

DERIVATIVES

- Stock exchange is the market place for trading of securities of a Company.
- To facilitate trading, the securities of a Company are listed with the Stock Exchanges.
- A security which is not listed with the Stock Exchange cannot be traded.
- Only Public Limited Companies are eligible to get its securities listed on the Stock Exchange.

Primary Market: Denotes Market for issue of New Securities.

The players in this market consist of

- ✓ Issuer Company,
- ✓ Subscribers to these securities,
- ✓ the regulatory agencies like the SEBI & the Government, and
- ✓ the intermediaries such as Brokers, Merchant Bankers, Collecting Bankers & Underwriters

Secondary Market: Denotes Market for trading of existing Securities, which are already listed with the Exchange.

The players in this market include

- ✓ Public Investors dealing in securities,
- ✓ Brokers,
- ✓ Mutual Funds, and
- ✓ Most importantly, the Stock Exchanges where the trading takes place.

Derivatives Contract:

- A Financial Instrument whose payoff structure is derived from the value of the underlying asset.

Note: The underlying asset could be Commodities, Precious Metals, Foreign Exchange Rate, Interest Rate relating to Financial Assets, Shares and Market Indexes.

Examples: Forwards, Futures & Options

Forward Contract:

- An agreement entered **Today** under which one party agrees to buy and the other agrees to sell an asset on a **Specified Future Date** at an **Agreed Price**

Futures Contract:

- A **standardised** contract between two parties where one of the parties commits to sell and the other commits to buy, a specified asset at an agreed price on a given date in future.
- A Futures contract merely upgrades a forward contract into a secured risk less, marketable instrument.

Mark to market margin - Parties to maintain a deposit (margin) with Clearinghouse.

- ✓ The margin amount changes with changes in daily prices.
- ✓ If the price goes up, the buyer's margin is reduced and the seller's margin is increased by an equal amount.
- ✓ If the price comes down, the buyer's margin is increased and the seller's margin is reduced by an equal amount.
- ✓ This process is called Marking to Market

Margin Requirement

- Trading in securities is carried out through members of securities exchange. To ensure that members are fulfilling their obligations and to infuse confidence in the minds of Investors, regulatory provisions are required.
- ✓ Accordingly, Stock Exchanges impose margin requirements on the operators in Securities Market.
- ✓ Margin is money deposited by both the Buyer & Seller to assure the integrity of the Contract.
- ✓ There are two types of margins
 1. Initial Margin &
 2. Maintenance Margin

Initial Margin: The amount of money, which a customer must deposit in his account whenever He establishes a Futures position.

- ✓ Minimum margins are set by the Exchange and are usually about 10% of the total value of the Contract.

Maintenance Margin: It is the Minimum margin required to hold a position.

- ✓ Maintenance margins should be sufficient to support the daily settlement process called “Mark to Market”, whereby losses that have already occurred are collected.
- ✓ Margin required to be kept by the Investor in the Equity Account equal to the specified % of the amount kept as initial margin.
- ✓ Normally, this is 75% to 80% of the initial margin

Note:

- ✓ Initial margin is deposited when a trade is opened, and refunded when it's closed.
- ✓ Maintenance margin is the lower bound for the acceptable level of margin.

Options

- An option is a **contract** between two parties under which the **buyer of the option** buys the **right** and **not the obligation** to **buy or sell**, a standardised quantity (**contract size**) of a financial instrument at or before a pre-determined date at a price, which is decided in advance.
- When the option gives the **buyer** of the option, the **right** to **buy**, it is called a **Call Option**
- When the option gives the **buyer** of the option, the **right** to **sell**, it is called a **Put Option**

Long Position: The party **who agrees to buy** on a future date is said to have taken a Long Position on the Underlying Asset.

Short Position: The party **who agrees to sell** on a future date is said to have taken a Short Position on the Underlying Asset.

