Introduction to Market Structures

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Lecture 1

Introduction to Industrial Organization, Preferences

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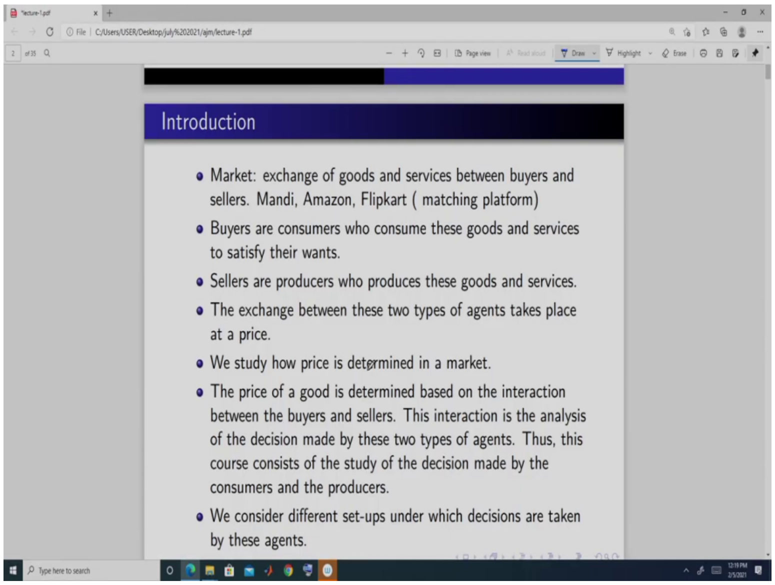

Hello, everyone. Welcome to my course Introduction to Market Structure. Mainly market means it is a place of exchange of goods and services between buyers and sellers, like Mandi, where the buyers and sellers meet to exchange goods. Amazon, Flipkart they are matching platform where the buyers put up their demand and the supplier, and or they choose the supplier from which they want to buy their good and the supplier provides them.

So, buyers are consumers who consume these goods and services to satisfy their want. Sellers are producers who produce these goods and services which are demanded by these buyers or the consumers. And the exchange between these two types of agents that is buyers and producers takes place at a price. So, we study how price is determined in a market; in this course our objective is to study this price, how it is determined.

Now price of any good is determined based on the interaction between the buyers and the sellers, right. Now this interaction is mainly analysis of the decision made by these two types of agents. So, in this course, in a way we will study the decision made by the consumers, and the decision made by the farmers or the producers. And what we will do, we will take different setups, different environments you can say and under which these decisions will be taken, okay.

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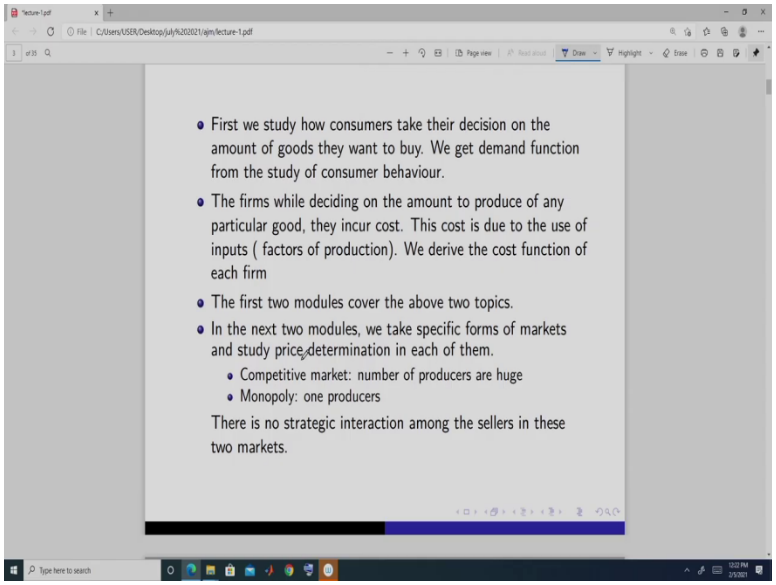

First, we study how consumers take the decision, that is how much amount of goods and services they want to buy if they face any price and if they have a fixed income, okay**.** So, we do that in the consumer behavior, that is our first module. And the firms while producing output, they need to employ inputs like land, labor, capital that is machine and so they incur costs in hiring these inputs. So that will give us something called the cost function.

And so, we will derive the cost function in this second module, where we will study how the firms takes decisions regarding the inputs that they are going to employ. So first these two are going to the first two modules. And the next modules are going to be on a specific form of market structure.

First, it is the competitive market and the second, is the monopoly market. In a competitive market, we assume that there are many sellers or many producers. So, none of them can determine the price. So, price is completely given independent of their decision. So, price is determined in the something called in the market, where supply is equal to demand. We will do these things in detail and then at that time you will come to know how do we get a supply curve, how do we get a demand curve, okay**.**

The next topic is the monopoly. In monopoly, we have only one producer. Now this one producer, so everyone who wants to buy this good or service, they have to buy it from this producer only, or this firm only. So, in that case the firm or the monopolist can determine the price. So, it can charge a very high price or it may charge a low price depending on the nature of demand or the objective of the firm. So, in these two form of market, we do not have any strategic interaction.

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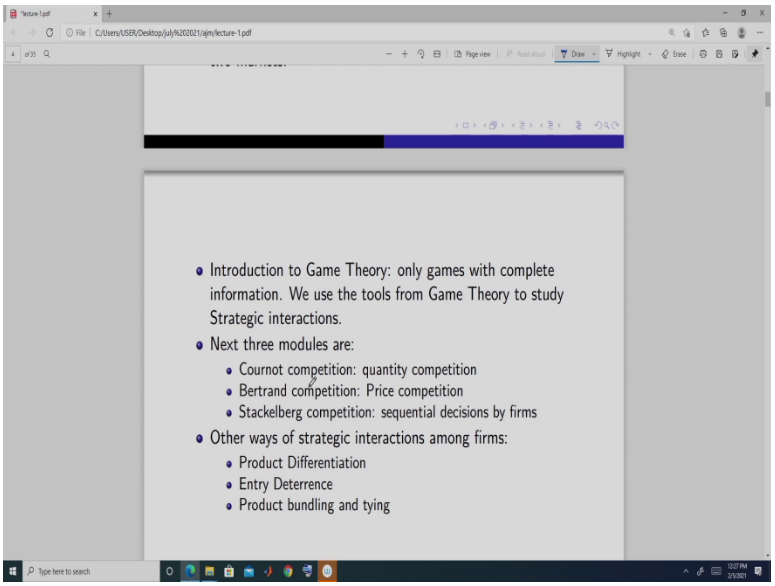

So next we study strategic interaction. Now what do we mean by strategic interaction? Strategic interaction means that if I take a decision, I have an opponent and I always consider how my opponent is going to react to my decisions. So, to study this kind of things we use Game Theory, and we use the tools from Game Theory, and specifically the non-cooperative games, okay. And we will study a little bit of Game Theory in the next module, and we will only study complete information games, both static and extensive games.

Now in games, generally what happens, we have some players, and the players behave in a specific way. They take decisions in a specific way and while taking the decision they always consider how the opponents are going to take their decision. Like for example, chess. In chess we have two players; one who is using the black game and another is the white one.

And they move alternately and while each one making a decision to make a move, they always consider how the other one is going to react to it. And so, we use mainly this kind of methodology to study the next, other forms of market. And we use some solution concept to study these games, specifically Nash equilibrium and subgame-perfect Nash equilibrium for extensive games. So, we will do this in a separate module.

And next, using these tools we will study market forms like Cournot competition, Bertrand competition and Stackelberg competition. In Cournot competition, firms decide how much amount of output to produce. While deciding that they take the output of the other firms as given. Then they see that if they react in this way how the other firm is going to react, and based on that they take the decision, okay. And here firms mainly decides on the output. And the market price is given from the market demand curve where each, when each quantity is already given.

Next form that we are going to study is Bertrand competition. In Bertrand competition firms decides the price. Now if suppose there are two firms, firm one and firm two and they produce a homogenous good. Homogenous good means that a buyer is indifferent between buying from firm one and/or firm two. It is the same type of good, okay.

Now if firm one sets a price, say firm two will decide whether to set the price little bit higher or little bit lower. And while firm one, taking this decision it will definitely see how firm two is going to react. And so, there is a going to be a competition during setting this price. So, we study this kind of market in this kind of competition in Bertrand competition.

