Quantitative Finance

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Module – 03

Lecture – 17

So, welcome back to the next class. So, we just closed at the slide, where you are discussing that, forward contracts, the exact date of delivery is not specified, which is very important. For the futures one, it is not specified; but, not for the forward; so, the subtle difference of time, which is the duration, the price, over-the-counter or trade in exchange. So, these are very fundamental differences between a forward and a future contract even though later on we will see the price calculation for in the very theoretical sense may be different; but, in order to basically do a simple practical explanation and calculation, we will consider the price calculation and based on the same fundamental concept.

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So, futures contracts are not traded in exchange as I told you. If the contract… It is a delivery of goods; they consider the quality of the delivery of goods and the quantum is very specifically specified.

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Now, we will consider different type of derivative, which is the option. So, now, the word option has meaning in ((Refer Time: 01:10)) sense. ((Refer Time: 01:12)) option means it is basically not obligatory on my part. So, exactly, the same concept is being continued here; whereas, option is basically a type of financial contract, which is not obligatory that, it has to be exercised between two parties. Now, in a forward and futures, you have basically a long and a short position. Similarly, an option would also have these two positions, but with added some things, which we will discussed within a second or so. A call option is an option to buy a certain asset or a commodity by a certain date and at a certain price. So, this date is known as the expiration date of maturity or maturity date. And, the certain price; and, it is basically being decided is basically on the exercise price or the strike price. So, if you remember in forward and futures, I use the symbol X or K is exactly the same. There in forward futures, we used the price k; here you will basically be using the price X or K whatever is convenient for us.

Now, a put option – so, now, let us again make a difference between call and put. Call means what you are trying to call back, which is a sort of buy. So, call actually means a buy as mentioned in the slide; and, put means something you are putting on the table, which is for sell. So, basically, put option is an option to sell a certain asset or a commodity whatever it is by a certain date, which is known as the expiration date or the maturity date and the certain price, which is the strike price or the delivery price. Now, if you consider the forward and futures, here a long and short. Now, options was basically call and put. So, for each call or each put, there would be long and short position; which

means technically options in a very simple sense would have four different cases. One will be call, put; the second will be call, short – would be call short and would be call long. The third and fourth would be put short and put long. So, technically, you have the option to buy to buy and option to buy to sell and option to sell to sell and option to sell to buy; so, these four contracts, which are there in the option. And; obviously, we will be thinking that, who has that option to exercise is basically the buyer of that call option or the put option, whoever is basically buying that option – call or put has the obligation to exercise his or her option. And, if he or she exercise his or her option; then, the seller is obligated basically to oblige on that; we will see that later.

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So, options can be of variety types. So, we will basically consider the first one – mainly the second one, which is the European option. They can be exercised only on the expiration date; while the American options would be which can be exercised any time before the expiration date. Expiration date is if you remember, I mention the time t is the time scale.

So, we will consider that, in the European option, there is a fixed time T when you can exercise. And, for the American option, the time period T is with respect to the European option about when you will exercise, would be less than equal to time capital T; that means, you can exactly exercise when time expires; that means the European option becomes the American option. Or, in case, if you basically exercise before T, then it is basically a time – American option such that when you will exercise is not known to the seller, because you as a buyer will decide depending on the price movement in the

positive and negative direction. And then, see what is beneficial for you. Other examples are look back option, Asian option, Bermuda option, Barrier option, Butterfly, so on and so forth. We will discuss them pictorially later on as we proceed with the course.

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Now, for the option, we will use the symbols as follows. X is the strike price, which was K in the case of forward and futures; remember. This suffix T is basically the time in the second symbol, which is S suffix T. So, S if you remember also in the forward and futures, I mentioned as the spot price. So, if you can recollect in the last day's discussion, we were mentioning that, there is room – 2 rooms: room 1 and room 2. In room 1, where you are actually selling and buying the actual object – commodity or index; that as a spot price, which is given by S with a suffix; which basically denotes the time. And, the room 2, where you are basically buying and selling that option or buying and selling that forward or the futures basically would have a price, which will denote for the forward and futures as capital F. So, that would basically come out later on what is the relationship between S and F.

