Fast Track Webinar Series

Batch XVIII

for

IBBI Valuation Exam (SFA) – (2024) Syllabus

Day 4

Option Valuation

Value of Call Option – BSM Model

- Step 1 : Calculate d1
- Step 2 : Calculate d2
- Step 3 : Calculate N(d1)
- Step 4 : Calculate N(d2)
- Step 5 : S*N(d1) - E*e^{-rt}*N(d2)

Step 1 : Calculate d1

d1 = $\dfrac{Log\left(\frac{S}{E}\right)+\left(r+\frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$

- Step 1a : $Log\left(\frac{S}{E}\right)$ {caution: logarithm [base e]}
- Step 1b : $\left(r+\frac{\sigma^2}{2}\right)t$
- Step 1c : $\sigma\sqrt{t}$

Thursday ◊ 01st FEB 2024 ◊ 08:30 to 09:30 AM ◊ www.3spro.blogspot.com

CA Dr GOPAL KRISHNA RAJU

Chartered Accountant, Insolvency Professional, Registered Valuer & Arbitrator

Visiting Faculty, Indian Institute of Management

Chartered Valuers Association of India

invites you for webinar on

Ind AS 16
Property, Plant & Equipment

DIRECTORS

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FACULTY

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(fondly referred to as 'Rajnikanth' of Valuation)

MODERATOR

CA Sampath Kumar VV

DIRECTORS

CA K Ramesh

CA Krishna Kumar R

Sunday 4th Feb 2024

8:30 AM TO 9:30 AM

RSVP Venkatesh
75502 25226

Fixed Income Securities

- **Types of fixed income securities:** categories of fixed income securities i.e. debt and preferred stocks along with different rights attached to both categories
- **Types of debt instruments:** sovereign securities; state and local government bonds; semi-government/agency bonds; corporate debt securities; corporate bonds; money market securities in relation to investments (CP, CD, T-Bills); tax free securities; asset backed securities
- **Terms used in fixed income securities:** fixed income securities; bond indenture; issuer and holder; covenants; maturity; par value, coupon rate, clean price, dirty price; repurchase agreement; yield to maturity, yield to put, yield to call; forward rate and spot rate

Fixed Income Securities

- **Bond duration:** Macaulay duration, Modified duration, Effective duration, Key duration
- **Credit rating of bonds:** risk assessment and factors considered in assigning credit rating
- Embedded options for issuer and holder; call/put for repayment; cap and floor on coupon; conversion options; pre-payment options
- **Derivative products:** types of derivative products; calculation of swap rates; valuation of swaps; accruals on swaps
- Related Fixed Income Money Market and Derivatives Association of India circulars for Non-SLR bonds, Traded bonds, Non-traded bonds-rated, Non-traded bonds-not rated, Floating rate bonds, Staggered redemption bonds, Perpetual bonds, Deep discount bonds, Bonds with call/put options, Tax free bonds, Security receipts/Pass through certificates

Fixed Income Securities – Options – (7 Marks)

- **Option valuation:** General principles
- **Option valuation models:** Black and Scholes; Black and Scholes Merton option pricing method; Binomial tree method; Monte Carlo simulation
- **Valuation of other financial assets and liabilities:** concept of financial and non-financial assets and liabilities; Valuation of other instruments like financial guarantees and warranties

Option Pointers

❖ **This chapter carries 4 to 7 marks in IBBI Valuation Exam**

❑ **Reference 1:** Page 78 – Valuation of Options | Technical Guide on Valuation | ICAI

https://resource.cdn.icai.org/50944clcgc40588.pdf

❑ **Reference 2:** Page 122 – Overview on Valuation of Options| Professionals Insight | ICAI

https://resource.cdn.icai.org/51396vsb41086.pdf

- ✓ Options Basics
- ✓ Factors influencing Option Valuation and on its changes, its impact in Call & Put Valuation
- ✓ Binomial Model; BSM Model

Option Pointers

- ✓ **Spot Price**
- ✓ **Holder - Option**
- ✓ **Writer – Obligation**

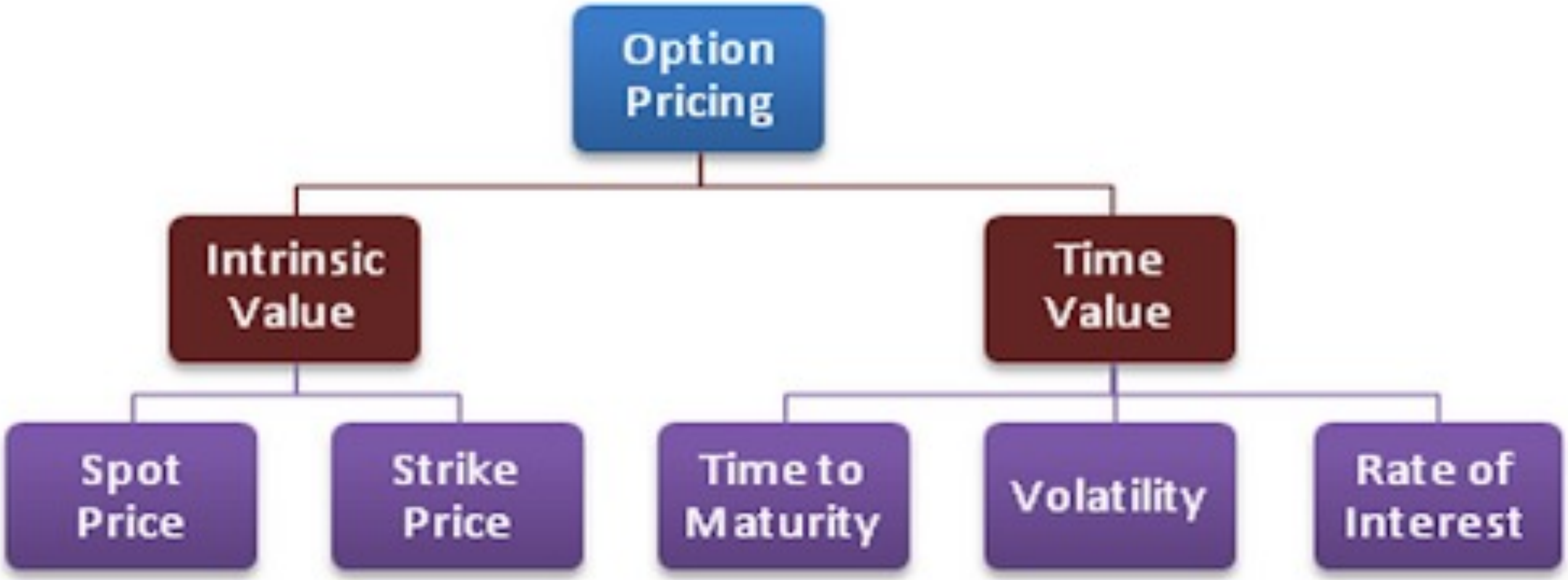
	Holder	Writer
Call	Option to Buy	Obligated to Sell
Put	Option to Sell	Obligated to Buy

