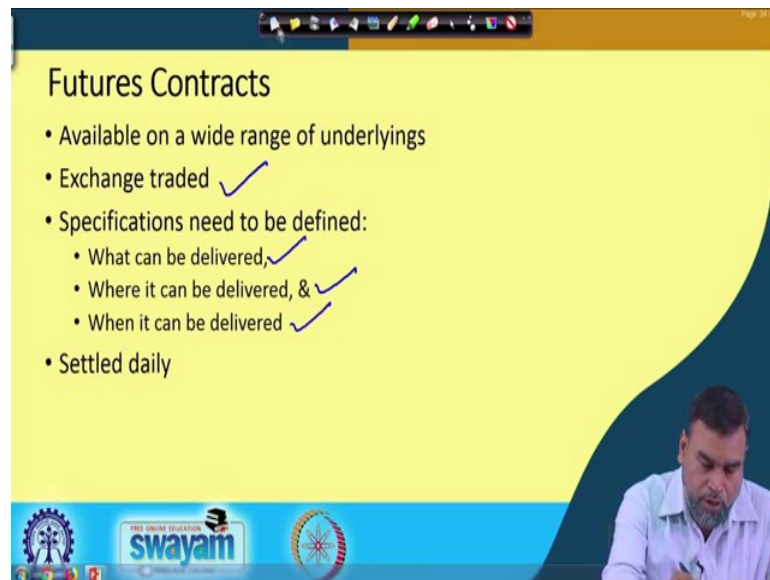


Financial Institutions and Markets
Prof. Jitendra Mahakud
Department of Humanities and Social Sciences
Indian Institute of Technology, Kharagpur

Lecture – 52
Derivatives Market – II

So, after discussing on the certain concepts related to derivative, and defining what exactly the derivatives market is; we can discuss the mechanism of this Derivatives Market and going into the different concepts or different issues related to particular market, in terms of the different type of instruments which are traded in the segment.

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Futures Contracts

- Available on a wide range of underlyings
- Exchange traded ✓
- Specifications need to be defined:
 - What can be delivered, ✓
 - Where it can be delivered, & ✓
 - When it can be delivered ✓
- Settled daily

The slide is part of a presentation from the Indian Institute of Technology Kharagpur, featuring the Swayam logo and a small video inset of a man in a white shirt speaking.

So, whenever you talk about the future contract already I have discussed with you, whenever you talk about the mechanism of the market and the mechanism basically discussed on the basis of the different instruments. And, here we have the instruments like futures, you have forwards, then you have the options, then you have the swap.

So, if you see one by one whenever you talk about the future contracts, in the market in the actual sense if you see these are available on a wide range of underlying; already I told you these are available in underlying means I am talking about the underlying assets, the spot market assets. These assets can be a financial asset or it can be the commodity, any kind of other goods which are available in the commodity market.

Now, already I told you this future contracts exchange traded and whenever any contract is designed; what are those specifications we want? We want what is the commodity should be delivered, where it should be delivered and what date it should be delivered. And if you see that in the contract, the future contract are settled daily on the basis of the underlying price the particular future contracts are settled on the daily basis. So, this is the basic mechanism of the future contract. So, that is the way the future contracts are basically traded in the market.

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The slide is titled "Standardized Contract Term" and lists the following terms:

- Tick size: Minimum price fluctuation
- Daily Price Limit: Restriction for the price movement in a single day
- Delivery Date
- Strike Price → *Pre-agreed price at which the delivery takes place*
- Sum of all outstanding long and short future market positions is always equal to zero

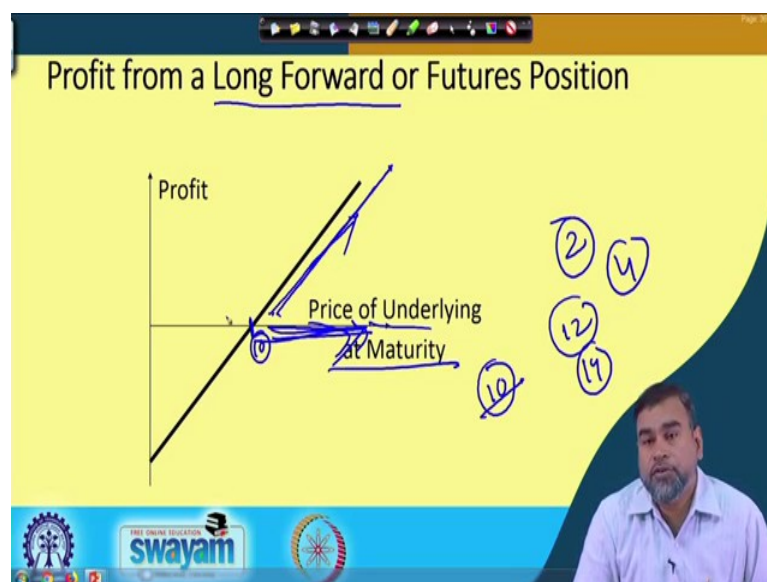
The slide also features a video feed of a presenter in the bottom right corner and logos for "swayam" and "MHRD" at the bottom left.