Next in Stackelberg competition, we study, we actually change the way decisions are made by the firm. In above two markets like Cournot and Bertrand the decisions are taken simultaneously. But in this form, in this form of market that is Stackelberg, decisions are taken sequentially. Like firm one who is first, decide first on the quantity and then firm two decides on the amount of quantity it is going to produce. Or first firm one decides on the price after observing that then firm two decides how much amount of price to set. So, this is going to be Stackelberg competition, and we will study it.

Next, we will study some other form of strategic interactions among the firms. So, first is the product differentiation. What do we mean by product differentiation? Product differentiation means that the firms try to differentiate their product. They do not try to produce homogenous product. So, if there are supposed two firms, firm one and firm two, they will produce goods like firm one's output is not completely substitute of the firm two. So, you can think in terms of different attributes these goods have. They will be differentiated in that term.

Second, in this part is the entry deterrence that we are going to study. Entry deterrence is that suppose there already exists a firm. And a new firm wants to enter this firm, market. Now whether the existing firm will allow this to happen? So, they may react in such a way that there may not be any incentive for this new firm to enter this market.

So, under what condition we can get this kind of situations? So, we will study this. So, this is also very important for studying like Antitrust policies, especially a firm may be deterring entry of new firms and trying to reap more profit, okay**.** And, so that is why the competition is not there in the market. So that is why entry deterrence is quite important.

Next, we are going to study the way the firm sell their product. Like they want to bundle it, like you will get this product only in specific quantity or you can get this quantity, these goods as whatever amount you want to, like they are completely divisible. Like when you are buying suppose rice, so you buy it in half kilo, like 1 kilo or 5 kilos or 10 kilos.

Instead, if we suppose bundle it, like it is only available in 5 kilos, 10 kilos and 25 kilos. So, this, whether the firm should use this kind of strategy or method, or they should allow it whatever amount the consumer wants they should be providing, or it is pre-determined, fixed available in only specific quantities.

And another thing that we are going to study is the tying. In tying what do we do? Suppose a firm is selling, suppose a product, a good and if you buy that good from that firm then you also get some other good from it. Like if you buy suppose a trouser then you also get a shirt along, or if you buy shoes, you also get a socks along with it, or if you buy suppose laptop you get a mouse along with it. So, this is like tying.

Now if one firm does this, follows this strategy whether the other firm is also going to follow the strategy or it is going to follow some other strategy? So, we are going to study these kinds of things in this section that is the tying; and the in bundling we will see in what quantity. And one portion of the bundling we will also study in monopoly, where we will study price discrimination in monopoly and in that thing, in the first degree and second degree it is related to a form of bundling, okay. So, this is going to be the structure of this course and I hope you are going to enjoy the same.

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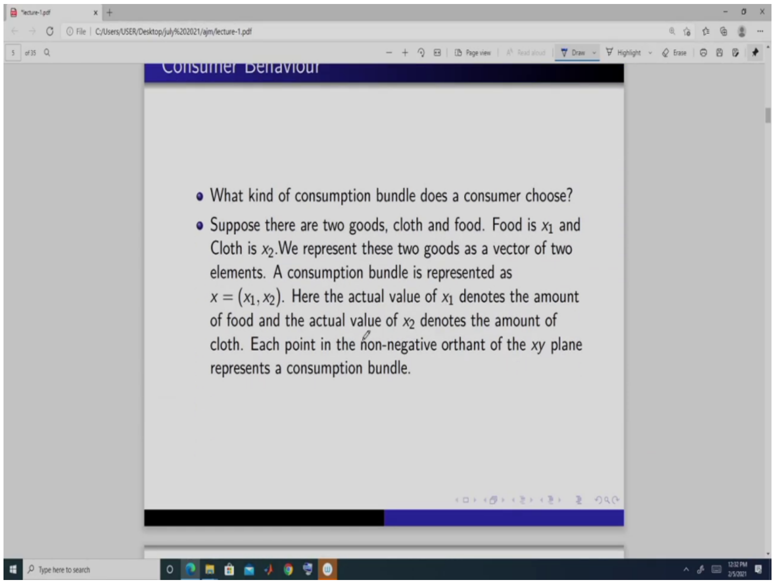

So now let us move to our first topic and that is consumer behavior. So here our objective is to derive the demand curve, okay, of a good. So, first question that we address in this section is what kind of consumption bundle does a consumer choose? Suppose you are given, you are in a world where there are only two good, cloth and food. And we represent food by x1 and cloth by x2. It can be any good but only two goods.

And these two goods are represent as a two-element vector that is x=(x1, x2). x1 is for good 1 and x2 is for good 2. And good 1 is food and good 2 is cloth, okay. So, a consumption bundle is, any consumption bundle is represented as a point in xy plane, positive orthant of that plane or you can say non-negative to be very specific.

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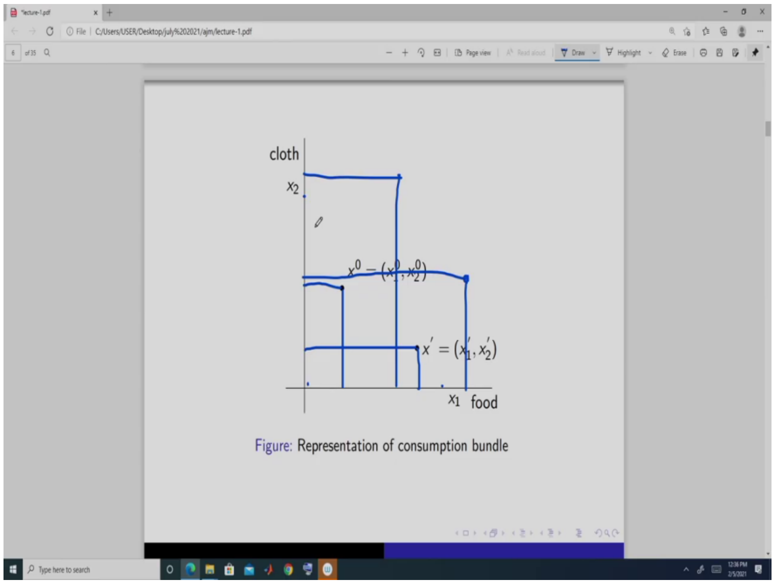

So, it is like this. So, we take, in this axis, this vertical axis good 2 and in this horizontal axis we take good 1 and each point in this orthant gives us one consumption bundle. Like this point x naught, i.e x_0, it gives this much amount of, this height is this much amount of good 2 and this much amount of good 1.

Actually, if we look at this axis then each point here denotes 1 unit. So, if you are looking at this, suppose this point, suppose this point so here this much amount of good 1 is demanded or is there. Then each point in this distance, in this length, determines the amount and then each point here determines 1 unit in this line, okay.

Now suppose this, here this much amount of good 1 and this much amount of good 2, okay. So, each point, like suppose if we take this point then here this much amount of this height is giving me the good 2 and this base, this much is giving me the good 1. If we take this point, then this much amount of good 1 and this height is giving me amount of good 2. Like this each point here gives me the consumption bundle.

Now here if we take, this point then in this bundle we have 0 unit of good 1 and this much amount of good 2. If we take this point, then we have this much amount of good 1 and 0 units of good 2. But we will not take any point in this orthant, or this orthant, and this orthant because here it is negative. So, it means that we have a negative amount, so it does not make any sense, what is a negative amount of a consumption bundle okay . So that is why we will only consider this point and each point here.

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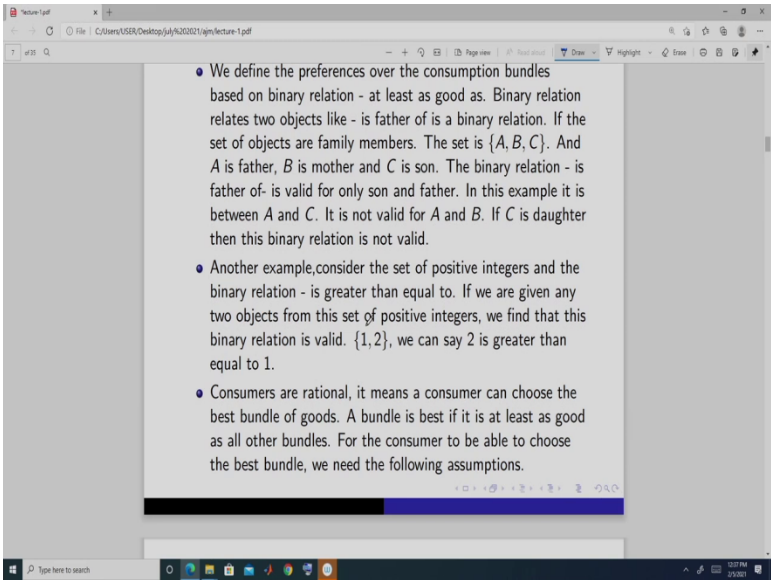

Now how do we define the preferences? Preferences means that when we are choosing then what we are doing? So, we are doing some form of a comparison, right. How do we do that? So, we introduce something called a binary relation, this. Binary relation is a way to relate two objects.

