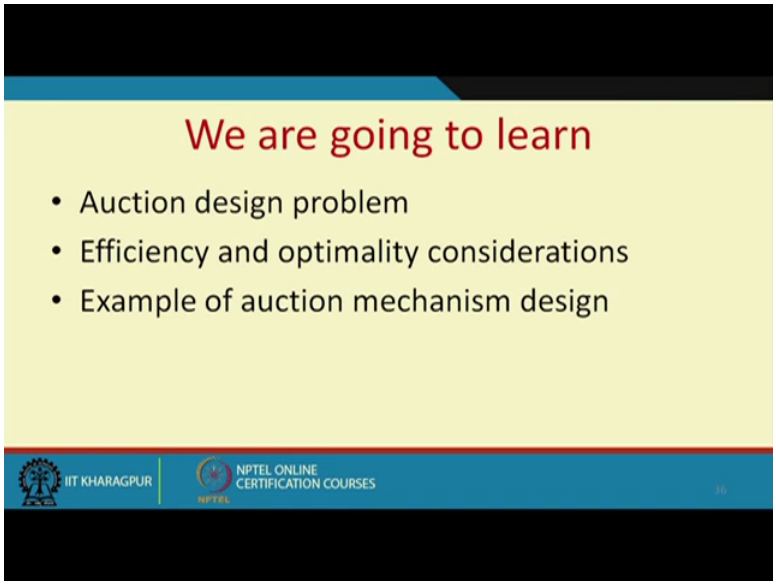
E Business
Professor Mamata Jenamani
Department of Industrial and Systems Engineering
Indian Institute of Technology Kharagpur
Lecture-58
Economic Considerations in Auction

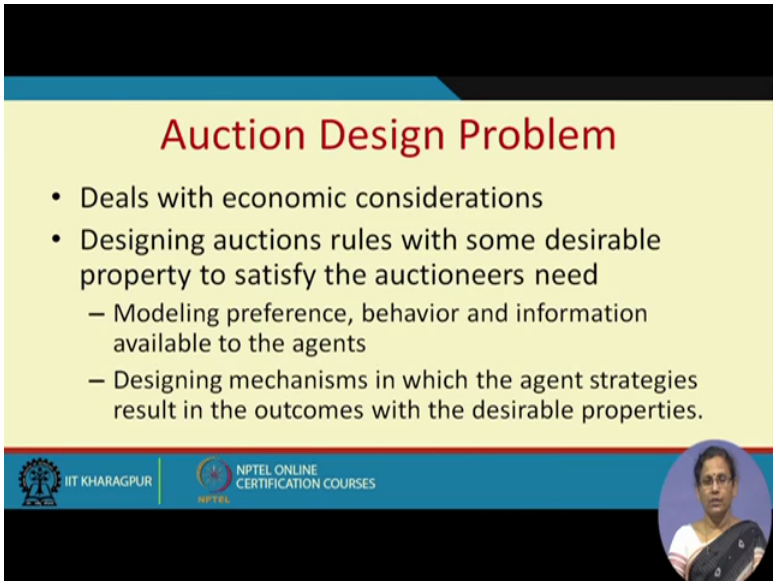
Welcome back, we continue our discussion on online auctions. In fact we started before... see what are online auctions are, they are just the online counterpart of general auctions. So what we have been doing since past 2 lectures is that we are trying to understand that auction is market mechanism, the price discovery mechanism and it is one of the dynamic pricing mechanism. It helps in price differentiation and that price differentiation is actually first-degree price differentiation where every product will have different valuation for buyer depending on the market condition. Then in the subsequent classes in the just previous class we learnt about how to differentiate between various auction types.

(Refer Slide Time: 1:36)



And we saw that auctions can be classified in many ways based on the based on the resource that is being auctioned, based on the payment rule and so on. Now today we are going to consider what are various economic considerations under auctions. So in this lecture we are going to learn about auction design problem, and try to understand what is the difference between efficiency and optimality consideration during design and we are going to see one example of one auction mechanism, I mean how auction mechanism design happen.

(Refer Slide Time: 2:04)



So when we talk about auction design problem it is first of all let me tell you it is a strategic level problem. By strategic level we mean here decision has to be made what kind of auction is to be conducted and what should be the general rules for conducting that auction. In economic literature while modelling auction mechanism while designing auction mechanism and modelling the bidding behaviour, et cetera, auction is considered as a gain and gain theoretical analysis is done to find out the equilibrium point. You need not have to worry that you have to learn now gain theory because I am not going to teach gain theory but in a very simple manner I will be explaining what is the meaning of auction design and how important it is.

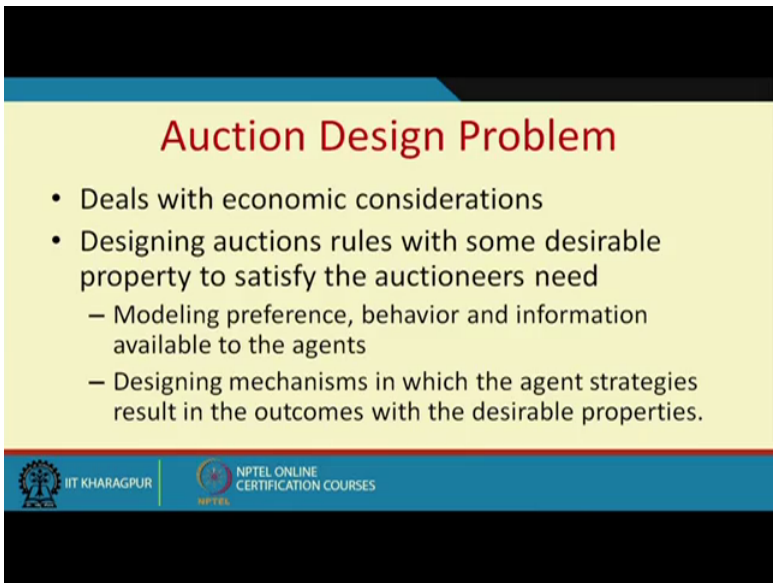
In fact in the very first lecture I was showing one example of of a spectrum auction which happened probably in New Zealand where what happened due to back design, the design what they did they designed a second price auction a Vickrey auction, so what is Vickrey auction? Vickrey auction is a situation in which the highest bidder gets the item but at the second highest bidders price. So in that particular auction in that particular spectrum auction, New Zealand spectrum auction what happened, theoretically the second price auctions are very good but, but what happened at that point of time during actual real auction the first bidder's value was very high and the second bidder's value it was in hundred probably in millions of so and second bidder's was in hundreds.

