Quantitative Investment Management
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Indian Institute of Technology, Roorkee
Lecture 40
Option Trading Strategies - 1

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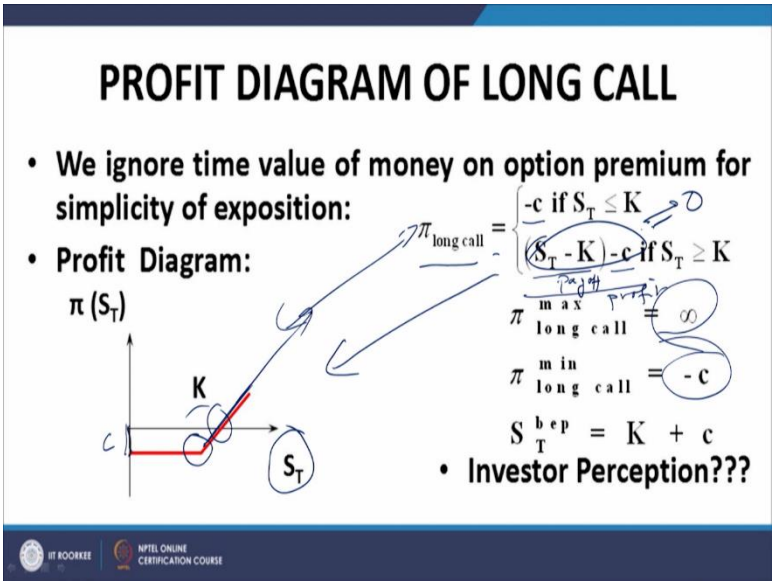

So, let us start with trading strategies with options. Let us recall or recap the simple strategies, the one option strategies, the long call, the short call, the long put and the short put. On the screen you have the profit diagram for the long call. Clearly, what is the long call? Long call is the right that vests in you if you are holding a long call position, a right vests in you which gives you the prerogative to buy the asset at a predetermined price which is called the exercised price.

So, let K be the exercised price that means you can buy the asset at K. Now, if the market price happens to be higher than K, you can buy the asset at K and sell the asset at the market price. Let us call it ST. So, the profit that emanates for you excluding the cost of the option, in other words, the pay-off that emanates to you is ST minus K.

That is the situation if ST is greater than K, if the market price is higher than the exercise price. On the other hand, if the market price is lower than the exercised price, then obviously if you want to buy the asset, you would rather buy it in the market than exercising the option and buying it at a higher price K. In that situation the call will lapse and as a result of it, the amount of premium that you pay will be lost to you.

So, in this case, the profit function is equal to the loss of premium if ST is less than K and is equal to ST minus K minus c if ST is greater than K because you are buying at K and you are

selling in the market at ST. So, this is your pay off and this is the cost of the option. So, this is your profit.

So, the diagram of this function is shown here. You can see here that so long as ST is left with K, this point the option is not exercised and the loss of premium accrues to your account. This is c, this is a loss, it is negative and once ST exceeds K or in other words, if the price of the underlying asset on maturity happens to take a value, you see it is a random variable. This is a random variable.

Now, we do not know what it is going to be at setting t equal to 0 but in the event that at maturity the stock price happens to be greater than the exercised price, the stock price happens to end up at a price greater than the exercised price then you will make a profit of ST minus K minus c which is represented by this 45-degree equation you can see here. So, this is the profit diagram corresponding to this is the profit function and this is the profit diagram. If ST is less than K, option is not exercised and if ST is greater than K, the profit is equal to ST minus K minis c.

Clearly this line is unbounded. What does it mean? It means that the profit on a long call position is unbounded. Higher is the value of your underlying assets price, higher is the profit rising out of holding a long call position. In fact, there is a one-to-one relationship if the stock price exceeds K then one unit increase in the stock price will correspond to one unit increase in the profit arising from the long call position measured at maturity.

So, the profit is unbounded. The minimum profit or the maximum loss is equal to the call price that is if ST happens to be less than K then obviously the call is worthless and the price that you have paid for getting into this long call position is a sunk cost as a loss. Then the breakeven point is given by this particular point that is K plus c. That can be worked out from the geometry of this figure but that can also be worked out from this profit function if you equate this to 0, you get ST breakeven is equal to K plus c.

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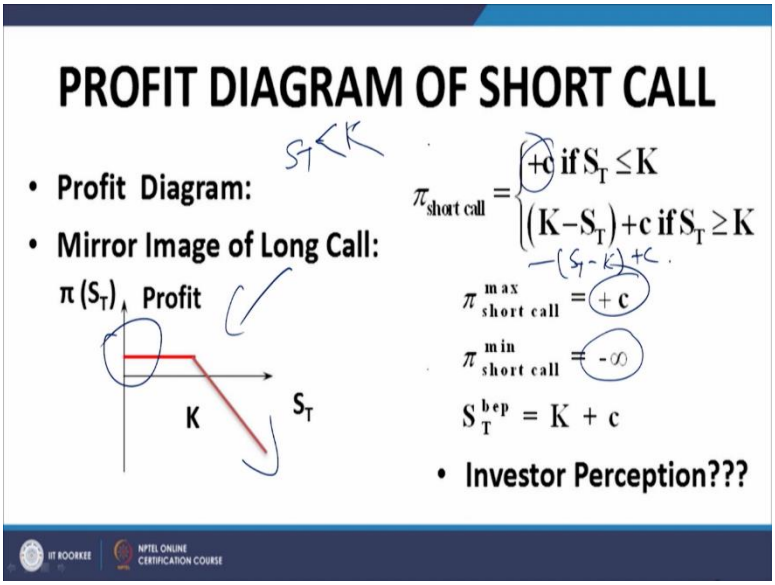

Profit diagram of shortcut this is a mirror image of the profit diagram for long call and this would be the diagram which you see here in the slide and the payoff function is also the inverse of the payoff function of the long call. The short call implies what that you are going to earn the profit on the premium on account of writing off the call and selling it to the party who is long in the option because the party is long in the option as a right he will pay you something and that something is called the option premium or the option price.

