9.4 BLACK SCHOLES PRICING MODEL

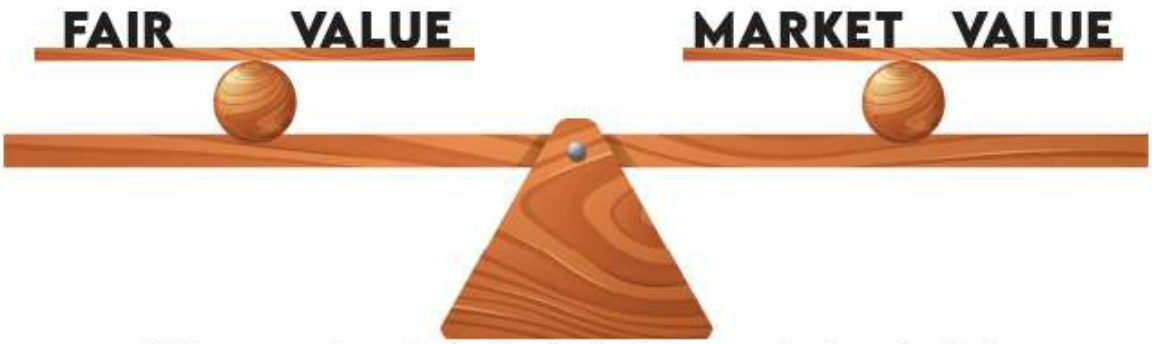
Explainer Video

The Black Scholes pricing model was developed by two finance researchers, namely Mr. Fischer Black and Mr. Myron Scholes.

MR. FISCHER BLACK

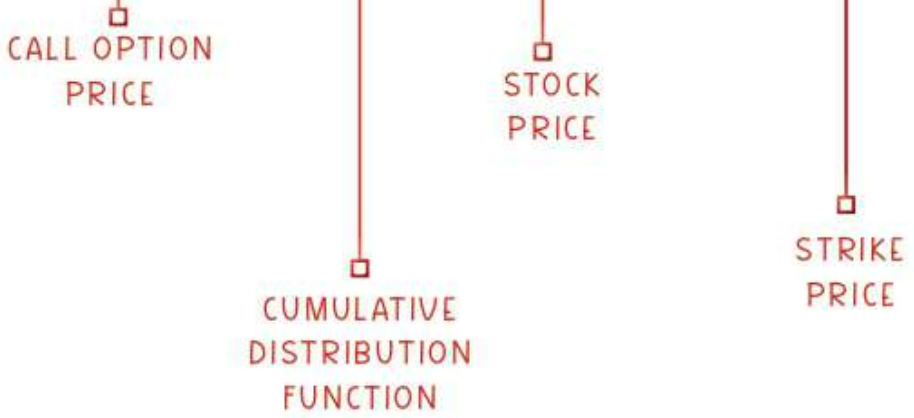
MR. MYRON SAMUEL SCHOLES

They made this pricing model to determine the fair value or the theoretical value of options. Based on this fair value determined, we can compare it with the market value.



This comparison helps in strategizing our trade or to find trading opportunities.

$$C(S, t) = N(d_1)S - N(d_2)Ke^{-rT}$$



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

$$d_2 = d_1 - \sigma\sqrt{T}$$

$T = (T_1 - t)$ -------- TIME LEFT TILL MATURITY (IN YEARS)

r -------- RISK FREE RATE

σ -------- VOLATILITY

This model is based on 6 main variables that are used to establish the fair price of an option contract. It also has a formula which may be very intimidating at first, but we won't be using it as such. We will focus on the 6 variables that are used and understand the model through them. We will understand how each factor affects the pricing. Based on that we will understand what makes the price of an option contract move.

