Quantitative Investment Management
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Lecture 41
Option Trading Strategies – 2

Welcome back. So in the last lecture I was talking about trading strategies comprising of one or more financial instruments, particularly derivatives. I discussed the long call and the long put strategies and the short call and short put strategies. The upside in the case of the long call is unlimited and therefore, the investor perception, when he goes for a long call strategy, is that the stock prospects are extremely bullish as on the date of maturity of the option. Recall, that we are talking about European options at the moment.

Then the short call, which is the inverse of the long call, would be optimal if the perception is inverse to that of a long call holder. That is, the person who indulges in the strategy, indulges in a short call strategy feels that the stock price is not going to go up, as a result of which the option would not be exercised and consequently, he would pocket the premium by writing a call on the stock.

Similarly, in the case of put options, the long put option strategy would be optimal if the perception is bearish as far as the investor is concerned, lower the stock price, in fact, on the date of maturity of the option the higher is the profit from a long put strategy and consequently, an investor who is bearish on the prospects of a particular stock would indulge in the long put strategy. The short put strategy is the inverse of the long put strategy and the trader or the party undertaking the strategy would be anticipating that the stock price would be bullish. And as a result of which the long put holder will not exercise the option and he could get the premium.

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Then I talked about the covered call strategy which comprises of what? Which comprises of a call option written on the underlying asset, that is, a short position in the call option together with a long position in the underlying asset. A long position in the underlying asset plus a short position in a call that is written on the same underlying asset. The behaviour of the strategy is pretty much similar to that of a short put strategy.

And then the protective put strategy involves a long position in the underlying asset and a long position on the, in a put option written on the same underlying asset. By virtue of having a long position in the put option on the same underlying asset, we are buying in some sense an insurance on a price fall in the underlying asset. If the value of the underlying asset falls below the exercise price of the put option that we have a long position in then I could exercise with the long put option and thereby reduce or minimize the loss that could emanated from the fall in price of the underlying asset.

Then we moved over to straddles and strangles. In the case of straddles, we have a long position in a put call option and a long position in a put option, both on the same underlying, same maturity, same exercise price and of course, both the options are European. The pair from the straddle is a v-shaped figure as a result of which the party who is long in the straddle makes a profit when the underlying assets price ends up distant away, significant distant away from the exercise price of the two options.

Either to the left or to the right. In other words, the price is much below the exercise price or much above the exercise price. That is, and if the price ends up pretty much close to the

exercise price, the party makes a loss equal to the combination of the or the aggregate of the cost of putting up or setting up the strategy, that is, the call of the, that is, the cost of the long call and the cost of the long put.

So, that is as far as straddle is concerned. And straddles would obviously be optimal when there is likely to be a significant corporate event in the life of the underlying company as a result of which, as a result of which the outcome of that event could significantly influence the underlying price or the stock price if the outcome turns out to be positive possibly the stock price could rise significantly and if the outcome turns out to be negative, the stock price could fall significantly.

For example, the settlement of a claims, of a massive claim or a settlement of a litigation, a decision on a litigation, a public offering or merger acquisition takeover proposal or some government announcements in the budget. So, these are examples which could help you if you are planning to take up a straddle strategy or these are the circumstances in which a straddle strategy could be, could turn out to be optimal.

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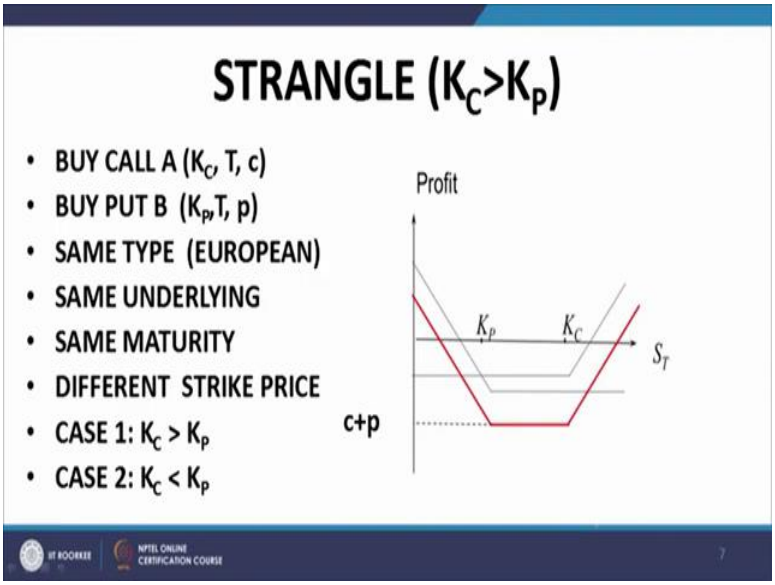

Then, we talked about strangles. In the case of strangles the strategies are pretty much similar to the case of a straddle, except for the fact that the exercise price of the long call and the long put are different. We have two scenarios here, we have the scenario in which the exercise price of the call option is greater than the exercise of the put option.

In this case, the diagram or the profit diagram is shown in the right hand panel of the slide. So, we buy a call A with excess price of K C, maturity T and cost C. We buy a put B of

exercise price K P maturity T and cost p. All, both of them are European, both are the same underlying, both of the same maturity but they have different exercise prices. As I mentioned, we have two scenarios, one K C greater than K P the other K C less than K P. I had discussed the scenario where K C is greater than K P.