And in the event that ST is less than K, what happens? In the event that ST is less than K then the party who was long in the option will not exercise the option. Why? Because you would rather buy the asset in the market price is lower than the exercised price and therefore because the party is long in the option will not exercise the option then you can pocket the premium and go score free.

But on the other hand, if the stock price happens to be higher relative to the options exercised price then of course the party who is long in the option will buy the asset at the exercised price and sell it in the market and correspondingly that would be a loss for you equal to ST minus k that would be a loss for you. Therefore, there is this minus sign or the loss is K minus ST or minus of ST minus of K and obviously it is reduced by the amount of premium that you have received.

So, you can see that the maximum profit is equal to plus c. You can see make out from this diagram and the maximum loss is unbounded. You can see here you are going indefinitely downwards and the break-even point is equal to K plus c as we saw in the previous diagram.

Now, let us briefly touch on the investor perception. When we were talking about the long call, the profit was unbounded.

And I also mentioned that there is a one-to-one correspondence between the price of the underlying and the value of the call at maturity if ST is greater than K and that means higher the stock price at maturity, higher is your profit. And therefore, what is the investor perception when it takes a long call position? It is quite straightforward. He is strongly bullish about the stock. He feels that the stock is going to finish up at a very high value on the date of maturity of the call and higher the value the stock takes higher is this profit. So, a person indulging in this long call position is strongly bullish about the prospects of the price of the underlying asset.

Conversely, here the party was taking a short call position is strongly bearish. Why it is so? Because if the stock price remains below K, if the stock price remains below K, he can pocket the amount of premium and go scott free because the option holder will not exercise the option. So, long as the stock price remains below K, it is to the benefit of the option and that would be his perception. A party would write an option on underlying asset when his perception is that the option would not be exercised.

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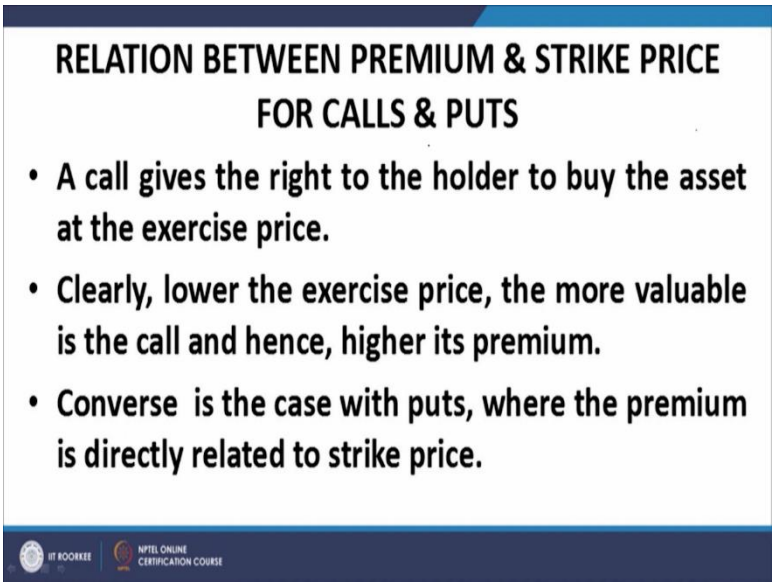

Relation between the premium and strike price of calls and puts. As I mentioned just now, higher the exercised price of a call option. What does it mean? It means you can buy the asset at a higher price. Lower the exercised price, you can buy the asset at a lower price. Naturally, if the exercised price is lower, it accrues to the benefit of the option holder and therefore you would be willing to pay a higher price for that.

In other words, the premium and the exercised price are inversely related for calls. The converse is the case for puts. Lower the excess price, lower would be the put premium. Why? Because you can sell the asset at a lower price, higher the exercised price, you can sell the asset at a higher price and therefore higher would be the put premium.

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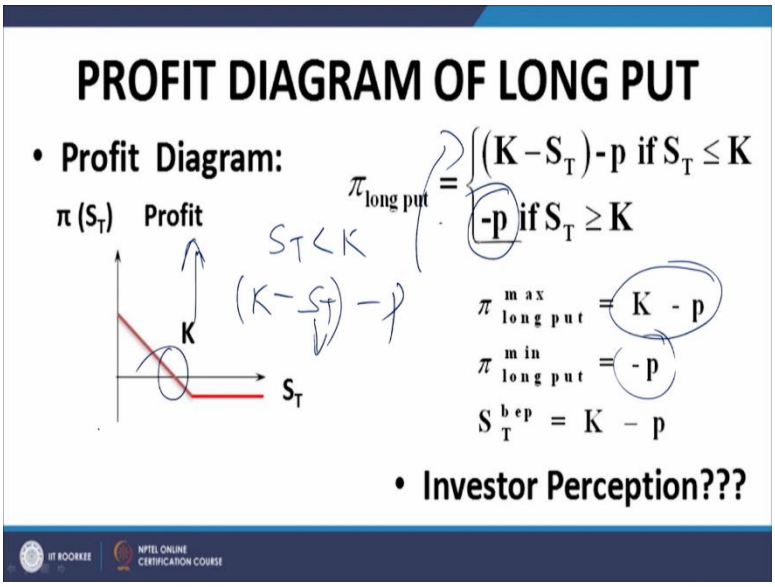

Profit diagram of a long put. What is the long-put option? Long put options are right to sell the underlying asset at a predetermined price K and now this option would be invoked only if ST is less than K because if ST is greater than K, then I would rather sell the asset in the market. Why should I exercise the price and get a lower value for my sale. And therefore, if ST is greater than K, the option would lapse but the premium that I paid for acquiring the option would be a loss to me and that is represented by this minus p.

