this purpose they calculated the theoretical values of 5814 options (3366 put and 2448 call option price observations) under the Black-Scholes assumptions. It is found that the descriptive and inferential statistics to know there are indeed significant differences between the magnitudes of percentage deviations in the period after compared to the period before Lehman Brothers failure.

**Manish Sharma and Dr. Kapil Arora (2015)** tried to find out the relevance of values of Black Scholes Model with respect to the market values for stock options. For this, one year historical closing price of ten companies and the NIFTY is taken from November 2012 to July 2013 for the period of one year to computation of volatility and 780 samples of stock options are taken from 8$^{th}$ July 2013 to 24$^{th}$ July 2013 paired sample t-test used on 30 call option sets the Null hypothesis is accepted in seven pairs which show that there is no significant difference between Black- Scholes model price and actual price. And remaining 23 call option pairs rejected the null hypothesis; there is significant difference between model price and market price.

**Dr. Shailesh Rastogi, Nithya Vetriselvam and Jeffrey Don Davidson (2017)** conducted an empirical study on theoretical option pricing model. In this study one-way analysis of variance is used when the data are divided into groups according to only one factor. And also they used t-test for there is any significant difference in the option prices calculated and the actual market price. For this purpose data were collected from 175 companies and a total of 525 market prices of call and put options are collected from the NSE website.

**Dr. Swapna H. R, Dr. Arpana. D and Dr. M. Venkataramana Reddy (2020)** conducted an Empirical Analysis on Pricing of Options in Indian Derivative Market. The historical data has been collected from NSE of two public sector and two private sector Manufacturing companies by applying Deliberate Sampling method. It is observed that the using historical volatility is estimating majority of the stock call option

premiums under Black-Scholes model. It is found that the pricing efficiency of Stock options improves when GARCH volatility is used instead of historical volatility for volatility variable in the pricing equation of all three option pricing models.

## Objectives of the study

1. To know the concept of option premium.
2. To study about the option pricing models.

## Option Contract

Option is a contract between two parties where one gives the right to other (but not the obligation) to buy or sell an underlying asset at a specified price on or before particular time.

## Concept of Option Premium

Holder of Option has to pay the price for having the right to buy/sell an underlying asset and the price of the conferred right without any obligation is known as Option Premium/Price.

This is the consideration paid by the buyer to the seller and it remained with the seller whether the option is exercised or not. This is fixed and paid at the time of the formation of option deal.

## Factors affecting on Option Price

1. **Current Stock Price and Exercise Price:**

   In the case of a call option the profit occurring to the holder is the excess of the current stock price over the exercise price. Accordingly, call option become more valuable as increase in stock price and less valuable as increase in exercise price.

   In a put option, the profit to the holder is amount by which strike price exceeds the current stock price. Accordingly, put option become more valuable as increase in strike price and less valuable as increase in stock price. Thus, changes in the stock price and exercise price have opposite effects on the value of options.

2. **Time to Expiration:**

   An option with longer life (longer time to expiration) will have more value than a similar option with a shorter life, because the long-life option has more time and opportunities to become profitable than a short life option. Thus, options become valuable as increase in time to expiration.

3. **Volatility of the stock price:**

   Volatility gives rise to wide fluctuations in stock prices. There may be a sharp rise or steep fall in stock prices. The holder of a call option benefits from increase in the stock prices. But, even in case of a decline in the stock prices, the loss is limited to the premium. Hence, volatility enhances the probability of higher payoffs from call option. Similar is the case with a put option. The holder of a put option benefits from decline in the stock prices. But, even when the stock prices increase, the loss is limited to the premium paid. Thus, both call and put options become more valuable as volatility of the underlying stock increases.

4. **Risk free interest rate:**

   Normally, as interest rates in the economy rise, stock prices tend to fall. A decline in stock prices will reduce the value of a call option and enhance the value of a put option. A fall in interest rates in the economy will be accompanied by a rise in stock prices which in turn, leads to enhance the value of a call option and reduce the value of a put option. Thus, changes in interest rates in the economy have an impact on the value of both call and put options.

5. **Dividends during the life of an option:**

   On the ex-dividend date, the stock price reduces to the extent of dividend paid. Such reduction in stock price on account of dividend reduces the value of call option but enhances the value of put option. Thus, anticipated dividends during the life of an option have a positive effect on put option and a negative effect on call option.

## Components of Option Premium

1. **Intrinsic Value**

   It is the difference between price of underlying asset and exercise price or zero.