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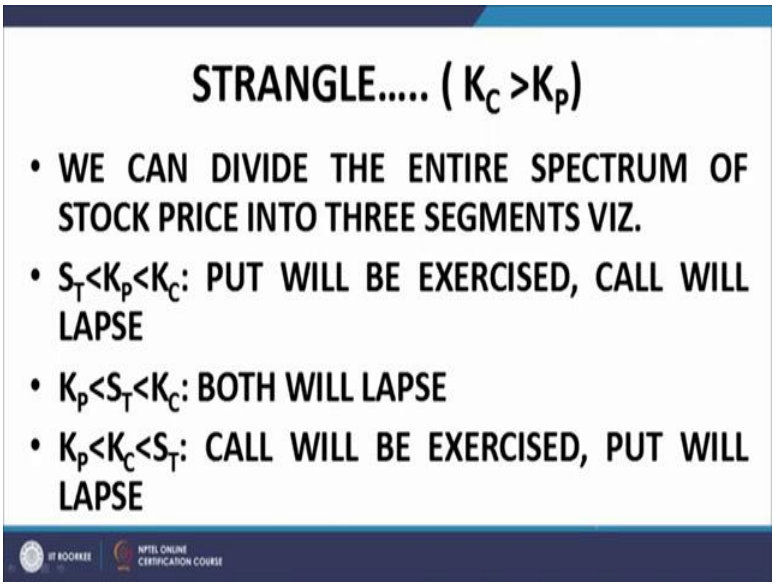

In this case we can split up the spectrum of stock prices into three segments, 0 is less than S T is less than K P, K P is less than S T is less than K C and then K C is less than S T. Now, in the first case when 0 is less than S T is less than K P then what happens? The put option will be exercised and the call option will lapse. In the case when K P is less than S T is less than K C, the, both of the options will lapse. Neither they call, nor the put will be exercised. And if K P is less than K C is less than S T, the call will be exercised, the put will not be exercised.

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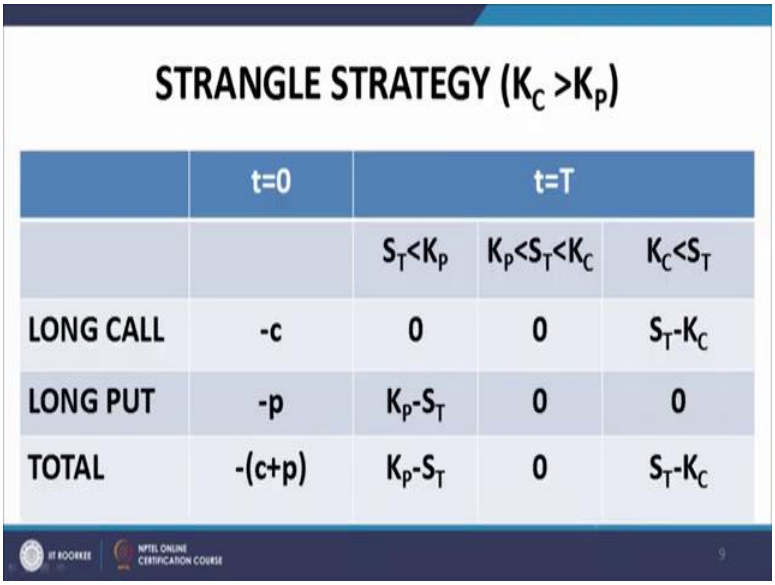

This is the tabular form of the payoffs from the, from the strangle strategy where K C is greater than K P.

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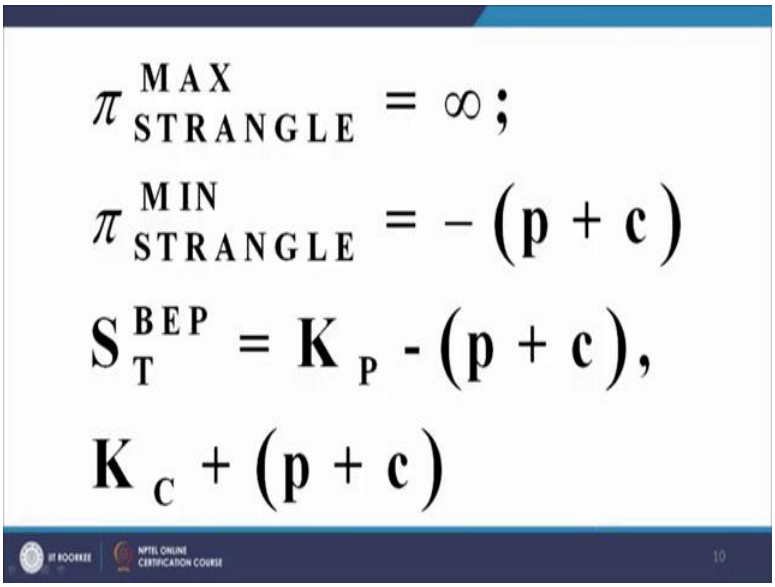

And these are the salient features. The profit is unbounded as you also saw from the diagram. The profit is unbounded. The loss is equal to the cost of creating the strategy, that is, the aggregate of the put option premium and the call option premium, and the breakeven points are equal to K P minus p plus c and K C minus, K C plus p plus c.

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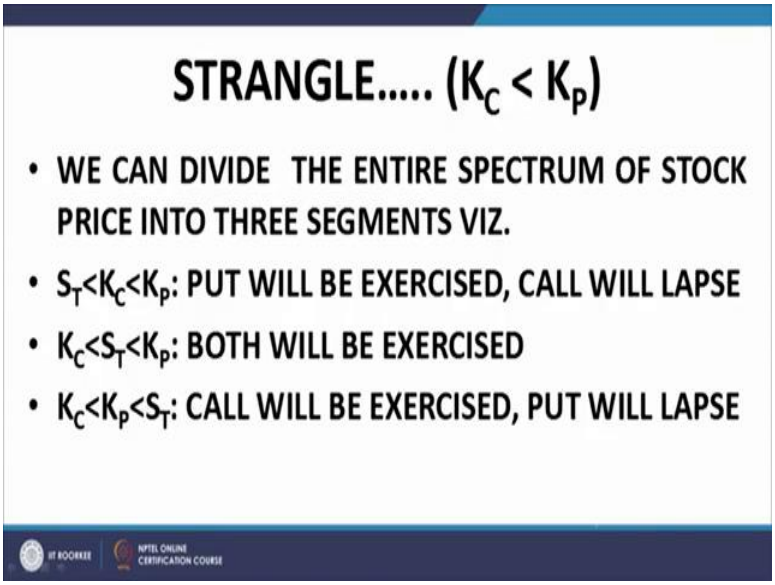

Then we look at the second strangle where K C is less than K P. We again divide the spectrum of stock prices into three segments, 0 less than K C in which case what will happen, the call will not be exercised but the put will exercised, put will be exercised, K C is less than S T is less than K P, in this case call as well as put both will be exercised.