In the event that ST is less than K, what I can do is I can buy the asset in the market at ST and sell it at K and therefore, I can make a profit of K minus ST, of course, without the option price. And if I consider the option price as well, this will be minus p and that is precisely what is shown in the first line of the profit function and that is also shown by this diagram. Lower the price, higher the profit, lower the value of ST, higher is the profit.

Why? Because the lower the market price of the asset, lower is the price at which you can buy it in the market and sell it against the option contract and now you can see here that the maximum profit is bounded. The maximum profit is bounded and it is equal to K minus P and that will occur when ST is equal to 0 and the minimum profit is minus p. That is a loss in the event that ST finishes up greater than K and the break-even point is K minus p, that is this

point here. This can be seen by easily seen by the geometry of the figure or by using this profit function as well.

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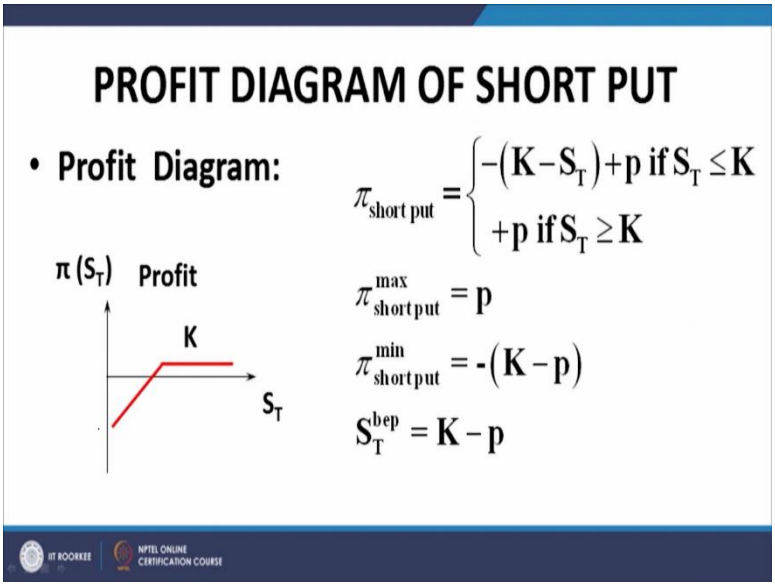

Short put is the inverse of the long point. So, let us not devote time to it.

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Now, we talk about complex option trading strategies. So, far we have talked about a long call, long put, short call, short put. Let us now talk about combinations of assets. Let us start with a covered call strategy then we will move on to the protective push strategy. We shall talk about Straddles and Strangles. We shall talk about strips and steps and then we shall talk about finally of spread strategies that would include vertical spreads, horizontal spreads, diagonal spreads and butterflies as well.

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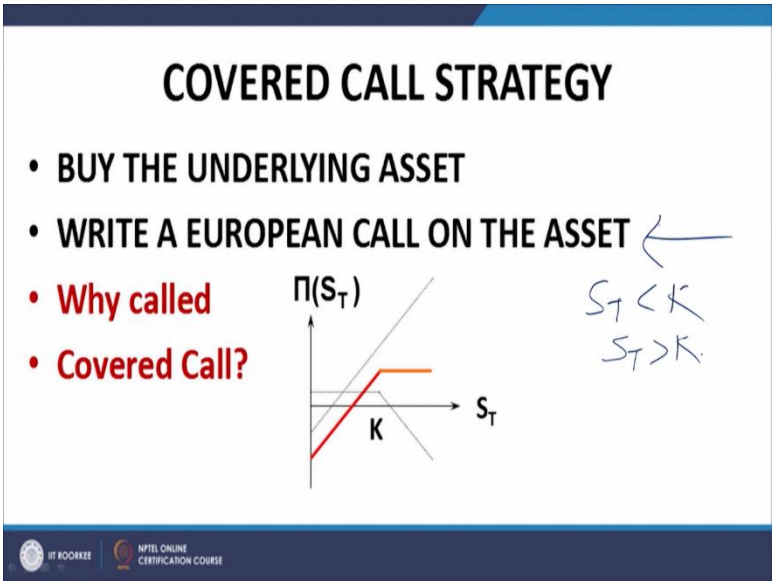

So, covered call strategy is an interesting strategy, it is a straightforward strategy. Buy the underlying asset and write a European call on the asset. Why it is called covered, that is the first question. See when you are writing a call, this is the point why it is called covered arises from this. If you are writing a call option, what does it mean? It means that if the stock price finishes up below the strike price, the call will not be exercised and that will not be a problem. That will not invoke any liability on your account.

But if ST finishes greater than K, you would be required to buy the asset at ST and deliver the asset at K because you are short in the call option. You are short in the call means the party who is long in the call has the right to buy. So, you have to deliver the asset and you have to deliver the asset at K but if the market price is higher at ST that means you buy the asset at ST and deliver the asset at K. That is the normal situation when you are only holding a European call, shot position in the European call.

But what happens if you also have a long position in the underlying asset? Then the advantage that accrues to you is that the possibility of your buying the asset in the market at a higher price to fulfil your delivery obligations against your short call position is not required. Why? Because you already have a long position in the underlying asset.

You already have that asset in your possession. So, in the eventuality that ST finishes up greater than K and you have to make delivery of the underlying asset because your long party invokes the call option, then you can use the asset which is lying with you which you own for meeting your delivery obligations. So, you are not affected by the rise in price, market price of the underlying assets. So, that is why it is called a covered call.

You cover the liability that may arise on account of the short position in the call option by holding a long position in the underlying asset. That is why it is called a covered call strategy. They are covering the call option by a long position in the underlying asset.