I do not remember the exact figures, you can see the previous slide to see the figures. But what happened as a result, due to that design the government now has to because what

government decided the rule, government decided the rule as the highest bidder will get the item but at the second-highest bidder's price. So even if the second highest bidders price was very low, because of the originally declared rule the government has to give the highest bidder at that price, now what is the benefit of the second price auction et cetera that we are shortly going to discuss is not known to everybody, only economists know that it has many beautiful properties.

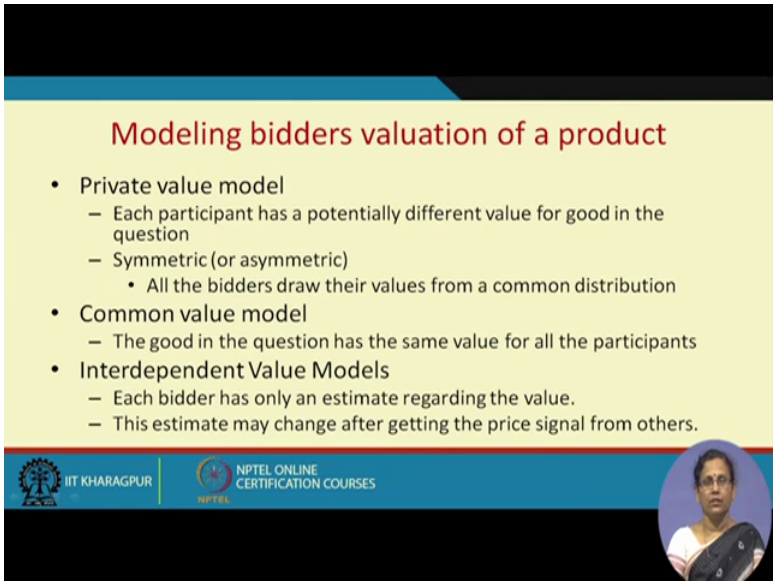
But there was it become a political issue, the government is trying to do something so that at very low prices auction is the spectrum getting auctioned as a result that particular auction was made null and void and with a better design rule the country went for spectrum auction once again. However, today we are not I mean these are the, I mean the auction design is the what are the point that I am going to make is the auction design is that important. Anyway, but right now we are not going in depth into the design but we will be getting an overview of how important the design problem is and see one example of example of a specific that second price auction that I was telling about that why this second price auction is good that we are going to look at.

(Refer Slide Time: 6:09)



Now, this auction design problem is about deciding the rules with certain desirable outcomes that satisfy the auctioneers need. So this design involves modelling preferences, behaviour, information available to the agents and so on. Now designing mechanism in which the agent strategies result in the outcome with the desirable property that mechanism is chosen out of many available mechanisms.

(Refer Slide Time: 6:41)



Now during this design process the first task is to model the bidder's valuation behaviour, how exactly bidder evaluates the product under consideration. There are 3 types of model in this category; the first one is the private value model, this is applicable to the situations where each bidder's valuation is different from the other. Now consider a situation, some antique is getting sold, it is very valuable, its price is very high. A rich person may try to give a very high let us say 1 million dollar for that. However, given this 1 million dollar to me definitely I will not be paying that much money for the antique. The point that I am going to make is that person that rich person and me both of them are bidding for the same item but my valuation of that item is different from that of the rich person, the other person.

So which means depending on my background, my economical condition and my requirement of the product because antique something which I may not need, I may not have might not have fulfilled many of my basic needs as well so therefore, the item under consideration that is in this case the antique is not that important in my life, so I would be paying my valuation of the antique will be very less if you have situation of this type where individual bidders have their I mean everybody has the potential different valuation for the good under consideration I mean everybody has a different valuation for the good under consideration then it comes under this private value model.

Now this private value model again it can be for symmetric, it can be symmetric or asymmetric. In case of symmetric all the bidders draw their valuation from a common distribution, by this we mean that the bidders who are participating, it is say let us say all the

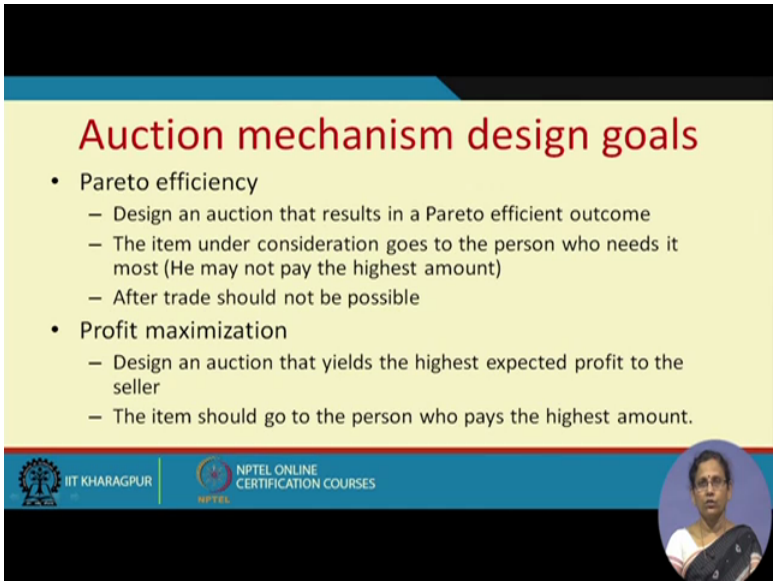
rich people, there are many rich people, 10 rich people let us say who have interest for collecting these antiques, all of them are bidding in this. So possibly all their valuations will come within a certain range okay, or in other words we can say all of them are going to draw their valuation from a common distribution but the case that I was considering already that myself and let us say that rich fellow in that case our valuations are we have asymmetric valuations, so the model can be for symmetric or asymmetric valuation.