9.5 VARIABLES AFFECTING THE PRICING AS PER BLACK SCHOLES MODEL

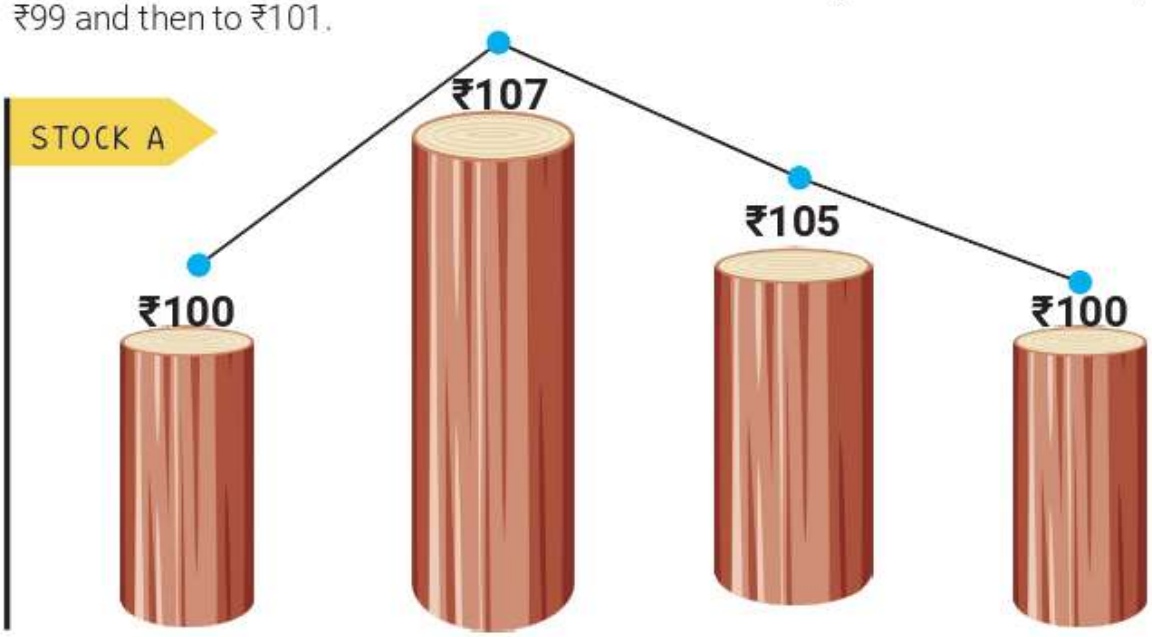
Explainer Video

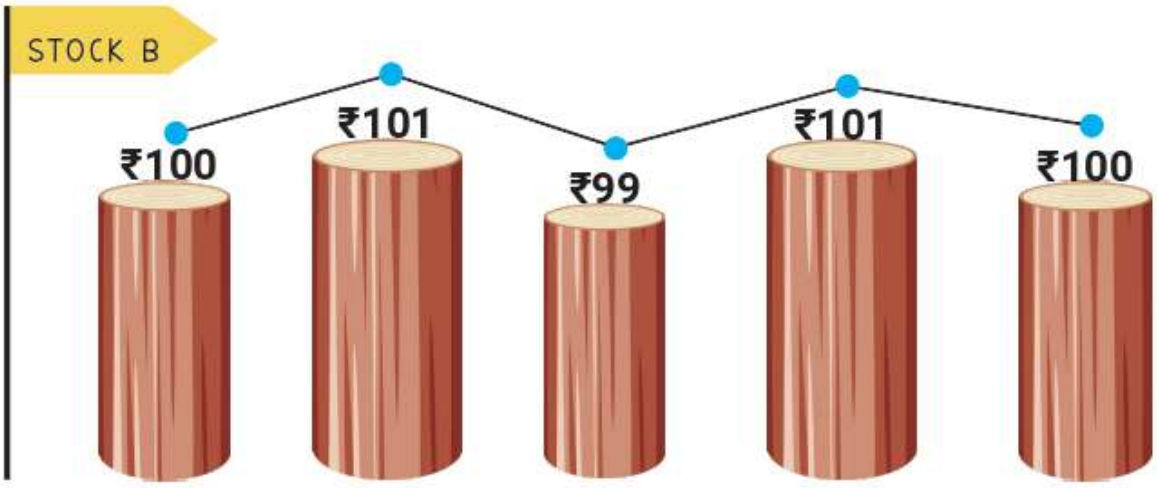
Black Scholes Model is a pricing method used to determine the fair value or theoretical value of the call or put option based on 6 variables:

VOLATILITY

Here, we discuss the levels of current volatility and expected volatility in the market. Higher the volatility, higher will be the premium.

For example, assume that there are two stocks, one is moving from ₹100 to ₹105, then to ₹107 and then back at ₹100. The other is moving from ₹100 to ₹101, then to ₹99 and then to ₹101.