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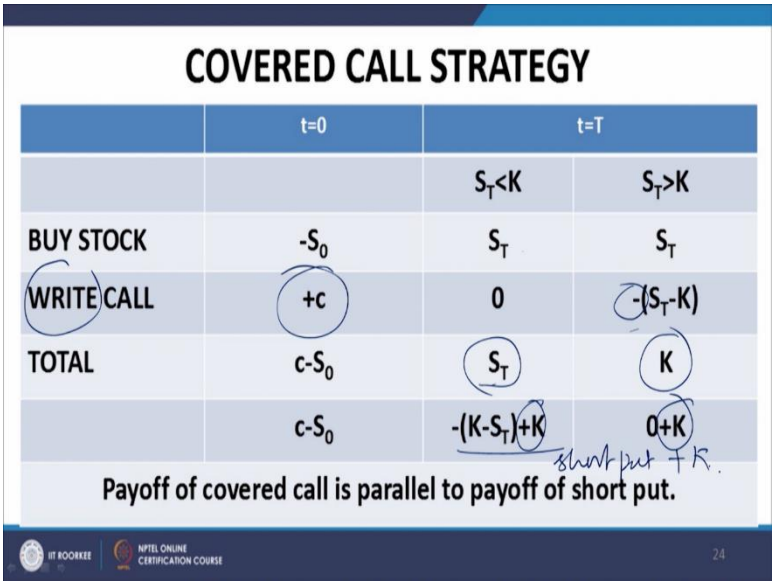

Let us see how the payoffs fan out. So, this is the diagram. You are buying the stock. So, what is a covered call? A covered call is a long position in the underlying asset plus a short position in the call option on the same underlying asset. So, buy the stock that cost you a 0 that will be worth ST at maturity. So, this is quite simple.

And because you have written the call, you will make a cash inflow of plus c. And against this, if ST is less than K, there is no liability but if ST is greater than K or liability is equal to minus of ST minus K why is this because you are short in the call option. So, when you work out the total payoffs, it turns out to be ST. If ST is less than K and k if ST is greater than K and this can be written in this form minus of K minus ST plus K and 0 plus K.

So, let me repeat. If ST is less than K, the total payoff is minus of K minus ST and if ST is greater than K, the total payoff is 0 plus K in each case. This plus K is there in both cases. So, let us separate it out for the moment. If you separate out this plus K factor from both the situations, you end up with minus K minus ST if ST is less than K and 0 if ST is greater than K. If you recall, this is precisely the payoff of a short put. So, you can write here short put plus K and the cost is equal to c minus S 0.

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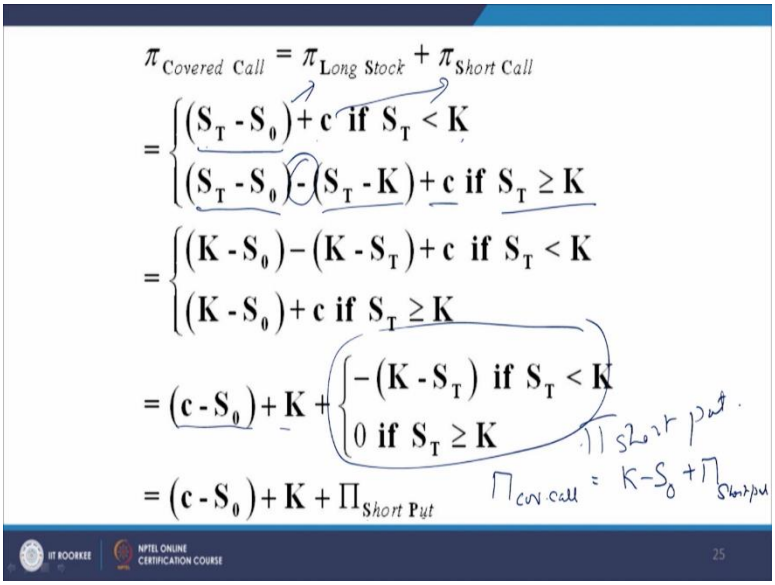

This is explicitly shown in this algebraic set of calculations using the payoff and the profit functions. This is if ST is less than K, the payoff is equal to ST minus S 0 plus c and this ST minus S 0 is arising from the long stock and this c is arising from the short call because ST is less than K. Therefore, this option is not going to be exercised and the premium is to your account and if ST is greater than K, what happens? If ST is greater than K this part is unchanged because it does not depend on K in any case.

And because of your short call position, you will have to make a payment and this is the negative side representing the payment of ST minus K and this plus c is the premium that you pocket. So, when you simplify this a little bit, what you have is c minus S 0 plus k plus pi of short put. If you look at this carefully, this is nothing but pi of short put.

Capital pi that is the payoff from the short put. So, the pi of a covered call, that is the profit function of a covered call is equal to c minus S 0 plus K plus the payoff of a short put. And if you ignore the c here, you can say that capital pi of covered call is equal to K minus S 0 plus capital pi short put.

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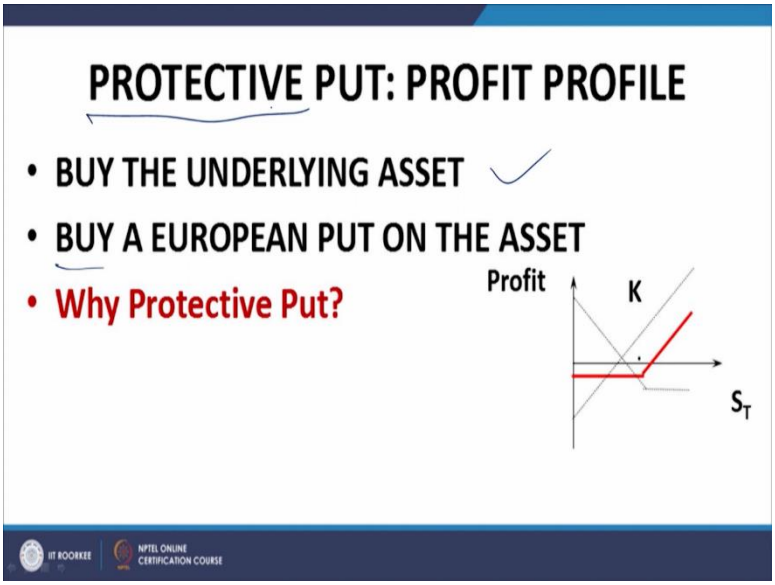

Protective put. Now in this case, what happens? You buy the underlying assets, you are long in the underlying asset and then you buy a put option on the underlying asset. This is obviously a very simple strategy. Why will you buy your European put on the underlying asset? Because you want to protect yourself against the fall in the price of the underlying asset. If the price of the underlying asset falls below your desired values, then obviously you can invoke the put option and sell the asset to the party short in the put option at the exercised price. So, that is the rationale behind using this word protective.

