Introduction to Market Structures
Professor Amarjyoti Mahanta
Department of Humanities and Social Sciences
Indian Institute of Technology, Guwahati
Lecture - 3
Examples of Utility Maximization, Demand Curve and Market Demand Curve

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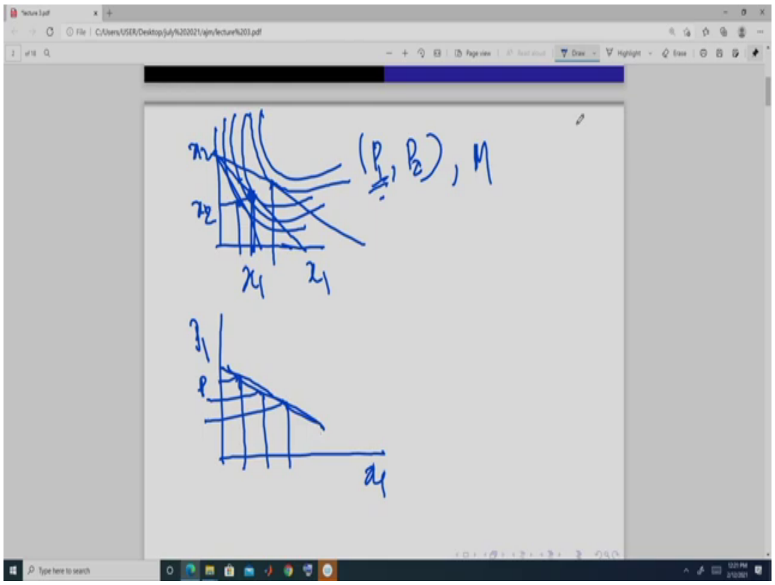

Hello, everyone. Welcome to my course Introduction to Market Structure. Before starting the lecture three, let me recap what we have done in lecture two. So, in lecture two we have derived demand curves. So, suppose we have two good, good1, good 2 and this is our budget line. So, all these points are feasible points we have to choose out of these points, and these are our indifference curves which we have got from the utility function and this is our optimal point.

So, at p_1 and p_2 price, we have demanded this much amount of good 2, good 1 and this much amount of good 2. So, this is our optimal point. Why this is an optimal point? Because if we choose any point here, then utility at this curve is higher than this. If we choose any point inside the set, then this curve point which is in this manner point, which is tangent to the budget curve is giving me higher utility.

So, that is why this is an optimal point which maximizes my utility subject to the budget constraint and that is why we have chosen that bundle and we have arrived at this for a given set of price $p_1$and p_2 and an income M. Now, if we change the price of good 1, suppose like this, then we will get suppose this is our optimal point if we reduce the price this is our, this is our optimal point.

So, like this, we will get different optimal point as we change the price of good 1 and so, we will get the demand curve. So, this is the demand for good 1 when price is this, this is the demand for good 1 and this is the demand so, like this. So, this is, this is at this price, at this price, at this price, okay. So, like this we get a demand curve. And today, we will derive this algebraically.

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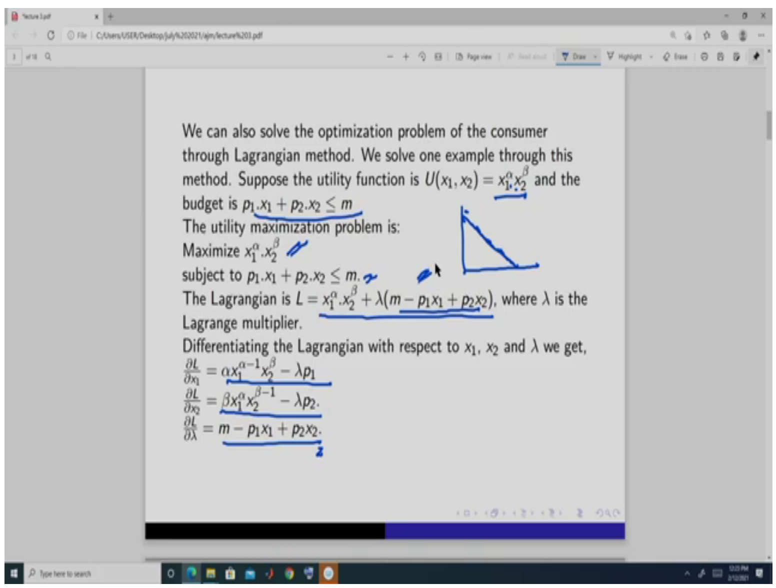

So, or what do we do? Suppose, for convenience, we have assumed a utility function like this- $U(x_1, x_2) = x_1^\alpha x_2^\beta$, this is a Cobb Douglas utility function, where alpha takes a value which is between 0 and 1 and beta takes a value which is between 0 and 1 and the budget constraint is like this- $p_1x_1 + p_2x_2 \leq m$. So, the problem is we need to maximize this utility subject to this budget constraint.