The next one is your common value model; in case of common value model the good in the question which is getting sold using auction has same valuation. So for this one I try to consider one example that that in fact in the very first class on auctions I told you what was the push for developing this auction theory? That time around 1970 the US government made auction of the oil fields I mean for oil exploration rights, auctioning the oil exploration rights in its shore.

Possibly in this situation the companies who will be bidding somehow they estimate the amount of oil available in those areas, so naturally their valuation for that oil for bidding for that oil exploration right will be almost same, so this is called common value model, all of them all the bidders are of equal are of similar background, all of them have equal interest on the object and they have same valuation for the object okay. Now next is your interdependent model, in case of interdependent model let us take one example of a laptop which is getting sold on auction in eBay. That laptop which you need and let us say some few other bidders need is after all the old laptop, we would like to buy it as cheap as possible, is not it? And there will be competition among us to buy that laptop.

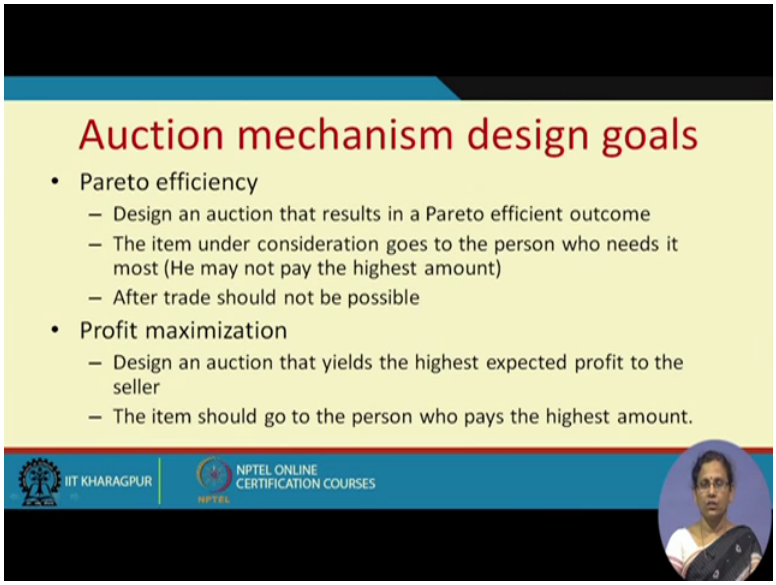
Now, from the beginning I will have just an estimate because it is a very old made, features are old, I will have just some estimate about its price and I bid accordingly. As I gets price signal from others, by price signal means from other's bid and I come to know that my valuation is indeed not right and probably because from others price signal I will be re-estimating my valuation, I will be thinking probably the value of the item is little bit more, so accordingly I will start increasing my bid so such situation in such situation we the bidding behaviour is modelled as interdependent value model. So here each bidder has only an estimate regarding the value, this estimate may change after getting the price signal from the other this is what I was telling you.

(Refer Slide Time: 13:42)



Now while designing auction mechanism what is mechanism? Mechanism is about deciding the rule of the game, auction is considered as a game, who are the players? Players are the bidders and the auctioneers of course. So these bidders will be competing with themselves to increase or decrease the price depending on the situation. When they will increase the price, in case of a forward auction which is a selling auction they will be trying competing with each other to increase the price so that the highest bidder gets the item and when they will be decreasing the price? If it is a reverse auction a buying auction, they will start at a high price and they will compete among themselves to decrease the price.

(Refer Slide Time: 14:45)



So so whatever so in this situation there are 2 important design goals; either the auction has to be Pareto efficient or the auction has to be profit maximising, now what is Pareto efficiency? Pareto efficiency is about design of an auction that results in a Pareto efficient outcome. By Pareto efficient outcome we mean, after the transaction is over in this case the auction, Pareto efficiency is not the property of auction only, it can be property of any economic transaction. So any economic transaction is Pareto efficient if after the transaction is over no further trade is possible in the market okay.

So which means the item has to go to that person who needs it most, now how do I know the person who needs it more? The person who will be paying the highest, what signal do I have? I have only the price signal, so I will be choosing that person who will be giving me the more the highest price, I will think that he is the most needy person. Now the question is, is it so? If I declare from the beginning that item will be going to the person who is providing me the highest price, people may try to give certain false valuation of the item false bids, so in that case I may not get the right price signal from the market, now consider a situation why what is the I mean how after trade can happen in this case.

Look, let us say government has made some apartments in various places within a city and it is selling those apartments. And it has decided a very good price for the apartment and it is trying to let us say conduct I mean it is just first-come first-served basis. So what will happen, it will try getting applications, price is fixed based on first-come first-served basis, the flats will be allocated, other preference of the buyers will not be considered. Now suppose I have 50 lakh rupees with me to buy the apartment and the price set by the government is less than 40 lakh rupees and I in the lottery or in the first-come first-served basis I got a home allocated to me which is quite far from my office.

And I know another person who has got a house got an apartment under this scheme whose apartment is near my office. Now I would like to exchange my apartment with the other person unless otherwise there is some government restriction, so what do I do now? The extra money that I had as my earlier I mean initial estimate of buying the flat that is 50 lakh rupees, I have 10 lakh rupees left with me so what will I do? I will be giving that money, offering that money to the other person whose apartment is near my office and try to exchange it. So in this market after this is over exchange is possible.