And K C less than K P less than S T, in this case, the put will not be exercised, the call will be exercised. Let me quickly repeat S T less than K C less than K P, put is exercised, call will not be exercised. K C less than S T less than K P, both of the options will be exercised. And K C less than K P less than S T, then only the call will be exercised.

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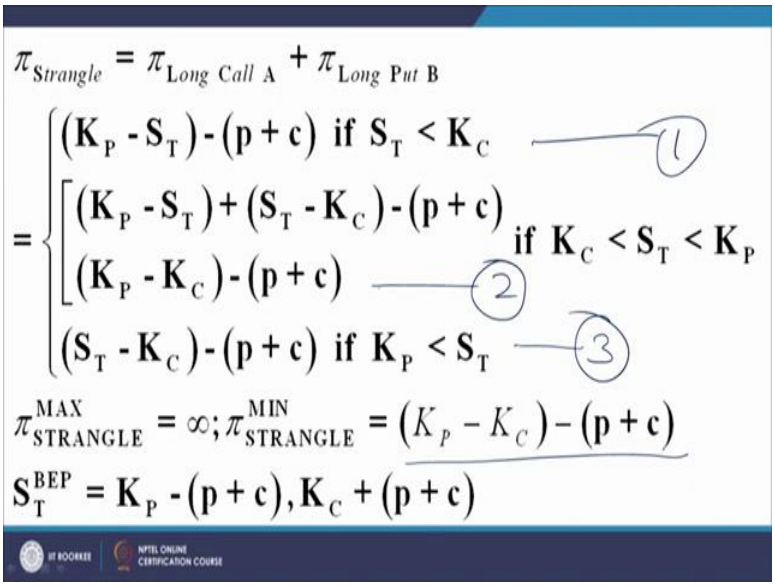

And here are the salient features of the profit function of a triangle. In the case when K C is less than K P if S T is less than K C, then this 1 will hold this is quite straight forward, if S T is less than, if S T is greater than K C but S T is less than K P then what happens, both the options are exercised and as a result of which we get the profit function given by equation number 2.

And of course, if K P is less than S T, obviously K C would also be less than S T because K C is less than K P then only the call option is exercised and we have this as the profit function, number 3 as the profit function. And as you can see here, the maximum profit of the strangle is unlimited, it is unbounded. The minimum profit is in this case it is not the cost of setting off of the strategy it is K P minus K C minus p plus c. And the breakeven points are at K P minus p plus c and K C plus p plus c.

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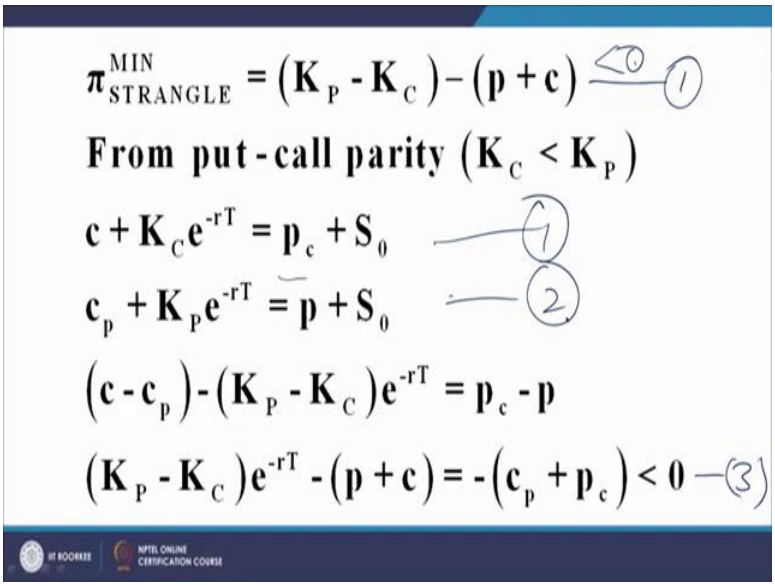

So, let us look at the minimum profit of the strangle that we saw in the previous slide was given as K P minus K C minus p plus c. And now let us look at what is going to be the sign of this expression, sign of equation number 1, whether it is greater than 0 or whether it is less than 0, for this purpose we write the put call parity for the call and the put which comprise the strangle, we have this as equation number 1 for the long call that comprises the strangle.

What is p c? p c is the put corresponding to this call option having the same exercise price as the call option that is K C. Similarly, for the long put option we have this equation number 2 as the foot call parity relationship. What is c p? c p is the call option with the same exercise price as the long put that constitutes the strangle.

So, using the equation number 1 and 2 and simplifying what we find is equation number 3 and equation number 3 shows that K P minus K C e to the power minus r T minus p plus c is less than 0. If we ignore the time value of money, if you take r is equal to 0 that is then we find that K P minus K C minus p plus c would be less than 0. This is an important part of the of the strangle configuration when K P is or K C is less than K P, K P is greater than K C.

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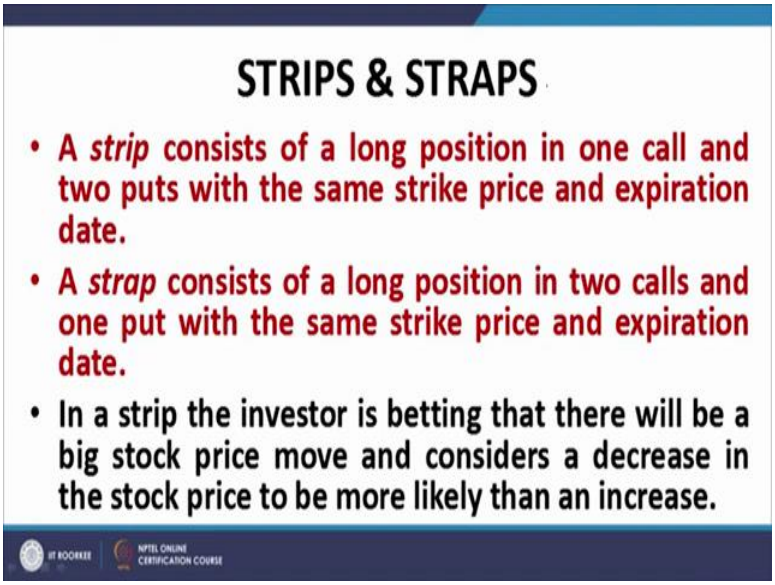

Now, we talk about strips and straps. A strip consists of a long position in one call and two puts with the same strike price and expiration date. So, in some sense this is similar to a straddle. In straddle what do we have? We have a long call and a long put with identical exercise prices, identical maturities and the same underlying asset.

