Niraj on Financial Derivatives

Ref: Books of Sir John Hull, Sir Damodaran and my teachers who are updating me in this segment.
Contents At A Glance

- Introduction
- Types Of Financial Derivatives
- Hedging Strategies Using Futures
- Option Strategies
- Option Pricing
- Why To Use Derivatives
- Users Of Derivatives
**Introduction** Markets in Derivatives

**Exchange-traded**
- Standardized* contracts are traded
- Regulated by exchange boards as:
  - E.g. CBOT (The Chicago Board of Trade)
    - Target of CBOT Initially: bring farmers and merchants together
  - CME (Chicago Mercantile Exchange)
  - CBOE (Chicago Board Options Exchange)

*Standard here means – Quantity pre specified followed by pre specified maturity.

**Over-the-counter**
(An alternative to exchange)
- Based on telephone- and computer-linked network of dealers.
- Conversations are generally tapped so as to avoid future disputes- since non-standardized contracts being traded.
- Typically much larger trades
- Participants are free to negotiate any mutually attractive deal
- Contract may not be honored sometimes.
Size of OTC and Exchange-Traded Markets

Source: Bank for International Settlements. Chart shows total principal amounts for OTC market and value of underlying assets for exchange market.
# OTC & ET Products

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Basis</th>
<th>Exchange Traded Market</th>
<th>OTC (Over the counter market)</th>
</tr>
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<tbody>
<tr>
<td>(i)</td>
<td>Product</td>
<td>Standard</td>
<td>Non-standard</td>
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<tr>
<td>(ii)</td>
<td>Pricing</td>
<td>More transparent</td>
<td>Less transparent</td>
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<td>(iii)</td>
<td>MTM</td>
<td>Easy</td>
<td>Difficult</td>
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<td>(iv)</td>
<td>Settlement risk</td>
<td>The Exchange</td>
<td>Contracting parties</td>
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<td>(v)</td>
<td>Negotiation</td>
<td>Marketwide</td>
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</tr>
<tr>
<td>(vi)</td>
<td>Example</td>
<td>BSE, NSE etc.</td>
<td>Forex Market</td>
</tr>
</tbody>
</table>
Introduction to Derivatives

Basically derivatives are agreements or contracts between two (or more) parties that has a value determined by the price of something else.

A derivative is a-
✔ financial instrument or security
✔ whose payoffs and values are derived from, or depend on
✔ Another financial instrument or security
✔ And the pay off is derived from that underlying.
The underlying asset could be a financial asset such as currency, stock and market index, an interest bearing security or a physical commodity.

Payment may be in Currency, securities, a physical entity such as gold or silver, an agricultural product such as wheat or pork, a transitory commodity such as communication bandwidth or energy.

For example, a bushel of corn is not a derivative; it is a commodity with a value determined by the price of corn. Eg. If you enter into an agreement with a friend that says: If the price of a bushel of corn in one year is greater than Rs.300, you will pay the friend Rs.100. If the price of corn is less than Rs.300, then the friend will pay you Rs.100. This is a derivative in the sense that you have an agreement with a value depending on the price of something else (corn, in this case).
Types of Financial Derivatives

- Options
- Forward Contracts
- Futures
- Swaps
Simply, Forward Contracts
- tailor made contract
- entered today
- for purchase (sell)
- of an asset in future
- for a certain price agreed today

**Features:**
Customer designed contracts
(i.e. contract size, expiration
date and the asset type and quality)
not available in public domain

**Trading:** Over-the-counter market
One party-In long Position (Buyer)
Another- In short position (Seller)

- Whether to buy or sell
- The underlying asset
- The maturity or the settlement date
- The delivery price
The table shows the quote given by a bank. Forward Contracts are used to hedge foreign currency risk.

Suppose a person is receiving $10000 six months later from now, to be safe from price fluctuations in days to come he may enter into an agreement with the bank to sell the $10000 today.

As per the rates given:
He will sell each $ @ INR 70.4353, total =70.4353*10000=704353
Assume (from above table) the real consequences on the expiry date.

Two Possibilities

- **$Price may rise**
  - (Say 1$ = INR 70.50)
  - Negative value to the contract

- **$ Price may fall**
  - (Say 1$ = INR 70.30)
  - Positive Value.

The actual price prevailing on the expiry date has nothing to with the forward contract as your payment/receiving has been previously fixed. (These payoffs can be positive or negative.)
Profit from a Long Forward Position

Profit from a Short Forward Position

Profit vs. Price of Underlying at Maturity, $S_T$
Futures

Definition

• An agreement between two parties
to buy or sell specified asset
• In future
• With settlement at
• various future dates

Features

• Exchange traded product
• specified contract size and
  specified delivery date
• Settled daily
• Settlement-in cash or physical
• Mostly closed out before maturity
• Futures prices - reported in the
  financial press
• mark-to-the-market provisions
Mr. A enters into a contract with Mr. B

SBI Future Seller

Right: To receive the agreed price
Obligation: To deliver the underlying

SBI Future Buyer

Right: To take delivery of the underlying
Obligation: To pay the contracted price

Both Parties have rights and obligations

Both Parties have to deposit initial margin

Position: Short in SBI Future & Underlying

Position: Long in SBI Future & Underlying

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Concept of Margins

- amount payable by both parties.
- recovered to cover one day maximum loss
- can be in the form of cash or other liquid assets
- [Generally, we do not deposit cash]

- Calculated daily & Settled in cash
- Overcomes the dark side of forwards.
- minimize the chance of default
- If the price rises, the seller has an incentive to default on a forward contract. But in future, after paying the clearinghouse, the seller of a futures contract has little reason to default.
- changes in the value recognized daily, there is no accumulation of loss
- Default rate is reduced when the investors do not know each other.
Credit Risk Mitigation