Now, this S suffix T is the underlying asset price at time is equal to capital T when it expires. For the time being, consider capital T is the expiration time. And, p is the option price; that means if I am a buyer, I have to pay some amount upfront to the seller. So, this p is the option price. In many cases, option price, where there is a put and a call, the prices technically would be different. So, we will basically denote small p for the put price, small c for the call price. So, remember that; even though we are using the symbol p for option price, technically, it is p and c depending on whether it is a put or a call.

And, obviously, p would have different suffix X naught with respect to the time, but respect to the different type of put options you have. c will also have a different suffix depending on what type – different type of call options you have.

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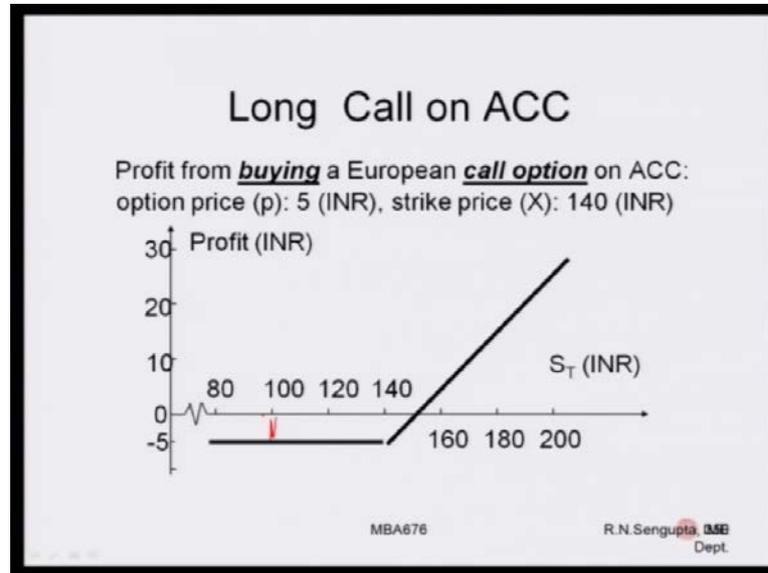
Now, consider long call on ACC, that is, you are trying to basically find out the price profit from buying a European call option on ACC; the option price p as I just mentioned is 5 rupees; that means, if I am buying, which technically means I am paying some money upfront. So, this amount of money, which I paid to the seller, is 5 rupees; hence, it is negative for me – this part. Now, the strike price, which has been denoted is 140; and, whatever that expiration date, that is not being drawn in this graph. Now, consider what will happen. If the… You have basically bought an European call option. Now, if you have bought a call option; if the prices are below 140, so, obviously, you would never exercise the option, because you can get it from the market as less than 140. Now, if the prices are greater than 140; so, what you will do? You will basically exercise at that price of 140 and utilize that particular stock or particular commodity and go into the market and immediately sell it.

So, what does call mean? Call here – basically buying. So, if the prices are 150 in the market and your contract says that you have paid and bought an European call option to buy it at 140. So, the moment you see the price is 150, you will immediately buy at 140 and sell it in the market at 150; may thus making a profit of 10 there minus the 5, which you have made already made upfront. So, technically, your total net profit is 10 minus 5. So, as the spot price S T increases to 160, 170, 180; so, your profits will also increase.

We have total net profit would be say for example, if the S T is 170. So, it will be 170 minus 140 minus the 5, which you have already paid up front. Now, consider what – if the price is 130; so, obviously, if you can buy it from the market, you will immediately buy it at 130; you would not buy it from the other person at 140. So, your overall loss is only 5 rupees you have already paid up front. So, this was basically the so-called position for buying a call option, which is long for a call option.