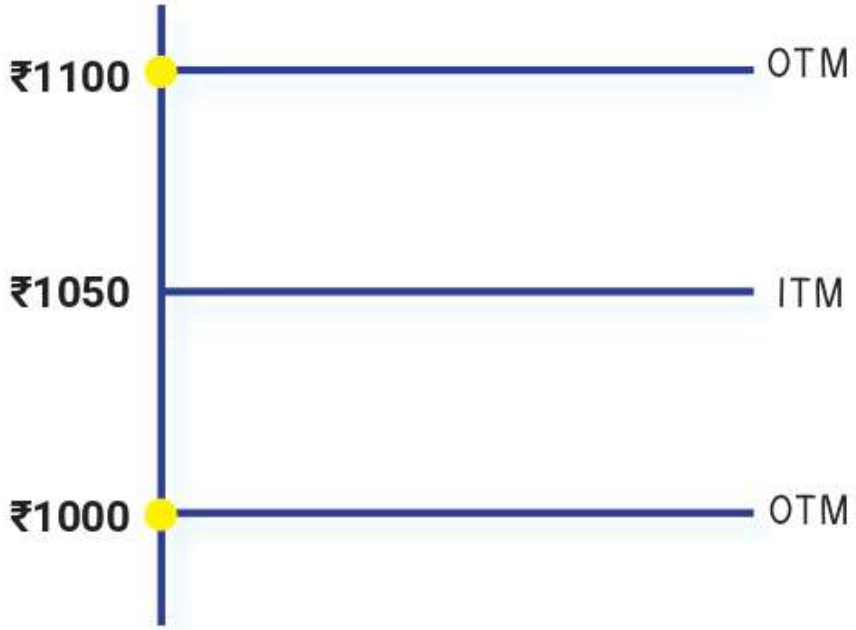
Which one these has a greater risk based on price fluctuations? The first one, right? The is risk is more because of bigger price movements. This goes to tell us that the first one is relatively more volatile, while the latter is less volatile.

Volatility is generally caused by some external event like COVID, Russia-Ukraine war etc that creates panic in the market or by economic environment which may not be very bullish. This increases uncertainty. With the increase in uncertainty, the risk for the seller of an option increases, and therefore, we have an increase in the premium. This is to ensure that the seller of the option is well incentivized to sell options even in turbulent times in the market.

UNDERLYING STOCK PRICE

As the price of the underlying asset changes, the in-built profits of the options contract change as well. This also changes the moneyness of the option contract. The movement in the stock price with respect to the strike price can change an out-of-the-money option to in-the-money.

For example,



Lets say the strike price of the underlying asset is ₹1050 currently. So, we can say that the call option contract with the same Strike Price is at the money and the Strike Price of 1000 is in the money and the one at ₹1100 is out of money.
But as the price of the underlying increases to ₹1100, the option at ₹1050 as strike price increases in value as it adds in-built profits into it. At the same time, if the price reduces from ₹1050 to ₹1000, the value for all the call options will decline.

For Call option,

For Put option,

TIME TO EXPIRY

How much time is left in expiry again affects the risk or uncertainty for the seller. The price of a stock may not move 100 points (say) in a day but the chances of it moving those many points in a month are much higher.

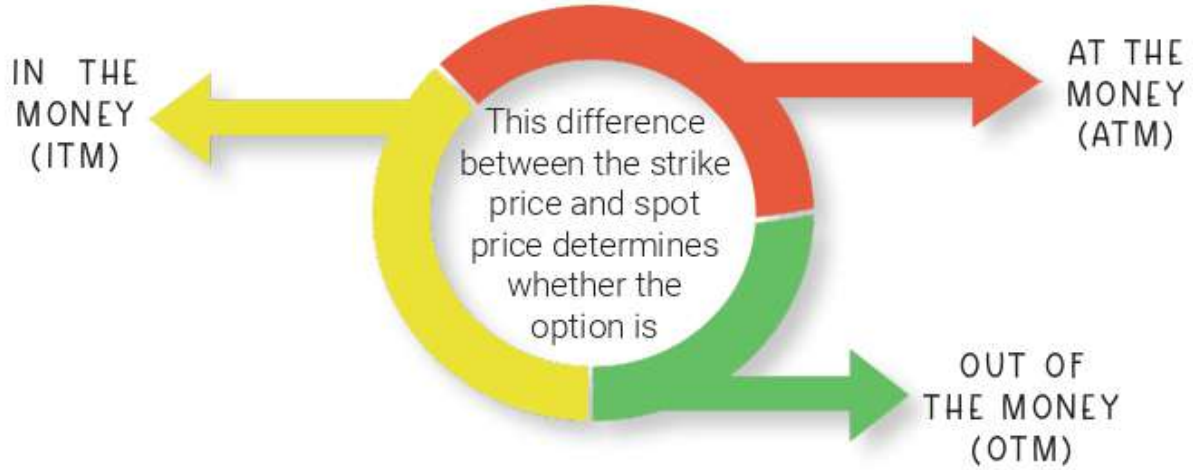
Therefore, the risk in an option expiring in a month is greater than the risk in an option expiring in a day or week.