Now think of auction, in case of auction if individually for each flat auction goes on then for the apartment which is near my office I will be paying the highest value probably and after

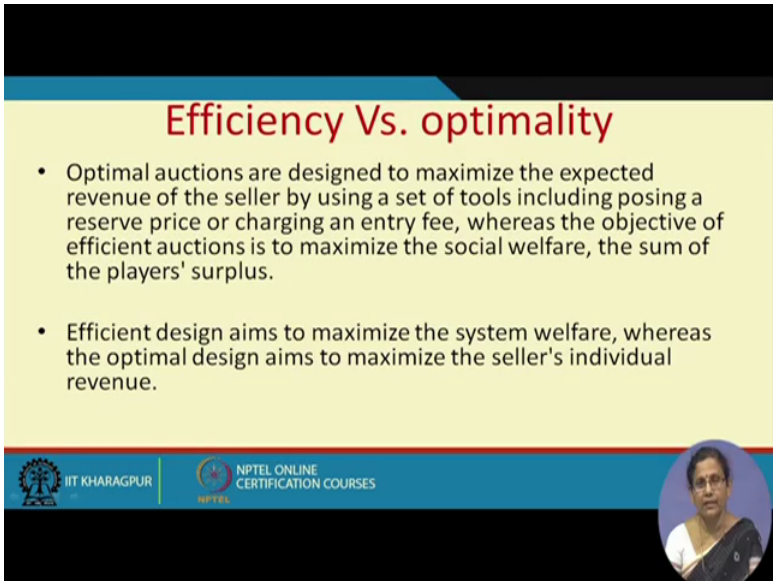
getting the item I will not go for further transaction in the market in fact, everybody depending on their own convenience they will be going for auctions in their specific locations okay. Now, the situation is bit problematic here as well, if the auction is going on it may so happen somebody else because nobody will be revealing their revealing how much money they truly have to spend so what they will be doing? They will be trying to hide some of their money.

If some benefit is given to reveal their valuation then everybody will do so, so here comes the use of second price auction. In second price auction, if I am told that if I am told that whatever I may bid, if I am the highest bidder then I have to pay the second-highest bidder's price so in that case I will be revealing my true valuation. In the auction in the first price auction probably I could have gone depending on my competitors I could have gone up to let us say 45 lakh or something, but there because I know I have to pay the second bidders price, I will be revealing that I will pay 50 lakh rupees so I saw this, so truly the way I was hiding my price, others might be also hiding their price, so now everybody will be revealing their valuation.

So if everybody reveals their valuation we know that who is the most needed person who is willing to whose valuation of the item is the highest because he needs it so whose valuation is the highest because everybody reveals their valuation now. The item will go to the person with highest valuation but with the second-highest price, so the amount which he bids and which he pays there is a difference. So he got some benefit, he got whatever he was prepared to pay he got it at a little less price therefore he will be assured and tell his valuation from the beginning.

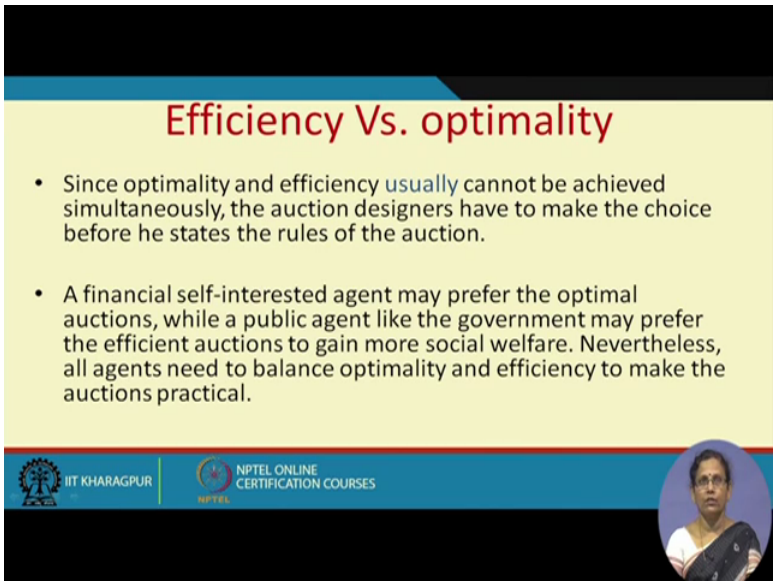
The second one is the profit maximisation, in case of profit maximisation the aim is to design the auction which yields the highest expected profit to the seller or minimises the cost of the buyer and the item should go to the person who pays the highest amount, he may not be the most needed person to get the item, by most needed we mean we did not bother what is the right valuation of the person. In the first case we were actually bothered what is the right valuation of the person, but here it is not.

(Refer Slide Time: 22:59)



Now coming to efficiency versus optimality, different situations demand efficient auctions and some other situations demand optimal auctions. For example, optimal auctions are designed to maximise the expected revenue of the seller using a set of tools including posing a reservation price of charging an entry fee, where as the objective of the efficient auction is to maximise the social welfare, the some of the player's surplus. Efficient auction design aims to maximise the system welfare and everybody is benefited, the system as a whole is benefited, where as the optimal design aims to maximise the seller's individual revenue.

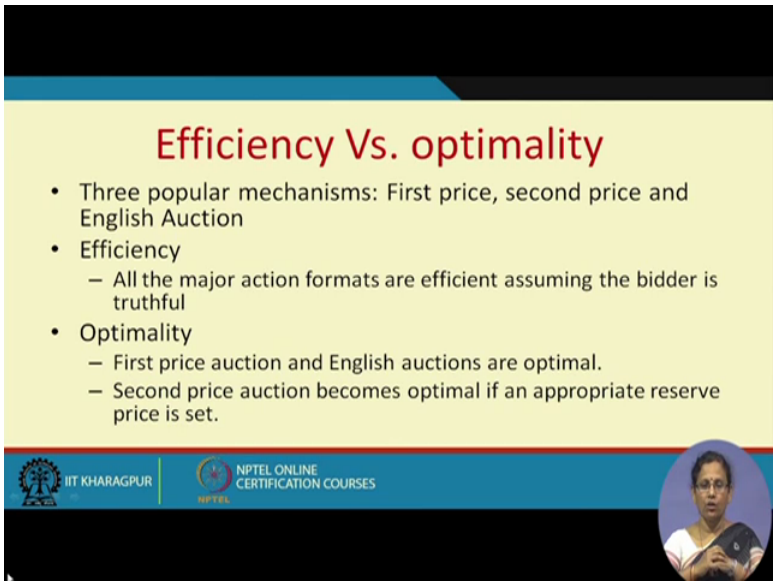
(Refer Slide Time: 23:50)