The agreement will be honored by the CH
To protect itself the CH demands that
  ▶ An initial collateral amount is deposited to cover future losses
  ▶ A futures account is marked to market daily. Daily margin increase to cover unrealized losses from daily market movements

No party will incur a big loss at maturity

Categories of futures contracts
  • Agricultural e.g. wheat, cotton, cattle.
  • Metals and petroleum e.g. platinum, copper, natural gas, crude oil.
  • Financial e.g. foreign currency, stock index, interest rate.
  • Others e.g. electricity, catastrophe, swap
SETTLEMENT IN FUTURES

ON DAILY BASIS

MTM MARGIN

BASED ON DAILY SETTLEMENT PRICE

DECIDED BY THE MARKET (STOCK EXCHANGE)

AT EXPIRY DATE

MTM MARGIN

BASED ON *FUTURE SETTLEMENT PRICE

* FSP IS ALWAYS EQUAL TO SPOT PRICE OF THE UNDERLYING AT EXPIRY.

Note: Overall Profit will be FSP - Contracted Price
Margin Cash Flows

When Futures Price Decreases

When Futures Price Increases

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Convergence of Futures to Spot

(a)

(b)

Futures Price

Spot Price

Spot Price

Futures Price

Time

Time

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## Forward Contracts Vs. Futures Contracts

<table>
<thead>
<tr>
<th>Basis</th>
<th>Forward</th>
<th>Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange</td>
<td>Traded on over-the-counter market</td>
<td>Traded on an exchange</td>
</tr>
<tr>
<td>Counterparty</td>
<td>Counterparty in the forward agreement</td>
<td>Clearinghouse</td>
</tr>
<tr>
<td>Transaction Timing</td>
<td>Transact when purchased and on the settlement date</td>
<td>Marked-to-market every day</td>
</tr>
<tr>
<td>Delivery</td>
<td>Delivery or final cash settlement</td>
<td>Contract is usually closed out usually takes place prior to maturity</td>
</tr>
<tr>
<td>Credit Risk</td>
<td>Some credit risk may arise</td>
<td>Virtually no credit risk</td>
</tr>
<tr>
<td>Regulation</td>
<td>Private, unregulated transactions</td>
<td>Highly regulated</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Illiquid</td>
<td>Highly Illiquid</td>
</tr>
<tr>
<td>Delivery Dates</td>
<td>Usually one specified delivery date</td>
<td>Range of delivery dates</td>
</tr>
</tbody>
</table>
Remember:
The hedge has the same basic effect if delivery is allowed to happen. However, making or taking delivery can be a costly business so delivery is not usually made even when the hedger keeps the futures contract until the delivery month.
AIM

- Take a position that neutralizes a particular risk as far as possible

PERFECT HEDGE

- That completely eliminates the risk.
- Perfect hedges are rare practically
Short Position in future Contracts
Appropriate when the hedger already owns an asset and expects to sell it.

Used when an asset is not owned right now but will be owned at some time in the future.

E.g. Used by a farmer who owns some hogs and knows that they will be ready for sale.

An Indian exporter will be receiving euros in three months. He will realize a gain if the euro increases in value relative to the INR and will sustain a loss if the euro decreases in value relative to the INR. A short futures position leads to a loss if the euro increases in value and a gain if it decreases in value. It has the effect of offsetting the exporter's risk.
Long position in future contracts
- appropriate when a company knows it will have to purchase a certain asset in the future and wants to lock in a price now.
- partially offset an existing short position

See Practically:
A trader needs 1000 pounds of gold after 3 months from now to meet a certain contract.  
Contract Size: 250 pounds  
Spot Price: $150 /pound  
3-M Future Price: $120 /pound  
The trader can hedge by taking a long position in 4 future contracts to be delivered in 3 months from now.  
This strategy locked the price @120 cents  
If the price of gold in 3 months time is 125  
Gain = (125-120) x 1000 = $5000

Use futures contracts than to buy the gold in the spot market as he has to pay $150 instead of $120 per pound and will incur both interest costs and storage costs.
### Long Hedge for Purchase

Define:
- $F_1$: Futures price at time hedge is set up
- $F_2$: Futures price at time asset is purchased
- $S_2$: Asset price at time of purchase
- $b_2$: Basis at time of purchase

<table>
<thead>
<tr>
<th>Cost of asset</th>
<th>$S_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain on Futures</td>
<td>$F_2 - F_1$</td>
</tr>
<tr>
<td>Net amount paid</td>
<td>$S_2 - (F_2 - F_1) = F_1 + b_2$</td>
</tr>
</tbody>
</table>

### Short Hedge for Sale

Define:
- $F_1$: Futures price at time hedge is set up
- $F_2$: Futures price at time asset is sold
- $S_2$: Asset price at time of sale
- $b_2$: Basis at time of sale

<table>
<thead>
<tr>
<th>Price of asset</th>
<th>$S_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain on Futures</td>
<td>$F_1 - F_2$</td>
</tr>
<tr>
<td>Net amount received</td>
<td>$S_2 + (F_1 - F_2) = F_1 + b_2$</td>
</tr>
<tr>
<td><strong>IN FAVOR</strong></td>
<td><strong>AGAINST</strong></td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>• Companies should focus on the main business they are in and take steps to minimize risks arising from interest rates, exchange rates, and other market variables</td>
<td>• Shareholders are usually well diversified and can make their own hedging decisions</td>
</tr>
<tr>
<td></td>
<td>• It may increase risk to hedge when competitors do not</td>
</tr>
<tr>
<td></td>
<td>• Explaining a situation where there is a loss on the hedge and a gain on the underlying can be difficult</td>
</tr>
</tbody>
</table>
Basis Risk

• Generally, it is the **spot price minus the futures price**
• Basis risk arises because of the uncertainty about the basis when the hedge is closed out.
• *Instances:*
  ✓ The asset whose price is to be hedged may not be exactly the same as the asset underlying the futures contract.
  ✓ The hedger may be uncertain as to the exact date when the asset will be bought or sold.
  ✓ The hedge may require the futures contract to be closed out well before its expiration date.