RISK METER

The profits of the seller are limited to the premium amount. As the possibility of loss increases due to uncertainty, the seller would higher reward for the higher risk taken. The premium hence will increase with an increase in time to expiry for both call and put.

STRIKE PRICE

The strike price affects the in-built profit value of the option with respect to the spot price of the stock. Based on the moneyness of the option then the price of the option is affected.



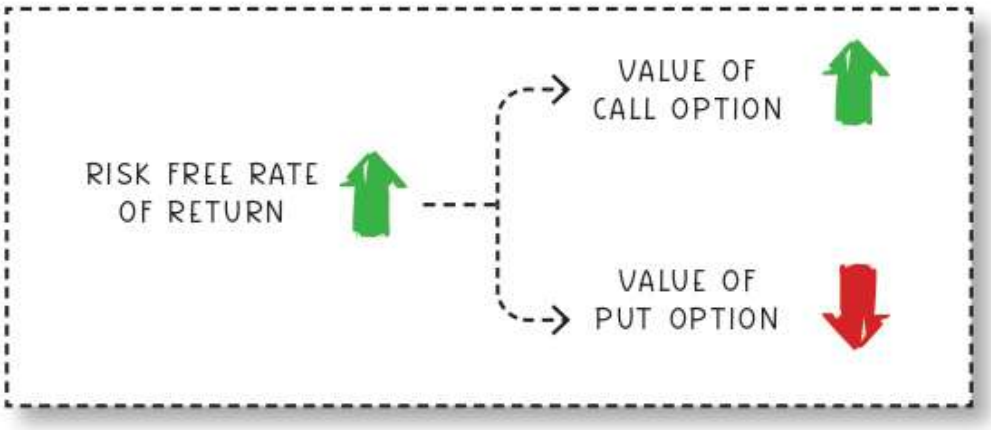
For Call Options,
Lower the Strike Price, higher will be the premium.

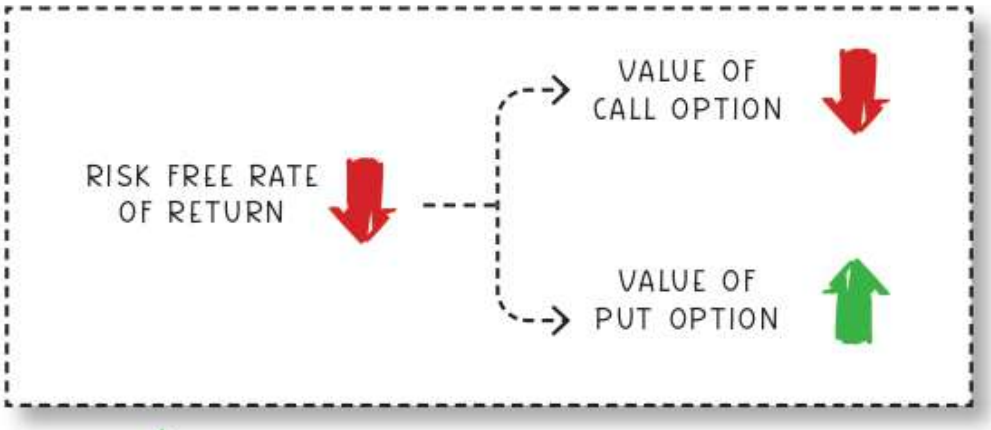
For Put Options,
Higher the Strike price, Higher will be the premium.