So, if we take a set, suppose like this, set {A, B, C,} it is a set of family members. And in this family, we have suppose three members, A denotes father, B denotes mother and C denotes son. And we take a binary relation like is father of, then, in this if we try to relate based on this binary then it is only valid if we take A and C because A is a father and C is the son. So, A is a father of C. But if we take A, B then it is not valid. If we take B, C then it is also not valid. If we take C, A then it is also not valid.

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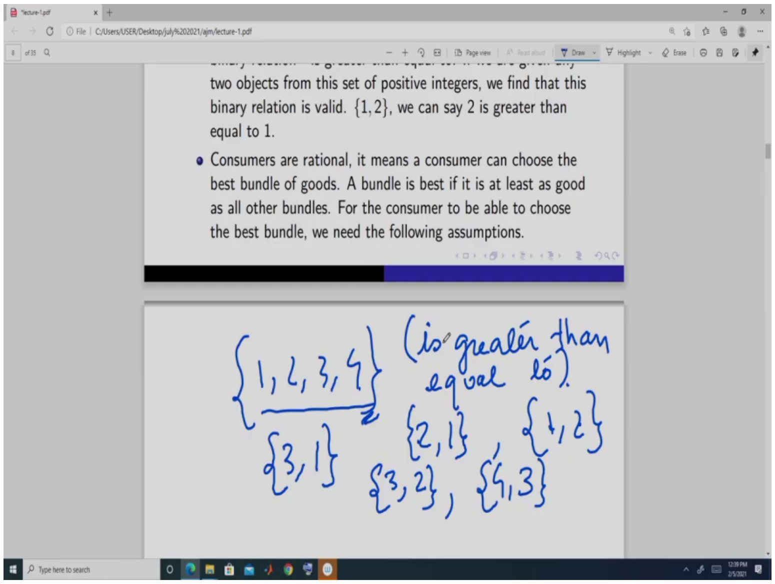

So binary relation is like a way to relate two objects. Like if we take sets of positive integer. Suppose like let us take one example, {1, 2, 3, 4} this. And suppose our binary relation is is greater than equal to, then this is valid if we write, if we take a subset from this {2, 1} of this set then this is, 2 is greater than equal to 1.

But this is not valid for this. So, what we are doing? We are relating first object with the second object. Here first object with the second object. So, if we take 1 is greater than equal to 2 it is not true. So, this is not valid. But this is valid. Then here if we take {3,1}so this is again valid. So, from here suppose if we are given this A point and we have to find out which is the greatest number.

Then we know, see 2 is greater than equal to 1; 3 is greater than equal to 1. Then 3 is greater than equal to 2, right. Then again 4 is greater than equal to 3. So, if we go on doing like this, we will find that 4 is greater than or equal to all the numbers, right. So here from this set we can find out that 4 is the greatest element in this right. So how it is possible? Using this binary relation "is greater than equal to", okay.

So here to study the consumer behavior we will also introduce such consumer, binary relations. So, we will first assume that the consumers are rational. When consumers are rational it means that if you are given a set of bundles from which you can consume, these are consumption bundle, that is there are some amount of good 1 and some amount of good 2. Then out of this set of consumption bundle you can choose the best bundle.

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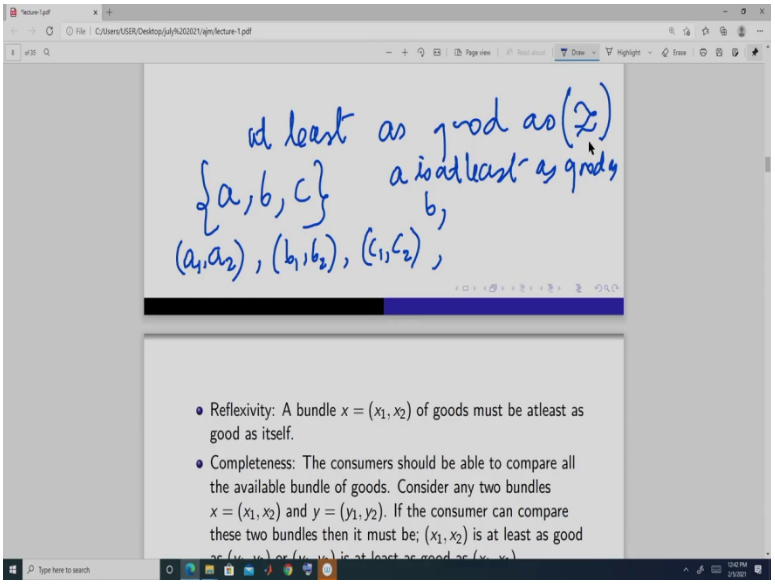

Now what is the best bundle? Best bundle is that bundle which is at least as good as all other bundles. So now here what do we do? We introduce a binary relation and that is at least as good as. So, our binary relation is “at least as good as”.

Now suppose we are given a set like {a, b and c}. So, this a is one bundle where a is something (a_1, a_2) , this b is something like this (b_1, b_2), and c is something like this (c_1, c_2), right. And then if we define this binary relation, it means a is at least as good as b or b is at least as good as c and c may be at least as good as a, like this, or c is not at least as good as a, something like this, so we define this. It is already given to us, okay. So, this is mainly binary relation that we are going to use. And what we do, this at least as good binary relation is represented in this way as a symbol, okay.

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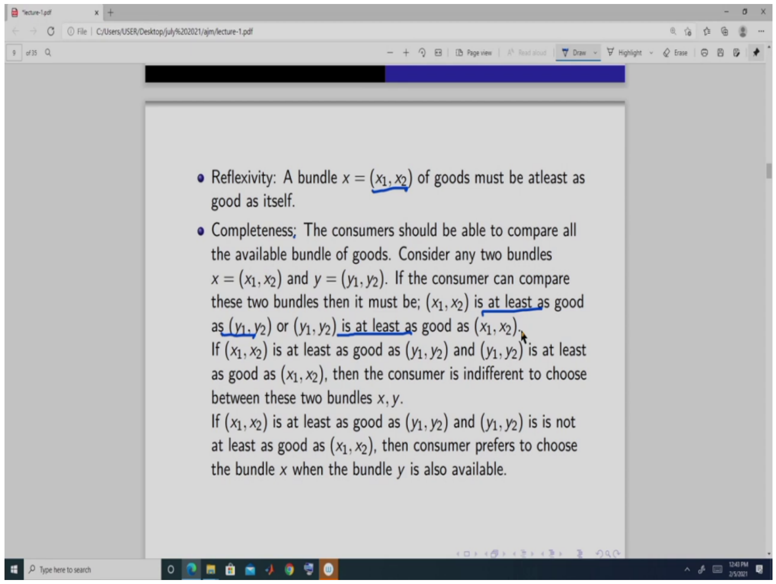

Now we specify certain assumptions on this binary relation, okay, so that we will be able to find the best bundle. First is reflexivity assumption. Reflexivity assumptions says that the bundle x, if we are given a bundlex= (x1, x2,) this x of goods then it must be at least as good as itself, okay. So, this is something like an obvious here, so if you are given a bundle then that bundle is at least as good as itself.