Then if you see that in the contract what are the other things also is required or is mention. We have a tick size, what do you mean by the tick size? Here tick size what does it mean? It basically talks about the minimum price fluctuations of that particular contract. Then you have also see the daily price limit; that means, the restrictions, how much price fluctuations in a single day is allowed?

The restrictions for the price movement is also mentioned there; then another thing what we can observe the strike price. The strike price means it is the pre-agreed price at which the delivery will take place; obviously, the delivery date will be mentioned in that case. And if you see that the sum of outstanding long and short future market positions is always equal to zero because how many long positions are there? The same amount of short positions are there. So, that is why the outstanding amount or outstanding of this positions are always equal to zero, buying and selling positions are same. How many are

bought. The same amount are sold; it is not like the equity market or the spot market it is basically always equal to zero. So, these are the standardized contract on what you can observe whenever you go for understanding the future market.

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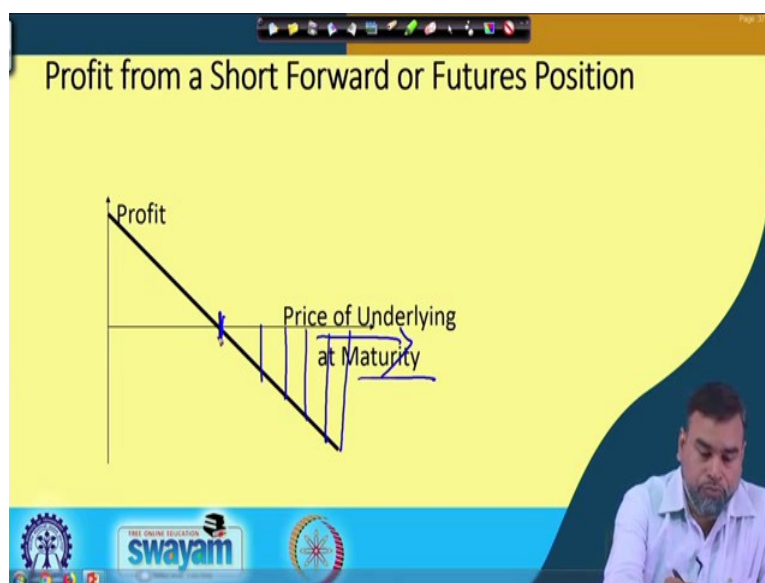


How the profit or the payoff we can derive from the forward or the future positions. You see you have a strike price or you have a price already decided mutually agreed price. Let do you know the mutually agreed price then if the particular price and you are a long forward; long forward means you are buying it.

So, if you are buying it then if the price is going up and up the particular price of the stock is going up and up it is increasing; then what is happening? Then obviously, the notional profit of that particular buyer is increasing. Because if you remember if you are you are agreed price is 10 rupees that this is 10 if it is 10 rupees, if it is 12 then you are making 2 rupees notional profit buyer. If it is 14 let it become 14 then it was become 4 rupees.

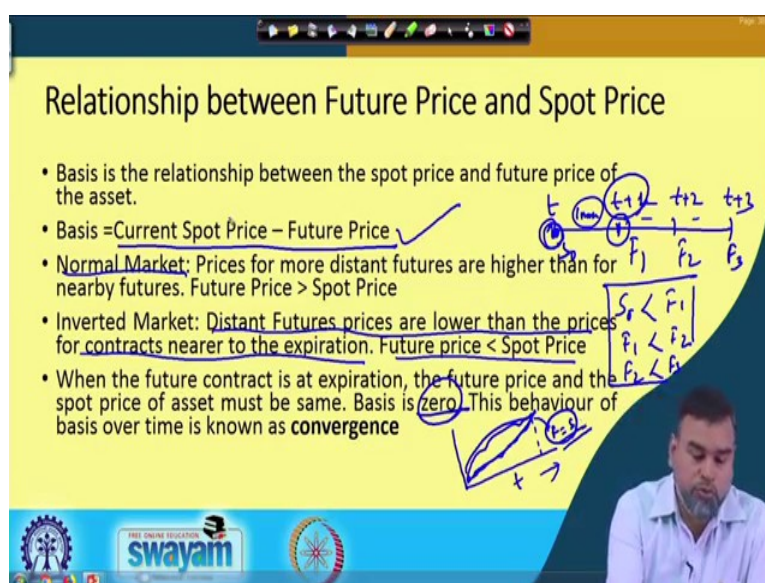
So, unless if the price is increasing then what is happening? Your profit also going up and up. So, the price of underlying at maturity if it is increasing if it is a long forward contract, then the profit of the investor is also increasing let us see, what is happening with respect to a short future contract ?

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It is reverse. If your price is increasing, price of the underlying asset is increasing then your profit is declining because basically you are selling it. So, whenever you are selling you are expecting. So, these are basically your negative profit. So, once it is the price is increasing your profit is basically declining or you are making the loss and whenever your price is more than the strike price then; obviously, what you can do? You are observing that in case of long the profit is increasing in case of short it is basically decreasing.

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If you remember we are discussing about the basis. So, in the basis what do you mean by the basis? The basis basically explains the relationship between the future price and the spot price. The basis is a concept which is used to examine or to establish the relationship between the future price and the spot price. And how the basis is calculated? The basis is nothing, but the current spot price minus the future price it is basically nothing, but the current spot price minus the future price that is the basis.