*The basis would be zero* if the asset to be hedged and the asset underlying the futures contract are the same at expiration of the contract.

The *hedge ratio* is the ratio of the size of the position taken in futures contracts to the size of the exposure.
Options

**DEFINITION**

✓ It is a contract
✓ giving its owner the right to buy or sell an asset
✓ at a fixed price
✓ on or before a given date.

**FEATURES**

✓ Traded both on exchanges and in the over-the-counter market

*Note: Any option will be exercised if the buyer gets advantages*
- **CALL OPTION**
  - gives the holder the right
  - to buy the underlying asset
  - by a certain date
  - for a certain price.

- **PUT OPTION**
  - gives the holder the right
  - to sell the underlying asset by
  - a certain date for a certain price

- **EXERCISE STYLES**
  - **American options**
    - can be exercised at any time before the expiration date
    - (Problem in pricing—so banned in India)
  - **European Options**
    - exercised only on the expiration date

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A futures/forward contract gives the holder the obligation to buy or sell at a certain price.

An option gives the holder the right to buy or sell at a certain price.
## Summary of the Determinants of Option Value

<table>
<thead>
<tr>
<th>Factor</th>
<th>Put Value</th>
<th>Call Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in Stock Price</td>
<td>Increases</td>
<td>Decreases</td>
</tr>
<tr>
<td>Increase in Strike Price</td>
<td>Decreases</td>
<td>Increases</td>
</tr>
<tr>
<td>Increase in variance of underlying asset</td>
<td>Increases</td>
<td>Increases</td>
</tr>
<tr>
<td>Increase in time to expiration</td>
<td>Increases</td>
<td>Increases</td>
</tr>
<tr>
<td>Increase in interest rates</td>
<td>Increases</td>
<td>Decreases</td>
</tr>
<tr>
<td>Increase in dividends paid</td>
<td>Decreases</td>
<td>Increases</td>
</tr>
</tbody>
</table>

*If the value of the underlying asset < Strike Price – Buyer does not exercise (CALL OPTION)*

*If the value of the underlying asset > Strike Price – Buyer does not exercise (PUT OPTION)*
Basics

1) Option seller sells the right and option buyer buys the right.

2) Call or Put should always be talked w.r.t. the underlying.

3) The party having the obligation shall pay security margin (Initial Margin)

4) There is an underlying stock or index

5) There is an expiration date of the option

6) There is a strike price of the option
Option Positions

Options trader buy call options with the belief that the price of the underlying security will rise significantly beyond the strike price before the option expiration date.

Investor buy put options with the belief that the price of the underlying security will go significantly below the striking price before the expiration date.

Option trader sells the option in the hope that they expire worthless so that they can pocket the premiums.

The converse strategy to the long put involves the selling of put options. Commonly known as put writing.
Diagrammatic Examples (Call Option)

Mr. A Enters into an agreement & Sells “Right”

Mr. A’s Right: NO
Mr. A’s Obligation: YES

Mr. A received the option Premium

He has the obligation to deliver the Underlying if the option is exercised by B

Short in Option & Underlying

Mr. B Enters into an agreement & Buys “Right”

Mr. B’s Right: YES
Mr. B’s Obligation: NO

Mr. B Pays the option Premium

He has the right to buy/take delivery of the Underlying

Long in Option & Underlying

Buyer always pays the premium and seller always receives the premium at entering into agreement.
Diagrammatic Examples (Put Option)

SBI Put Option (Seller)  
Mr. A

Enters into an agreement & writes “Put Option”

SBI Put Option (Buyer)  
Mr. B

Mr. A’s Right  NO
Mr. A’s Obligation  YES

Mr. A received the Put Option Premium

He has the obligation to deliver the Underlying if the option is exercised by B

It's the buyer who shall decide whether to exercise the option or not

Mr. B’s Right  YES
Mr. B’s Obligation  NO

Mr. B Pays the Put Option Premium

He has the right to buy/take delivery of the Underlying

Short in Put Option  
Long in Underlying  
(If option is exercised by Mr. B)

Long in Option  
Short in Underlying  
(He has to deliver the underlying)
**Some Terminologies**

**Strike Price**
Price at which the underlying asset is to be bought or sold when the option is exercised.

It's relation to the market value of the underlying asset affects the **moneyness** of the option and is a major determinant of the option's premium.

The price in the contract is known as the exercise price or strike price.

**Premium**
Simply, price for the right depends on the strike price, volatility of the underlying, as well as the time remaining to expiration.

The act of buying or selling the underlying asset via the option contract is referred to as exercising the option.

**Expiration Date**
Once the stock option expires, the right to exercise no longer exists and the stock option becomes worthless. The expiration month is specified for each option contract. The specific date on which expiration occurs depends on the type of option. The date in the contract is known as the expiration date or maturity.