The rationale of using this word protective because it protects the value of your underlying asset in which you have a long position by taking a long put on that asset, if the market price of the underlying asset falls, you can invoke the put option at the exercised price and sell the asset at the exercised price. That is the rationale behind the use of the word protective.

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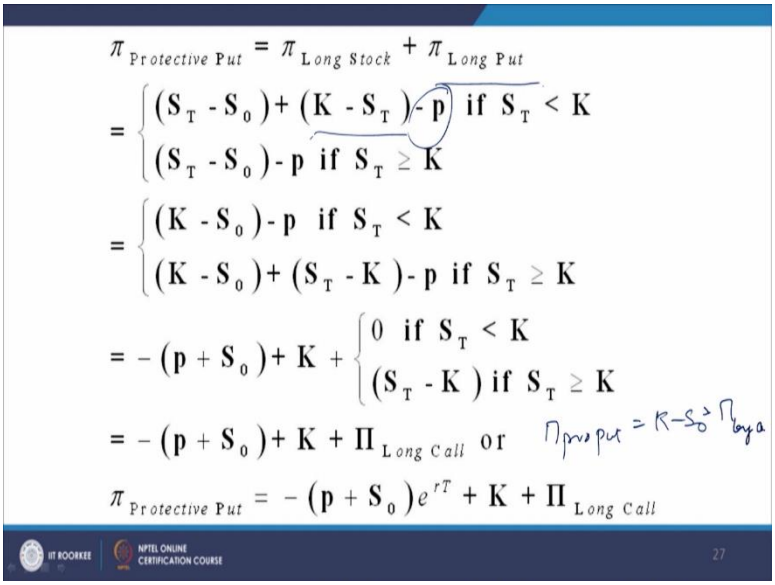

As far as the payoff and profit functions are concerned, it is pretty similar to what we did for the long call. The profit of a protective put is equal to profit from a long stock and profit from a long put. Long stock gives you ST minus S 0 irrespective of whether ST is less than K or ST is greater than K and this long put gives you what? It gives you K minus ST if ST is less than K and gives you 0 if ST is greater than K and this p is the price you pay for acquiring the long position in the put option.

When you simplify this, if we see this expression which is similar to what we had earlier, you can see that capital pi of protected put is equal to K minus 0 plus capital pi of long call. This is easily seen by the algebra that is here with quite elementary.

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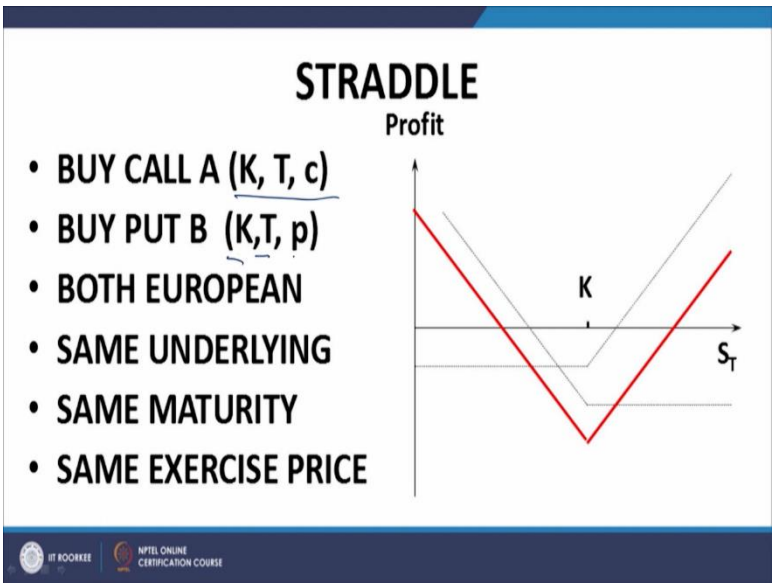

Now, we talk about a Straddle. A straddle comprises of two options, long positions in both the options, two options both European, both long positions, both same underlying, same maturity, same exercise. Let me repeat two options one call, one put, both of European type, both having the same underlying, both having the same maturity, both having the same exercise price.

So, we buy a call A at K. K is the excess price, T is the maturity, c is the call premium, the price that we pay for the option and we also buy a put option, same exercise price, same maturity and the price that we pay for the option is p. They have the same underlying asset and they are both European.

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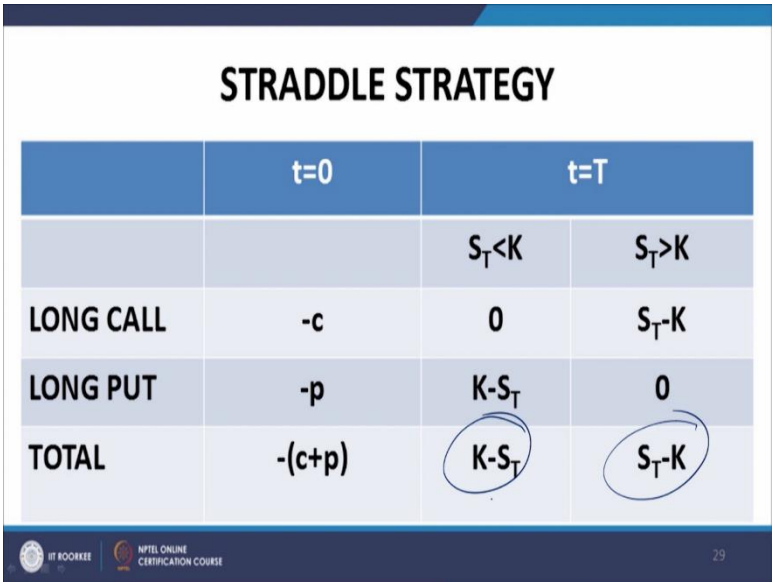