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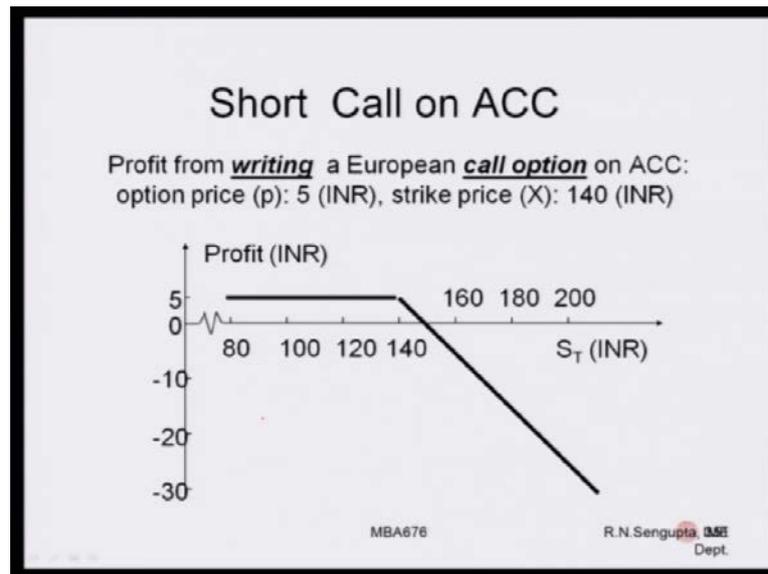
So, now, consider if you have a long on a call option, obviously, there is an opposite player, who is short on the call option. So, if you consider the cumulative profit first between both of them; then, obviously, it will be 0. So, if it is 0, then the actual profit function for the person, who is on a short call with respect to you, who was on a long call will just be the mirror image. So, how would you form the mirror image?

Just rotate the profit function for any of the person, who is on a long call. If you convert it – you want to convert in a short call, you rotate it along the x-axis or vice-versa. So, if you see the profit function for this person, who is on a short call is just the mirror image; because the person has already got upfront the amount of money, which is 5 and the moment the prices are greater than 140, you would basically exercise; which means he or she would basically face a loss. And, the losses are given as it is if it is 170 as I mention. So, obviously, you will face a loss of 170 minus 140, which is minus thirty in negative sense obviously. But, you will add plus 5 because he or she has already got upfront 5 rupees.
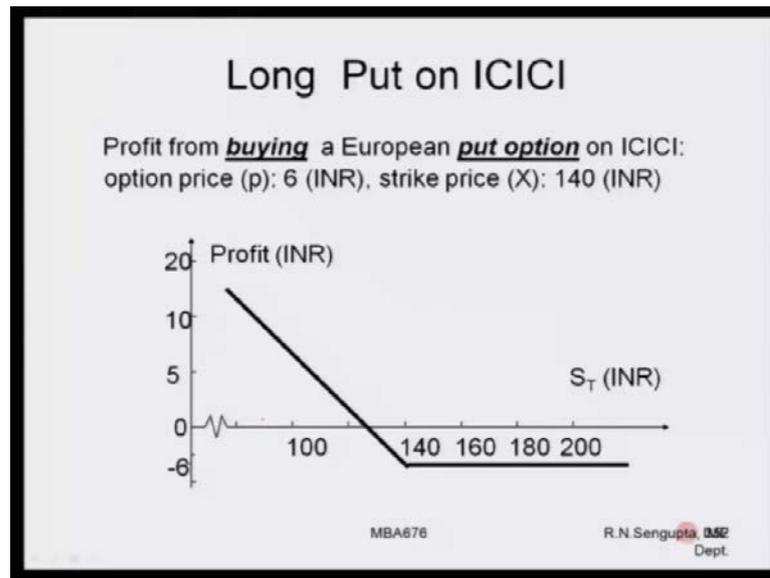
Now, consider the put option. So, similarly, for the put, you will have a long and a short. So, first, let us consider the long position on ICICI. So, profit from buying a European put option for the case, where the option price is p. Again remember, this p and c are the actual price to the put and the call. But, I am using the symbol p throughout these four examples. So, do not get confused by that. So, the price is 6 rupees and the strike price is 140. So, if you have bought a put option; then, technically, if the prices increases to more than 160; so, obviously, would not exercise, because you have put means you are trying to put on the table to sell. So, obviously, we get a price of 160; which means rather sell in the market at 160 and not at the price of 140, which you have already decided on the option. But, in case say for example, if the prices being there in the market is about 100; say for example, 100.