In a normal market just I was explaining you; in a normal market the prices for more distance future are higher than for the nearby future. So, let at future price also more than the spot price. If I write in this way that we are here today, this is your $t + 1$ this is your $t + 2$ this is your $t + 3$. So, today price means this is the spot price, this is your future price maybe this period is one month all their gap is one month.

So, in a normal market what we expect this spot price are the time t should be less than the future price for the $t + 1$. I am not talking about the spot price of the $t + 1$ on that day I am talking about if you are calculating the future price at the time t , then this is basically let your F_1 , this is your F_2 , this is your F_3 this is your S_0 . Then we are assuming that your spot price should be less than F_1 in your F_1 should be less than F_2 and F_2 also should be less than F_3 .

So, that basically happens in a normal market condition why it happens? Because the risk is more the risk concept is involved in this particular case. So, this is the way basically the mechanism works, but if you go to an inverted market it is reversed. The distant futures prices are lower than the prices for contracts near to the expiration and future prices is less than the spot prices it is reversed.

But when the future contract is at expiration the future price and the spot price of asset must be same that the basis is zero; that means, there is a convergence. The behaviour of the basis of basis over time is known as this behaviour basically is convert is considered as the convergence; that means, if this is the time. So, the price basically move in this way in this way. So, here if there is an expiration, then here your future price is equal to your spot price.

So, that is basically we call it convergence. So, at the time of expiration the future price and spot price of that particular contract is equal to both are same and therefore, the basis is equal to 0. If this two are the same then the basis will be 0. So, this is the way the

concept of basis basically work, but over this time this particular fluctuation always we can observe.

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Spread

- Spread is the difference between two future prices
- If the two prices are for the future contracts on the same underlying good, but with different expiration dates, the spread is an **intra commodity spread**
- If the two future prices that form a spread are future prices for two underlying goods then the spread is an **inter commodity spreads**

Diagram: A line with points S, F1, and F2. Arrows indicate the relationship between S and F1, and F1 and F2.

Logos: Swayam logo and a circular logo with a gear and a person.

Video feed: A man in a white shirt is visible in the bottom right corner.

Then another concept we have that is called this spread, then what is the spread? The spread is nothing, but here we are basically trying to establish between the spot price and the future price, but whenever we talk about the spread, spread is basically the difference between the two future prices. Here we have if you see what you have done? We have your S you have F 1, you have F 2. So, on we are comparing with S it as F 1 then S with F 2 like that and a basis is nothing, but the difference between either this two or this two.

But whenever we are talking about the spread the spread is the difference between the two future prices F 1 with F 2. If the two prices are for the future contracts on the same underlying asset, asset is same whether a two different F 1 and F 2 two future prices on the basis of the time with different expiration dates this spread is an intra commodity spread that is defined as the intra commodity spread; that means, one contract is matured after 2 months, another contact is matured after 6 months.

Let you are trying out the, but the commodity is same then if you try to find out the price difference of the six months contract and the two months contract that is basically defined as the intra commodity spread. But if the two future prices that form a spread or future prices of two different commodities then that particular spread is called inter commodity spread.

If this particular price or contract price depends upon the one underlying asset we call it the intra commodity spread, if these are two different commodities what we basically called, this is called inter commodity spread that is the way the spread is different from the basis and this is the way the spread is defined.

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Long, Short Hedges and Optimal Hedge Ratio

- A long futures hedge is appropriate when you know you will purchase an asset in the future and want to lock in the price
- A short futures hedge is appropriate when you know you will sell an asset in the future & want to lock in the price
- **Optimal hedge ratio:** Proportion of the exposure that should optimally be hedged is

$$h = \rho \frac{\sigma_S}{\sigma_F}$$

where

- σ_S is the standard deviation of ΔS , the change in the spot price during the hedging period,
- σ_F is the standard deviation of ΔF , the change in the futures price during the hedging period
- ρ is the coefficient of correlation between ΔS and ΔF .

The slide also features a Swamyam logo and a small video inset of a man in the bottom right corner.

Then we can see that how basically we can make the hedging using any kind of future positions. So, whenever you go for the hedging, basically we use a concept called the hedge ratio. So, our basic job is to find out that hedge ratio. A long future hedge is appropriate when you know that you will purchase an asset in the future and want to lock the price. When you can go for the long future hedge, you know that you are going to buy the asset and you feel that the price you may go up that is why you can lock the price now.

And short future hedge is appropriate, when you know that you are going to sell the asset in the future and the price may come down. So, that is why you can lock that particular price. So, this long future hedge and short future hedge is appropriate whenever you are expecting that you know that you are going to buy or sell the asset in the future and you are expecting the price movement in a particular direction, then only this long future and short future hedging is applicable in that particular context.