In case of again going further, this optimality and efficiency usually cannot be achieved simultaneously, so therefore the auction designer has to make the choice before he states the

rule of the auction. Usually the financially self-interested agents like that of business houses, et cetera, they prefer optimal auctions, while a public agent like that of government may prefer an efficient auction to gain more social welfare, anyway so most agents anyway try to balance their optimality and efficiency to make the auctions practical okay.

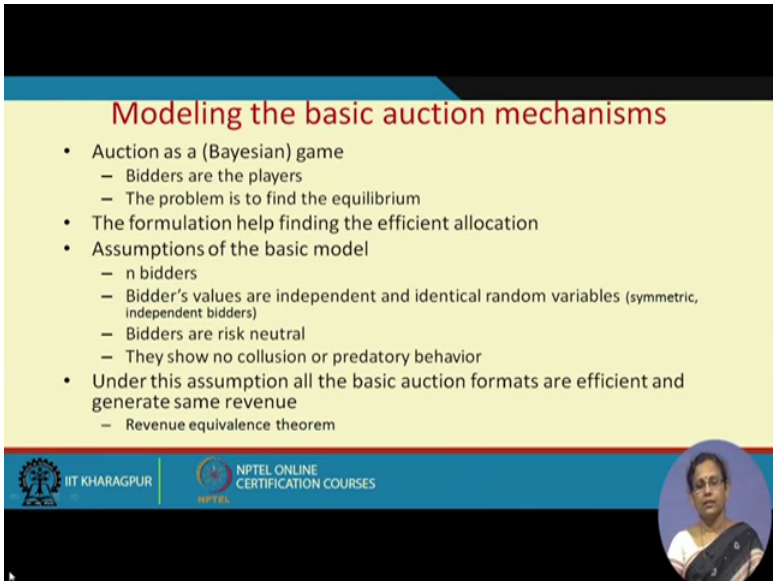
(Refer Slide Time: 24:35)



Now when we consider 3 popular auction mechanisms like first price auction, second price auction and English auction, in a very simple format like you have a single buyer and you have a single I mean the you have a single in case of a reverse auction you have single buyer and many sellers, in case of forward auction you have one seller and many buyers, so in this situation if a single object is getting sold or bought single object single unit of single object, all the major auction format are efficient assuming that the bidder is truthful.

Now assuming the is bidder is truthful is again a little bit stringent condition, how do I know the bidders are truthful? We are going to shortly see that the second price auction or the Vickrey auction that I was talking about so far indeed enforces the bidders to be truthful, a rough kind of proof we are going to see. Then next is your optimality, the first price auction and English auctions are optimal, the second price auction becomes optimal if an appropriate reserve price is set okay.

(Refer Slide Time: 26:14)

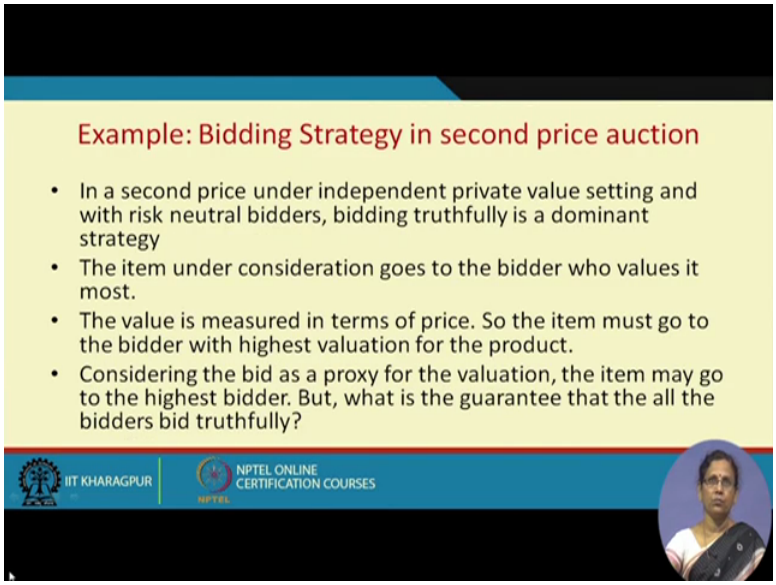


Now as I was telling you, by modelling the auction mechanism auction is considered as a game, in fact it is considered as a Bayesian game because the exact bidding value of the bid value of the bidders is not known. Here the bidders are the players, the problem is to find out the equilibrium from which nobody can deviate in fact in all the (())(26:36) problem the problem is to find out the find out the equilibrium point from which nobody can deviate, so we have to now formulate the model to find out how to make the efficient allocation.

There are many other auctions in the model, there are some n number of bidders, all the bidders values are independent and identically distributed random variables, they are symmetric and they are independently draw their variation, bidders are risk neutral. In fact, about risk neutrality we did not discuss when it consider the bidding behaviour the bidder can be risk neutral or risk cover or risk lover. In case of risk lover, in case there is more risk he would not like the situation, in case of risk loving environment risk loving bidders in case there is a an environment where the bidder has to take risk, he will love it and in case of risk neutral, he is independent between taking risk or not taking risk.