- ✓ **Strike Price / Exercise Price**
- ✓ **The Option buyer pays a price for this right.**
- ✓ **Value of an Option / Option Premium = Paid by Holder to Writer upfront**

- **Call Option:** If at expiration, the value of the asset is less than the strike price, the option is not exercised and expires worthless. If, on the other hand, the value of the asset is greater than the strike price, the option is exercised and the buyer of the option buys the asset at the exercise price.
- **Put Option:** If the value of the underlying asset is greater than the strike price, the option will not be exercised and will expire worthless. If on the other hand, the value of the underlying asset is less than the strike price, the owner of the put option will exercise the option and sell the asset at the strike price.

Pointers

- **Time Value = Option Premium - Intrinsic Value**
- **Option Premium = Intrinsic Value + Time Value**
- **American options can be exercised anytime from purchase until the date of expiration whereas European options can only be exercised at the time of expiration.**



Intrinsic Value

- The intrinsic value is the difference between the underlying spot price and the strike price, to the extent that this is in favour of the option holder.
- For a call option, the option is in-the-money if the underlying spot price is higher than the strike price; then the intrinsic value is the underlying spot price minus the strike price.
- For a put option, the option is in-the-money if the strike price is higher than the underlying spot price; then the intrinsic value is the strike price minus the underlying spot price. Otherwise the intrinsic value is zero.

In summary, intrinsic value:

- **= current stock price − strike price (call option)**
- **= strike price − current stock price (put option)**

Time Value

- **The option premium is always greater than the intrinsic value.**
- This extra money is for the risk which the option writer/seller is undertaking. This is called the time value.
- Time value is the amount the option trader is paying for a contract above its intrinsic value, with the belief that prior to expiration the contract value will increase because of a favourable change in the price of the underlying asset. The longer the length of time until the expiry of the contract, the greater the time value. So,
- **Time value = option premium − intrinsic value**

1. The Intrinsic Value of a Call Option is:

a) Strike Price – Current Stock Price

b) Time Value – Option Premium

c) Current stock price − strike price

d) Market Value + Time Value

Time value = option premium – intrinsic value

Bermudan Option

- American options allow a trader to exercise their buy or sell an option at any time before the option's expiration date.
- European options specify that a trader can only choose to exercise (or not) his option *on* the date of expiration.
- Bermudan options allow a trader to exercise his option on any of **several specified dates** before the option expires; thus, Bermudan options are sort of a middle ground between American and European options.

2. WHICH option allow a trader to exercise his option on any of several specified dates before the option expire

a) Australian option

b) Bermudan option

c) European option

d) American option

3. An option which can be exercised any desired time before an expiry date is classified as:

a) Australian option

b) Money option

c) European option

d) American option

	CALL	PUT
Buyer (owner)	Right to buy	Right to sell
Seller (writer)	Obligation to sell	Obligation to buy

IV, ITM, ATM, OTM

- The intrinsic value of an option represents the current value of the option, or in other words how much In The Money (ITM) it is.
- For options that are Out of The Money (OTM) or At The Money (ATM), the intrinsic value is always zero.
- This is because a buyer would never exercise an option that would result in a loss. Instead, he would let the option expire and get no payoff.

Factors influencing options valuations

- Current stock price
- Exercise price
- Risk free rate of interest
- Time to expiration
- Price volatility of the share

Factors affecting pricing of Options

The key factors affecting the value of an Option are as below:

- ***Current Share Price (S)*** is the price at which the share (underlying asset) is being currently traded.
- ***Exercise Price (K)*** is the price at which the Option can be exercised.
- ***Time to Expiration (T)*** is the time for which the Option remains active and exercisable. T for a European Option is a fixed date and that for an American Option is any date before and including date of expiration.
- ***Volatility of Share Price (σ)*** is the rate at which price of a share increases or decreases for a given return.
- ***Risk-free interest rate(Rf)*** is generally the rate of government securities.
- ***Dividends expected during the life of the Option (D)*** is the expected dividend yield on the stock.

4. Which of the following is not a factor affecting Option valuation?

a) Current value of the underlying assets

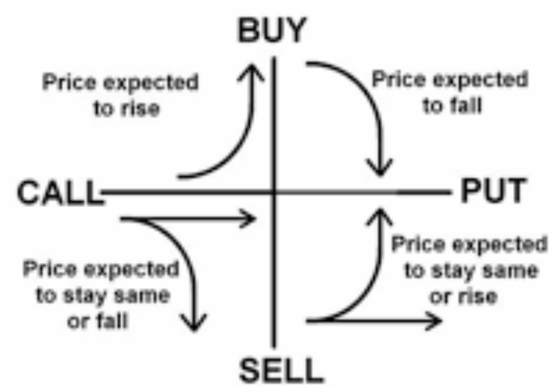
b) Office Overhead Cost

c) Exercise price

d) Rate of the interest

OPM

- Various option pricing models, which work on a number of assumptions and inputs, are used to arrive at the value of options.
- In practice, Black-Scholes and a simpler Binomial Model are preferred for option pricing.