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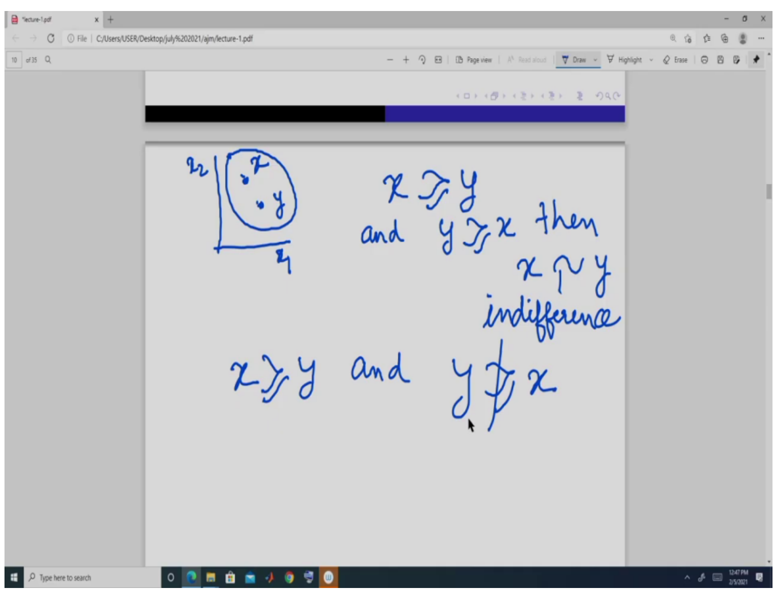

Next thing is completeness. Completeness says that we are given a set of bundle, from that pick any two bundle, okay. Suppose one is x and another is y. Now consumer should be able to compare them, that is, that x should be at least as good as y or y should be at least as good as x, right. So, suppose this is good 1, this is good 2, this point is suppose x and this point is suppose x and this point is y, okay, now, this is y.

Now, if suppose we have set, from which I have to choose a bundle is given by this set, all the points lying in this set, right. Then I should have that at least as good as y or y is at least as good as x. If it is not there then while comparing all this bundle based on this relation that is at least as good as this, then I will not be able to compare these two. right.

Then I may find out which one is best from all these things, but this when it comes to comparing these two bundles, I will be silent. I will not have anything to say. I will not, so that is why if we are given a set and from that set whatever bundle we take, it should be, it should have this relation that is "at least as good as" must be defined with all other bundles, okay. This is what completeness tells us.

Now suppose we are given any bundle that is x and another bundle is y. And if x is at least as good as y and y is at least as good as x, so in that case we say that we are indifferent between these two goods and we say, we write it in this way, that suppose x is at least as good as y and y is at least as good as x, then we write x is indifferent to y, okay. So, this is indifference i.e $x \sim y$.

Next if we have something like this, like x is at least as good as y and y is not at least as good as x, okay. Or you can write it in this form, $\sim y \geq x$, okay any form will do. No, it is better to use this because then there is no confusion. Suppose it is y is not at least as good as x, then we say that x is preferred to y. So, this is, $x > y$ is preferred to relationship, okay. So, I hope all of you are following, okay

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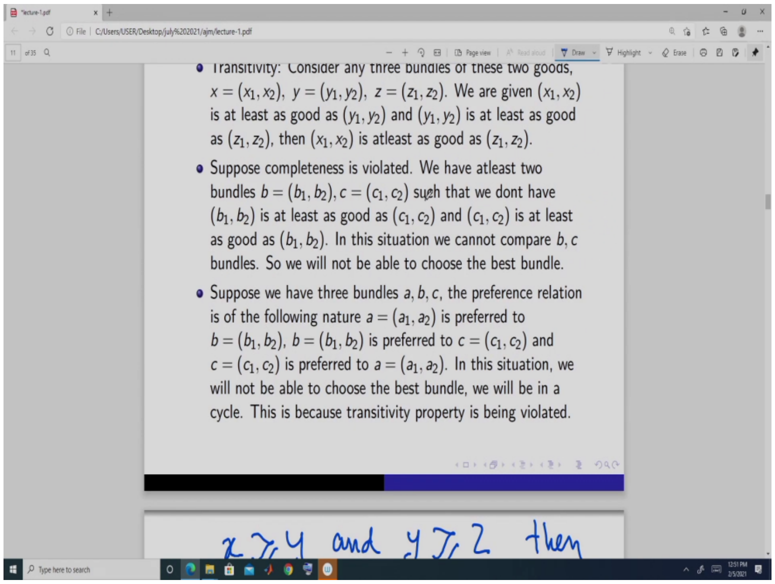

Next assumption that we or next axiom that we consider is that it is called transitivity. It is more, something some like we are taking a decision in a consistent way. So, suppose from this available set of bundles we are taking three bundles x= (x_1, x_2), y= (y_1, y_2) and z= (z_1, z_2), okay. Then if x is at least as good as y and y is at least as good as z, then x must be at least as good as z, okay.

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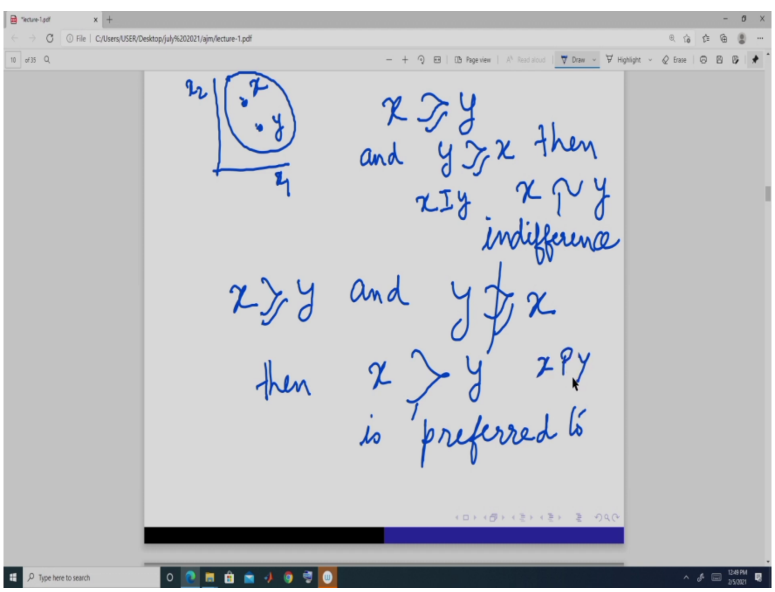

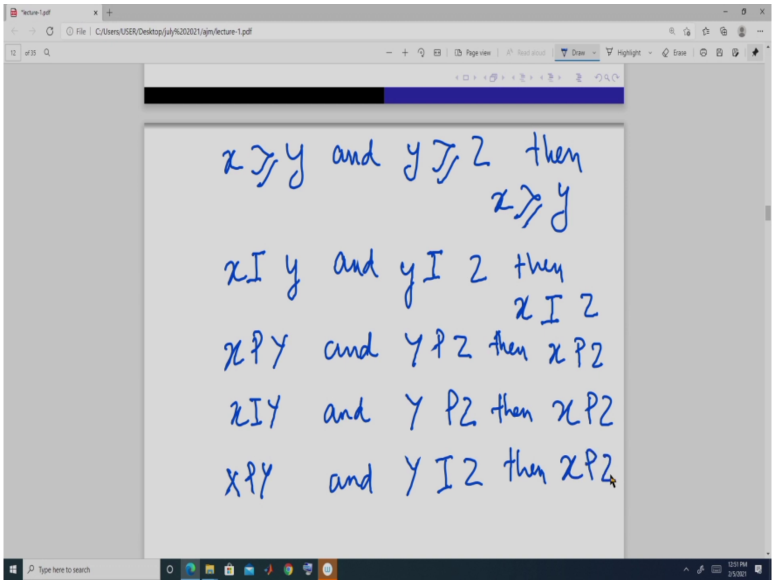

So, it is something like this, that we are given x is at least as good as y i.e $x \geq y$ and y is at least as good as z, i.e $y \geq z$, then we must have x at least as good as y, $x \geq y$, okay. This is transitivity. So, from here we can, see we will get, suppose x is indifferent between y and we are indifferent between y and z, then we get that we are indifferent between x and z.

Or if we take it this way, x is suppose, or you can, this indifference, if this sign is complicated we can take, write it in this way also, x indifferent to y or this we can write as x P y. This is easier, right? So, we will use that only. So, suppose we are indifferent between x, then I get this or if I prefer x to y and I prefer y to z then I prefer x to z, right.

So, or from here we can get like this. Suppose I am indifferent between x and y i.e xPy and, but I prefer y over z then x will be preferred to z. Or if I suppose x is preferred to y i.e xPy and y is; I am indifferent between y and z, then I can write that x is going to be preferred to z. Or you can just reverse this here also, it is possible, okay.