   Intrinsic Value of Call Option = Max (0, So – E)

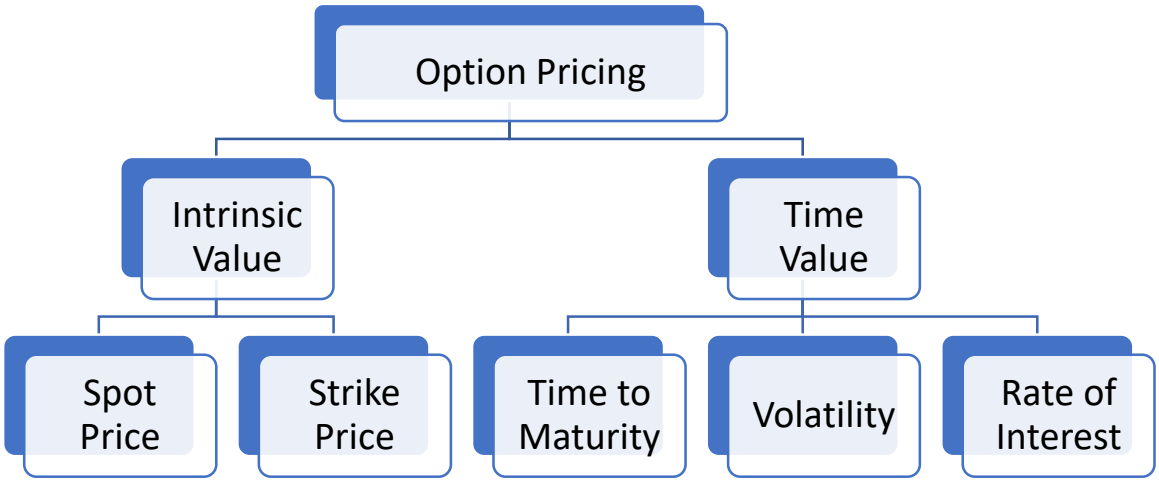
   Intrinsic Value of Put Option = Max (0, E - So)

2. **Time Value / Extrinsic Value**

   It refers to the difference between premium of option and intrinsic value of option.

   Time Value of Call Option = C – [Max (0, So – E)]

   Time Value of Put Option = C – [Max (0, E - So)]




## Models of Option Pricing

### 1. Black and Scholes Model

Most option traders have heard of the Black- Scholes model but few really know much about it. The Black Scholes model was coined by Fisher Black and Myron Scholes in the year 1973. In the same year they published paper in the Journal of Political Economy under the title "The Pricing of options and corporate liabilities". Robert. C. Merton published a follow up paper further expanding the understanding of the model. Merton and Scholes received the Nobel Prize for their work in the year 1997. Fisher Black was ineligible because he had passed away earlier and the Nobel Prizes are not awarded post humously.

### Assumptions of Black and Scholes Model

The Black-Scholes Option Pricing Model (BSOPM) take into consideration the impact of all the factors on the value of an option and attempts to determine the theoretical price of an option. The model presents a theoretical formula for calculating the price of a call option. If we know values of variables, we can use the BSOPM to calculate the theoretical price of an option. The analysis makes certain assumptions regarding the market environment in which option trading takes place. The assumptions are stated below:

1. There are sufficient numbers of participants to ensure continuous trading.
2. There are no transaction costs.
3. All securities are perfectly divisible.
4. There are no arbitrage opportunities. Since the market is efficient.
5. Borrowing and Lending are possible at the risk-free interest rate, which remains constant.
6. There is no dividend on the stock during the life of an option.

7. Stock prices follow a random walk. It implies that stock price at any future time has a log normal distribution i.e., its natural logarithm is normally distributed.

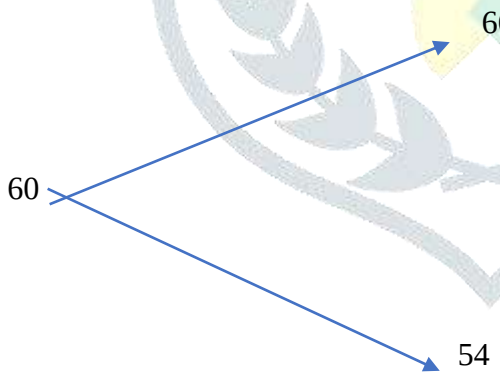
## 2. Binomial Model of Option Pricing

A useful model of stock option pricing has been developed by Cox, Ross and Rubinstein in the year 1979, using the concept of the binomial tree. The price of underlying stock an option may follow different paths in the future. It may increase or decrease. The various paths likely to be followed by the stock price may be represented in the form of a diagram which is known as a binomial tree of future stock prices.

### Assumptions of Binomial Option Pricing Model

1. There is no transaction cost, taxes and margin requirement.
2. Market is competitive and there is no arbitrage opportunity.
3. Interest rates for future period can be predicted with certainty.
4. The investor can borrow or lend an amount at a rate of interest 'r'.
5. The current price of the share is so and it can take two possible values after 1 year.

The current market price of a stock is Rs.60. It is expected that the price may either move up by 10% or move down by 10% by the end of the month.




One step binomial tree

From the diagram it can be seen that at the end of the period, the stock price may be Rs.66 or Rs.54. The probability of upward movement is 0.6, then the probability of downward movement would be 0.4 (i.e., 1- 0.6).