Factor	*Call value*	*Put value*
Increase in asset price	Increases	Decreases
Increase in strike price	Decreases	Increases
Increase in variance of asset price	Increases	Increases
Increase in time to expiration	Increases	Increases
Increase in interest rates	Increases	Decreases
Increase in dividends paid	Decreases	Increases

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

5. With the increase in the Spot Price of the underlying assets, the value of <u>Call Option</u>:

a) Increase

b) Decrease

c) Has no effect

d) Increase to an extent and decrease there after

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

6. With the increase in the value of the Strike price, the value of Call Option:

a) Increase

b) Has no effect

c) Increase to an extent and decrease there after

d) Decrease

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

7. With the increase in Variance of the underlying assets, the value of Call option:

a) Has no effect

b) Increase to an extent and decrease there after

c) Increase

d) Decrease

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

8. With the increase in time to expiration, the value of **call option**:

a) Decrease

b) Has no effect

c) Increase to an extent and decrease there after

d) Increase

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

9. With the increase in the interest rate, the value of <u>**call option**</u>:

a) Increase

b) Decrease

c) Has no effect

d) Increase to an extent and decrease there after

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

10. With the increase in the Spot Price of the underlying assets, the value of put option:

a) Increase

b) Increase to an extent and decrease there after

c) Decrease

d) Has no effect

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

11. With the increase in the value of the Strike price, the value of put option:

a) Increase to an extent and decrease there after

b) Increase

c) Decrease

d) Has no effect

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

12. With the increase in dividends paid, the value of <u>call option</u>:

a) Increase

b) Decrease

c) Has no effect

d) Increase to an extent and decrease there after

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

13. With the increase in variance of the underlying assets, the value of <u>put option</u>:

a) Has no effect

b) Increase to an extent and decrease there after

c) Increase

d) Decrease

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

14. With the increase in time to expiration, the value of <u>put option</u>:

a) Increase

b) Decrease

c) Has no effect

d) Increase to an extent and decrease there after

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

15. With the increase in the interest rates, the value of put option:

a) Increase

b) Increase to an extent and decrease there after

c) Decrease

d) Has no effect

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

16. With the increase in dividends paid, the value of <u>put option</u>:

a) Increase to an extent and decrease there after

b) Increase

c) Decrease

d) Has no effect

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

	If This Factor Is Increased:	Call Price	Put Price
1	Stock Price	▲	▽
2	Exercise Price	▽	▲
3	Risk-Free Rates	▲	▽
4	Volatility	▲	▲
5	Time to Expiration	▲	▲
6	Dividends	▽	▲

17. The value of the Call option decreases due to the change in which of the following factor of Option valuation:

a) Increase in strike price

b) Increase in rate of interest

c) Extent of volatility in value of asset

d) Longer expiration

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

18. The value of Put option decrease due to change in which of the following factor of option valuation:

a) Extent of volatility in value of asset

b) Increase in strike price

c) Increase in rate of interest

d) Longer expiration

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

19. The value of put option increase due to change in which of the following factor of option valuation:

a) Decrease of volatility in value of asset

b) Increase in rate of interest

c) Longer Expiration

d) Increase in Spot Price

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

20. The value of put option increase due to change in which of the following factor of option valuation:

a) Increase in strike price

b) Extent of volatility in the value of asset

c) Longer expiration

d) All of the above

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

21. The value of put option increase due to change in which of the following factor of option valuation:

a) Increase in value of underlying asset (Spot)

b) Increase in Strike price

c) Increase in Volatility

d) Both (b) and (c)

Increase in	Call	Put
Spot Price	↑	↓
σ^2 (Variance)	↑	↑
Time	↑	↑
Interest rate	↑	↓
Dividend	↓	↑
Exercise / Strike Price	↓	↑

Naked option

- A trading position where the seller of an option contract does not own any, or enough, of the underlying security to act as protection against adverse price movements.
- Naked trading is considered very risky since losses can be significant.
- An options trader could sell, for example, call options with a strike price of $10. If the stock's price rises to $20 or $30 on good news, and the option is naked (the seller does not own the underlying stock).
- He or she would be required to buy the specified number of shares at the current price, and sell them to the option buyer for the $10, resulting in a significant loss.

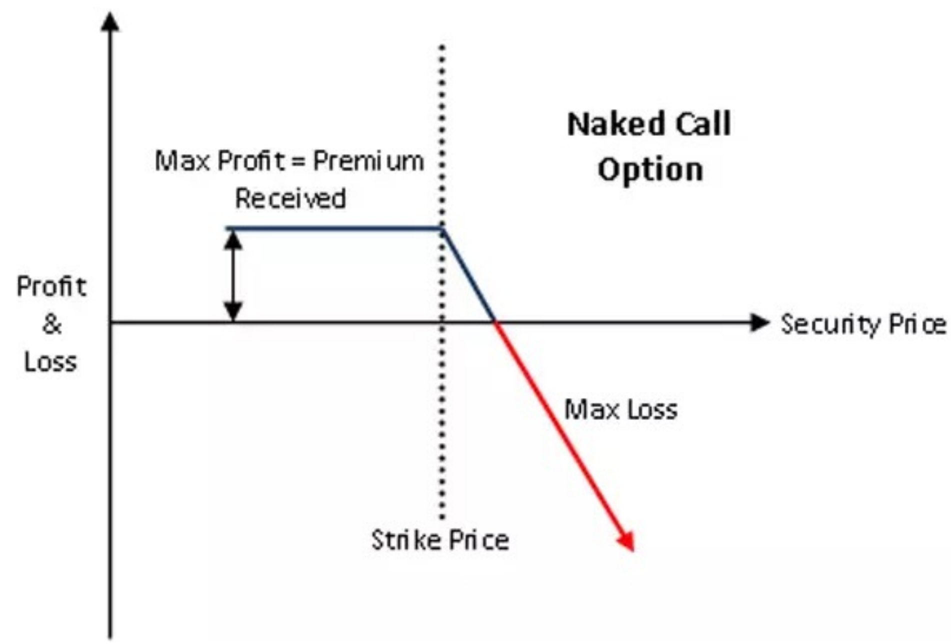
22. Option that do not have stock in portfolio to back up option is classified as:

a) Naked option

b) Undue option

c) Due option

d) Total option



Valuation of Options

Options are valued by using one of the following valuation models:

- **Black-Scholes Model**
- **Black-Scholes-Merton Model (BSM Model)**
- **Binomial Model**
- **Monte Carlo Simulation**

Binomial Model

- **Single-Period – Binomial Model (Delta-Hedging)**
- **Multi-Period - Binomial Model (Tree)**

The **binomial option pricing model** is an **options valuation method** developed in 1979. The **binomial option pricing model** uses an iterative procedure, allowing for the specification of nodes, or points in time, during the time span between the **valuation** date and the **option's** expiration date.

The Binomial Option Pricing Model (BOPM)

- S = Spot Price
- E = Exercise Price / Strike Price
- r = rate of Interest
- R = 1 + r
- d = downward rate
- u = upward rate
- B = Borrowing (Equivalent)
- C_u = Intrinsic Value when Price is at upward end
  - $C_u = \text{Max}\,[(uS - E), 0]$
- C_d = Intrinsic Value when Price is at downward end
  - $C_d = \text{Max}\,[(dS - E), 0]$

$$\Delta = \frac{C_u - C_d}{(u-d)S}$$

$$B = \frac{(u)C_d - (d)C_u}{(u-d)(R)}$$

Value of Call Option $C_o = \Delta S + B$

The Binomial Option Pricing Model (BOPM)

- S = Spot Price
- E = Exercise Price / Strike Price
- r = rate of Interest
- R = 1 + r
- d = downward rate
- u = upward rate
- L = Lending (Equivalent)
- Pu = Intrinsic Value when Price is at upward end
  - Pu = Max [(E - uS),0]
- Pd = Intrinsic Value when Price is at downward end
  - Pd = Max [(E - dS),0]

$$\Delta = \frac{P_d - P_u}{(u-d)S}$$

$$L = \frac{(u)P_d - (d)P_u}{(u-d)(R)}$$

Value of Put Option $P_o = L + \Delta S$

23. If Spot Price = 70; Exercise Price = 78; Interest Rate = 8%; d (downward) = 0.9; u (upward) = 1. 5; Then Value of Call Option is

a) 9.87

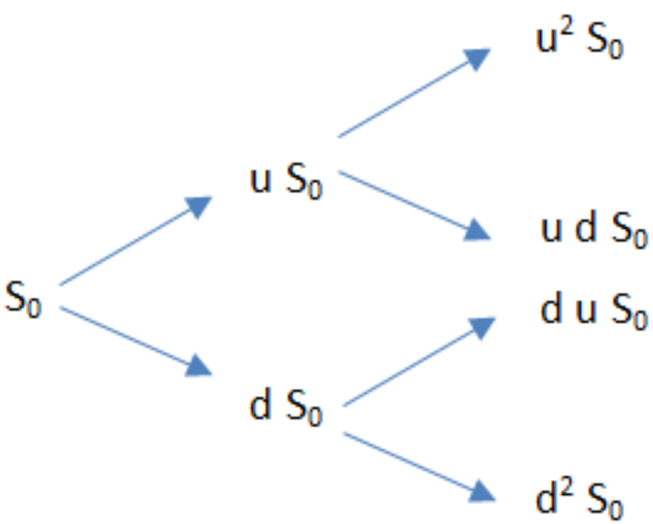
b) 7.50

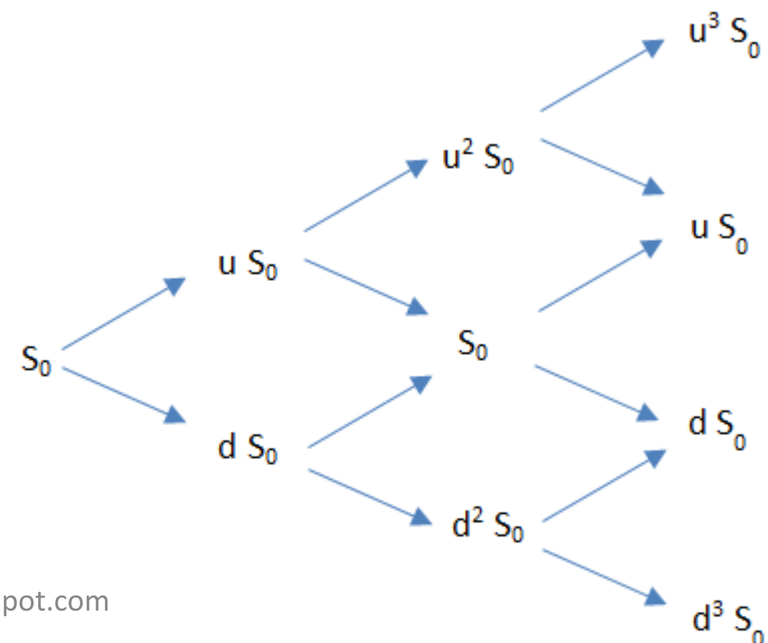
c) 3.56

d) 1.88

The Binomial Option Pricing Model (BOPM)

- **Step 1:** We begin with a single period.
- **Step 2:** Then, we "stitch" single periods together to form the Multi-Period Binomial Option Pricing Model.
- The Multi-Period Binomial Option Pricing Model is extremely flexible, hence valuable; it can value American options (which can be exercised early), and most, if not all, exotic options.