Here, instead of one call and one put we have one call and two puts, long position in one call and long position and two puts on the same underlying, same maturity, same exercise price and of course, this same type, that is, European. We are talking about European options at the moment.

A strap is also similar. In the case of a strap what do we have? We have a long position in two calls and long position in one put. So, in the case of a strip we have a long position in one call and two puts, in the in case of a strap we have a long position in two calls and one puts, that is the difference between strip and strap.

In a strip, the investor is betting that there will be a big stock price move just like in the case of a straddle, and considers a decrease in the stock price to be more likely than an increase.

Why? Because please note he is having a long position in two puts and puts tend to reward the investor, reward the trader when the stock price tends to be down.

Now, because you are long in two puts you will make a profit of two units for each unit change or each unit decline in the exercise price, in the stock price below the exercise price. So, that is the reason that in the case of a strip, the investor is betting on a significant change in the stock price first of all. And number 2, the possibility of the price declining is significantly more in the perception of the investor compared to the possibility of the pri, of the stock price increasing.

Although if the stock price increases significantly, the long call would come into play and again you would make a profit but the profit that you would make if the price declines would be double the profit that you would make if the price increases because he is long in two puts compared to a long position in one call.

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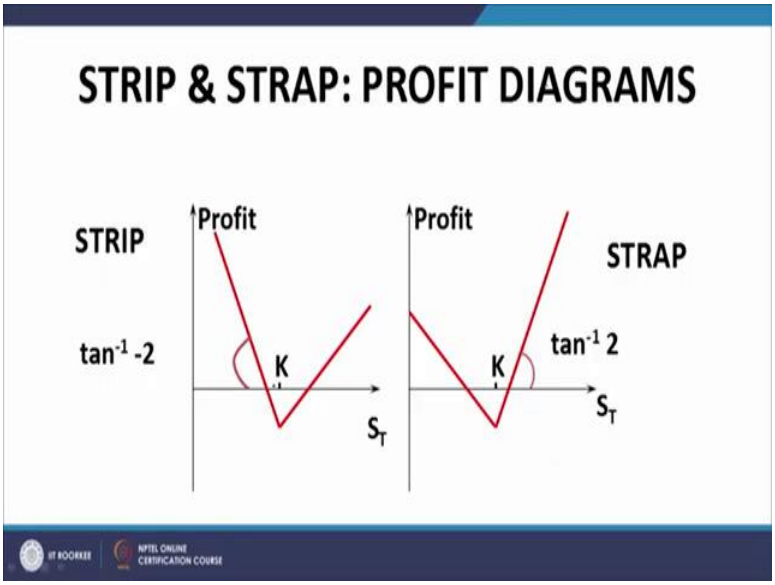

And this is the diagram. You can see this angle is, this angle here is tan inverse 2. That means what? That means if you are in this region, if you are in this region that is to the left of K that is the stock price is below the exercise price, Then for every unit decline in the stock price, you will make a profit of 2 units on the basis of the 2 long puts that you have.

On the other hand, if the stock price increases beyond K, and then your incremental profit rather is 1 unit for each unit increase in the stock price. And the right hand panel shows you these payoff for the profit diagram in the context of a strap. The left hand side gives you the strip profit diagram.

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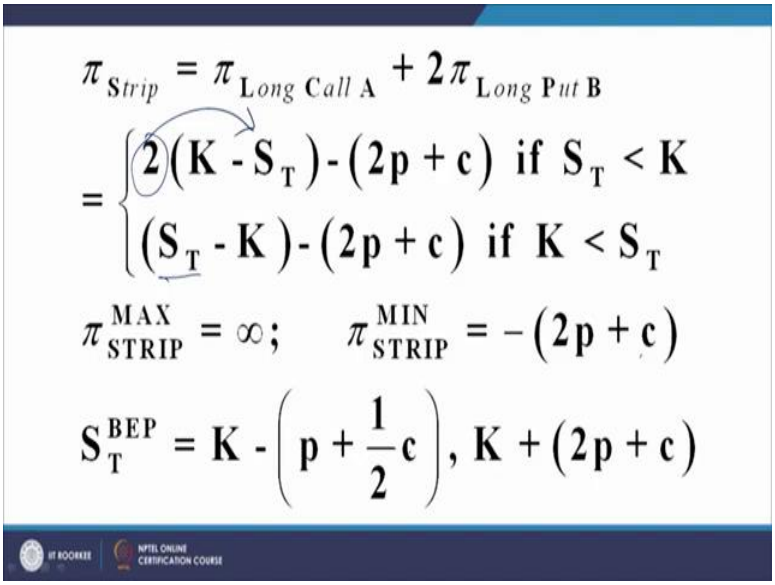

And these are the profit functions of the strip, and strap can be worked out. Similarly, you can see here if S T is less than K then this 2, if you simplify, this, it turns out to be 2 K minus 2 S T, 2 K minus 2 S T. The fact that the coefficient of S T S 2 means that if you differentiate with respect to, with respect to S T you find you get value of 2, that means for every unit change in decline in the stock price the profit increases by 2 units. Because you have got two puts, you see. It is elementary, in fact.

And if you, because you have long 1 call, the pri, the profit increases 1 unit for every incremental increase in the stock price. The coefficient of S T is 1. Maximum profit is unbounded as you saw in the diagram also. The minimum profit or the maximum loss you may say is equal to the cost of setting up of the strategy that is 2 p plus c, 2 P means the cost of setting up of 2 puts long position in 2 puts, and the cost of C that is the long position in the call option, the breakeven points are given as shown in the slide.

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Now, we talk about spread strategies. Now, the general definition of a spread strategy is that it consists of a combination of a long position and a short position in options of the same type. For example, it could be a long position in a call option and a long position, and a short position in the call option or it could be a long position in a put option and a short position in the put option. Now, there are different types of states, spreads. Number 1, we have vertical spreads. Number 2, we have horizontal spreads, and number 3, we have diagonal spreads.