So, to do this what we do, we use something called a Lagrangian method. And here you will see that since our utility functions are of this nature, since we have assumed that they are convex, so, the utility will always be at the boundary, optimal point is always going to be at the boundary, okay. So, we can take the Lagrangian in this form, okay.

So, we do not have to use something called a Kuhn-Tucker method in this case, okay, we use the simple Lagrangian method. So, this is our objective - $x_1^{\alpha}x_2^{\beta}$ and this is our constraint- $m - (p_1x_1 + p_2x_2)$, okay. And this lambda (λ) is something called the Lagrangian multiplier. So, what we are doing in a way while solving this maximization problem that we are maximizing this part i.e. $x_1^{\alpha}x_2^{\beta}$ and we are actually trying to minimize this part, i.e. $m - (p_1x_1 + p_2x_2)$. Because when we choose a bundle, we want to choose it in such a way that it gives you maximum bundle and at the same time the expenditure should be minimum, okay, then only this is satisfied.

So, we set up the Lagrangian in this form, and then since it is differentiable, so we take, we optimize this with respect to x_1, x_2 and lambda (λ). So, here when we take the first derivative of this expression, this Lagrangian,- $L = x_1^{\alpha}.x_2^{\beta} + \lambda\left(m - p_1x_1 + p_2x_2\right)$ we get this term- $\frac{\delta L}{\delta x_1} = \alpha x_1^{\alpha-1}\ x_2^{\beta} - \lambda p_1$, second a with x2, we will get this term- $\frac{\delta L}{\delta x_2} = \beta x_1^{\alpha}\ x_2^{\beta-1} - \lambda p_2$ and when we differentiate with respect to lambda we get this term- $\frac{\delta L}{\delta\lambda} = m - p_1x_1 + p_2x_2\ ,\ okay.$ So, this concept.

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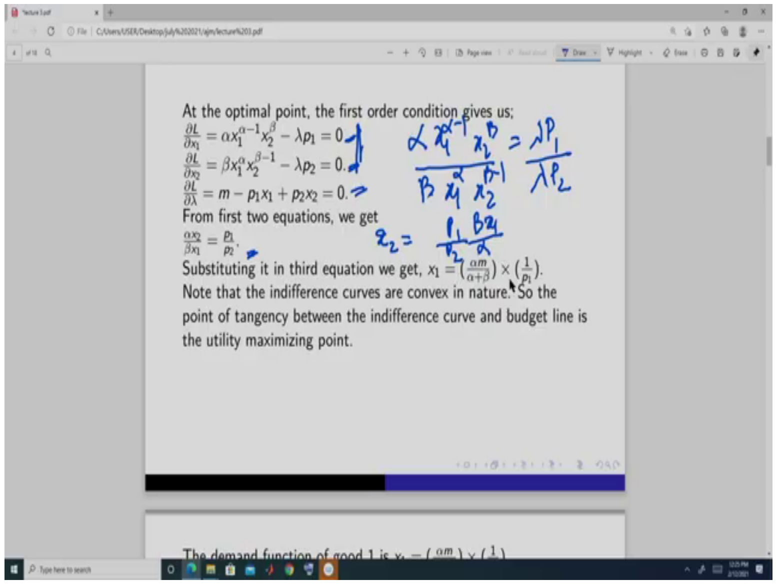