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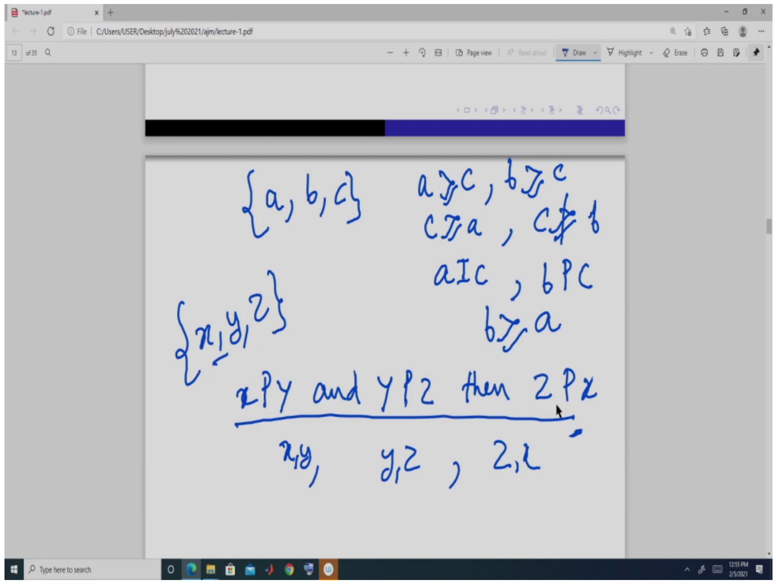

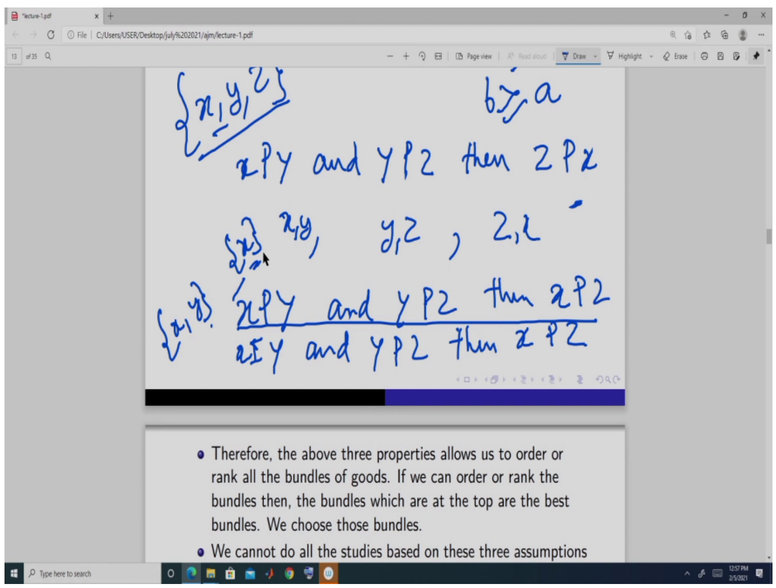

Now we will see that if suppose completeness is violated then what happens? So, suppose we are given a set of bundle like this {a, b and c}. So, we are given that a is at least as good as c, and b is at least as good as c, and we are given c is at least as good as a, and we are given that c is not at least as good as b, okay, but only this is given. We do not know what is the relation between a and b, how they are, whether a is at least as good as b or b is at least.

So, in this case from here what do we get? a is at least as good as c and c is at least as good as, so we get that a, I am indifferent between a and c. Now from here we know that b is preferred to c, right. But we can apply transitivity and then say that b is preferred to a. But we do not know, it is not specified here. And we, so, so that is why we will not be able to find or compared all the, so that is why we should be given that a is at least as good as b.

This, if we are given this then we can now apply transitivity and we can say since a is at least as good as this and from here we can, okay, but if we are not given this then we cannot say. So that is why completeness is a requirement, to find out how we, which one to choose from this a; because we will choose that which is at least as good as all others or which is preferred to all these bundles, all the bundles.

Now suppose transitivity is violated. So, if transitivity is violated what it means? So, it is something like this. That suppose x is preferred to y and y is preferred to z. Then from transitivity we know that x should be preferred to z. But instead suppose we are given; we are given z is preferred to x. Now you choose, which one we will choose?

From this set {x, y and z}, you prefer x to, over y. So, you should choose x if you are given these two, these two things only, x and y. And you will choose y if you are only given x and z, you will choose z if you are given, but then if y is also there here then you will prefer y. But since x is preferred to y you will get, so we get a cycle kind of thing. So, in this situation if we are given this we cannot conclude or we cannot come to a conclusion which one we are going to choose. So that is why transitivity is a necessary thing.

Now if these three are given then we can always choose the best element. Like from here we know if we are given this, then if transitivity is satisfied then we will have a situation like this, x is preferred to y and y is preferred to z, then from here x is preferred over z. So, from here we can choose x, right

Instead suppose we are only given that suppose x is indifferent to y and y is preferred over z then from here we know x is preferred over z and y is also preferred over z. And I am in different between x and y. So, I will be indifferent between choosing x and y bundle from this set, right. So, I will have two best bundles.

But in this case, in this situation, I will have only one best bundle and that is x, this one {x}, if we are given, if the preferences are in this way. If preferences are of this nature, then we will have two, if preferences are this nature, then we will have only one. So, these three conditions or these three assumptions allow us to find the best element or best bundle from a set of bundles, okay.

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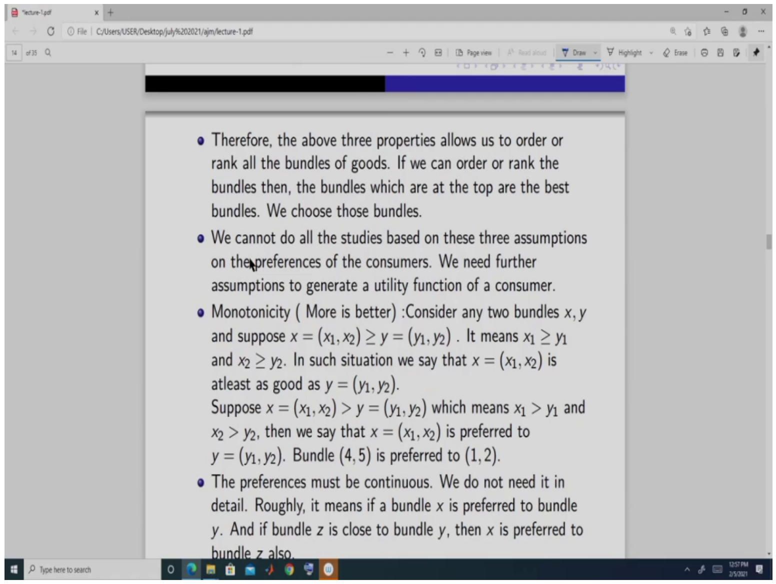

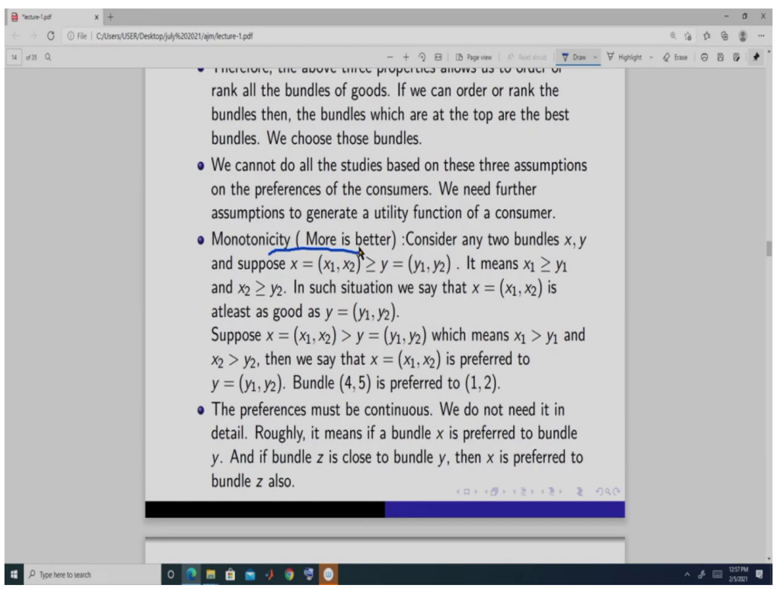

Now the problem with this is that it is too basic. So, we cannot do all the analysis or we simply cannot derive the demand curve from these three assumptions. We need some further assumptions, okay and further conditions to get, to derive something called the utility function and we will see that. So, first assumption that we make is monotonicity assumption, this. Monotonicity assumption means that more is better. What does that mean?