RISK-FREE RATE OF RETURN

The government bond return is considered to be risk free rate of return. This is because within an economy, the government has the right to print more money and they can always repay liability by printing more money.

The impact of the risk-free rate of return is that as the risk-free rate increases, the value of call option increases and value of put option decreases. At the same time, if the risk free rate decreases, the value of call decreases and the value of put increases. The reason for this to happen is that as the risk free rate increases in the economy, the overall interest rates in the economy also increases. When this happens, the expected returns from most asset classes go up. Since, asset prices are likely to go up, Call Options become relatively more expensive and Put options become less valuable.





So, as the stock price is expected to rise at a higher pace than risk-free rate, the options price is affected.

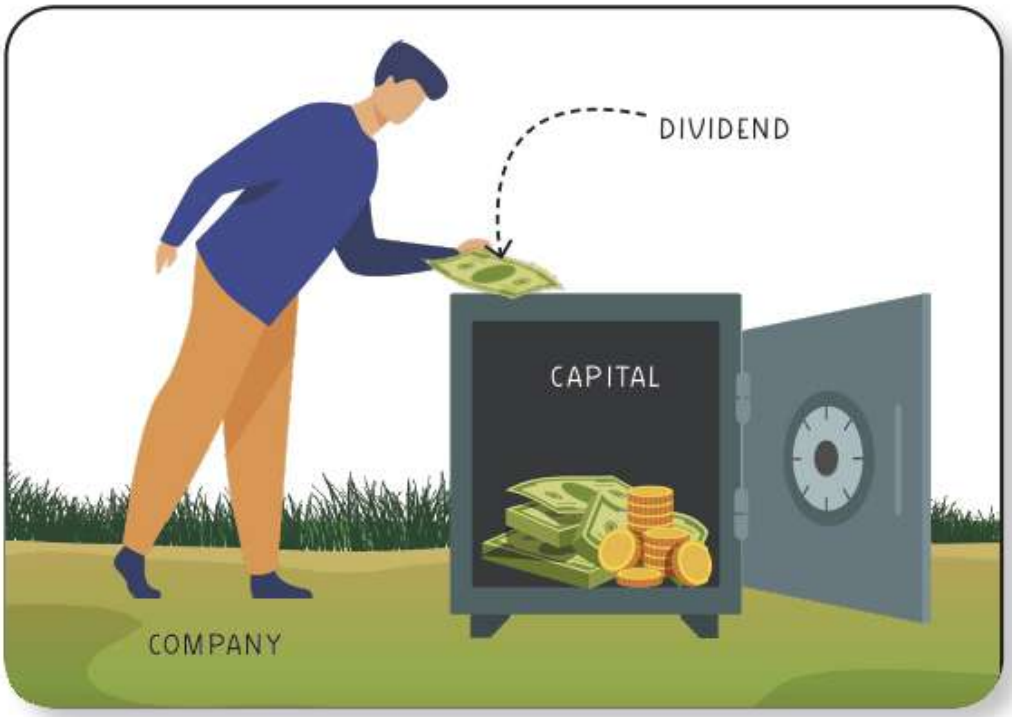
The Seller will only take on the risk despite increased likelihood of the share prices increasing, if they receive a higher premium for the same.

We can look at the Market Return as this,

MARKET RETURN = RISK FREE RATE + RISK PREMIUM

DIVIDEND YIELD

Dividend Yield refers to the amount of dividend that a company pays to its shareholders. As a company does this, the price of the stock in the market would go down.



So, ***for example,*** if a stock was priced at ₹200 and the company decides to give ₹10 as dividend. The dividend distribution would bring the price of the stock down to ₹190 or ₹185. (This is just a hypothetical situation.)

Companies with high dividend yield have lower capital appreciation. As a result, as dividend yield increases, call options become less valuable and put options become more valuable.

Similarly, with lower dividend yield, the capital appreciation is higher. As Dividend Yield decreases, the value of call option increases and value of put option decreases.

As of now these factors may seem confusing, but as you spend time with options, you will get more and more comfortable with the same. Understanding of these factors is important to understand how prices of different option contracts move and how all of them come together in different trading strategies that we will form. With this we conclude out discussion of factors that affect Black-Scholes option pricing model. We do not really need top understand the calculation but we do need to understand these factors that affect the calculation.