The strategy the implications of the strategy the pay-off from the strategy are shown in this particular diagram. It is K minus ST, if ST is less than K in ST minus K if ST is greater than K. The logic is simple, if ST is less than K the call lapses, they put in the money and they put pairs of K minus ST and if ST is greater than K, they put lapses. The call is in the money and it pays-off ST minus K. So, that is precisely what is happening here and the cost that you have for incurring the strategy or for creating the strategy is equal to the premium that you pay for the call and the put that is c plus p.

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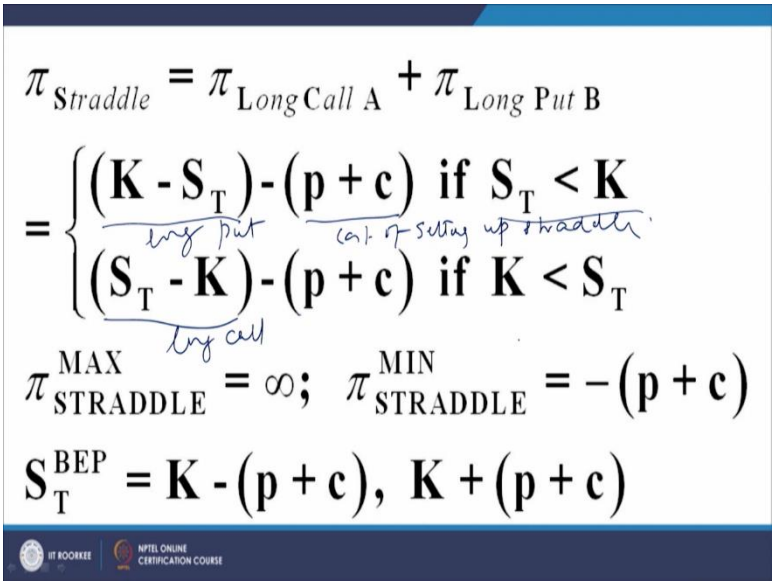

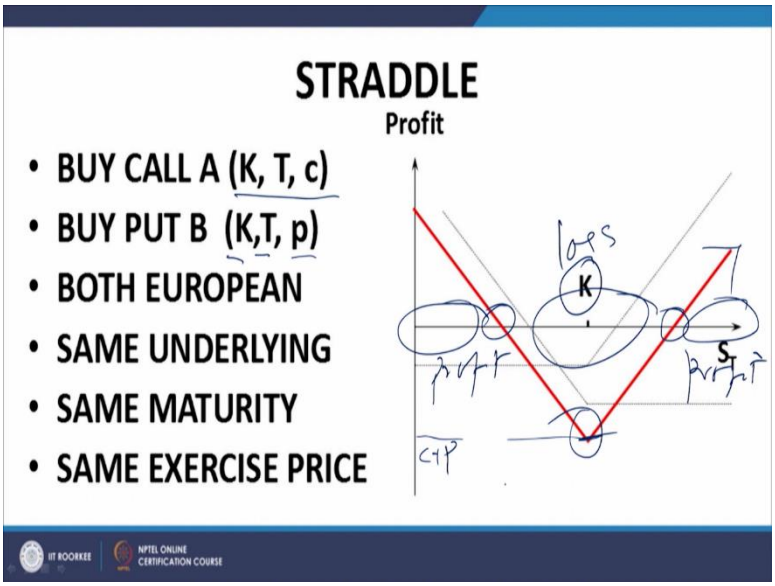

And therefore, this is the diagram that this is the table of the payoffs from the straddle strategy. The profit function can also be arrived at analytically. For the long call it is if ST is less than K, what happens? The long call A lapses and the long put is in the money and therefore, this is the long put and this is the cost of straddle cost of setting up straddle.

Similarly, if ST is greater than K, the call is in the money and gives you a pay of ST minus K. So, let us call it long call and this is the same thing. And you can see here the diagram is given in the next slide and the diagram is given here in this slide. It is a V. This is equal to this point. If you look and draw this here, this is c plus p.

This represents the maximum loss. This is the first break-even when the put is operative. This is the second break-even when the call is operative. These are the dotted lines and they are

representing the long call and the long put which constitutes the strategy. Obviously, the profit is unlimited as you can see here. The loss is limited to c plus p.

Now, the question is what is the investor perception when it takes up the strategy? You can see here that the party who has taken up the strategy, the investor who has implemented the strategy tends to make a profit in this region and in this region whereas it tends to make a loss in this region, loss profit, profit. So, what is the rationale? The rationale is that if the price of the underlying asset finishes in close proximity of the exercised price, please note this is the exercised price. This is the exercised value. The maximum loss occurs at the exercised price.

If the price of the underlying asset at maturity of the options, both of them is close to the exercise price you are likely to make the maximum loss. You are likely to make large amount of loss. However, if the value of the price of the underlying asset finishes up at a distance either to the left or to the right, either to the left or to the right of the exercised price you are likely to make a profit. And the greater this distance or greater is the divergence from your exercised price in either direction, the greater would be your profit.

So, what would be the perception of the investor? The perception of the investor would be that the stock price is unlikely to stay in the close proximity of the exercised price. It is likely that there is going to be some significant event in the lifetime of that company such that it could either push the stock price very high far away from the exercise price or very low again far away from the exercise price either in the negative direction or in the positive direction.