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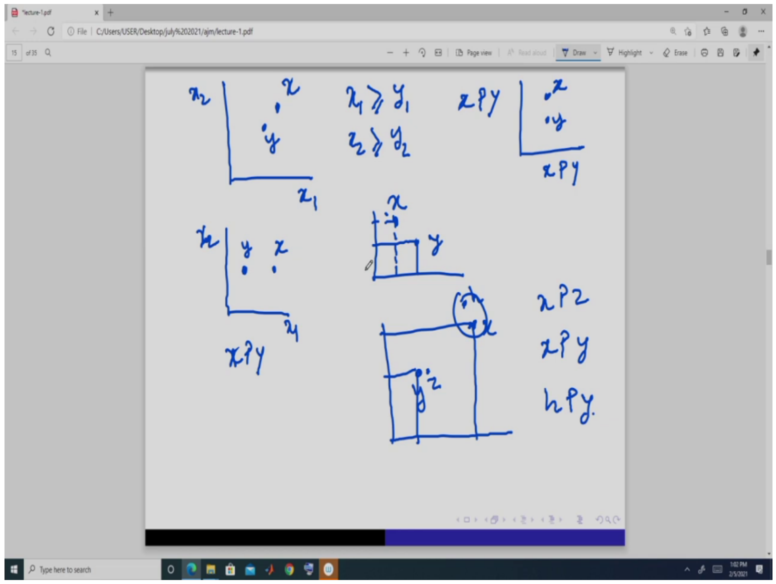

That suppose we are given a bundle x and y, okay. So, you have this bundle. This is suppose bundle x and suppose this bundle is, suppose this is x and this is y. Now from this, we know that x1 is greater than equal to y1 and x2 is greater than equal to y2. Now if the situation is something like this, then we say x is always preferred to y that is x is preferred to y, xPy, okay

Or instead of this, if the situation is something like this, suppose x is this and y is this. So here amount of good 1 is same in both x and y bundle but amount of good 2 is higher in x than here. Here again we can say that x is preferred to y. And similarly, we will also say, if suppose this is y bundle and this is the x bundle**,** then we again say x is preferred to y because amount of good 2 is same and x1 is greater than y1. So good 1 is more in this.

So, in these three situation, we can have three, these three possible ways and we know how we define the preference. But this is silent if we have a thing like this. If this is x and this is y because here this x2 is greater than y2 but x1 is less than y1. So, we do not know based on monotonicity. So, and monotonicity mainly says that more is better. If in a bundle anything more is there than another bundle then we should always prefer that bundle which has more amount or higher amount of any one of these goods, okay. So, this is the monotonicity assumption.

And next assumption is something called a continuity assumption. Preferences must be continuous. So, it means what? It means that, it is something like this. See we will not do this in detail, okay. Suppose this is y and this is x. From monotonicity we know that x is always preferred to y because both the good x1, y1; x1 is greater than y1 and x2 is greater than y2 here in this case.

Now if we have a bundle here z which is close to y then since x is preferred to y so x will be preferred to z also. So, this is mainly what continuity tells us, okay**.** Or if we have any bundle here, suppose this, which is given by suppose h then h is going to be preferred over y. Or here x is going to be preferred over z, something like this because it is near this and it is very far from, like this.

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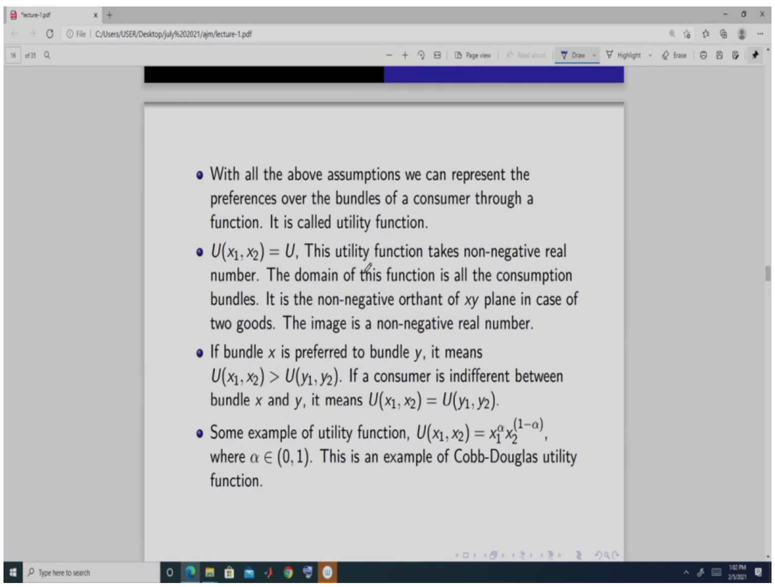

So, if we assume these five assumptions that is reflexivity, completeness, transitivity and monotonicity and further continuity then we can represent these preferences through a function. And this function is called a utility function, okay. So, it is something like this.

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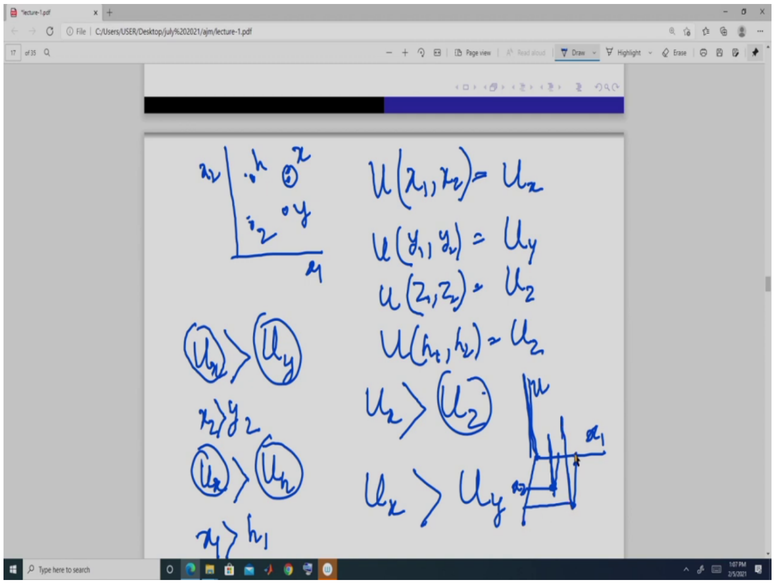

So, we have, good x1 and x2. Based on all the above five assumptions we know that if we are given, suppose this in our set, suppose these four bundles then we know which one to choose; like from monotonicity we will definitely going to choose this bundle because all goods are more in this. But here if you take this, so good 2 is same but good 1 is higher here.

If you look this here good 1 is same but more or less same but good 1 is, good 2 is higher and compare, so we will choose this bundle, right. Now what do this utility function says, that we have a function like this $U(x_1, x_2)$which is a function of this amount of good 1 and good 2 and when we plug in these bundles, we get a real number and that gives us total level of satisfaction that we get from consumption of this bundle.

So, we get a satisfaction level like this. Suppose this is, this bundle is x, this is y, this is z and this is suppose h, okay**.** Then we get some utility from x1, x2 is, suppose this is x, i.e $U\left(x_1, x_2\right) = U_x$; some utility that we get from consuming y1 y2 and suppose this is $U\left(y_1, y_2\right) = U_y$; and you get another and that is $U\left(z_1, z_2\right) = U_z$ and we get $U\left(h_1, h_2\right) = U_h$. Now here based on monotonicity we can say that utility from x1 this is greater than utility of y. Why? because x2 is greater than y2, y2 whereas x1 in both the case are same.

Again, we can say that x is greater than h i.e $U_x > U_h$, why? Because x2 is same as h2 but x1 is greater than h1. So, we have something like this. Now this U_x takes a real number, this U_y takes a real number, this U_x takes a real number and this U_z also takes a real number. So, we can compare these real numbers, you can always compare. So, from here if we know this and we know then U_x is always greater than U_z. Why, both x1 is greater than z1 and x2 is greater than z2, if you compare it.

Now this will also be a real number and we can compare the real numbers. So, since this is here, from here we get U_x is greater than U_y and now depending on the actual value that we assign to this we will, but this is, we can find out which bundle to choose from here, right out of this because we will have these four utilities and we will have these four real numbers and we can compare these real numbers and that will give us which one to choose from these four, right.