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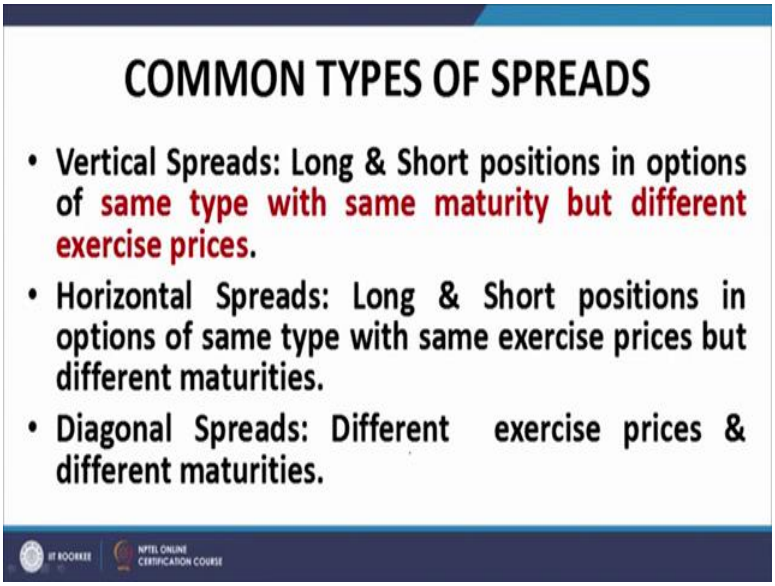

What are vertical spreads? Vertical spreads are those spreads which comprise of options of the same type long position and short position in option of the same type but with different exercise prices, same underlying but same maturity as well. So, let me repeat, vertical spreads

comprise of a long position in an option of a given type, short position in an option of the same type with the same underlying asset, of course same European or American as the case may be.

Then number 3, they would have the same underlying as I mentioned. They would have the same maturity as well but they would have different exercise prices. So, vertical spread means different exercise prices, otherwise same and a long position and a short position, everything same, except for the exercise prices. Exercise prices would be different.

In the case of a horizontal spread what happens? Everything is same except for the fact that the maturities are different. So, in the case of horizontal spread we have a long position in a given option, a short position in the same option, same underlying, same exercise price but different maturities. So, that is a horizontal spread.

And what is the diagonal spread? It is quite obvious, it would comprise of different maturities as well as different exercise prices. So, quickly recap, vertical spread, same maturity different exercise prices, same underlying, horizontal spread same underlying, of course, same exercise price different maturities, and diagonal spreads, different maturities, different exercise prices and same type of course long and short position.

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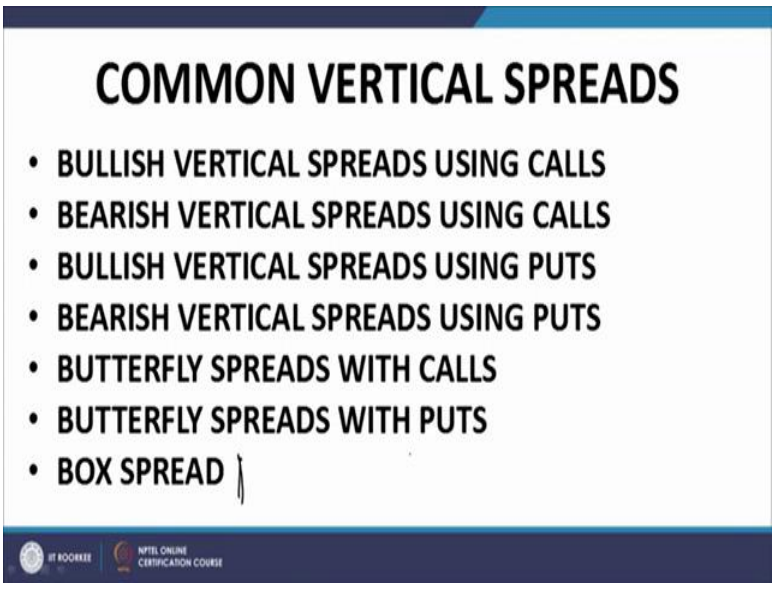

So, what are the common vertical spreads? Bullish vertical spread with call options, bearish vertical spread with call options, bullish vertical spread with put options, bearish vertical springs with put options, butterfly spreads with calls, butterflies spreads with puts and then box spread. Let us quickly move on.

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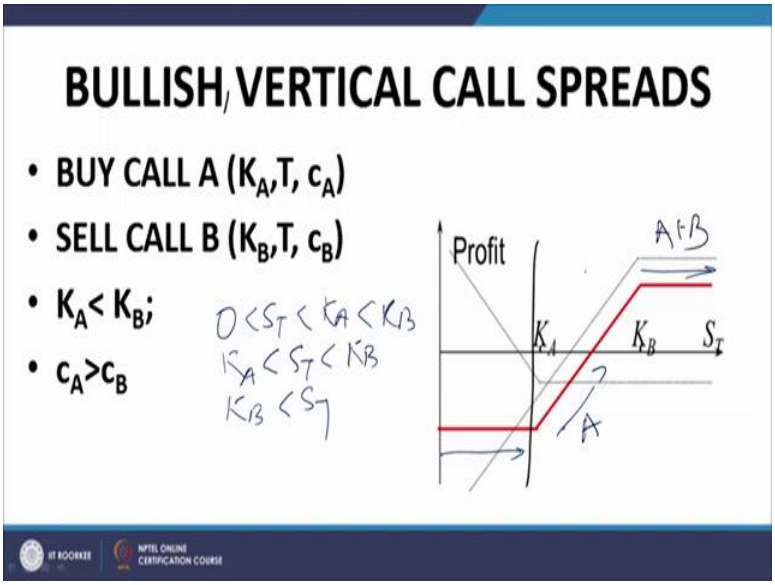

First case bullish vertical spread using call option, bullish vertical spread using call option. What is this? This is a long position in a call A and a short position in a call B, both are European and both are call options, one is long that is A, the other is short, that is B. The exercise price of A is lower, the excess price of B is higher. Therefore, what will happen?