So, obviously, if you go to the market, you have to sell at 100 rupees. But, if you look back; if you already sign an option and whatever the value at the price at which you will sell that is 140; so, technically, what you will do is that, if you did not have that particular asset or a commodity, you will buy it from the market at 100 and sell it to the person at 140. Thus, making a profit of 140 minus 100 minus the 6 rupees you have already paid up front.

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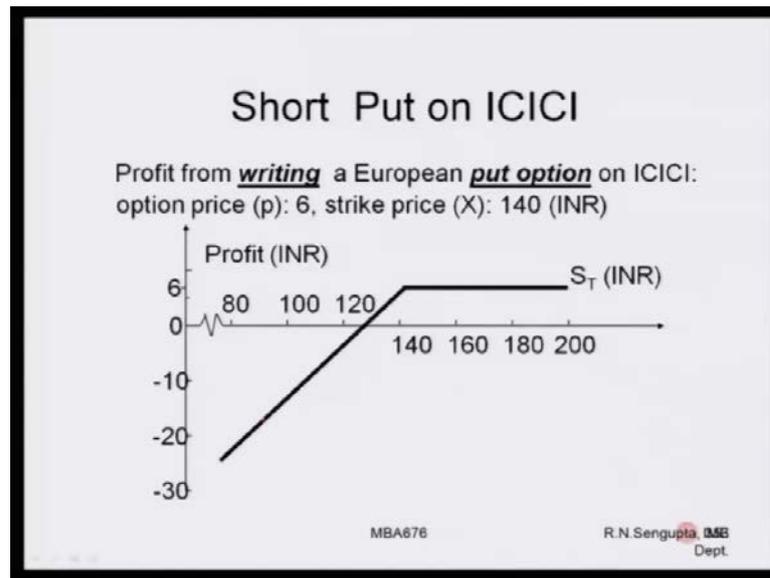
Consider now, you are going for a short put for the same option. And, it is ICICI, the exactly the strike price. The option price is exactly everything is same. Then, the net profit function will just be a mirror image of the person, who was in a long put position. So, now, if I add up the long put and the short put, addition of all the profit functions, should be 0, which is a straight line along the x-axis.

Similarly, if you have the call option – long and short, adding both of them would give you the same picture. So, what is important for you to understand is that, in the option case, the expiration time, which has not been drawn in this four graphs, the strike price or the delivery price, which is basically X or K, whichever symbol you use, and the spot price are very important in order to understand what is the profit function of both the person or a seller and a buyer. But, again remember – for a forward and futures, which is obligatory; for option, it is not obligatory. So, obligation of exercising basically rest on the person, who has bought the option.

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So, payoffs considering price is 0. So, this important point, which is mentioned, is just for your information and do not get confused. So, the price p or small c, which you have already denote, consider for the time being, these prices are 0 – theoretical 0. So, a long position on a call, a long position on a put or short position on a call and a short position on a put, have the profit function as given. In the first case, it is max of S T minus X. S T is the spot price; X is the delivery of the agreed upon price; max of that value comma 0; a long position is basically max of X minus S T comma 0.