The rules of valuation are based on two basic concepts – Continuous compounding & Short Selling

Continuous Compounding:

$$\text{Annual Compounding} \quad A = P \times (1 + r)^n$$

$$\text{Compounding less than a Year} \quad A = P \times (1 + r/m)^{m n}$$

$$\text{Continuous Compounding} \quad A = P \times e^{r t}$$

$$\begin{array}{lll} \text{Where,} & A & = \text{Compounded Value} \\ & P & = \text{Amount to be compounded} \end{array}$$

r	=	Rate of interest
n	=	Number of Years
e	=	Exponential Value (2.7183)
m	=	Number of compoundings in a year.
t	=	Time in Years

Continuous Discounting:

$$A = P \times e^{-(r t)}$$

Where,

A	=	Discounted Amount
P	=	Amount to be discounted

Equivalent Rates:

Normal to Continuous $r_2 = m \times \ln (1 + r_1/m)$

Continuous to Normal $r_1 = m \times (e^{r_2/m} - 1)$

Where,

r1	=	Normal Rate
r2	=	Continuous compounding rate
e	=	Exponential Value (2.7183)
m	=	frequency of compounding in a year
Ln	=	Natural Logarithm

- **Short selling** involves selling a stock which *you don't own* and buying it back later to *square* the position.
- A short seller resorts to this strategy because he expects *prices to fall* and wants to benefit from the fall

Pricing of Forward & Futures Contracts

- ✓ Forward contracts will be priced using the cost of carry model.
- ✓ Futures price will be similar to that of Forward pricing.
- ✓ The forward or futures price so computed will be called the Theoretical Forward Price or Fair Forward Price (FFP)
- ✓ If the Actual Forward Price (AFP) is not equal to the FFP, then arbitrage opportunities will emerge as the Investor will buy in one market and simultaneously sell in the other market to make risk free gains.

Rule: 1 Buy Forward & Sell Spot: ($AFP < FFP$)

- ✓ If the Actual Forward Price is less than the Theoretical Forward Price, the stock is undervalued *in the Forward Market*.
- ✓ The Investor will sell the stock in the spot market, invest the proceeds at the risk free rate of interest, buy in the Forward Market and use the proceeds to settle payment when the forward contract materializes .
- ✓ He then proceeds to pocket the difference.

Rule: 2 Buy Spot & Sell Forward: ($AFP > FFP$)

- ✓ If the Actual Forward Price is greater than the Theoretical Forward Price, the stock is overvalued *in the Forward Market*.
- ✓ The Investor will borrow money at the risk free rate of interest, buy the stock in the spot market and immediately sell it in the Forward Market.
- ✓ He then proceeds to pocket the difference.

Theoretical or Fair Forward Price – Formulae:

1. Securities providing no Income

$$F = S_0 \times e^{rt}$$

2. Securities providing known cash income (Ex. Dividend)

$$F = (S_0 - I) \times e^{rt}$$

Where, $I = Y \times e^{-(rt)}$

3. Securities providing a known yield

$$F = S_0 \times e^{(r-y) \times t}$$

4. Carry type commodity (Ex- Gold)

$$F = (S_0 + S) \times e^{rt}$$

5. Non-carry type commodity (Rice, Wheat)

$$F = (S_0 + S) \times e^{(r-c) \times t}$$

Where,

F	=	Theoretical Forward Price
S ₀	=	Current Spot Price
e	=	Exponential Value
r	=	Rate of Interest
t	=	Number of years
I	=	Present value of Income
Y	=	Income

y	=	Yield
S	=	Present value of storage cost
c	=	Convenience Yield

If required: Convenience Yield Is the return that an Investor realises for carrying inventory over his immediate need. This is considered as negative cost.

Hedging: Any act which reduces the price risk of a position taken *in the cash market*

- ✓ By taking a position that is the opposite of the position taken in the cash market, one can hedge with a *Futures market*.

Short Hedge: One should sell futures, if taken a long position on the asset in the cash market. (Selling Futures)

- ✓ If the price falls, one will lose in the spot market but gains in the futures market
- ✓ If the price goes up, one will gain in the spot market but loses in the futures market

Long Hedge: One should buy futures, if taken a short position on the asset in the cash market – Buying Futures

- ✓ If the price falls, one will gain in the spot market but loses in the futures market
- ✓ If the price goes up, one will lose in the spot market but gains in the futures market

Basis Risk: Hedging eliminates price risk but opens up a second risk, called Basis Risk.

- ✓ Basis refers to the difference between spot price and futures price.
- ✓ Basis risk is the possibility that the basis will change over time.