So, this is the advantage of utility function. So that is why, what we do, if we make this assumption then we can represent these bundles based on the utility that we attain from this, from the consumption of this, or the satisfaction that we get from this. So, it is something like this that if we are given like this, so this may be good 1, this may be good 2 and this is our utility.

So, any bundle here this much amount of good 2 and this much amount of good 2, the height is, this height is going to give me the level of utility. For this point again this height is going to give me the utility, right. And since these two goods are, this is preferred to this, so utility is higher. So, we get something like this.

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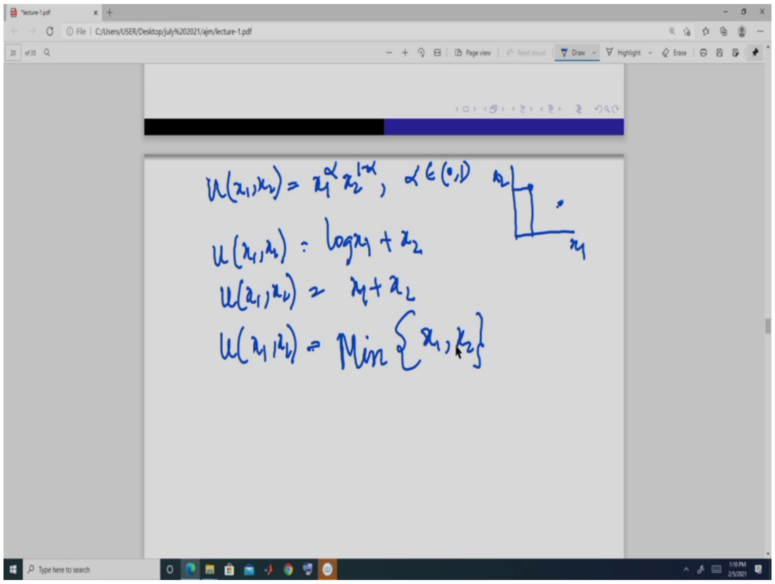

So, we will now do some examples of utility functions, okay. So, some examples of utility functions are something like this- $U(x_1, x_2) = x_1^{\alpha} x_2^{1-\alpha}$ that if we are given x1, x2 is where this alpha belongs to 0 and 1. It can be any number between 0 and 1. So this is an example of something called the very well-known utility function that is Cobb Douglas utility function, this.

And here wherein we plug in, in this a, so based on these two we will get a real number. So, if we take, this is x1 and this is x2, any point this, this much x1, this much x2 you plug in these two here, the outcome is going to give you the utility from this. Take any point, you plug in the value here. You will get the a for specific value of alpha.

Another utility function that we can talk about is this- $U(x_1 x_2) = log x_1 + x_2$.this is one, this is something called a quasi-linear utility function. Here you plug in the value of x1, x2 and you will get the all the positive value you will get the utility, right. And for here we do not have these, these values because x, in this case x will always take a value which is greater than 0, otherwise log is not defined, right.

Next example you can take is something like this, $U(x_1 x_2) = x_1 + x_2$ this, this is one. So here you can see that these goods are this one, x1 and x2, they are, so you plug in this value and the utility you get is simply the sum of these two. Or you can take another example like this. So, this is an example of perfect substitute and like Min of this- $U(x_1 x_2) = Min\{x_1, x_2\}$. this is example of perfect complements, goods are x1 and x2 are perfect complement. We will do these four examples in detail.

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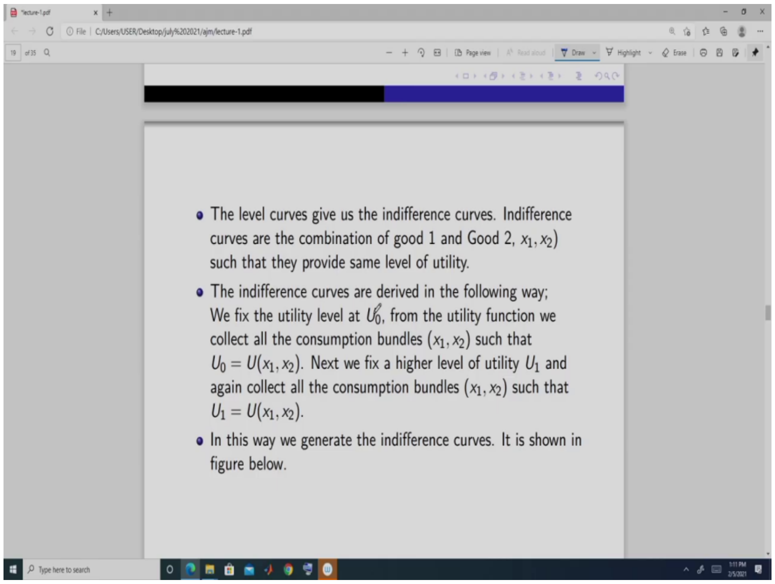

Now so what do we get? That we assign a number to each point like this based on the specific utility that the consumer has, utility function of that consumer we get the real numbers for each of this point, in this positive orthant, okay. Now from here we define something called indifference curve. So, what this indifference curve says? Indifference curves are like level curves. So, it is something like this, this.

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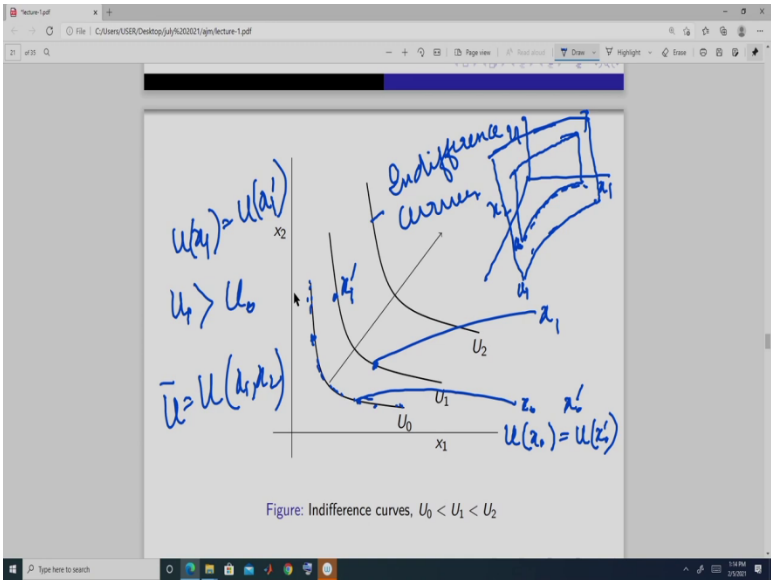

So, what we are doing here that this is a level curve which is the utility from each of these points we get is u naught, i.e U_0. So, this point is suppose x naught i.e x_0 and this is suppose x naught dash. Then utility from x naught is equal to utility from x naught dash, these two, okay. So, we take all this. So, it is something like this that if we take x in this axis x1 and y2 in this good 1 good 2 and utility in this axis then these points, if this is one indifference curve then height is going to be same for each, so this height is same height.

Now this you will get at the same height, each, if all of these are at the same level. Suppose this is u1 and this is u naught, okay, something like this. So here if we take this, suppose this is x1 and this is suppose x1 dash then utility from x1 is equal to utility from x1 dash, i.e $U(x_1) = U(x_1^{'})$. And since this is at a higher level so and we are making that assumption from the monotonicity. So, this utility from u1 is greater than u naught.

So, in this north east direction utilities are increasing. But each point is giving me same level of utility. So, these are called, something called indifference curves, okay. So, we generate indifference curve in this way. What we do? We fix suppose a level of utility at this and we have a utility function which is given like this $U = U(x_1, x_2)$and then we find out at this level of utility u bar all the combination of x1 and x2 which are giving me same level of utilities.

And so, then we join them and we get the indifference curve. Or you can think it in terms of three dimension that is all the points which have the same height and their height is giving you the utility, level of utility, okay.