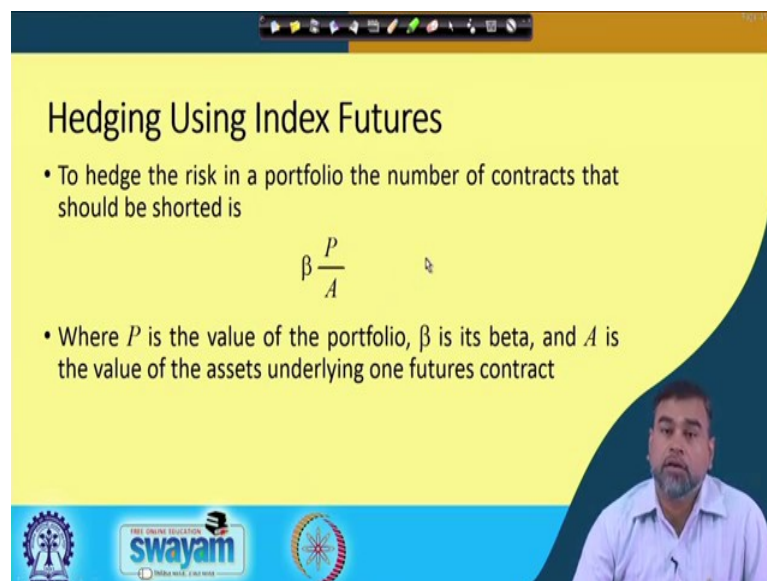
And how the optimal hedge ratio is basically measured and how do you basically defines the hedge ratio? It is the proposition of the exposure that should optimally be hedged to

hedge the risk in this particular market taking the position both in the spot and the future how it is measured? This is basically nothing, but sigma into this standard deviation of the spot market divide by the standard deviation of the future market.

So, the standard deviation of the change in the spot price and the standard deviation due to the change in the future price and row is the correlation coefficient between the change in the spot price and change in the future price. It is just like the beta concept what we use it whenever we calculate the market risk.

So, if you run the regression between the future price and spot price whatever coefficient you get that basically is nothing, but the hedge risk. That means, that much position you have to hold on in a particular market to hedge the risk in the other market that actually the use of the hedge ratio, that always we use whenever we are using the derivative for the hedging.

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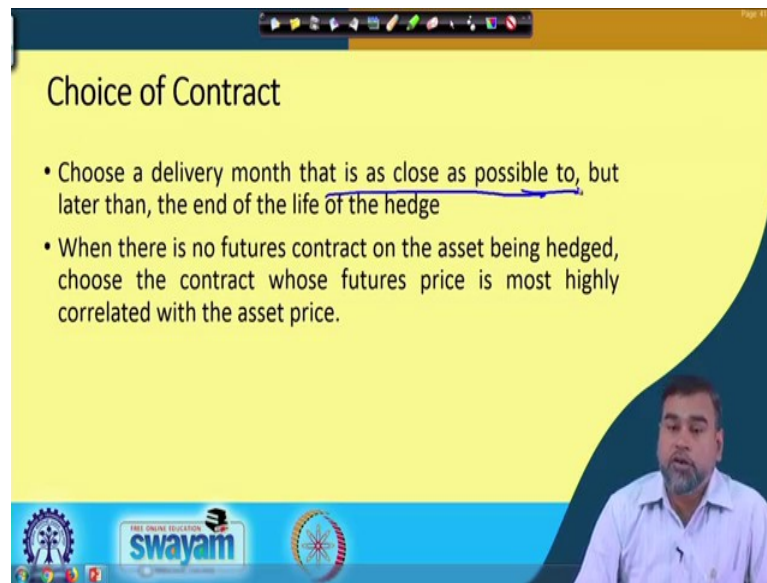


Hedging Using Index Futures

- To hedge the risk in a portfolio the number of contracts that should be shorted is
$$\beta \frac{P}{A}$$
- Where P is the value of the portfolio, β is its beta, and A is the value of the assets underlying one futures contract

So, how basically you can do it? For example, to hedge the risk in a portfolio the number of contracts that should be sorted that is basically your portfolio value $\beta P / A$. P is the value of the portfolio β is the β when market risk and A is the value of the asset to underlying the future contract. So, this is the way basically the amount of money what basically you can hedge in the other markets.

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Choice of Contract

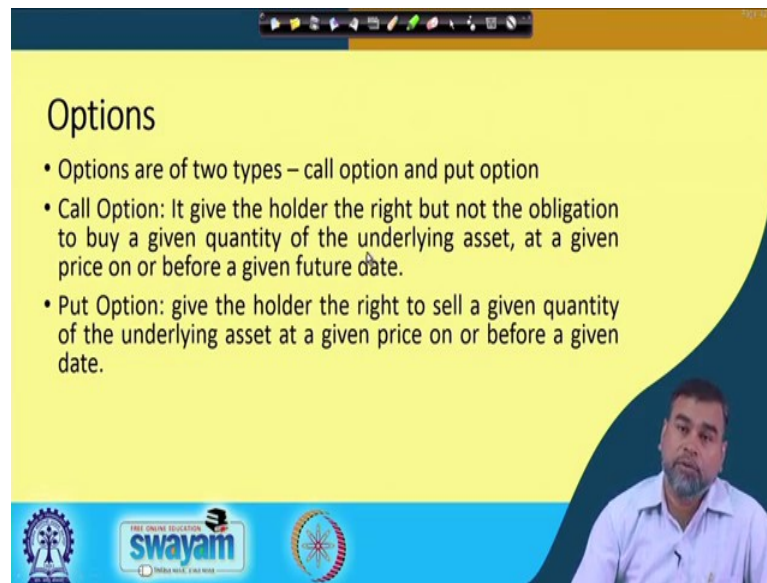
- Choose a delivery month that is as close as possible to, but later than, the end of the life of the hedge
- When there is no futures contract on the asset being hedged, choose the contract whose futures price is most highly correlated with the asset price.