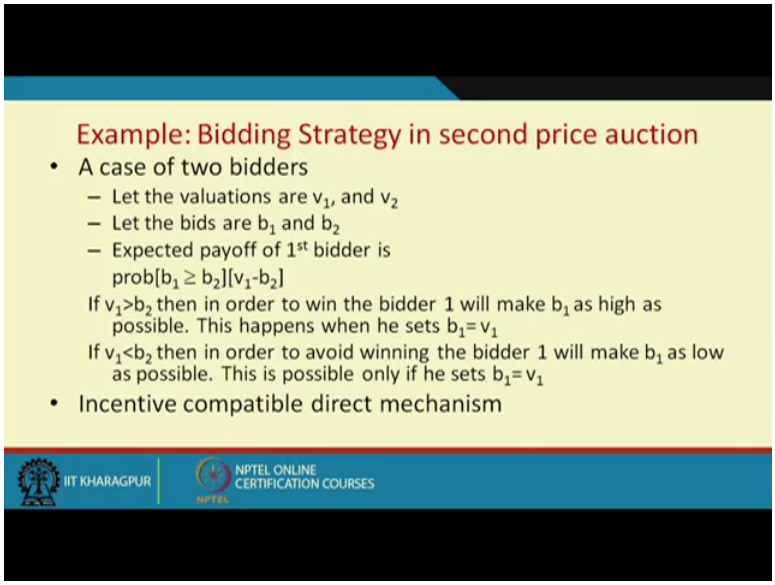
And again another assumption is, the bidders themselves show no collusion or predatory behaviour. By collusion we mean the bidders themselves are not colluded with themselves and somehow control the market. Now under this assumption all the basic auction formats are efficient and generate same revenue, this particular result is a very important result called revenue equivalent theorem.

(Refer Slide Time: 28:31)



Now us look at look at the example of a bidding strategy and second price auction because we are not going to have very I mean the elaborate discussion on how to design auctions, rather we will see that what is the meaning of auction design see, so far we have been telling that the auction one of the basic assumption is bidders truthfully reveal their bid, now what is the guarantee that they will truthfully reveal their bid? Now we are going to see a situation where the bidders even if I mean without you directly stating because of the rule of the auction they will be compelled to truthfully bid and that is why this is supposed to be a very good property okay.

(Refer Slide Time: 29:30)



Now look at this why they will be bidding, we are considering a very simple case of 2 bidders, let their valuation for the object be b 1 and b 2. Now let the bidders bid the values b 1 and b 2. Now what is the difference between valuation and bidder value? Let us say, let us consider that apartment example again. My valuation of the apartment is 50 lakh rupees but while placing the bid I will be little cautious why to reveal my true valuation. I will be bidding Rs 40 lakh only to start with or maybe Rs 30 lakh to start so there is a difference between what I bid and what I value.

So in case of forward auction my valuation will be more than my bid value, in case of reverse auction my valuation will be less than my bid value. Now, what is my expected payoff? First of all what is my payoff? What after winning this auction what am I going to get? I am going to get v 1 – b 1 if I am the first bidder my variation is v 50 lakh rupees, my bid is 40 lakh rupees, if I win I am going to save 10 lakh rupees. Now what is the guarantee that I am going to win? That is a chance event, so my probability of winning is actually the probability that my bid is higher than the other person's bid so this probability of b 1 greater than equal to b 2 , b 1 is mind it is greater than or equal to b 2 into v 1 – b 2 so my expected payoff which is evaluated based on which I will be deciding my bidding strategy because bidding is not yet over so it is exposed, it is before.

So probability of b 1 greater than equal to b 2 into b 1 – b 2 okay , so look, actually we are considering about the second price auction so if it would have been first price auction, my benefit would have been v 1 – b 1, but the second price auction tells me that tells me that I will be getting the item at the second bidder's price so the benefit that I am going to get is v 1 – b 2 so my payoff my expected payoff is probability of my winning into my valuation minus other person's bid. Now let us try to figure out under this situation whether I will be truthfully bidding or not.

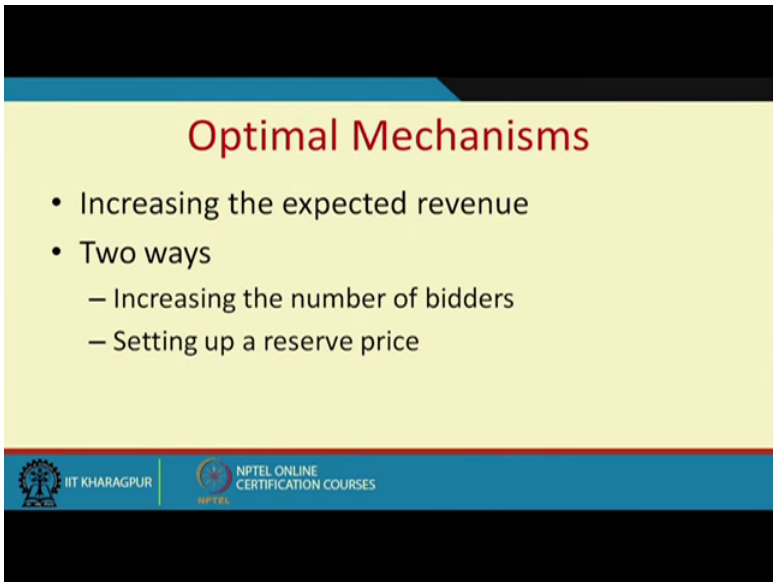
Now look, if v 1 is greater than b 2 I mean truly my valuation is greater than the other person's bid value then in order to win I will make b 1 my bid value as high as possible why? Because I want to increase my probability of winning this value unless otherwise I win then only I will be getting some benefit otherwise I will not be getting the item only, my benefit will anyway become 0, even if I have that 50 lakh rupees it is of no use, I did not get the apartment of my choice so therefore I will be trying to make my bid as high as possible so that my probability of winning is very very high, so how much I can go? I can go up to my

valuation, I had 50 lakh rupees for buying an appointment so I cannot go beyond that so I will be going up to that.