Because the premia is inversely related to the exercise price in the case of call options, the premium of the call option A will be higher than the premium of call option B. That means what? That means that it will entail a cash outflow on the part of the investor to set up the strategy because he is long in call A, and the premium of call A is higher.

In other words, he is buying call A and the premium on call A is higher, therefore he has to pay a higher amount of money compared to the money that he would receive by taking a short position in call B, which has a higher exercise price. So, this is the diagram. The right hand panel shows you the diagram and you can again split up the stock price spectrum into three parts. 0, less than S T is less than K A, K A less than S T less than K B and then K B less than S T. Now, when 0 is less than S T is less than K A, what will happen?

Obviously it has to be less than K B as well. Then what happens? Neither call A nor call we will be exercised and the payoff to the investor would be negative, that is, the expire or the difference of premium between the price that he has paid for buying option A and selling option B. So, the cash outflow in that case would be, which would be a negative figure.

Now, if S T is less than K A less than K B what happens? And that we have already discussed is S T is less than K A less than K B, we have discussed. Neither option is

exercised. So it is only the difference of premium that materializes. If K A is less than S T is less than K B, then option A will be exercise because S T is greater than K A. So option A will be exercised. And you are long in option A, please note. So this region starts in that case, and K B will not be exercised because your stock price is below K B.

And if the stock price is below the exercise price, call options do not get exercised. Why? Because they are right to buy. Then even K B is less than S T, both the options will be exercise. Your long position in option A will be exercised and the short position in option B will be exercised by the person whosoever is long in option B.

As a result of it the slopes will cancel each other and we have this horizontal line here. So, that is the explanation of this figure. This is the figure where, this is the portion where none of the options is exercised, this is the portion where A is exercised and this is the portion where A plus B are both exercised.

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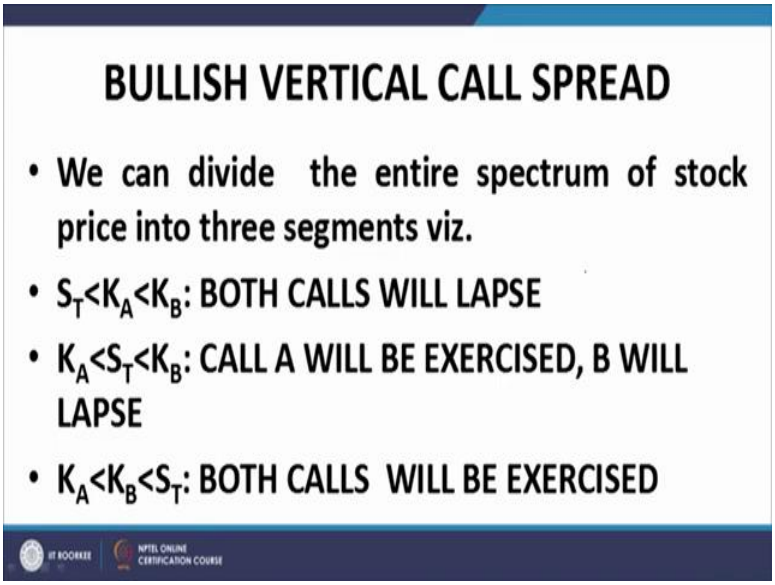

So, this is, I have already explained this just now, so we move on.

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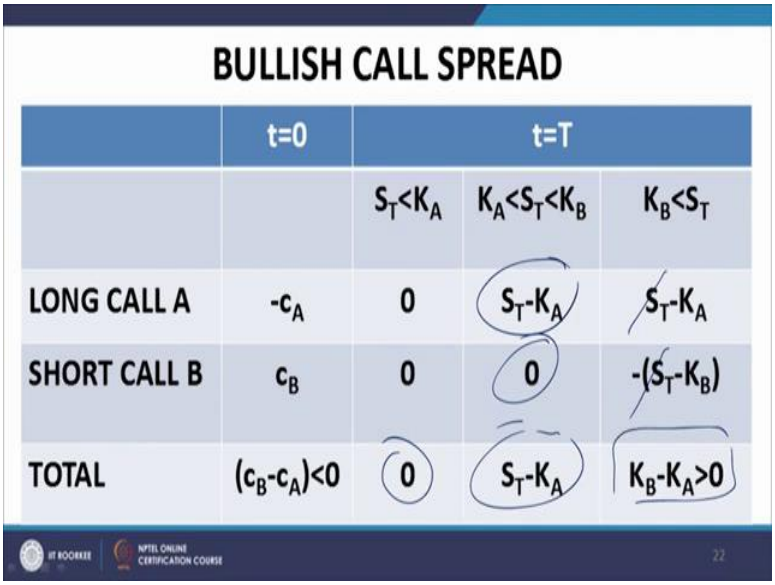

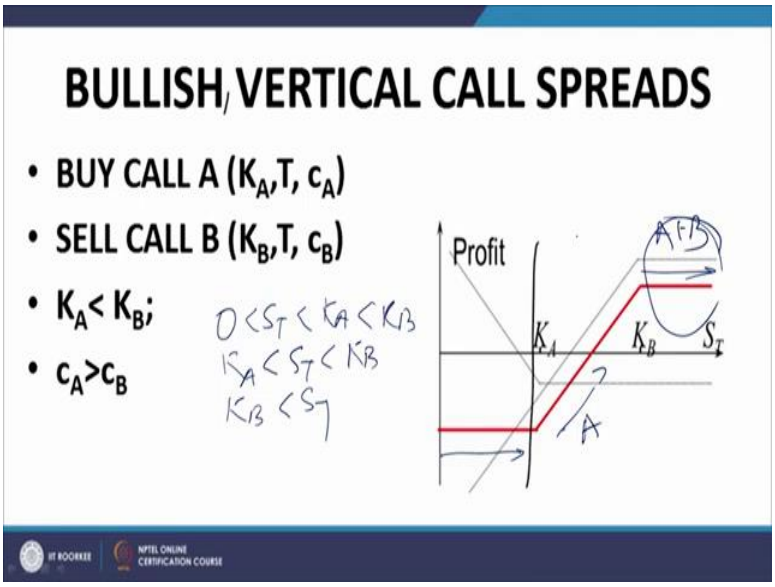

This is the tabular representation of the payoffs. You can see here, if S T is less than K A, the payoff is 0 and therefore the cost is, the cash flow is equal to C B, that is, what you receive minus C A but with negative because C B is less than C A. the exercise price B, of call B is higher. The exercise price of call A is lower and therefore, the premia are inverse of this

And if K A is less than S T is less than K B then option A is excercised. It gives you this payoff, option B is not exercised, so it gives you this payoff, 0, and the net payoff is equal to S T minus K A, as you saw in the diagram as well. And in the case when S T is greater than K B and obviously greater than K A as well, both the options are exercised.