Similarly, a short position would basically be minimization of short position; or, call is minimization of X minus S T comma 0. And, a short put would basically be minimization – S T minus X. So, whichever you look, the relationship is very simple to understand. So, either if you bring a minus here or a plus here, you will basically be able to understand the overall profit function for all these four cases.

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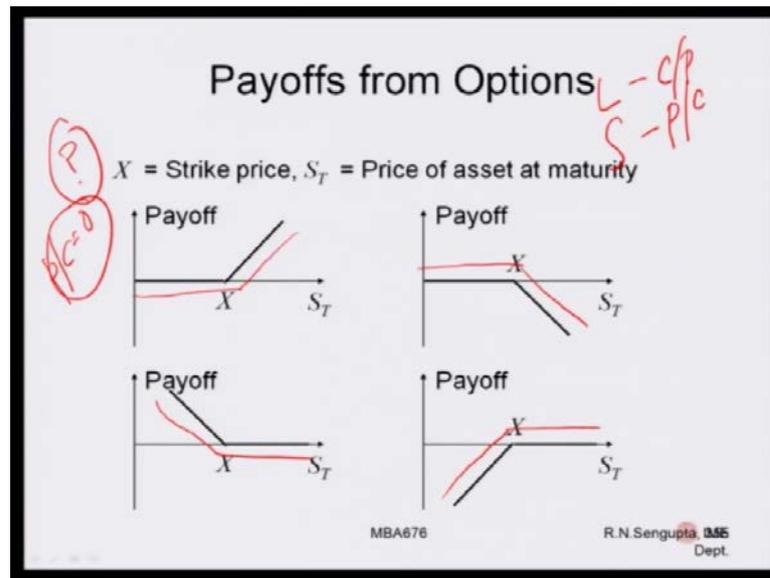
So, if I draw the payoff functions, remember again, the p or the c technically are 0; which is actually not true. So, if you have the profit functions; then, they become like this. So, actually, they are like this. So, the red ones are the actual ones and you can find out the profit functions also. So, these are the graphs. So, these are the payoffs and the strike price and the spot price are being given for four different type of options; call put, which is basically… Or, you are not a call put is basically long call, long short and it basically would be long short. So, you have the call and a put, and a call and a put. So, obviously, for put position, you have two positions; for a call position, you have two positions; my apologies. So, basically, there are four combinations depending on a call and put, and a long and short concepts.

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So, now, considering prices are not 0. So, if you basically change this equation, you have this. So, basically, you will try to bring p p or c c, which is basically the prices as a plus and a minus depending on whether you are paying the money or getting the money. If I am a buyer, I pay upfront; if I am a seller, I get the money upfront. Only remember – for this call option, in place of p, you can replace by c also as mentioned. So, in the later on problems, we will see that p and c would basically denote the call and put prices being paid.

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So, there are basically three types of traders in the market. This is the hedgers, who want to avoid exposure to adverse movements in the prices. Speculators, who wish to take a

position in the market either they are betting that the price will increase or decrease; their main motive is basically to make profit. And, arbitrageurs – wants to lock in a profit by simultaneously entering a transaction in two or more markets. So, what we will try to understand is that, later on is that, how options, forward, futures are utilized in order to minimize the risk, not with the basic profit motive function to be true; which means that you are trying to basically utilize the options or buy and sell different type of options in order to reduce your overall risk. So, we will study that later on as we proceed.