So in the first case when v 1 is greater than b 2 in reality, in order to win bidder 1 will make b 1 as high as possible and how much high, and this b 1 will become v 1 so he will be bidding, he will be telling his true valuation. And because everybody will be giving true valuation, market will be efficient, the item will go to the highest person now let us look at the second situation. Second situation is my valuation is less than b 2 which means the other person's bid my valuation is much lower than the other person's bid so if I win by chance, my payoff will actually be negative so I will try to decrease my probability of winning so how do I do it?

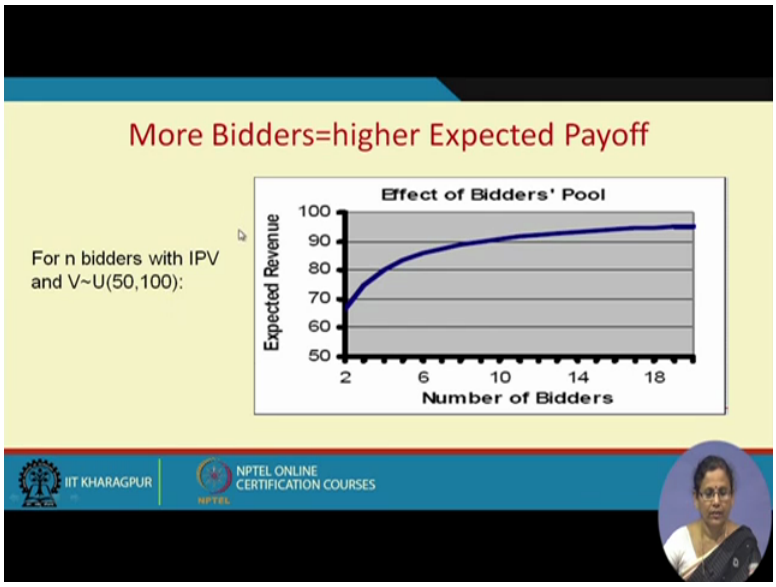
I will make this 0 so that my expected pay off 0 and I do not win and end of it getting negative payoff so how is it possible? If I make my bid value same as that of my valuation so in both the cases whether my valuation is greater than the other person's bid whether my valuation is less than other person's in both the cases I am compelled to give my true valuation this is what I was selling about auction design, designing the rule of the game because the rule of the game is the highest person will be getting the item but with the second highest person's price, this difference that comes up that compels everybody to pay their true to declare their true valuation because they are anyway going to get some benefit because they are paying the second highest bidder's price so such mechanisms are called incentive compatible direct mechanisms.

(Refer Slide Time: 35:56)



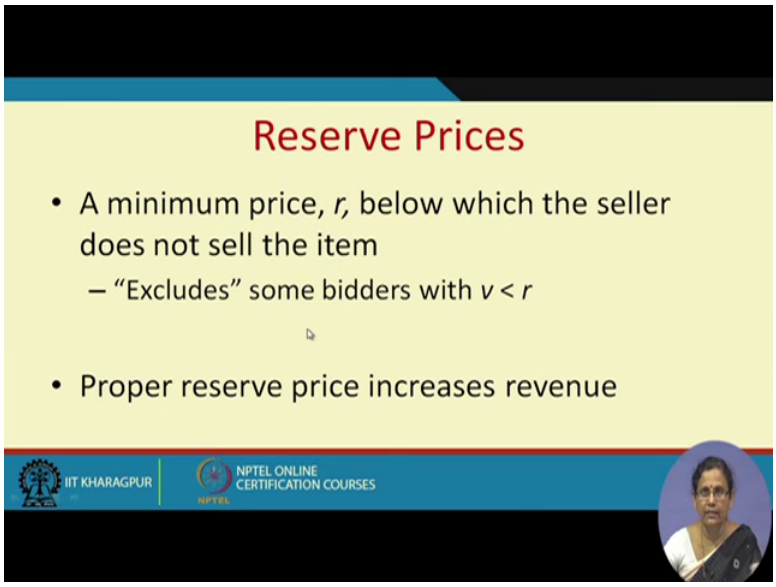
Now in case of optimal mechanism the idea is to increase the expected revenue, this can happen in 2 ways. Even the efficient auctions can be made optimal by following this, so here you have to increase the number of bidders or you can set up a reservation price.

(Refer Slide Time: 36:15)



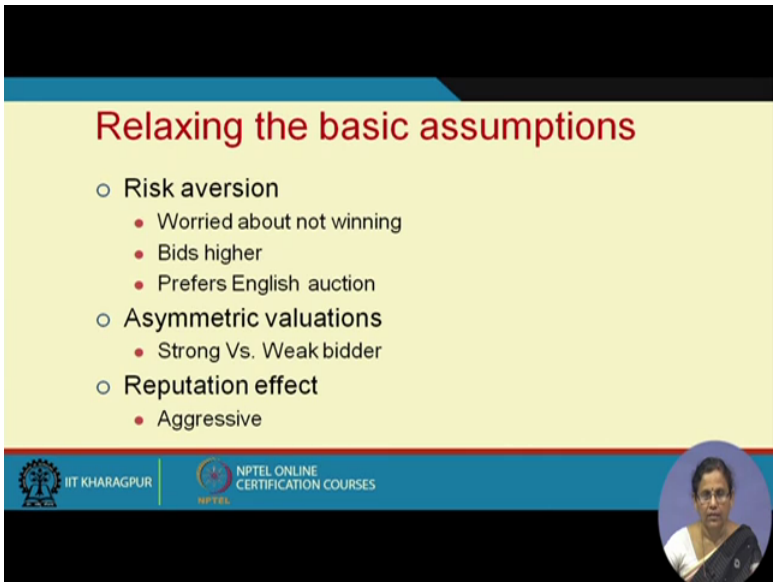
If you look at the market I mean if you look at some study this is what happens if the number of bidders increase. As the number of bidders increase , the expected revenue increase keep on increasing and this becomes stable after sometime, depending on the kind of setting you are working.