Assumptions of the BOPM

- ✓ There are two (and only two) possible prices for the underlying asset on the next date. The underlying price will either:
  - Increase by a factor of u% (an uptick)
  - Decrease by a factor of d% (a downtick)
- ✓ The uncertainty is that we do not know which of the two prices will be realized.
- ✓ No dividends.
- ✓ The one-period interest rate, r, is constant over the life of the option (r% per period).
- ✓ Markets are perfect (no commissions, bid-ask spreads, taxes, price pressure, etc.)

Black-Scholes-Merton Model (BSM Model)

- The BSM Model for option pricing was introduced and evolved by Fischer Black, Myron Scholes and Robert Merton in 1973.
- The hypothesis of the BSM model is that assumes the **lognormal** property of stock prices, which means that % changes in prices of shares during a short time frame are normally distributed.
- Value of the Option using BSM Model can be interpreted to be the present value of the expected payoff (current price minus present value of strike price) of the option at expiration.
- A variable with lognormal distribution can supposedly take any value between zero and infinity.
- BSM Model is generally adopted to value **European Options**.

Black-Scholes-Merton Model (BSM Model)…

The main determinants (variables relating to the underlying asset) that form inputs to the BSM model are:

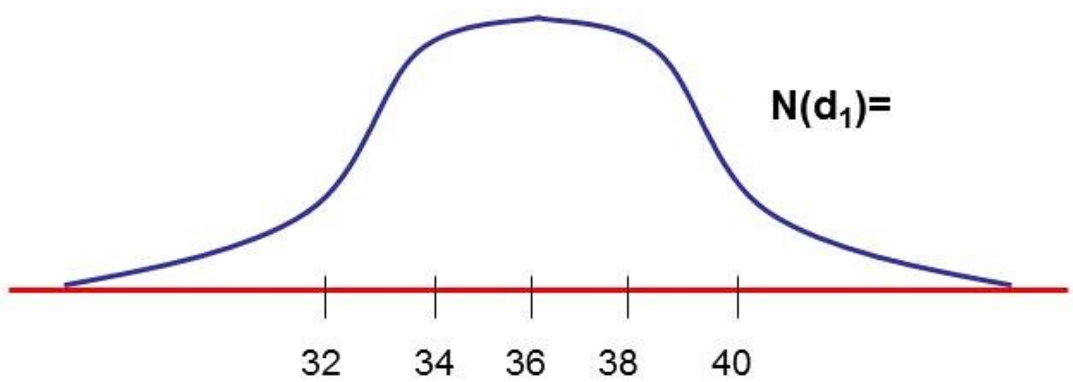
1. Fair value of the underlying asset / current share price (S)
2. Strike price of option (K)
3. Risk-free rate (Rf)
4. Volatility in share price (σ)
5. Life of the option / Time to expiration (T)
6. Expected dividends on underlying asset (D)

Call Option Premium $= SN(d_1) - N(d_2).Ee^{-rt}$

$$d_1 = \frac{\ln(S/E) + (r + \sigma^2/2)t}{\sigma\sqrt{t}} \qquad d_2 = d_1 - \sigma\sqrt{t}$$

Black-Scholes Option Pricing Model

$$(d_1) = \frac{\ln \dfrac{P_s}{S} + \left(r + \dfrac{v^2}{2}\right) t}{v\sqrt{t}}$$



In probability theory, a log-normal (or lognormal) distribution is a continuous probability distribution of a random variable whose logarithm is normally distributed. Thus, if the random variable X is log-normally distributed, then Y = ln(X) has a normal distribution.

24. The Black-Scholes model assumes .... continuous probability distribution:

a) Lognormal

b) Uniform

c) Triangular

d) Poisson

- Merton and Scholes received the 1997 Nobel Memorial Prize in Economic Sciences for their work, the committee citing their discovery of the risk neutral dynamic revision as a breakthrough that separates the option from the risk of the underlying security.
- Although ineligible for the prize because of his death in 1995, Black was mentioned as a contributor by the Swedish Academy.

25. The Black-Scholes model was developed mainly for pricing of:

a) European style options

b) American style option

c) Both (a) and (b)

d) NOTA

The Black-Scholes Merton (BSM) model is a differential equation used to solve for options prices. **The model won the Nobel prize in economics.** The standard BSM model is only used to price European options and does not take into account that options could be exercised before the expiration date.

26. The expected volatility of the underlying asset is known as:

a) Sigma - σ

b) Delta - δ

c) Gamma - γ

d) Theta - θ

27. The black scholes option pricing model is dependent on which five parameters:

a) Stock price, exercise price, risk free rate, variance, time to maturity

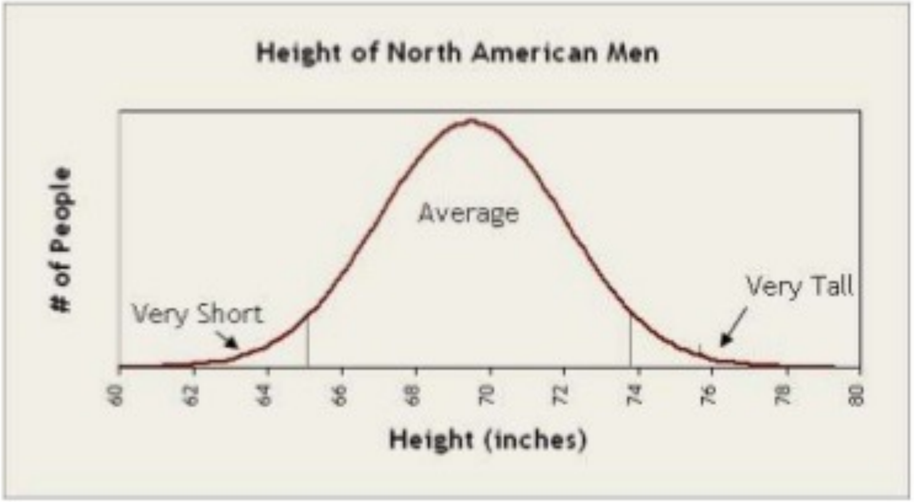
b) Sale price, exercise price, risk free rate, variance, time to maturity