For example, if the company has a public issue coming up and if there is a possibility of that the public issue may not be fully subscribed then if it is not fully subscribed could call a significant fall in price. If it is well subscribed, if it is significantly oversubscribed then maybe the price of the stock would go significantly up.

Similarly, if there is a legal case or if there is a merger or acquisition strategy proposal coming up there is somebody who is willing to take up the company and depending on whether the deal materializes or not the stock price could either plummet or it could jump up significantly.

So, in this kind of situation when there is something in the near future that is going to affect significantly the fortunes of the company you may implement a straddle strategy. So, this we have already done. This is pay off analytically. The maximum profit is infinite as you saw. It

is unbounded. The minimum is the cost of setting up of the strategy. The maximum loss is the cost of setting up of the strategy.

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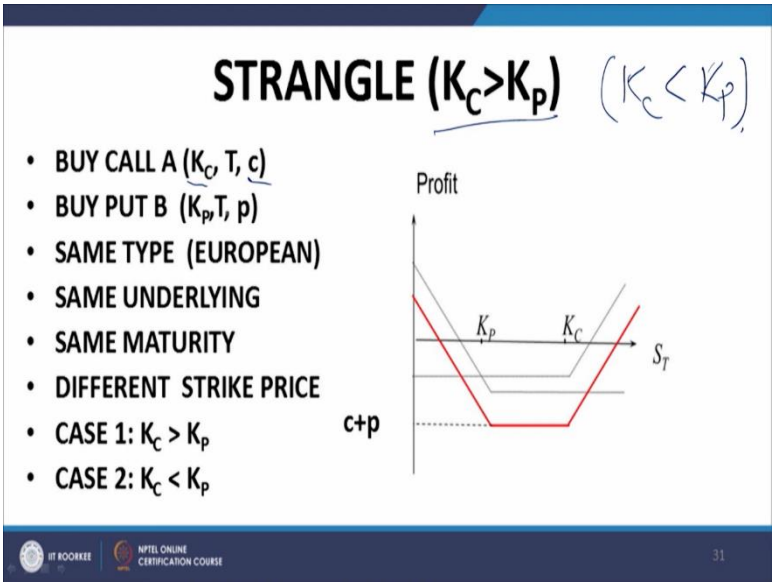

Then we talk about this strangle. The strangle now there can be two types of strangle. One is Kc is greater than Kp. The other can be Kc is less than Kp. We will take them up separately. Let us first talk about Kc is less than Kp. So, strangle is pretty much similar to a straddle. In a straddle, what did we have? We had a long call. We had a long put on the same underlying, same exercise price, same maturity and same type that is European.

Here we also have all those characteristics but for the character that they have the same exercise price they do not have the same exercise price. There can be two situations where the call exercise price is greater than the put's exercise price or the call exercise price is lesser than the put exercise price. We shall examine themselves separately.

Let us first talk about the call exercise price greater than they put exercise price. So, we buy a call A with the strike price Kc comma T comma c. Kc is the call exercise price, T is the maturity which is the same for both the options. C is the call premium. It is an offer. Please note you are buying the options. Similarly, for put B. It is Kp, T, p. Same type, same underlying, same maturity, different strike price.

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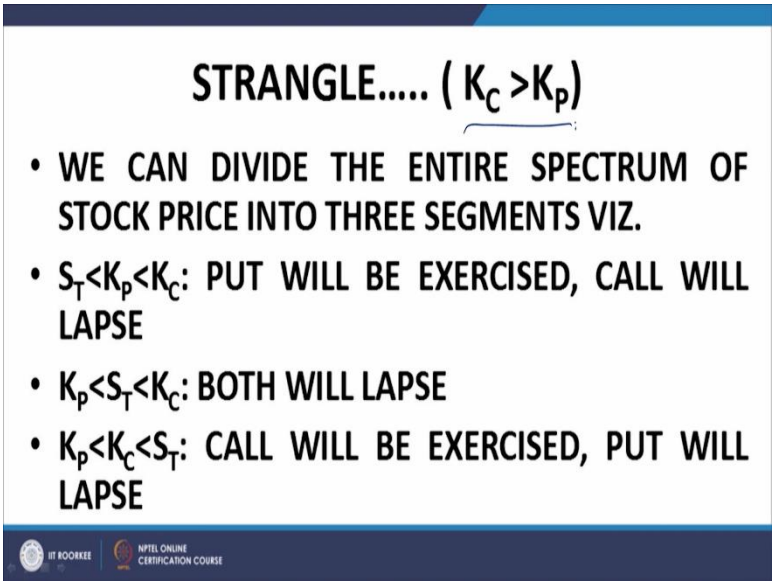

Now, in this situation Kc is greater than Kp. What happens? We can split up the entire spectrum of stock prices into various segments into three segments. Number one in this case what will happen? Put will be in the money, put will be exercised and call will lapse. Kp less than T is less than Kc both will lapse and Kp is less than Kc is less than ST in that case the call will be exercised. The put will lapse.

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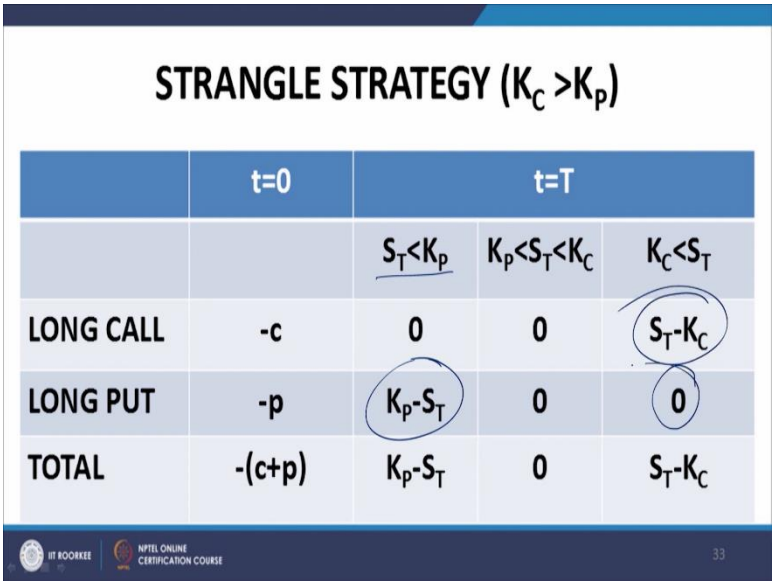

So, on that basis we have this diagram which by now is quite simple to interpret. We have ST less than Kp, Kp less than ST less than Kc. Sandwich between Kp and Kc and here is Kc less than ST. So, in this case what happens? The put is exercised and this is pay off from the long put. In this case, neither of them are exercised or the payoff is 0. And in this case the call is

exercised and the payoff from the call is the put is not exercised and the payoff on the put is 0.