**Spot Price**
The current price at which a particular security can be bought or sold at a specified time and place.

**Contract Multiplier**
states the quantity of the underlying asset that needs to be delivered in the event the option is exercised. For stock options, each contract covers 100 shares.
Cash Flows & Profits

In the Hands of Option Buyer

Expiry Date

NIL

Option Not Exercised

Inflow

Option Exercise

Outflow

Option Exercised

NIR

Option Not Exercised

Remember: Always at Inception of the agreement buyer has outflow and seller has inflow

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# Quantifying The Amounts

<table>
<thead>
<tr>
<th>PUT OPTION</th>
<th>CALL OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUYER</strong></td>
<td><strong>CALLER</strong></td>
</tr>
<tr>
<td>If $X &gt; S$</td>
<td>Inflow $(X-S)$</td>
</tr>
<tr>
<td>If $X &lt; S$</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note:** Say $X$ means Strike Price & $S$ means Spot Price
### Profit Or Loss - (Premium To Be Adjusted With The Cash Flows)

<table>
<thead>
<tr>
<th>PUT OPTION</th>
<th>CALL OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case I:</strong></td>
<td><strong>Case II:</strong></td>
</tr>
<tr>
<td><strong>If X &gt; S</strong></td>
<td><strong>If X &lt; S</strong></td>
</tr>
<tr>
<td><strong>BUYER</strong></td>
<td><strong>BUYER</strong></td>
</tr>
<tr>
<td>Inflow (X-S)</td>
<td>Outflow (S-X)</td>
</tr>
<tr>
<td><strong>SELLER</strong></td>
<td><strong>SELLER</strong></td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Premium</td>
<td>(P)</td>
</tr>
<tr>
<td>Profit (Loss)</td>
<td>X-S-P</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Limited Profit</td>
</tr>
<tr>
<td></td>
<td>Limited Loss</td>
</tr>
<tr>
<td></td>
<td>To the extent of Premium</td>
</tr>
<tr>
<td><strong>Premium</strong></td>
<td><strong>Premium</strong></td>
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<tr>
<td>(P)</td>
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<td><strong>Profit (Loss)</strong></td>
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<td>S-X-P</td>
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<tr>
<td><strong>Case II:</strong></td>
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<tr>
<td><strong>If X &lt; S</strong></td>
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<tr>
<td>0</td>
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</tr>
<tr>
<td><strong>BUYER</strong></td>
<td><strong>BUYER</strong></td>
</tr>
<tr>
<td>Outflow (X-S)</td>
<td>Inflow (S-X)</td>
</tr>
<tr>
<td><strong>SELLER</strong></td>
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<td></td>
<td>Unlimited Profit</td>
</tr>
<tr>
<td></td>
<td>Unlimited Loss</td>
</tr>
</tbody>
</table>
OPTION PRICE = INTRINSIC VALUE + TIME VALUE

OPTION PREMIUM

INTRINSIC VALUE

EXTRINSIC VALUE

Quoted Price

[Determined by
using Theoretical
Price]

Computed by
Comparing Spot
Price & Strike Price

Keeps on Changing
due to change in
Spot Price

Bal. Fig
In Case of Call Option

Example: IDFC Spot Price at time “t” = 120
IDFC Call Option Strike Price = 110 [Right to buy]
IDFC Call Option Price (premium) = 15

Now, Intrinsic Value = Spot Price – Strike Price
120-110 = 10 (Portion of profit already made)

Time Value = 15-10 = 5 (Profit yet to be made).

Break Even Spot Price at Expiry: Strike Price + Premium
= 110 + 15 = 125
In Case of Put Option

Example: IDFC Spot Price at time “t” = 120
IDFC Call Option Strike Price = 135 \textit{[Right to Sell]}
IDFC Call Option Price (premium) = 20

Intrinsic Value: Strike Price \text{–} \text{Spot Price}
= 135-120 = 15

Extrinsic Value = 20-15 = 5

Break Even Spot Price at Expiry: Strike Price \text{–} Premium Paid
= 135 -20 = 115

Note: In theory time value declines at a constant rate while in practice the decline rate would be faster nearer the expiry date
MONEYNESS OF OPTION

It describes the relationship between the strike price of an option and the current trading price of its underlying security.

**ITM (IN THE MONEY)**
- ITM options are expensive since IV are high
- Call option: \( X < S \)
- Put option: \( X > S \)

**ATM (AT THE MONEY)**
- IV = 0
- \( S = X \)

**OTM (OUT OF THE MONEY)**
- Nil intrinsic value
- \( X > S \)
- \( S > X \)
<table>
<thead>
<tr>
<th>Strike Price (INR)</th>
<th>Moneyness</th>
<th>Call Option Premium</th>
<th>Intrinsic Value</th>
<th>Time Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>ITM</td>
<td>15.50</td>
<td>15</td>
<td>0.50</td>
</tr>
<tr>
<td>40</td>
<td>ITM</td>
<td>11.25</td>
<td>10</td>
<td>1.25</td>
</tr>
<tr>
<td>45</td>
<td>ITM</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>ATM</td>
<td>4.50</td>
<td>0</td>
<td>4.50</td>
</tr>
<tr>
<td>55</td>
<td>OTM</td>
<td>2.50</td>
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<td>2.50</td>
</tr>
<tr>
<td>60</td>
<td>OTM</td>
<td>1.50</td>
<td>0</td>
<td>1.50</td>
</tr>
<tr>
<td>65</td>
<td>OTM</td>
<td>0.75</td>
<td>0</td>
<td>0.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strike Price (INR)</th>
<th>Moneyness</th>
<th>Put Option Premium</th>
<th>Intrinsic Value</th>
<th>Time Value</th>
</tr>
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<tbody>
<tr>
<td>35</td>
<td>OTM</td>
<td>0.75</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>40</td>
<td>OTM</td>
<td>1.50</td>
<td>0</td>
<td>1.50</td>
</tr>
<tr>
<td>45</td>
<td>OTM</td>
<td>2.50</td>
<td>0</td>
<td>2.50</td>
</tr>
<tr>
<td>50</td>
<td>ATM</td>
<td>4.50</td>
<td>0</td>
<td>4.50</td>
</tr>
<tr>
<td>55</td>
<td>ITM</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>60</td>
<td>ITM</td>
<td>11.25</td>
<td>10</td>
<td>1.25</td>
</tr>
<tr>
<td>65</td>
<td>ITM</td>
<td>15.50</td>
<td>15</td>
<td>0.50</td>
</tr>
</tbody>
</table>
OPTION STRATEGIES