And therefore you can see here, S T and S T cancel out, and the net payoff is equal to K B minus K A, which is independent of S T. And that is the region that we have this straight line

here. And this is the straight line, this represents the region where both the options are exercised and the net payoff is independent of the stock price S T because this is, and so this line is parallel to the X axis, that is, the S T axis.

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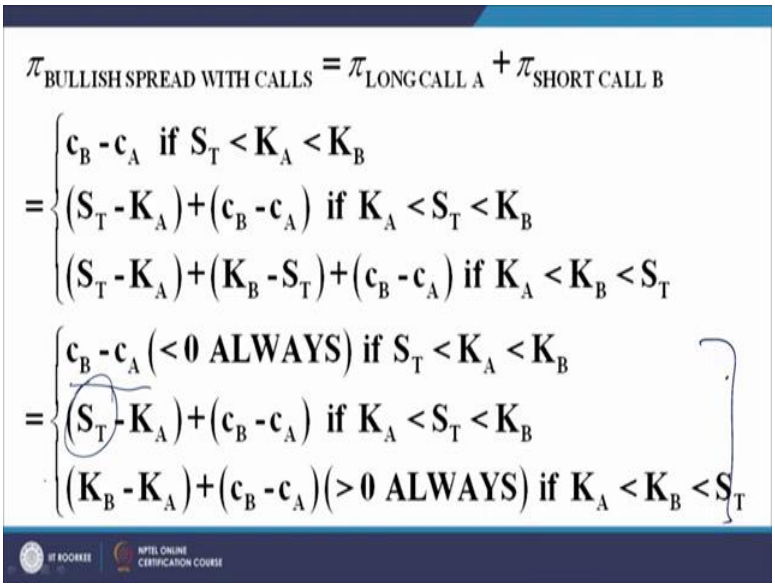

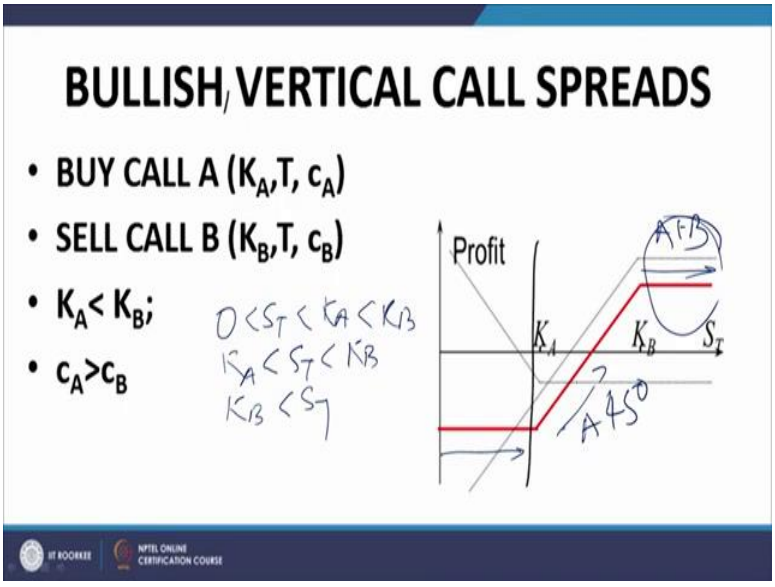

This is the analytical representation and profit function representation of the vertical spread with call options. You can see here, in this particular set of equations, if S T is less than K A less than K B, the net payoff is C B minus C A which is negative. If S T is greater than K A but less than K B, then the payoff is this.

And this is directly related to S T. So with one unit. So, the slope of this line, that we have, here this line is 45 degrees because the coefficient of S T is 1. And then the final part when S T is greater than both K A and K B, the, both the options are exercised. And because we are

long in one and short in the other, the S T S T cancels out and we have a payoff which is independent of the, which is independent of the stock price.

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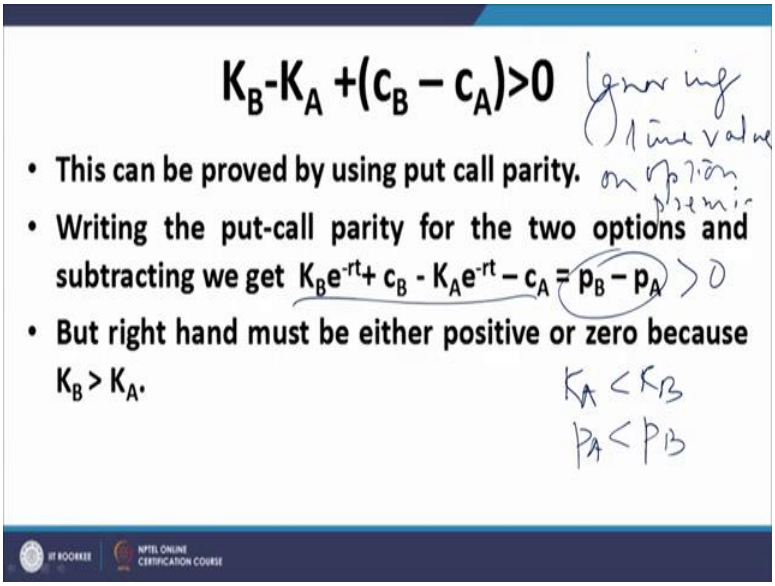