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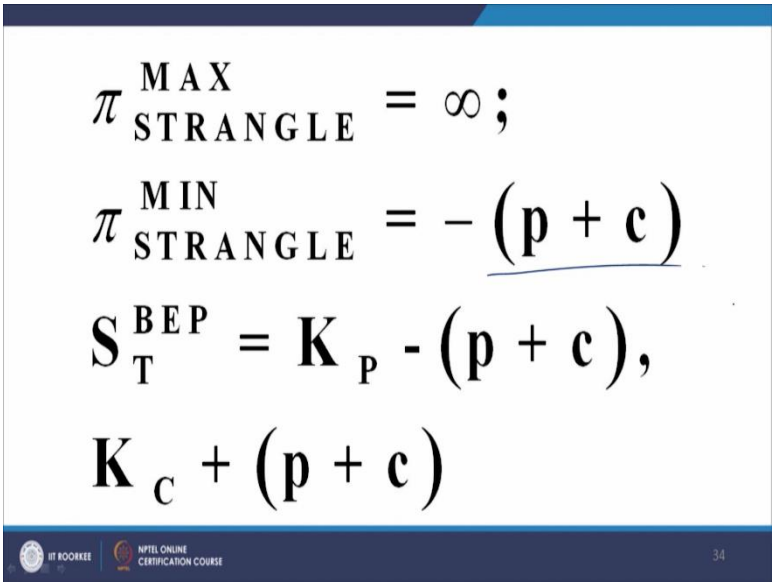

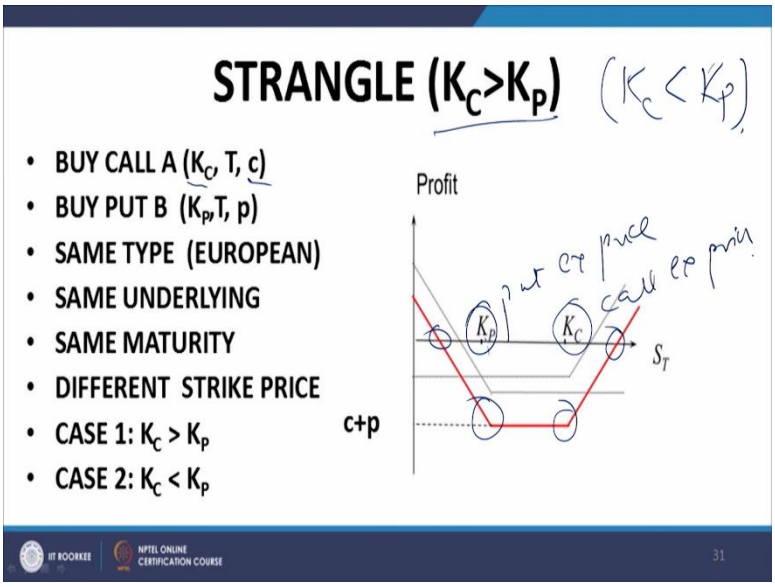

The maximum profit from a strangle is again infinite. The profit is unbounded. The maximum loss is p plus c. You can make it here. And the breakeven points are Kp minus p plus c and Kc plus p plus c. These are the two break even points. This one and this one. This is the profit diagram you have here. This is the Kp. This is the Kp is less than Kc. These are the two exercise prices of the put. So, in contrast to the straddle which is V shaped this has a flat-bed between Kp and Kc. There is a flat-bed representing constant payoff between Kp and Kc. The investor perception is pretty much the same.

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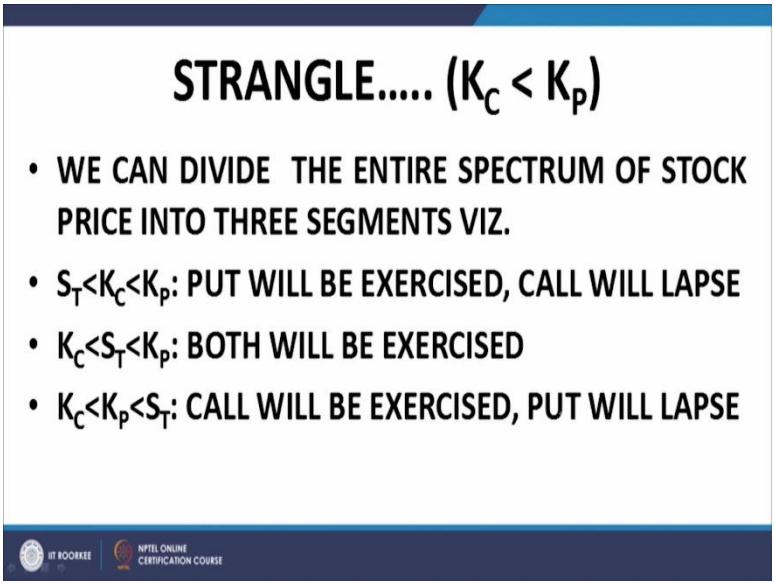

And then we shall talk about Kc less than Kp in the next lecture. Thank you.