Option Strategies

One Instrument Strategies

i) Long Call
ii) Short Call
iii) Long Put
iv) Short Put
v) Married Put
vi) Protective Put
vii) Covered Call

More than one instrument Strategies

Spread
i) Bull
   Put
   Call

Combinations
i) Straddle
   ii) Strip
   iii) Strap

ii) Bear
   Put
   Call

iii) Butterfly Spread
    Put
    Call

iv) Calender Spread
ONE INSTRUMENT STRATEGIES
Long Call

Belief that the price of the underlying security will rise significantly beyond the strike price before the option expiration date

View:       Bullish
BE Spot Price:   S = [X+C]
Profit:        Rise in Price
Profit at expiry: When S > BEP
   Profit          S – [X+C]
   Max. Profit     Unlimited
Maximum Loss:   C [The Premium]

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Short Call

Belief that stock price falls below the strike price of the call options by expiration

View: Bearish
Profit: Fall in Price
BE Spot Price: \( S = [X+C] \)
Profit at expiry: When \([S < \text{BEP}]\)
  Profit \([X+C] - S\)
  Max. Profit \(C\)
Maximum Loss: Unlimited
  \(\text{If price exceeds BEP}\)

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Long Put

Belief that the price of the underlying security will go significantly below the striking price before the expiration date.

View: Bearish
Profit: Fall In Price
BE Spot Price: X - C

Profit at expiry: When S < BEP
  Profit: X - [C+S]
  Max. Profit: X - C
Maximum Loss: Premium

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Short Put

Belief that the price of the underlying security will rise significantly beyond the strike price before the option expiration date

**View:** Bullish

**Profit:** If Price Rises

**BE Spot Price:** $S = [X - C]$

**Profit at expiry:** When $S > BEP$
- Profit $S - [X - C]$
- Max. Profit $C$

**Maximum Loss:** $[X - P]$

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Belief that the stock price will fall and you want to protect the profits made from a stock, buying a put option will mitigate such loss.

Buy one Stock at $S$,
Buy Put Option at $X$ and $S=X$

View: Bullish
BEP: $[X+C]=$Price of Stock
Profit: $S>$Purchase Price of Stock +C
Maximum Profit: Unlimited
The holder buys the stock at first and **later on** he will buy the put option. Used as a means to protect unrealized gains on shares from a previous purchase.

**View:** Bullish

**BEP:** \([X+C] = \text{Price of Stock}\)

**Profit:** \(\text{Price of Stock} > [X+P]\)

**Maximum Profit:** Unlimited
Covered Call

Call options are written against a holding of the underlying security

Earn a premium writing calls while at the same time appreciate all benefits of underlying stock ownership

A short position in a call option on an asset combined with a long position in the asset

Far less risky than naked calls

In the Money Covered Call

• Max Profit = Premium Received - Purchase Price of Underlying + Strike Price of Short Call

• Max Profit Achieved : When Price of Underlying ≥ Strike Price of Short Call

BEP = Purchase Price of Underlying - Premium Received

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MORE THAN ONE INSTRUMENT STRATEGIES
Spread

Created by the simultaneous purchase and sale of options of the same class on the same underlying security and same expiration dates but with different strike prices.

Spread Constructed using CALLS - Call Spread
Spread Constructed using PUT - Put Spread

Spread designed to earn profit from a rise in price - **bull spread**
Spread designed to earn profit from a fall in price - **bear spread**
Some Concepts in Spread

Note 1) A higher strike price call option would be less costlier as compared to lower strike price call option.

Note 2) A higher strike price put option would be more costlier as compared to lower strike price put option.

Note 3) Maximum loss is fixed for Net Payer of Premium
Maximum gain is fixed for Net Receiver of Premium
Bull Call Spread:

Strategy:
Sell high strike price call option & simultaneously, buy low strike price call option

Gain: When price of stock rises above higher strike price.
Say we have two call options:

Low Strike Price Call Option be X1

Higher Strike Price Call Option be X2

C1 & C2 be the Premium paid on X1 & X2 resp. where C1 > C2

Move as per strategy and view the cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Spot Price at Expiry</th>
<th>X1 Call Option</th>
<th>X2 Call Option</th>
<th>Net Premium</th>
<th>Maximum Profit (Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case I</td>
<td>&lt; X1</td>
<td>Worth Less</td>
<td>Worthless</td>
<td>-C1+C2</td>
<td>C1+C2</td>
</tr>
<tr>
<td>Case II</td>
<td>between X1 &amp; X2</td>
<td>S-X1</td>
<td>Worth Less</td>
<td>-C1+C2</td>
<td>(S-X1)-C1+C2</td>
</tr>
<tr>
<td>Case III</td>
<td>&gt; X2</td>
<td>S-X1</td>
<td>X2-S</td>
<td>-C1+C2</td>
<td>(X2-X1) -C1+C2</td>
</tr>
</tbody>
</table>
Bull Put Spread:
**Strategy:** Sell high strike price put option & simultaneously, buy low strike price put option
Say we have two put options:

Low Strike Price Put Option be X1

Higher Strike Price Put Option be X2

P1 & P2 be the Premium paid on X1 & X2 resp. where P2>P1

Move as per strategy and view the cases

<table>
<thead>
<tr>
<th>Case I</th>
<th>Case II</th>
<th>Case II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Price at Expiry &lt;X1</td>
<td>Spot Price at Expiry falls between X1 &amp; X2</td>
<td>Spot Price at Expiry goes above X2</td>
</tr>
<tr>
<td>X1 Put Option</td>
<td>(X1-S)</td>
<td>Worth Less</td>
</tr>
<tr>
<td>X2 Put Option</td>
<td>(S-X2)</td>
<td>(S-X2)</td>
</tr>
<tr>
<td>Net Premium</td>
<td>-P1+P2</td>
<td>-P1+P2</td>
</tr>
<tr>
<td>Maximum Gain (Loss)</td>
<td>(X1-X2) - P1+P2</td>
<td>(S-X2) - P1+P2</td>
</tr>
</tbody>
</table>
Bear Call Spread