c) Economic price, exercise price, risk free rate, variance, time to maturity

d) Stock price, exercise price, discount rate, variance, time to maturity

Continuous Random Variables

A **continuous random variable** *X* takes on all values in an interval of numbers. The probability distribution of *X* is described by a **density curve**. The probability of any event is the area under the density curve and above the values of *X* that make up the event.



28. According to black scholes model, trading of securities and stock prices moves respectively:

a) Constant and randomly

b) Randomly and constant

c) Randomly and continuously

d) Continuously and randomly

29. A method of adjusting for cash dividends is the .... model:

a) Fisher

b) Sharpe

c) Merton

d) Miller

- The Black-Scholes formula includes the following variables: the price of the underlying stock, the strike price of the option in question, the time until the expiration of the option, the implied volatility of the underlying stock, and the risk-free interest rate.
- Since the formula does not reflect the impact of the dividend payment, some experts have ways to circumvent this limitation.
- One common method is to subtract the discounted value of a future dividend from the price of the stock

Monte Carlo method for option pricing

- In mathematical finance, a Monte Carlo option model uses Monte Carlo methods to calculate the value of an option with **multiple sources of uncertainty** **or** **with complicated features.**
- The first application to option pricing was by Phelim Boyle in 1977 (for European options). In 1996, M. Broadie and P. Glasserman showed how to price Asian options by Monte Carlo.
- An important development was the introduction in 1996 by Carriere of Monte Carlo methods for options early exercise features.

LSM Carlo method

Least Square Monte Carlo is a technique for valuing early-exercise options (i.e. Bermudan or American options). It was first introduced by **Jacques Carriere** in 1996. It is based on the iteration of a **two step procedure:**

1. First, a backward induction process is performed in which a value is recursively assigned to every state at every timestep. The value is defined as the least squares regression against market price of the option value at that state and time (-step). Option value for this regression is defined as the value of exercise possibilities (dependent on market price) plus the value of the timestep value which that exercise would result in (defined in the previous step of the process).
2. Secondly, when all states are valued for every timestep, the value of the option is calculated by moving through the timesteps and states by making an optimal decision on option exercise at every step on the hand of a price path and the value of the state that would result in. This second step can be done with multiple price paths to add a stochastic effect to the procedure.

30. Monte Carlo option model uses Monte Carlo methods to calculate the value of an option with ………………….

a) Multiple Uncertainty situations

b) Complicated scenarios

c) Certainty Approach

d) Either (a) or (b)

Mini Case

31. If Spot Price = 450; Exercise Price = 570; Interest Rate = 10%; d (downward) = 0.88; u (upward) = 1.4; Then Value of Call Option is (using Binomial Model)

a) 25.05

b) 28.84

c) 23.08

d) 19.84

32. Which method is not used for valuing Options?

a) Black-Scholes Model

b) Binomial Model

c) Monte Carlo Simulation

d) Time-Series Model

Formulae's

- **Time Value = Option Premium - Intrinsic Value**
- **Option Premium = Intrinsic Value + Time Value**
- **Value of Call Option (Binomial Model): Co = ΔS + B**