Hedge Ratio: Number of futures contract to buy or to sell per unit of spot position is called the Hedge Ratio

Formula: Hedge Ratio = $(\sigma S / \sigma F) \times \text{Correlation F S}$

Where,

S = Change in spot price &

F = Change in futures price

Number of futures contract to trade = Hedge Ratio $\times \frac{\text{Rupee value of spot position requiring hedging}}{\text{Rupee value underlying one futures contract}}$

Note:

- The Rupee value of one unit of NIFTY is Rs. 200 and that of SENSEX is Rs. 50.
- The extent of hedging (hedge ratio) is determined by the beta of a security.
- If the beta is greater than one (i.e. hedge ratio is greater than one) then the position hedged would be higher than the underlying position and would be proportionate to the beta of a security.

- An option is said to be “in-the-money” if exercising the option will bring about a gain.
- An option is said to be “out-of-the-money” if exercising the option will result in a loss.
- An option is said to be “at-the-money” if exercising the option will result in neither a gain nor a loss.

Note: The option premium paid to buy these options to be ignored since it represents a sunk cost.

Note: The position is automatically reversed for the Writer of the option, since options are essentially a zero sum game.

An option's premium consists of two parts

- (a) Intrinsic value and
- (b) Time value.

Intrinsic value is that part of the option premium which represents the extent to which the option is in the money.
It is the real worth of the option.

Note: There is no intrinsic value for the options that are at the money or out of the money.
i.e Intrinsic value cannot be negative.

Time value represents the balance (Premium less Intrinsic value)
and is the premium paid for the time value of money.

Note: Time value falls with time and falls to zero on the expiration date.

Rule :

Status	Intrinsic Value	Time Value
In	If Call: $MP - EP$ If Put : $EP - MP$	$\text{Max} (P - Iv, 0)$
At	Nil	Premium
Out	Nil	Premium

Choices

- After one has **bought** an option, the **Holder** has three choices

Choice 1: Do nothing

Choice 2: Close out – i.e. a reverse trade.

- ✓ If one **owns** a call, he should **write** a matching call.
- ✓ If one **owns** a put, he should **write** a matching put.

Choice 3: Exercise the option

- After one has **written** an option, the **Writer** has two choices

Choice 1: Do nothing

Choice 2: Close out

- ✓ If one has **written** a call, he should **buy** a matching call
- ✓ If one has **written** a put, he should **buy** a matching put.

Value of an option on expiry:

- The value of a **Call/Put** on the expiry date will depend on whether the stock price on that date will finish above or below the Exercise Price.

Call Option:

Formula: Value of call on **Expiry** $C1 = \text{Max}(0, S1 - E)$

Where, $S1$ = Spot price on expiry,
 E = Exercise or Strike Price

Rule 1: If on the expiry date, the stock price finishes below the exercise price, the call will be Out of the Money and will not be exercised.

∴ Value of the call will be zero.

Rule 2: If on the expiry date, the stock price is equal to the exercise price, the call will be At the Money and will not be exercised.

∴ Value of the call will be zero.

Rule 3: If on the expiry date, the stock price is above the exercise price, the call will be In the Money and will be exercised.

∴ Value of the call will be $S1 - E$ (i.e. $MP - EP$)

Rule 4: A holder will exercise a call option, if by buying at EP and selling at MP, he gains.

Put Option: Formula: Value of Put on **Expiry** $P1 = \text{Max}(0, E - S1)$

Rule: 5

Status	Value of Call	Value of Put
$EP > MP$	Zero	$E - S1$
$EP = MP$	Zero	Zero
$EP < MP$	$S1 - E$	Zero

Rule : 6

Party	Gains	Loss
Call Buyer	Unlimited	Limited
Put Buyer	Limited	Limited
Call Writer	Limited	Unlimited
Put Writer	Limited	Limited

Break-Even Price

The Market price at which the Call Buyer or Put Buyer neither makes a profit nor incurs a loss.

Rule: 7

	Call	Put
Buyer	$MP - EP - P = 0$	$EP - MP - P = 0$
Seller	$EP - MP + P = 0$	$MP - EP + P = 0$

Arbitrage

- If the actual value (price) of the call or put on the expiry date is not in line with theoretical value, arbitrage opportunities will open up.
- ✓ If the actual price is less than the theoretical price, the option is undervalued.
- ✓ If the actual price is greater than the theoretical price, the option is overvalued.
- ✓ Undervalued options should be bought and overvalued options should be sold.
- ✓ The Undervaluation or Overvaluation is in the derivative market.
- ✓ To make arbitrage gain in the case of a call option, the arbitrageur buys the option in the derivative market (if under valued) and immediately sells the share in the cash market.