Strategy:

Sell lower strike price call option & simultaneously buy higher strike price call option
Say we have two Call options:

Low Strike Price Call Option be X1
Higher Strike Price Call Option be X2

C1 & C2 be the Premium paid on X1 & X2 resp. where C1>C2

Move as per strategy and view the cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Spot Price at Expiry</th>
<th>X1 Call Option</th>
<th>X2 Call Option</th>
<th>Net Premium</th>
<th>Maximum Gain (Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case I</td>
<td>X1 &lt;&lt; X1</td>
<td>Worthless</td>
<td>Worthless</td>
<td>C1-C2</td>
<td>C1-C2</td>
</tr>
<tr>
<td>Case II</td>
<td>X1 &lt; X2 &amp; X2</td>
<td>X1-S</td>
<td>Worth Less</td>
<td>C1-C2</td>
<td>(X1-S)+(C1-C2)</td>
</tr>
<tr>
<td>Case II</td>
<td>X2 &gt; X2</td>
<td>Worthless</td>
<td>Worthless</td>
<td>C1-C2</td>
<td>(X1-X2)+(C1-C2)</td>
</tr>
</tbody>
</table>
Bear Put Spread

Strategy:
Sell lower strike price Put option & simultaneously buy higher strike price put option.
Net Payer of Premium

Say we have two put options:

Low Strike Price Put Option be X1

Higher Strike Price Put Option be X2

P1 & P2 be the Premium paid on X1 & X2 resp. where P1<P2

Move as per strategy and view the cases

<table>
<thead>
<tr>
<th>Case I</th>
<th>Case II</th>
<th>Case II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Price at Expiry &lt; X1</td>
<td>Spot Price at Expiry falls between X1 &amp; X2</td>
<td>Spot Price at Expiry goes above X2</td>
</tr>
<tr>
<td>X1 Put Option ((S-X1))</td>
<td>Worth Less</td>
<td>Worth Less</td>
</tr>
<tr>
<td>X2 Put Option ((X2-S))</td>
<td>((X2-S))</td>
<td>Worth Less</td>
</tr>
<tr>
<td>Net Premium (P1-P2)</td>
<td>(P1-P2)</td>
<td>(P1-P2)</td>
</tr>
<tr>
<td>Maximum Gain (Loss) ((X2-X1) + (P1-P2))</td>
<td>((X2-S) + (P1-P2))</td>
<td>((P1-P2))</td>
</tr>
</tbody>
</table>
Butterfly Spread

Involves positions in options with three different strike prices

Created by:
- buying a call option with a relatively low strike price, $X_1$;
- buying a call option with a relatively high strike price, $X_3$; and
- selling two call options with a strike price, $X_2$

<table>
<thead>
<tr>
<th>X1=95 (say)</th>
<th>X2 = 100</th>
<th>X3 = 105</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) Buy 1 Call</td>
<td>(II) Sell Two Calls</td>
<td>(III) Buy 1 Call</td>
</tr>
<tr>
<td>C1 = -10 (say)</td>
<td>2xC2 = 2x7</td>
<td>C3 = -5</td>
</tr>
</tbody>
</table>

- $X_1 < X_2 < X_3$
- $X_2 - X_1 = X_3 - X_2$
- $C_1 > C_2 > C_3$
<table>
<thead>
<tr>
<th>Conditions</th>
<th>Case I</th>
<th>Case II</th>
<th>Case III</th>
<th>Case IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Price at Expiry &lt; X1</td>
<td>0</td>
<td>S-X1</td>
<td>S-X1</td>
<td>S-X1</td>
</tr>
<tr>
<td>X1 Call Option</td>
<td>0</td>
<td>0</td>
<td>2(X2-S)</td>
<td>2(X2-S)</td>
</tr>
<tr>
<td>X2 Call Option</td>
<td>0</td>
<td>0</td>
<td>2(X2-S)</td>
<td>2(X2-S)</td>
</tr>
<tr>
<td>X3 Call Option</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S-X3</td>
</tr>
<tr>
<td>Net Premium</td>
<td>(2C2-C1-C3) = -1</td>
<td>(2C2-C1-C3) = -1</td>
<td>(2C2-C1-C3) = -1</td>
<td>(2C2-C1-C3) = -1</td>
</tr>
<tr>
<td>Maximum Gain (Loss)</td>
<td>-1</td>
<td>(S-X1-1)</td>
<td>(S-X1)-2(S-X2)-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Note: Profit will be maximum when S is equal to X
COMBINATIONS

- STRADDLE
  - LONG STRADDLE
  - SHORT STRADDLE

- STRANGLE
  - LONG STRANGLE
  - SHORT STRANGLE

- STRIP
  - LONG STRADDLE + LONG PUT

- STRAP
  - LONG STRADDLE + LONG CALL
STRADDLE

• LONG STRADDLE

Strategy:
- Buy a call and a put both having
  - same underlying
  - same expiry date
  - same strike price

View: Large movement in price either way.