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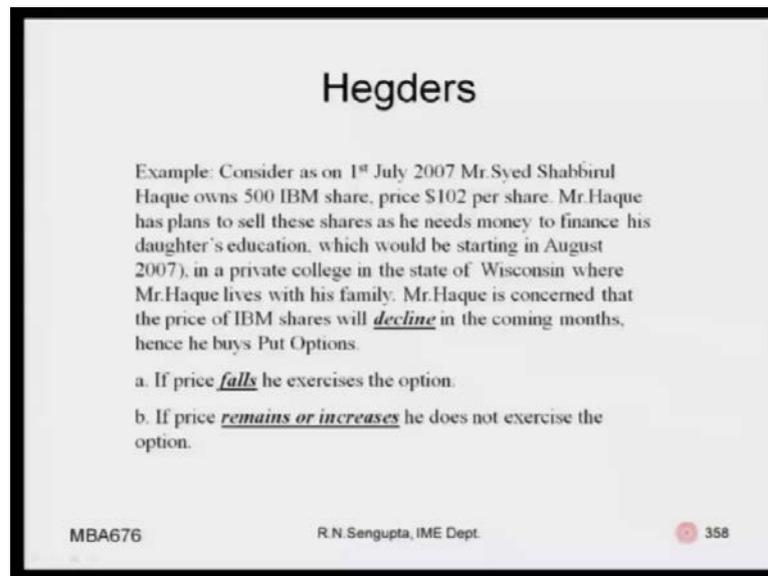
So, example – consider on 1st July 2007, Mr. Syed Shabbirul Haque owns 500 IBM shares, price 102 per share. Mr. Haque has plans to sell these shares as he needs money to finance his daughter's education, which would be starting in August 2007 in a private school in the state of Wisconsin, where Mr. Haque lives with this family. Mr. Haque is concerned that, the price of IBM shares will decline in the coming month; hence, he buys a put option. So, if the price falls; so, obviously, he will exercise that option because he has already locked in a price at which he will sell; if the price falls, he will immediately sell such that the price at which he sells is more than the price, which is existing in the market.

So, obviously, he would not be making in a loss. If the price remains or increases, he does not exercise, because he will basically immediately go to the market, sell those IBM shares at the higher market price, which is existing in the market depending on the demand and supply; then, basically be away from that and utilize that money to fund his daughter's study.
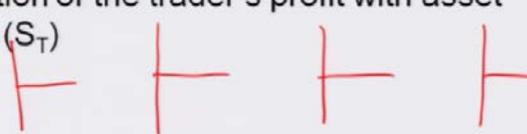
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A trader enters into a short forward contract on 100 million yens. The forward exchange rate is 0.0080 dollars per yen. How much does the trader gain – lose if the exchange rate at the end of the contract is 0.0074 per yen dollars and 0.0091 dollars per yen. So, now, think the person had 100 million yens and the forward exchange rate is 0.0080 dollar per yen. So, obviously, you find out the total value. Now, what you want to understand is that, that 100 million yens depending on the contract, whatever the price is, this is the price, which you have found out; exchange rate is given – forward exchange rate. Now, the end of the day, the price can either fall to 0.0074 or increase to 0.0091. So, this 100 million yens if you found out; if you multiply by this value; and, 100 million you multiply by this value, and in another case, you multiply by this value; that would give you the actual price at which that 100 million yens would be exchanging hands.

So, now, if your actual value, which you have… Value means the actual value… If you consider the forward and the buy and sell curve for the forward one and if you are basically going for a short contract; remember – sell; so, depending on the price movement whether they are in a positive direction or the negative direction depending on which graph is applicable for you; you can find out whether you are making a profit or a loss. So, you are actual motive is not to make it extraordinary profit; it is basically to go into a contract in order to lock on your excess loss; that means, minimize your overall excess loss.

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So, a trader buys a call option with a strike price of 45 and a put option with a strike price of 40. So, there are now two different ones. So, both options have the same maturity; the call prices cost 3 and the put cost 4; which means this is small c, this is 4. So, draw the diagram showing the variation of the trader's profit as changing the price of S T. So, now, the strike prices are given in both these cases; the c value and the p value are given. So, obviously, if you have to first decide out of these four graphs, which would be true for you; you are buying a call; remember these two important words. And, based on that, you basically try to analyze your problem. So, with this, we will end this class and continue our discussion in the next class in the area of options, futures and how different type of prices, and all these things are calculated.

Thank you.