So, how the contracts are basically chosen? Choose a delivery month, that is as close to as possible, but later than the end of the life of hedge. When there is no delivery future contract on the asset being hedged, then choose the contract which future prices is most highly correlated with a asset price because you see you want to hedge the risk in the spot market while taking the position in the future market.

So, what kind of future contract you should choose? You have to choose a particular for example, you want to hedge the risk for five for five months or three months or two months. So, that is why you should choose the delivery month that is close to as possible as to the end of the life of the hedge. That means, if you are life of the hedge as five years 5 months or 3 months accordingly you try to find out the delivery months whose period is also 5 months or the 3 months.

But if that 5 months or 3 months contract is not available with you of that particular asset, then you look for another asset which is highly correlated with that asset. But, the hedging period is relatively close to your expiration of that particular contract or expiry of that particular contract, that is the way you can choose the contract for the hedging the risk in this particular markets.

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Options

- Options are of two types – call option and put option
- Call Option: It give the holder the right but not the obligation to buy a given quantity of the underlying asset, at a given price on or before a given future date.
- Put Option: give the holder the right to sell a given quantity of the underlying asset at a given price on or before a given date.

The slide features a yellow background with a blue wave-like shape on the right side. At the bottom, there is a blue banner with logos for 'swayam' and 'INDIA WISE, YOUNG WISER'. A video inset in the bottom right corner shows a man with a beard and glasses speaking.

Then already I told you that if you go by the option mechanism, in the option market we have two types of options in general or some people call it there are four type of options. So, we have divide either in terms of theoretical sense or we can say that maturity sense or we can say that the trading sense. Call option gives the right call option holder takes the right, but not the obligation to buy the asset and the put option holder has right to sell, but they are not obliged to sell the asset at a given price.

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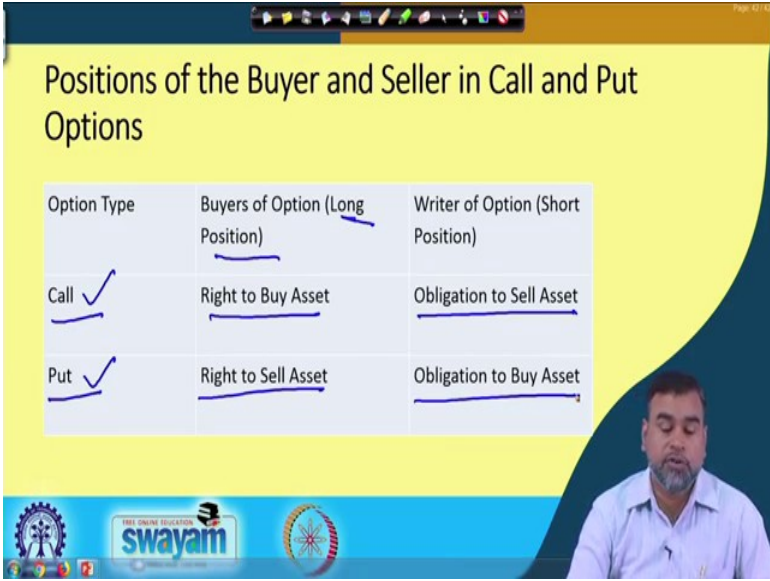
American vs European Options

- An American option can be exercised at any time during its life
- A European option can be exercised only at maturity

The slide features a yellow background with a blue wave-like shape on the right side. At the bottom, there is a blue banner with logos for 'swayam' and 'INDIA WISE, YOUNG WISER'. A video inset in the bottom right corner shows the same man from the previous slide speaking.

And we have an American option and we have a European option. And you know European option is only exercise at maturity and the American option can be exercised at any time during its life. So, this is the way the options are divided that already we have discussed. But one thing you see that what basically here we are trying to find out in the options we are trying to find out the option price.

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Option Type	Buyers of Option (Long Position)	Writer of Option (Short Position)
Call ✓	Right to Buy Asset	Obligation to Sell Asset
Put ✓	Right to Sell Asset	Obligation to Buy Asset

And the option price is nothing, but whatever price we want to give to that particular option holder, whenever we buy the asset that we will explain that how this thing is related to the pricing of that.

So, here if you compare between this two let we have the call option then you have the put option. Then these are buyers of the option either somebody is buying a call option somebody is buying a put option that is well they are taking long position. So, if they are taking a long position if it is a call option they have right to buy the asset, but they are not obliged to buy the asset.

But if they are taking a long position for the put they have the right to sell the asset, but whenever you go for the short positions their they have the application to sell the asset and they are the application to buy the asset it is basically reverse. In that sense basically the long position and short position of the call option and put options are defined then we can see that the concept called the moneyness.

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The slide is titled "Call and Put Options at Expiration". It contains two bullet points with handwritten underlines and corrections:

- If the price of the underlying asset is lower than the exercise price on the expiration of a call option, the call would expire unexercised.
- When at expiration the price of the underlying asset is greater than the exercise price, the put will expire unexercised.