- **Value of Call Option [BSM] (Co) = N(d1)*S - E/(e^(r*t))*N(d2)**

$$\Delta = \frac{C_u - C_d}{(u-d)S}$$

$$B = \frac{(u)C_d - (d)C_u}{(u-d)(R)}$$

Put-Call Parity

$$C + Xe^{-rT} = P + S$$

$where:$

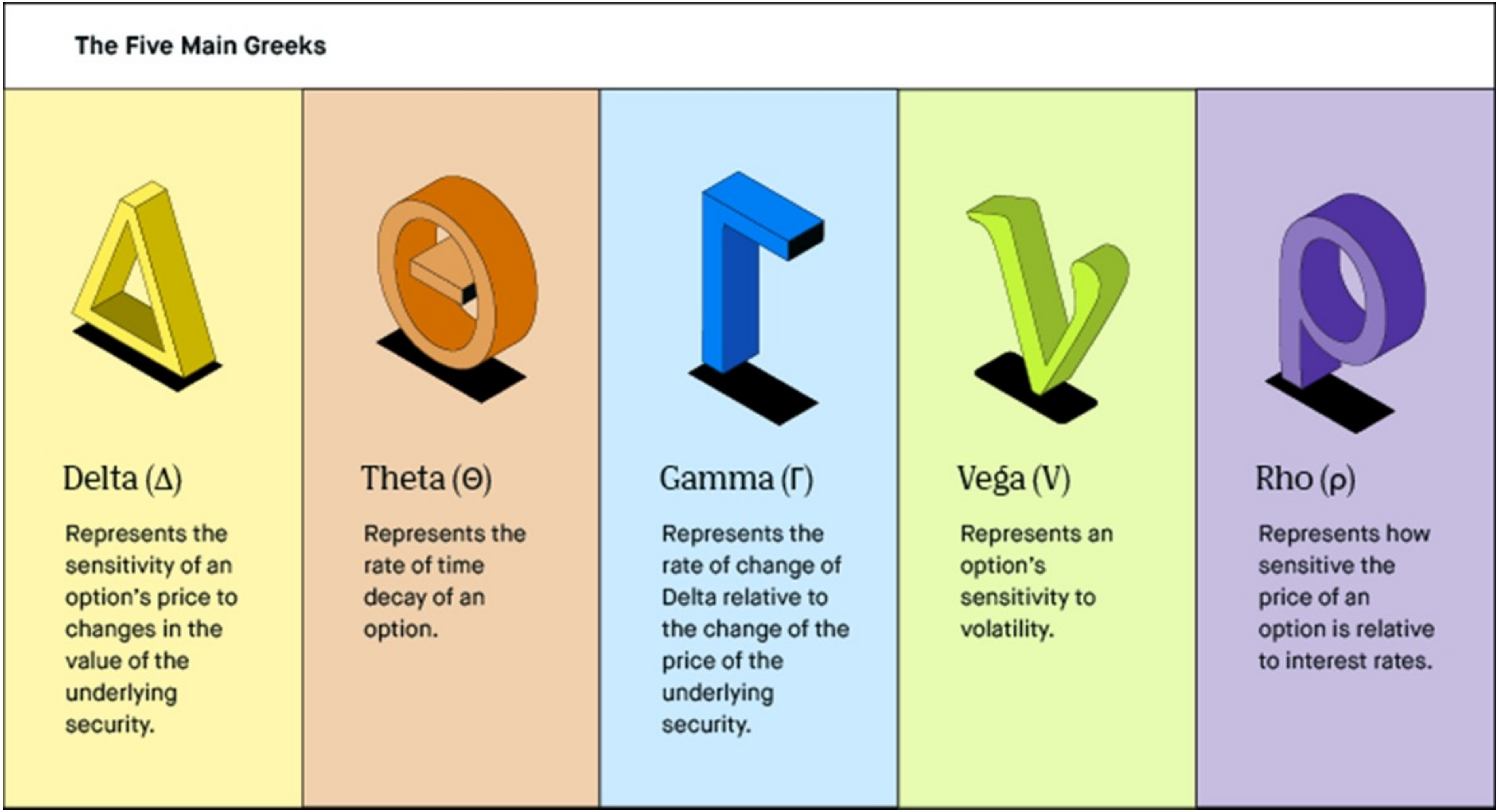
$C = call\ premium$

$Xe^{-rt} = present\ value\ of\ the\ strike$

$P = put\ premium$

$S = the\ current\ price\ of\ the\ underline$

The Option Greeks



33. Option Delta is the ratio of spread of possible option price to the spread of possible share price

a) Call Ratio

b) Put Ratio

c) Hedge Ratio

d) Option Ratio

34. The option delta is calculated as the ratio:

A. (the spread of possible share prices) / (the spread of possible option prices)

B. (the share price) / (the option price)

C. (the spread of possible option prices) / (the spread of possible share prices)

D. (the option price) / (the share price)

6 Inputs that affect Option Prices

	Sign of Input Effect		
Input	**Call**	**Put**	**Common Name**
S (Spot)	+	-	Delta
K (Exercise)	-	+	
t (time)	+	+	Theta
σ (Standard Deviation)	+	+	Vega
R (Risk Free Rate)	+	-	Rho
D (dividend)	-	+	

35. Which of the following measures the impact of a change in the Stock (Spot) price on an option price?

A. Vega

B. rho

C. delta

D. theta

36. Which of the following measures the impact of a change in Time remaining until option expiration on an option price?

A. Vega

B. rho

C. delta

D. theta

37. Which of the following measures the impact of a change in the underlying stock price Volatility on an option price?

A. Vega

B. rho

C. delta

D. theta

38. Which of the following measures the impact of a change in the Interest rate on an option price?

A. Vega

B. rho

C. delta

D. theta

Mini Case

39. Calculate the Value of Call Option using Binomial Option Pricing Model

Particulars	Asset X	Asset Y
Spot Price (S)	100	100
Exercise Price (E)	110	95
Interest Rate (r)	8%	7.5%
Period (n)	1 year	1 year
Upward Limit (u)	25%	20%
Downward Limit (d)	20%	25%

Mini Case

40. Calculate the Value of Put Option using Binomial Option Pricing Model

Particulars	Asset X	Asset Y
Spot Price (S)	100	100
Exercise Price (E)	110	95
Interest Rate (r)	8%	7.5%
Period (n)	1 year	1 year
Upward Limit (u)	25%	20%
Downward Limit (d)	20%	25%

Exotic Options

- An **exotic option** is an option which has features making it more complex than commonly traded vanilla options. Like the more general exotic derivatives they may have several triggers relating to determination of payoff.
- An exotic option may also include non-standard underlying instrument, developed for a particular client or for a particular market.
- Exotic options are more complex than options that trade on an exchange, and are generally traded over the counter (OTC)

OTC Options

- OTC options are exotic options that trade in the over-the-counter market rather than on a formal exchange like exchange traded option contracts.
- OTC options are the result of a private transaction between the buyer and the seller.
- OTC option strike prices and expiration dates are not standardized, which allows participants to define their own terms, and there is no secondary market.