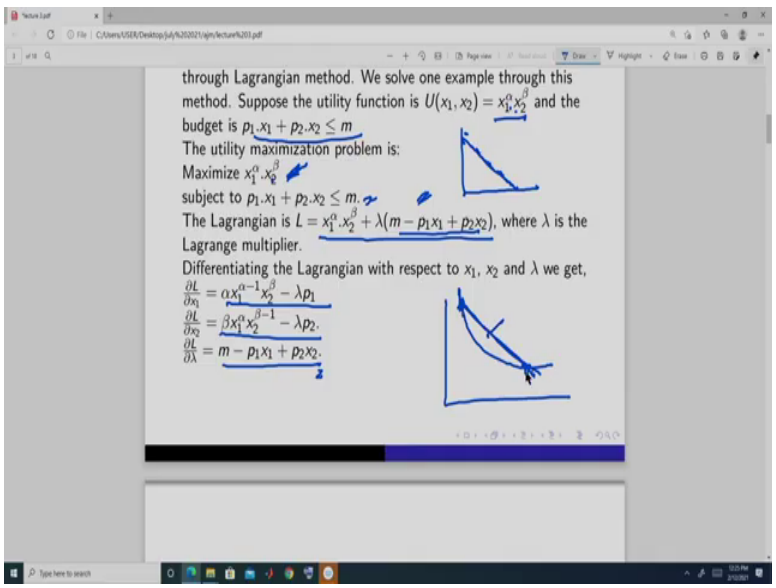

Now, the first order condition of this optimization gives us that this should be always equal to 0, i.e $\frac{\delta L}{\delta x_1} = \alpha x_1^{\alpha-1} x_2^{\beta} - \lambda p_1 = 0$, this should always be equal to 0, i.e $\frac{\delta L}{\delta x_2} = \beta x_1^{\alpha} x_2^{\beta-1} - \lambda p_2 = 0$, and this should be always equal to 0, i.e $\frac{\delta L}{\delta \lambda} = m - p_1 x_1 + p_2 x_2 = 0$. So, from this first order condition, what do we get if we equate these two, we get this thing, i.e $\frac{\alpha x_2}{\beta x_1} = \frac{p_1}{p_2}$, right, because it is a simple calculation, right, we take this to this side and then divide it by this and we will get it like simply if we, okay, and this you can see it will give me this- $\frac{\alpha x_2}{\beta x_1} = \frac{p_1}{p_2}$.

Now, from here what we do, we write it in terms of suppose x2 so, we can write x2 as p1 divided by p2 beta x1 divided by alpha i.e $x_2 = \frac{P_1}{P_2} . \frac{B x_1}{\alpha}$ and we substitute this in this equation in place of x2 and we get x1 in this form- $x_1 = \left(\frac{\alpha m}{\alpha+\beta}\right). (\frac{1}{p_1})$. So, here note that this is the first order condition and if we are doing, solving any optimization, we need to look at the second order condition also, right. But since this, i.e $x_1^{\alpha} x_2^{\beta}$ is a well-behaved utility function, if you look at the indifference curves of this a, it is something like this.

So, it satisfies something called the convexity property right, if we take this point and this point, then any point which is the linear combination of these two, it is preferred to these two points, right. So, that is why we do not need to check the optimal second order condition here. And, and if you want to pursue it, you can look at any graduate textbook you will find it, but in this course, we do not need that much, okay.

So, we will generally assume that the utility functions are such that the indifference curves are convex to the origin, okay. And so, we will get, we do not need to take the second order condition, first order condition is sufficient to give us the optimal point. okay

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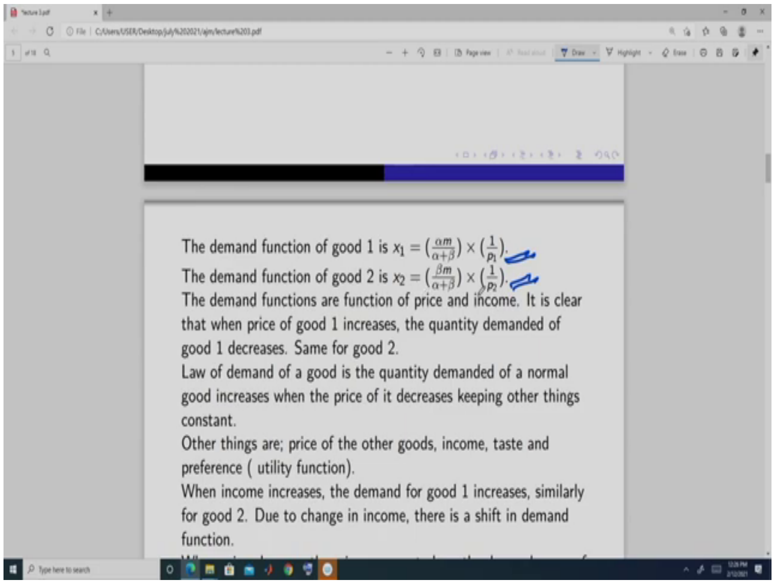