Below the text, there is a handwritten diagram showing a number line with points 90, 100, and 110. A circle is drawn around 90, and another around 110. A line connects them, with "100" written in the middle. Above the line, it says "Strike Price".

The slide also features the Swayam logo and a small video inset of a man in the bottom right corner.

So, here if you see that if the price of the underlying asset is lower than the exercise price of a call option, then the call would expect on exercised what does it mean? Let you have decided that the particular day, the call basically the strike price you have decided at 100 rupees. And on that day the market price of the option is let 110 or either market price of the option a market price of that security is 90. The market price of the security maybe under 110 it maybe 90, but the strike price is 100 and you are the buyer and you are not obliged to buy.

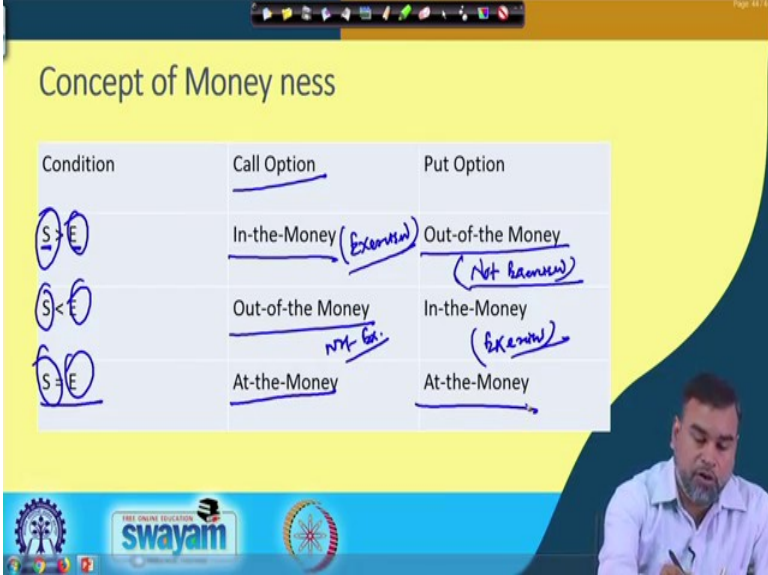
You are the right to buy or you are not obliged to buy then what is happening? If it is 110 in the market then you can exercise that option because you are getting at 100 rupees. But if in the market is a 90, you may not exercise the option because the 100 is the strike price or exercise price whatever has been pre agreed price you have decided and at that day, whenever the particular thing will be exercised you have seen that in the market the prices 110 happily the buyer will go on exercised the option get the commodity at a price of 100 rupees.

But on that day if the market the prices is 90, there is no point of exercising that. Because it is available at a price of 90, you go and directly buy it from the market why you will go for exercising of the option. That is why if the price of underlying asset if lower than the exercise price on the expiration of the call option, the call would expire on exercised.

But when at expiration the price of the underlying asset is greater than the exercised price, the put option also will be exercised because put option is the right to sell. So; obviously, seller will want on that particular day in the market the price will be less and the strike price will be more then he is gaining. And the buyer wants in the market on that day the price will be more than strike price that is why he will be notionally gaining.

So, therefore, what basically we can see that, depending upon the situation between the strike price and the actual market price on that particular day, we can think of whether the option will be exercised or not exercised. So, that particular concept is defined through the concept called the moneyness.

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Condition	Call Option	Put Option
$S > E$	In-the-Money (exercised)	Out-of-the-Money (Not exercised)
$S < E$	Out-of-the-Money (not ex.)	In-the-Money (exercised)
$S = E$	At-the-Money	At-the-Money

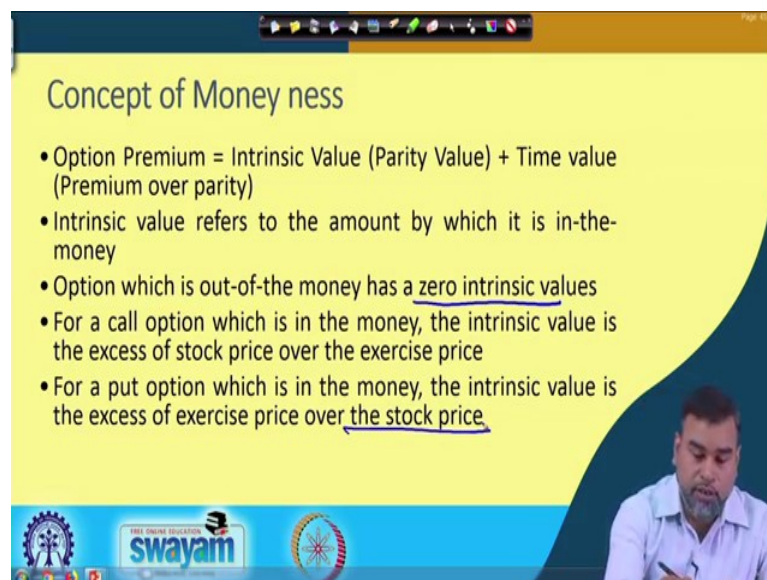
So, what do you mean by then moneyness already I have explained to you. That moneyness is here you see, your S is equal to the spot price or price of that underlying asset on that particular day and E is equal to your exercise price.