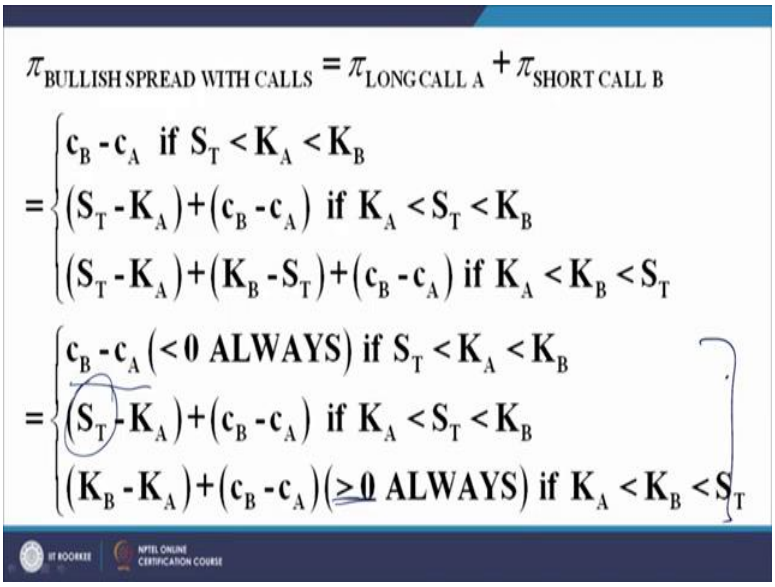

So, let us look at the sign of this K B minus K A plus C B minus C A, let that is this expression this part. I have shown that it is I have written here that it is greater than 0, let us establish this fact. This is, can be easily established by writing down the put call parity relationship for the two options.

And then subtracting them, what we have is K B e to the power minus r T plus C B. The S naught factor in the put call parity equations will cancel out and what we will be left with is K B e to the power r T minus C B minus K A minus e to the power r T minus C A is equal to

p b minus p a. p b is the put option corresponding to the exercise price K B and p a is the put option corresponding to the exercise K A.

Now, because K A is less than K B, it must necessarily be that p a is less than p b because remember, put option is a right to sell. And that means what? p a is less than p b means this is, this is greater than 0. And this means that this is greater than 0. Of course, we are ignoring the time value of money for the moment because in general in the case of options it is insignificant at least for short dated options. So, we have K B minus K A plus C B minus C A is greater than 0 on the basis of ignoring time value on option premia.

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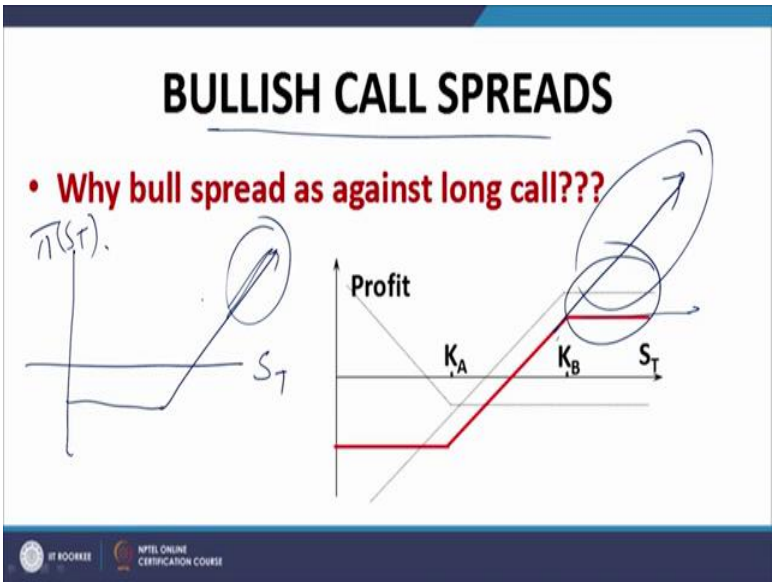

So, now we come to a very interesting issue. Why? Bullish spread as against long call? Let me first draw the diagram for the long call. This is how the long call diagram is seen. Now, the interesting part is why would somebody prefer a bullish spread rather than a long call. Why would you prefer a bullish spread rather than a long call?

You see what is happening is if you compare these two diagrams, what is happening is that this part is missing in this particular one. In other words, the slope line is replaced by a horizontal line. In other words, what we can see here is if we go for a bullish spread, we are losing out on potential profit if the stock at maturity finishes up greater than K B. Had we had a long call, then this line would have been in this form.

Therefore, what we are seeing here, if S T ends up greater than K B, we do not get any profit. Although, if we had taken a long call strategy, obviously we would have made a profit of 1

unit per unit increase in the stock price. So, the question is why would somebody sacrifice this profit, this region of profit and go for the straight line. That is a very interesting question.

The answer is quite simple. The answer is that the person who is taking up this bullish call spread, who is indulging in the strategy has the perception that the stock price is not going to increase beyond K B. In other words, he is bullish about the stock price, he is happy about the stock price going up, but at the same time he is anticipating that the growth in the stock price will truncate, will stop at K B, it will not go further.

Therefore, what he does is he writes an option, call option with a stock, with a exercise price greater than K B because his anticipation, if it turns out to be true, then the stock price will turn out to, if the stock price turns out to be higher than K B then only that particular short position comes into play and he has to incur the liability of honouring his commitment.

But his perception is that that would not occur, that would not arise, the stock price at maturity would be below K B that is his anticipation, that is the expectation. And so on the basis of his anticipation, his expectation, he says okay I will write a call option and I will pocket the premium because that option is not likely to be exercised as per my perception. And I will use that premium to set up this, a certain amount of cost in incurring, that is incurred for taking the long position in call option A.

So, let me quickly repeat this. The perception of the investor who indulges in a spread strategy is that the stock price is going to lie within a range, it is not going to in this case, in this particular case, it is not going to go beyond K B. And because it is not going to go beyond K B, he is happy to write a call option if somebody is there to buy it, he is happy to write the call option because he feels that that will not be exercised and he can pocket the premium and use that premium to reduce the cost on taking of his long call strategy, long, in option A.

So, that is the rational behind a spread strategy. It is all a question of perceptions. If you are, if you have a strong perception that the stock price is going to go up and significantly up, you would, rather you use a long call strategy than a spread strategy. If you feel that this upward movement of the price is going to truncate at certain level, then you can write a call above that level of truncation, use the premium to set up a part of the profit, a part of the cost that you are going to incur for taking a long call position. We will continue in the next lecturer, thank you.