Put – Call Parity

The Put-Call parity is the general relationship between value of call and value of put at same strike price for same expiration.

Formula:

$$S + P = C + \text{PV of Exercise price}$$

Value of Call Option

$$C = S + P - \text{PV of Exercise price}$$

Value of Put Option

$$P = C + \text{PV of Exercise price} - S$$

Where,

P = Price of a put option

C = Price of a call option

S = Current price of underlying stock.

Strategies

Spread: Spread involves taking positions in options of the same type. (Call options or Put Options)

A Spread consists of simultaneous purchase & sale of option contracts on same underlying asset.

Rule: 1 Between two calls, the one with a lower exercise price will command a higher premium.

Rule: 2 Between two puts, the one with a higher exercise price will command a higher premium.

There are two kinds of spreads – Bull Spread & Bear Spread.

A **butterfly spread** is created by opening two positions in one strike price and offsetting them with one transaction at a higher strike price and another transaction at a lower strike price.

- ✓ This spread creates a position whereby the trader makes a gain within a range of up-move and down-move of price.
- ✓ This is a strategy adopted by an investor who feels that a large move in the market is not likely.

The opening strike price is the average of the higher and the lower strike price and is called the Middle Strike Price.

1. Buy 2 calls at Mid-Strike price, write one call above and one call below.
2. Write 2 calls at Mid-Strike price, buy one call above and one call below.
3. Buy 2 puts at Mid-Strike price, write one put above and one put below.
4. Write 2 puts at Mid-Strike price, buy one put above and one put below.

- ✓ A bull butterfly spread would be most profitable if the underlying stock increases in value.
- ✓ A bear butterfly spread would be most profitable if the underlying stock decreases in value.

E1	=	Lower Exercise price
E2	=	Middle Exercise price
E3	=	Higher Exercise price
S	=	Spot price on maturity

Straddle is a strategy to be adopted in a volatile market.

- ✓ Straddle requires a combination of put and call options
- ✓ Straddle involves simultaneous purchase or sales of options with the same strike price and same expiry date.

Long Straddle: Simultaneous purchase of call and put (Long Call & Long Put) at same strike and same expiration.

- ✓ In a long straddle, a trader losses within a range of up and down swing in price.
- ✓ The loss cannot exceed the total premium paid.
- ✓ The trader has unlimited profit potential if the price is less than the lower limit or above the upper limit of the loss-range

Short Straddle: Simultaneous sale of call and put (Short Call & Short Put) at same strike and same expiration.

- ✓ In a short straddle, a trader gains within a range of up and down in price.
- ✓ The profit cannot exceed the total premium received
- ✓ The trader is exposed to possibility of unlimited loss, if the price is less than the lower limit or above the upper limit of the profit-range.

A Strip involves buying one call and two puts all with the same exercise price and same expiry date.

This is adopted when a decrease in price is more likely than an increase.

A Strap involves buying two calls and one put all with the same exercise price and same expiry date.

This is adopted when an increase in price is more likely than a decrease.

Gross Payoff on Strip & Strap

	$S < E$	$S > E$
Strip	$2 \times (E - S)$	$(S - E)$
Strap	$(E - S)$	$2 \times (S - E)$

A **Strangle** involves the simultaneous purchase or sale of options with the same expiry date but with **different Exercise Prices**.

Long Strangle: Buy a call and buy a put (same number of calls & same number of puts) at the different exercise price but same expiry date.

- ✓ The Exercise price (E1) of the Put is lower than the Exercise Price (E2) call so that a profit will arise if the stock price falls below E1 or raises above E2.
- ✓ Between the two exercise prices, neither option will be exercised and there will be a loss equal to the amount of premium paid.

Short Strangle: Write a Call and Write a Put (Same number) at different exercise price but same expiry date.

1. Portfolio Replication Model
2. Option and Stock Equivalents
3. Risk Neutral Model
4. Binomial Model
5. Black and Scholes Model

Portfolio Replication Model:

Case 1: Options finishing Only In-the-Money

Formula: $C_0 = S_0 - E / (1 + R_f)$

Step 1: Identify whether all option fall only in the money.

Step 2: Compute the risk free investment. (i.e. PV of exercise price)

Step 3: Apply the formula: $C_0 = S_0 - E / (1 + R_f)$

Where, C_0 = Value of call option today,

S_0 = Current spot price of shares,

E = Exercise price,

R_f = Risk free rate of return