S is equal to the market price of the asset on that day and E is equal to exercise price and here what you have seen that, if your S is greater than E; E means the exercise price exercised price means that is the price whatever you have decided that on that price this particular contract will be or the transaction should be taken place. Then if your s is greater than E then if it is a call option then it is in the money, in the money means it will be exercised. But it is a put option then it is out of the money it will not exercised right.

But if it is reversed S is less than E ; that means, the market price is less than the exercised price, then it is out of the money call option is out of the money it will not be exercised and the put option is in the money then it will be exercised. But if S is equal to E on that day the market price is equal exercise price, then it will be exercised; that means, it is at the money it is also at the money.

So, whenever we go for a exercising the option, either we have to see whether it is a call option the market price should be more than the strike price or the exercised price if it is a put option then it is reversed, if both are same on that day then what we can say? Both are basically at the money; that means, the option will be exercised the contract will be exercised. So, that concept is called the concept of moneyness.

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Concept of Money ness

- Option Premium = Intrinsic Value (Parity Value) + Time value (Premium over parity)
- Intrinsic value refers to the amount by which it is in-the-money
- Option which is out-of-the money has a zero intrinsic values
- For a call option which is in the money, the intrinsic value is the excess of stock price over the exercise price
- For a put option which is in the money, the intrinsic value is the excess of exercise price over the stock price.

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Through this concept we basically try to find out the intrinsic value of the option premium and the time value of the option premium. Then here the option premium is basically nothing, but the intrinsic value and the time value and what is the intrinsic value? Intrinsic value basically the amount by which the option is in the money and the option which is out of the money has a zero intrinsic value.

And for a call option which is in the money the intrinsic value if the excess of stock price over the exercise price if the underlying asset is a stock. And for a put option which is in the money the intrinsic value is the excess of exercise price over the stock price, because

here we assume that the underlying asset is the stock price. If you see this example then you can get it clear.


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Example

Option	Exercise price	Stock price	Call Option price	Classification	Intrinsic value
1	80	83.5	6.75	In-the-money	3.5
2	85	83.5	2.5	Out-of-the-money	0

Handwritten notes on the slide:

- For Option 1: $6.75 - 3.5 = 3.25$ (Time value)
- For Option 2: 2.5 (Time value)



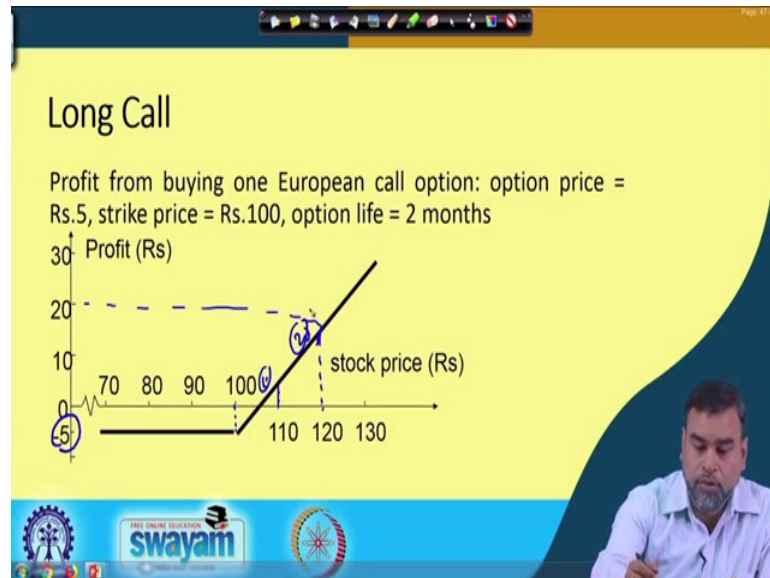
You see there is the option the exercise price is 80; let the underlying asset the stock, the stock prices is 83.5. When the call option price is 6.75 which was decided we will explain that how the call option is explained how it is determined and let now what is happening? If it is a call option then; obviously, your stock price is more than the exercise price that is why it is in the money then this stock price minus the exercise price that is 3.5 this is basically the intrinsic value.

Then what is the time value? The time value is 6.75 minus 3.5 how much? 3.25 that basically will give you the time value of money. So, the option premium has two components how the option premium means that is the option price and how the premium is defined, how it is determined we have to use certain kind of models for that we will explain further.

In another condition we have the exercise price is 85, but the stock price is 83.5 then; obviously, if it is a call option this is out of the money then the intrinsic value is 0. But whole premium whatever we have already paid because this money is paid to the seller you see how it is work. Whenever you are going for the option if you have already some premium you have paid to the seller, then that basically is called the option premium. And, already this is paid and that thing if it is not exercised then whole option value is