(Refer Slide Time: 36:54)



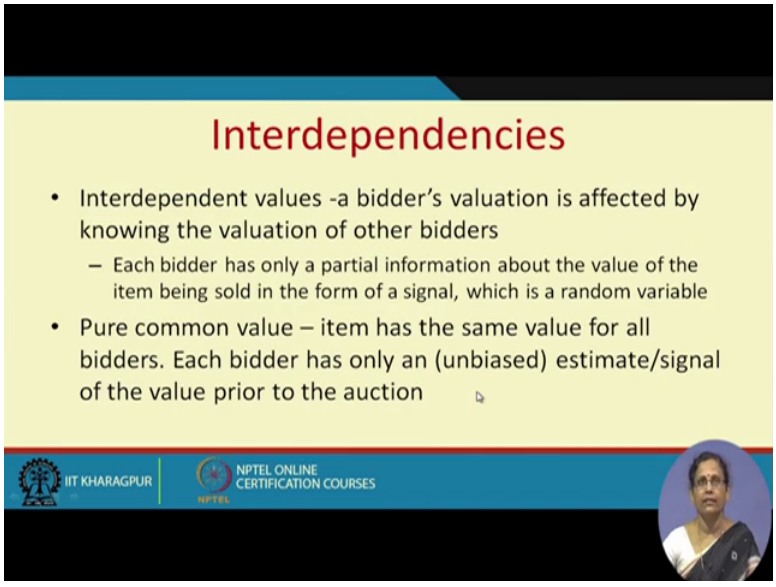
Similarly, if you put a reservation price below which the seller is not willing to sell the item, it will exclude some of the bidders with lower valuation and the expected revenue increases in the process.

(Refer Slide Time: 37:03)



So besides this you can also think of relaxing the basic assumptions with including the property of risk aversion then asymmetric valuations then you can increase the improve the reputation effect, how reputed is the bidder in the market and so on.

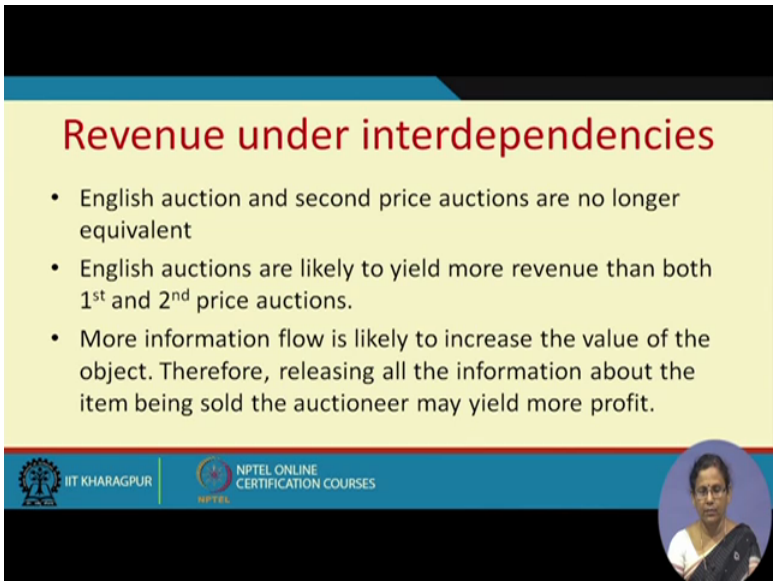
(Refer Slide Time: 37:23)



Then the next one is about interdependencies, we were talking about independent value model so far, now it is about interdependencies. Now in case of interdependencies as I have

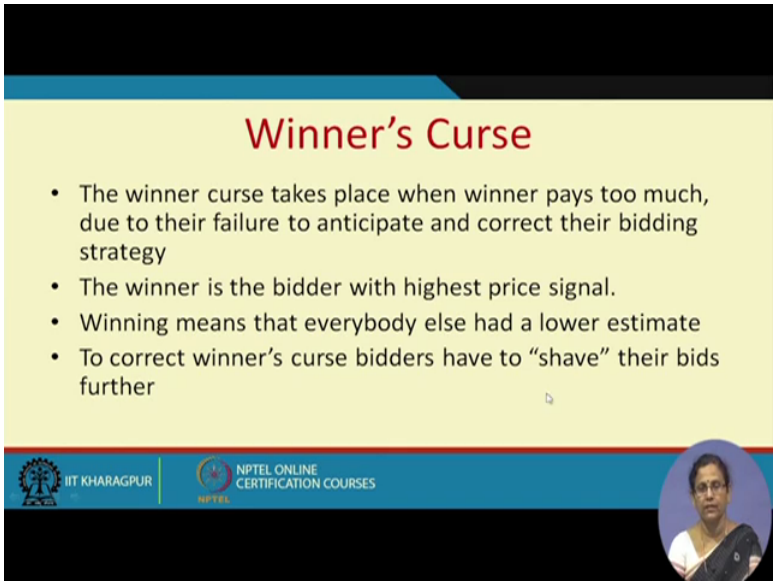
told you the bidder's valuation is affected by knowing the valuation of the other bidder. This in case of a pure common value model even if I have some initial estimate of the item, signal price signal from others is going to change it, so some interesting phenomenon happens in case of interdependencies.

(Refer Slide Time: 38:12)



The English auction and second price auctions no longer remain equivalent as has been in independent primary value setting IPV setting. Now these English auctions are likely to here the English auctions are likely to yield more revenue then both first and second price auction. Now this increase in as more information flow, it increases further increases the value of the object.

(Refer Slide Time: 38:41)



Another very important phenomena happen here, in this case if the bidder is not little cautious, he faces a situation called winner's curse because everybody has almost similar valuation of the object, just because getting wrong price signal he will keep on... the prospective winner tries increasing his speed thinking that probably he does not have the right estimate and he ends up finally paying more for an object which values less, so this phenomenon is called Winner's curse, so these are some of the considerations, economic considerations that happen in the auction so we stop here and next class we are going to talk about an even more interesting phenomena in this auction, thank you very much.