• SHORT STRADDLE

Strategy:
- Sell a call and put both having
  - same underlying
  - same expiry date
  - same strike price

View: No (or little) movement in price.
STRANGLE

• LONG STRANGLE

Strategy:
Buy one call and put
- having same underlying
- having same expiry date
- but different strike price

View: Very large movement in price

• SHORT STRANGLE

Strategy:
Sell one call and put
- having same underlying
- having same expiry date
- but different strike price

View: No large movement in price

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• STRIP

Strategy:
Buy 2 Puts and 1 call having
  - same underlying
  - same expiry date
  - same strike price

• STRAP

Strategy:
Buy 2 Calls and 1 put having
  - same underlying
  - same expiry date
  - same strike price
Future Pricing

Simply, it is the theoretical value of a future contract

Cost of Carry Model

- states futures price should depend upon two things:
  - The current spot price.
  - The cost of carrying or storing the underlying good from now until the futures contract matures.

\[ F = S + C \]

Assumptions:

- There are no transaction costs or margin requirements.
- There are no restrictions on short selling.
- Investors can borrow and lend at the same rate of interest
\[ F = S + C \]
\[ F = S + \left[ S \times r \times T / 12 \right] \]
\[ F = S \left[ 1 + (r \times T / 12) \right] \]

Hence, future price is the compounded value of the underlying price at risk free rate over the contract life.

Alternatively,
\[ F = S \times e^{rt} \]

Where,
\[ e^{rt} \] means continuous compounding.

Note: Both formulae will give same result if value of e^{rt} is taken upto one factor.

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Pricing of Dividend Paying Stock

DIVIDEND

PAID IN LUMP SUM

PAID CONTINUOUSLY

Note: Income would reduce cost of Strategy while expense will increase the same.
Paid in lump sum

**Option 1:**
Step I: Adjusted “S”
   \[ S_{\text{Adj}} = S - \text{PV of all dividends} \]
Step II:
\[ F = S_{\text{Adj}} \times \left[ 1 + \left( \frac{r\% \times T}{12} \right) \right] \]
\[ F = S_{\text{Adj}} \times e^{rt} \]

**Option 2:**
\[ F = S \times \left[ 1 + \left( \frac{r\% \times T}{12} \right) \right] \]
- Compounded value of dividend expected to be received on expiry date.

Paid Continuously:

**Option 1:**
\[ F = S \left[ 1 + \left( \frac{r\% - y\%}{12} \right) \times T \right] \]
\[ F = S \times e^{(r\% - y\%)T} \]
Creating a replicating portfolio:

- **Objective**: use a combination of risk free borrowing/lending and the underlying asset to create the same cashflows as the option being valued.

  Call = Borrowing + Buying $\Delta$ of the Underlying Stock  
  Put = Selling Short $\Delta$ on Underlying Asset + Lending.

- The number of shares bought or sold is called the option delta.

- The principles of arbitrage then apply, and the value of the option has to be equal to the value of the replicating portfolio.
Option Details
K = $40
\( t = 2 \)
\( r = 11\% \)

100 \( \Delta - 1.11 \) B = 60
50 \( \Delta - 1.11 \) B = 10
\( \Delta = 1, B = 36.04 \)
Call = 1 * 70 - 36.04 = 33.96

70 \( \Delta - 1.11 \) B = 33.96
35 \( \Delta - 1.11 \) B = 4.99
\( \Delta = 0.8278, B = 21.61 \)
Call = 0.8278 * 50 - 21.61 = 19.78

Call = 33.96

Call = 19.42

Call = 4.99

50 \( \Delta - 1.11 \) B = 10
25 \( \Delta - 1.11 \) B = 0
\( \Delta = 0.4, B = 9.01 \)
Call = 0.4 * 35 - 9.01 = 4.99

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The version of the model presented by Black and Scholes was designed to value European options, which were dividend-protected.

The value of a call option in the Black-Scholes model can be written as a function of the following variables:

\[
S = \text{Current value of the underlying asset} \\
X = \text{Strike price of the option} \\
t = \text{Life to expiration of the option} \\
r = \text{Riskless interest rate corresponding to the life of the option} \\
\sigma^2 = \text{Variance in the ln (value) of the underlying asset}
\]
Factors Affecting Option Prices

- The current stock price
- The strike price
- The time to expiration
- The volatility of the stock price
- The risk-free interest rate
- The dividends expected during the life of the option
• Value of call = \( S \ N(d_1) - K \ e^{-rt} \ N(d_2) \)

Where,

\[
d_1 = \frac{\ln\left(\frac{S}{K}\right) + (r + \frac{\sigma^2}{2}) t}{\sigma \sqrt{t}}
\]

\[
d_2 = d_1 - \sigma \sqrt{t}
\]

The replicating portfolio is embedded in the Black-Scholes model. To replicate this call, you would need to:

• Buy \( N(d_1) \) shares of stock; \( N(d_1) \) is called the option delta

• Borrow \( K \ e^{-rt} \ N(d_2) \)
**Meaning:**

$N(d1)$

Equal to $\Delta$ of replicating portfolio method. It means no. of units of underlying.

**Statistical**

Area from $Z = -\infty$ to $Z = d1$

---

**Meaning:**

$N(d2)$

Prob. That option will be exercised at expiry.

**Statistical**

Area form $Z = -\infty$ to $Z = d2$
Adjusting for Dividends

• Paid in Yield form
  - If the dividend yield \( y = \frac{\text{dividends}}{\text{Current value of the asset}} \) of the underlying asset is expected to remain unchanged during the life of the option, the Black-Scholes model can be modified to take dividends into account.

\[
C = S e^{-yt} N(d_1) - X e^{-rt} N(d_2)
\]

\[
d_1 = \frac{\ln \left( \frac{S}{X} \right) + (r - y + \frac{\sigma^2}{2}) t}{\sigma \sqrt{t}}
\]

\[
d_2 = d_1 - \sigma \sqrt{t}
\]

• Paid in Lump Sum
  - Concept of Adjusted “S”
    \[= S - \text{PV of all dividends during option life.}\]
  - Now, use BSM method as if there is no dividend

\[
P = K e^{-rt} [1-N(d2)] - S e^{-yt} [1-N(d1)]
\]

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Most practitioners who use option pricing models to value real options argue for the binomial model over the Black-Scholes and justify this choice by noting that

- Early exercise is the rule rather than the exception with real options
- Underlying asset values are generally discontinuous.