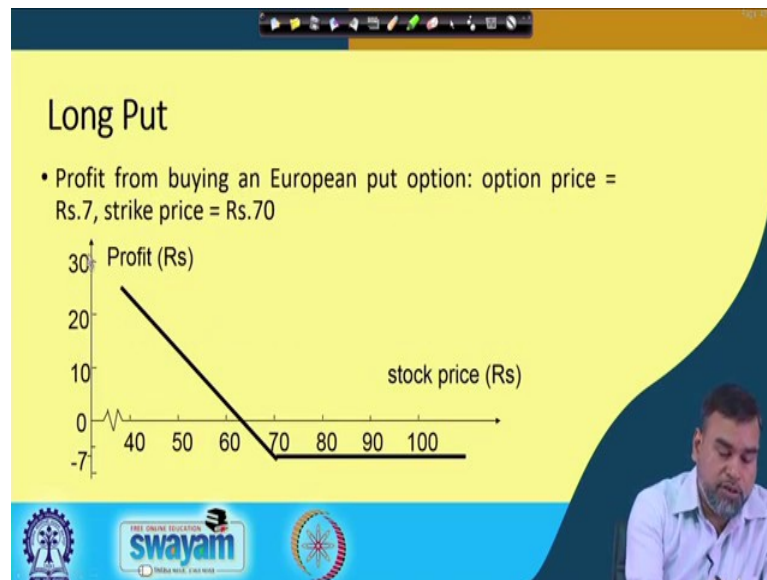
basically 3.5, only the intrinsic value is 0 and this all the 2.5 basically related to the time value. So, that is what basically the two components of the option premium one is your intrinsic value and other one is the time value.

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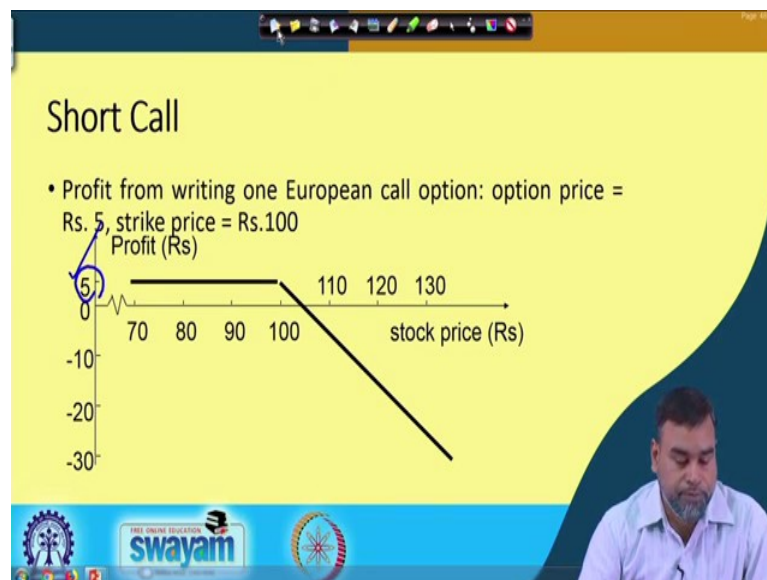
You see this is a payoff diagram for the call option buying a call option. Here if you see that option price is 5 that already I told you this one is the buyer has paid to the seller that is why it is minus 5, already you have negative cash flow then your strike price is 100. Then after that whenever the option price is in the particular underlying assets price is increasing your payoff is increasing at 110 it is 10 this is 20 so on. So, this is the way basically the pay off matrix for buying the call option can be look like this is the profits basically.

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So, then if you see that buying or selling a call option it will be reverse the seller has got 5 rupees the seller has already got this.

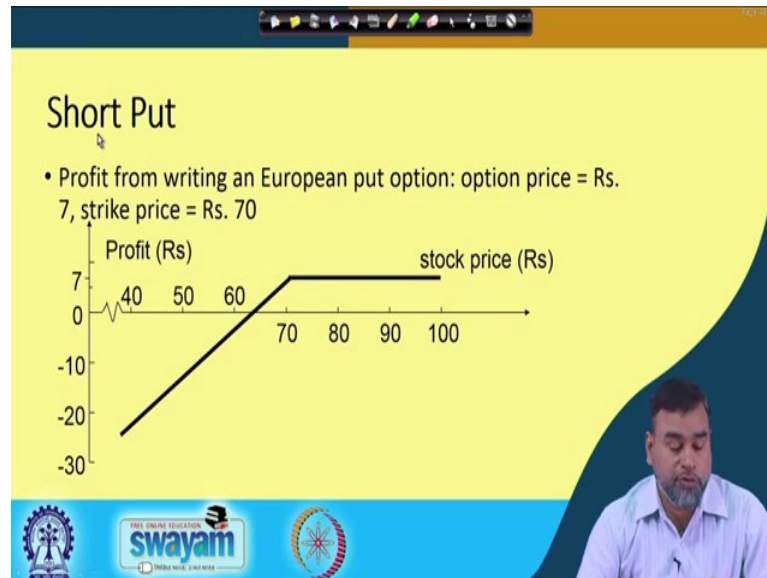
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The seller has got the 5 rupees, then now if it is going again and again increasing the stock price then you have a negative profit. Then finally, adjusted with respect to the 5 rupees is the only pay off what you can get from that or profit from that.

Then if you see another one is longer buying a put option, option price is 7 you have already paid it, strike price is 70 when if go on stock price is increasing accordingly you are pay off is also changing.

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And if it is selling a put option, then the strike price is 70 stock price is increasing then your profit is increasing. So, this is the way the pay off matrix basically looks like and further we will explain that what is the difference between pay off and profit and as well as how basically the pricing of this particular securities are done.

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References

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- Hull, John C. *Options, Futures, and Other Derivatives, 9th Edition*, Pearson, 2014.

These are the references what you can follow.

Thank you.