Fundas

a) Asian options

b) Barrier options

c) Basket options

d) Bermuda options

e) Binary options

f) Chooser options

g) Compound options

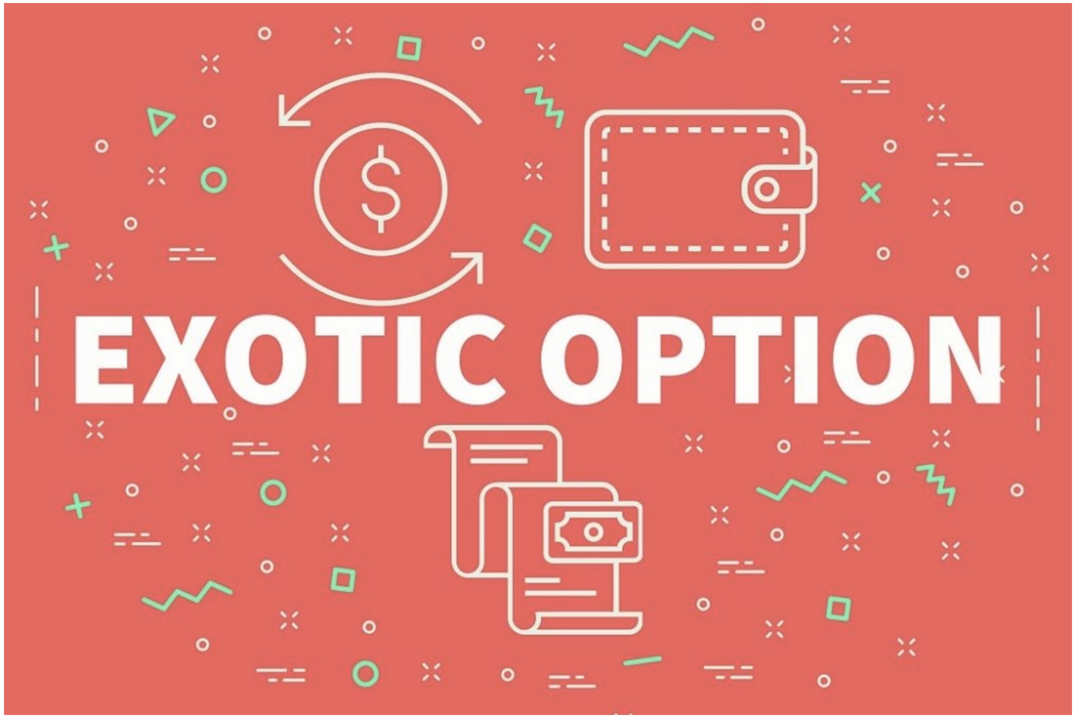
h) Extendible options

i) Lookback options

j) Spread options

k) Range options

Types of Exotic Options



Exchange Traded Options

- Exchange Traded Options (ETOs) are a derivative security which means their value is derived from another asset, typically a share or (stock market) index.
- An ETO gives you the right but not the obligation to buy or sell a given security at a certain price within a given time.
- There are two main types of ETOs: Calls - the right to buy, and Puts - the right to sell.
- Trading ETOs is risky and should not be attempted unless you have a sound understanding of their characteristics and the market they operate in.

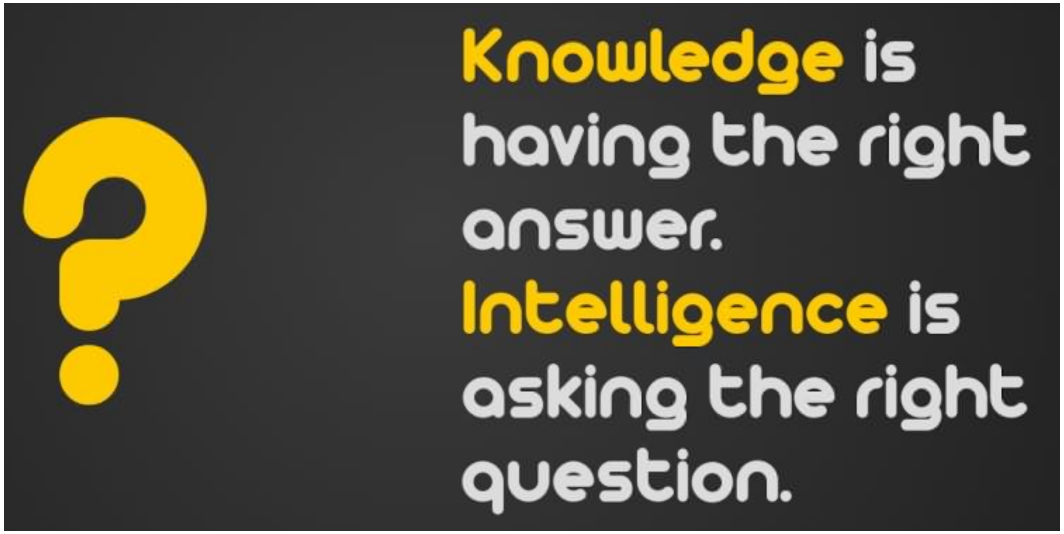
Fundas

Spread Option

- A **spread option** is a type of option where the **payoff is based on the difference in price between two underlying assets**.
- For example, the two assets could be crude oil and heating oil; trading such an option might be of interest to oil refineries, whose profits are a function of the difference between these two prices.
- Spread options are generally traded over the counter, rather than on exchange.
- A 'spread option' is not the same as an 'option spread'.
- A spread option is a new, relatively rare type of exotic option on two underlyings, while an option spread is a combination trade: the purchase of one (vanilla) option and the sale of another option on the same underlying.

A firm can have value only if it ultimately delivers earnings

1	c	11	b	21	d	31	c		
2	b	12	b	22	a	32	d		
3	d	13	c	23	b	33	c		
4	b	14	a	24	a	34	c		
5	a	15	c	25	a	35	c		
6	d	16	b	26	a	36	d		
7	c	17	a	27	a	37	a		
8	d	18	c	28	d	38	b		
9	a	19	c	29	c	39X	8.64		
10	c	20	d	30	d	40X	10.49		



CA Dr GOPAL KRISHNA RAJU

Chartered Accountant, Insolvency Professional & Registered Valuer

Partner : K GOPAL RAO & CO | Chartered Accountants

Mumbai, Chennai, Bengaluru, Coimbatore, Hyderabad, Trichy, Madurai & Tiruvallur

Email: gkr@icai.org; gkr@kgrca.in **Blog:** www.3spro.blogspot.com

Mobile: 98400 63269 | 98401 63269