If you can develop a binomial tree with outcomes at each node, it looks a great deal like a decision tree from capital budgeting. The question then becomes when and why the two approaches yield different estimates of value.
Swaps Contracts

• Arrangements to exchange cash flows over time.
• Provides a means to hedge a stream of risky payments.
• One party makes a payment to the other depending upon whether a price turns out to be greater or less than a reference price that is specified in the swap contract.
• Two basic types - **interest-rate swaps** or **currency swaps**.
Interest-Rate Swaps

• Agreement to exchange a floating-rate payment for a fixed-rate payment or vice versa.

• **Use:**
  - Used to modify interest rate exposure.
  - transform a floating-rate loan into a fixed-rate loan, or vice versa. transform a floating-rate investment to a fixed-rate investment, or vice versa.

• For example, in an interest rate swap, the exchangers gain access to interest rates available only to the other exchanger by swapping them.

  In this case, the two legs of the swap are a fixed interest rate, say 3.5%, and a floating interest rate, say **LIBOR + 0.5%**. In such a swap, the only things traded are the two interest rates, which are calculated over a notional value. Each party pays the other at set intervals over the life of the swap. For example, one party may agree to pay the other a 3.5% interest rate calculated over a notional value of $1 million, while the second party may agree to pay **LIBOR + 0.5%** over the same notional value. It is important to note that the notional amount is arbitrary and is not actually traded.

The London Interbank Offered Rate (LIBOR) is the rate most international banks charge one another for overnight Eurodollar loans.
Currency Swaps

✓ agreements to deliver one currency in exchange for another.
✓ one party agrees to pay interest on a principal amount in one currency &
✓ in return, it receives interest on a principal amount in another currency.
✓ Principal amounts are not usually exchanged in an interest rate swap.
✓ Here principal amounts are usually exchanged at both the beginning and the end of the life of the swap.
✓ For a party paying interest in the foreign currency, the foreign principal is received, and the domestic principal is paid at the beginning of the life of the swap. At the end of the life of the swap, the foreign principal is paid and the domestic principal is received.

• **Use**: -transform a loan in one currency into a loan in another currency.
  -transform an investment denominated in one currency into an investment denominated in another currency.

Niraj Thapa
Why To Use Derivatives?

- **Risk management:**
  Eg. The farmer—a seller of corn—enters into a contract which makes a payment when the price of corn is low. This contract reduces the risk of loss for the farmer, who we therefore say is hedging. It is common to think of derivatives as forbiddingly complex, but many derivatives are simple and familiar.

- **Speculation—serve as investment vehicles**
  Eg. if you want to bet that the S&P 500 stock index will be between 1,300 and 1,400 one year from today, derivatives can be constructed to let you do that.

- **Reduced transaction costs**
  Eg. The manager of a mutual fund may wish to sell stocks and buy bonds for this he has to pay fees to broker which is costly while it is possible to trade derivatives instead and achieve the same economic effect as if stocks had actually been sold and replaced by bonds.

- **Regulatory arbitrage**
  It is sometimes possible to circumvent regulatory restrictions, taxes, and accounting rules by trading derivatives. Derivatives are often used, for example, to achieve the economic sale of stock (receive cash and eliminate the risk of holding the stock) while still maintaining physical possession of the stock. This transaction may allow the owner to defer taxes on the sale of the stock, or retain voting rights, without the risk of holding the stock.

- **To change the nature of a liability**
- **To lock in an arbitrage profit**
- **To change the nature of an investment without incurring the costs of selling one portfolio and buying another.**
Users of Derivatives

• Market-Maker:
Market-makers are intermediaries, traders who will buy derivatives from customers who wish to sell, and sell derivatives to customers who wish to buy. Generally, market-makers are like grocers who buy at the low wholesale price and sell at the higher retail price. Market-makers typically hedge this risk and thus are deeply concerned about the mathematical details of pricing and hedging.

• Economic observer:
They try to make sense of everything (like the logic of the pricing models)

• Arbitrageurs
Arbitrage involves locking in a riskless profit by simultaneously entering into transactions in two or more markets.

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Six examples will be used to illustrate some of the perils, especially ethical perils, in use of financial derivatives:

- Equity Funding Corporation of America (1973)
- Baring Bank (1994)
- Orange County, California (1994)
- Long Term Capital Management (1998)
- Enron (2001)
- Global Crossing

- Each of them represented an effort to use financial derivatives to produce inflated returns. Two cases were proven to be frauds. Two appear to have been innocent of fraud. Two are still to be seen.
- Each was a major financial catastrophe, affecting not only those directly involved but the world at large.
• “I view derivatives as time bombs, both for the parties that deal in them and the economic system”-Warren Buffett

• It is quite complex and various strategies of derivatives can be implemented only by an expert and therefore for a layman it is difficult to use this and therefore it limits its usefulness.

• When company failure on derivative markets, shareholders, creditors and other relevant parties tend to be lose their confidence in the company’s performance, therefore, it will face a much worse financial position. Shareholders may start to sell their stocks, and creditors may ask for early repayment of credit. Under these circumstances, the reputation of company may be seriously damaged.

• Derivatives instrument can be profitable for investors if investors are able to time the markets. A mistake in accurately predicting the market can lead to substantial loss.

• Finance experts often express that traders can switch from being hedgers to speculators or from being arbitrageurs to speculators.

• Further derivatives are complex segments.
THANK YOU

Feed back & suggestions are welcome at

tniraj20@hotmail.com