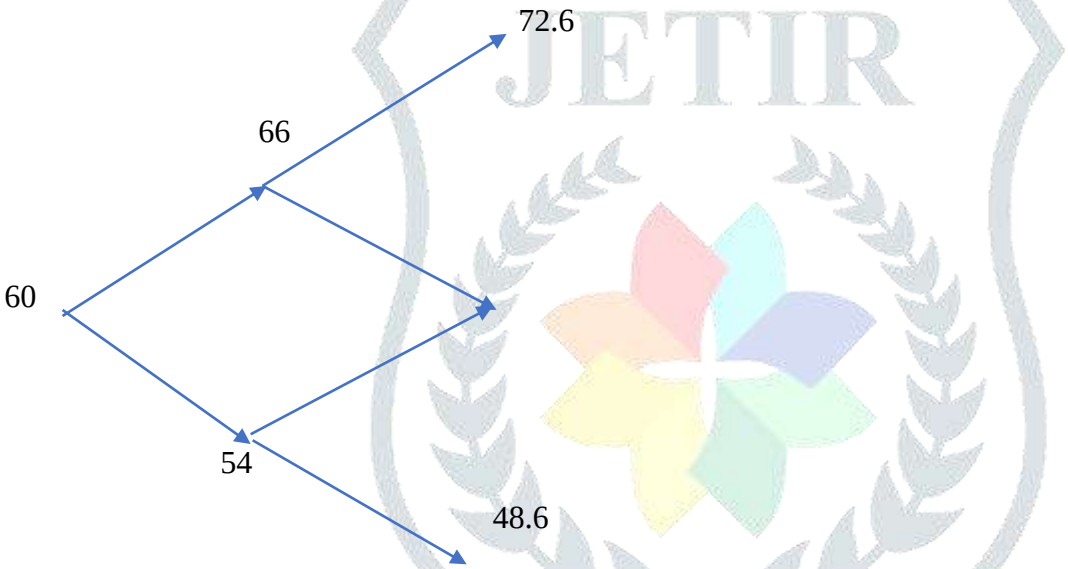
To consider a European call option with exercise price of Rs.62, expiring at the end of the month. If the stock price at the end of the month is Rs.66, the option will have a value of Rs.4 (Rs.66 – Rs.62). If the stock price is Rs.54, the call option will have no value as the exercise price exceeds the stock price; the option value would be 0.

Since we know the probability of upward and downward movements, we can calculate the expected option value at the end of the period. This is the probability weighted average of possible option values.

Expected option value = (4 x 0.6) + (0 x 0.4) = Rs.2.4

The expected value at the end of the month is worked out as Rs.2.4 the present value of this amount is taken as the current price of the option. The amount has to be discounted with the risk-free rate using continuous discounting process.

We can now extend the diagram into a two-step binomial tree where, at each step, the stock price may either move up by 10% or move down by 10%. The extended diagram is shown as below.




Stock Prices in a two-step binomial tree

There are three possible stock prices at the end of the period 2, namely, Rs.72.6, Rs.60, and Rs.48.6. the binomial tree may be extended in a similar fashion to several steps or time intervals.

In the case of binomial tree with more than one step, the option values at the final nodes are calculated first. The current price of option is determined by working backward. This process is known as backward induction. From the option values at the final nodes, the option values at the preceding nodes are calculated. The option values at previous nodes are calculated as the present value of the expected option value one time step later.

### The Black and Scholes Model and Binomial Model-A Contrast

The first major advance in option pricing was made by Black and Scholes in 1973 through the development of a mathematical model for pricing stock options. The next was made by Cox, Ross and Rubinstein in 1979, in the form of Binomial model for stock option pricing.

The BSOPM is the most commonly used option pricing model. The model is popular because it provides an analytical solution through a formula. The formula can be programmed into a computer or calculator to obtain option prices quickly. The model was developed for valuing European style options. Hence, it may not provide reliable results when used for valuing American style options where early exercise of the option is a possibility.

The Binomial model can be used successfully for valuing American style options which may be exercised early (i.e., before maturity). The Binomial model is more flexible, allowing for variations in interest rates and stock volatility during the life of the option. A major disadvantage of the Binomial model is that it does not permit an analytical solution through a formula; the solution has to be obtained numerically through an iterative process involving several steps.

## Conclusion:

An option contract made between holder and writer of the option. Writer gives the right and receive premium from holder of the option. The components of an option premium include its intrinsic value and extrinsic value of underlying asset. As the option nears its expiration date, the time value will edge closer and closer to 0, while the intrinsic value will closely represent the difference between the underlying asset price and strike price of the contract. The moneyness affects the option's premium because it indicates how far away the underlying price is from the particular strike price. As an option becomes further in-the-money, the option's premium normally increases. Conversely, the option premium decreases as the option becomes further out of the money. Binomial and Black-Scholes models, which value options by creating replicating portfolios, composed of the underlying asset and riskless lending or borrowing. These models can be used to value assets that have option-like characteristics.

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