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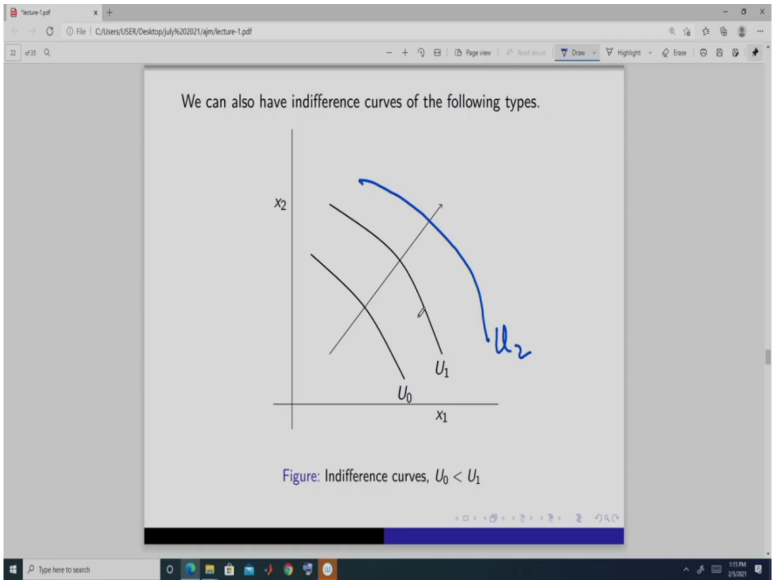

But here from till the assumptions that we have made till now we may have a indifference curve of this nature also and utility is increasing. Suppose this is again, it is something like this, like this, we may get this. Now what is the problem of this kind of utility function? We will see that when we do, when we actually derive the demand function not now.

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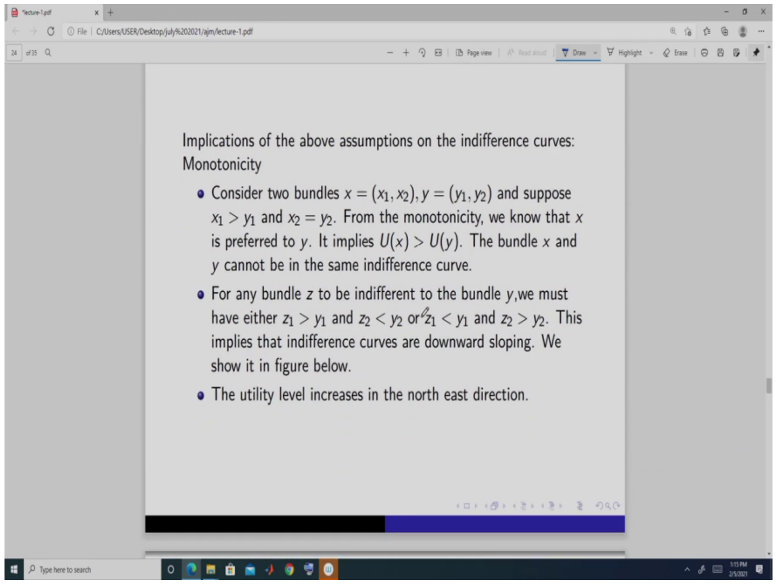

So, but these are a specific form of utility functions and we in this course we do not want this kind of indifference curves. So, what we will do now? So, we need some further assumptions. And before moving to further assumptions we will see actually the two assumptions that we have made monotonicity and transitivity, what is the implication of these assumptions.

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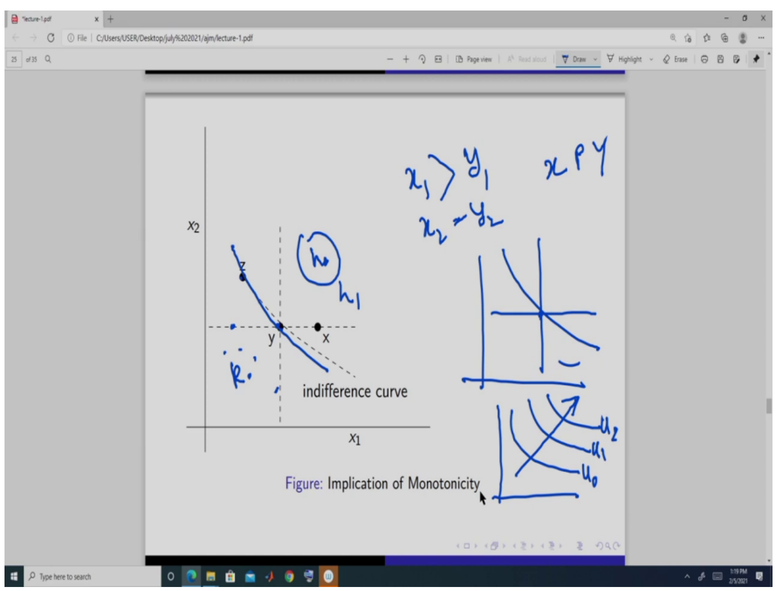

First the monotonicity. Now suppose we are given three points. This is, or three bundles x, y, z. Now if you look at these bundles you will see that in this bundle x1 is greater than y1, but x2 is equal to y2, right. So, from monotonicity we get x is preferred to y, right. And if you take any point here in this region and compare it with y, so any point suppose like h which is here or it may be suppose h naught is here, or h1 is here, then all of these are going to be preferred to y.

Now if you take any point here. Suppose these are k, okay, this is suppose k. Then y is going to be preferred to k from monotonicity, it is obvious because each of them are greater. And if you take point in here or here also y is going to be preferred. So, if you are taking this point then any point which needs to, which will be indifferent to this should be either in this portion or it should be in this portion, okay.

So, this gives us what? This gives us that the indifference curves should be downward sloping like this. So, we get the indifference curve should be like this from the monotonicity assumption. They should always be like this. So, if we specify any point here than any point which must be indifferent to this should either lie in this section of the curve or it should lie in this section. It cannot lie in this portion or in this portion, okay.

So, the first implication of monotonicity assumption is that the indifference curves are downward sloping, indifference curves are downward sloping, okay. And second thing is that if we take this a then the, here still, the second implication is that these level curves, the utility here, this, this, so U_2, U_1 should be greater than U_0, U_2 should be greater than U_1.

So, utility level or this level curve should be increasing in this north east direction. So, the height of this third a which gives me the utility should be increasing, okay. So, this is the implication of monotonicity.

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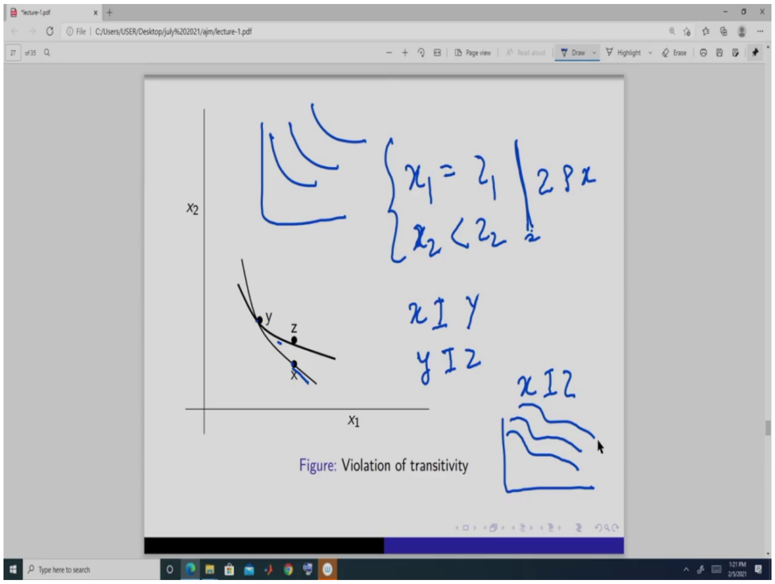

Figure: Violation of transitivity

Now what is the implication of transitivity? So, the transitivity is, now take three points x, z and y like this. And suppose the indifference curves are like this nature. So, this is one indifference curve and this is another indifference curve. Now from here we know that x1 is equal to z1 and x2 is less than z2, right. It is obvious from this.

But now see x and y are in the same indifference curves, so x is, I am indifferent between x and y, right. x and z are in same indifference curves. So, I am indifferent between y and z. right. So, apply transitivity, you will get what, that I should be indifferent between z and x right. But we have this. So, from here we know that z is preferred over x. So, we get a contradiction.

So that is why if transitivity is there, then indifference curves are never going to intersect. So, these level curves are never going to intersect. So, they will be always one over another, right. So, indifference curves are always going to be of this nature, or the indifference curves depicting different levels can be of this nature like this, but they are never going to intersect, okay. So, in today's lecture we will cover only till this much and in next lecture we will continue from this, okay. Thank you very much.