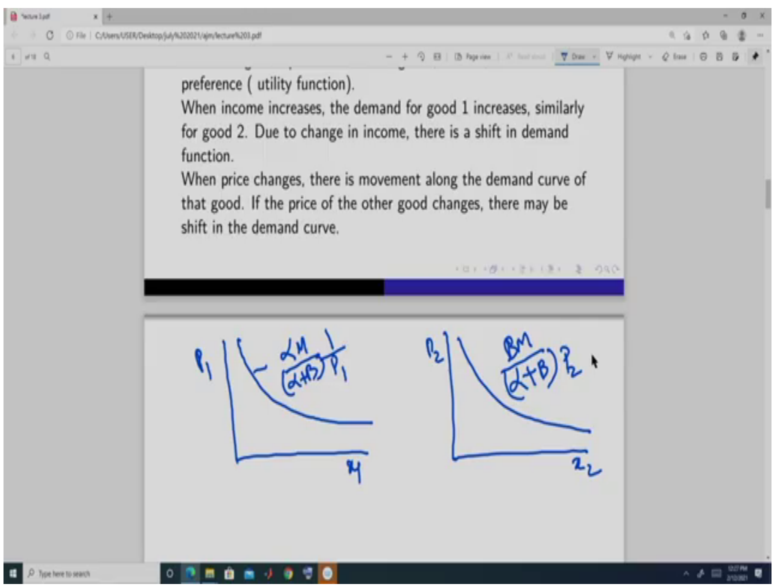

So, now, based on this, we get this - $x_1 = \left(\frac{\alpha m}{\alpha+\beta}\right).\ (\frac{1}{p_1})$ as a demand curve of a demand function of good 1 and this is demand function of good 2- $x_2 = \left(\frac{\beta m}{\alpha+\beta}\right).\ (\frac{1}{p_2})$. And if you look at them carefully, you will see that when it is something like this, that if we plot x1 here, p1here, it is curve line like this and it is something like this and this is, you can say this curve is like this- $\left(\frac{\alpha m}{\alpha+\beta}\right).\ (\frac{1}{p_1})$ this curve is beta m is like this-$\left(\frac{\beta m}{\alpha+\beta}\right).\ (\frac{1}{p_2})$. , so they are downward sloping.

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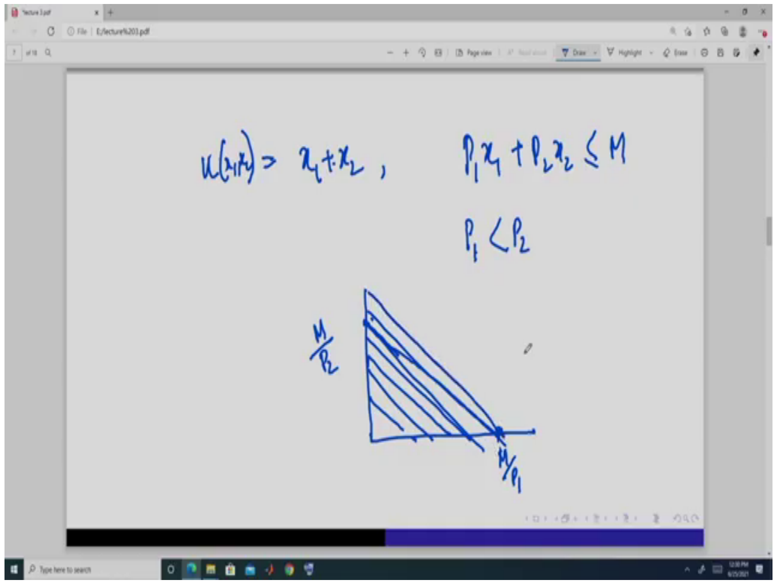

Now, let us solve another problem and that is suppose good 1 and good 2 are perfect substitute. So, this is your utility function, utility function is given like this- $U\left(x_1, x_2\right) = x_1 + x_2$ and our budget set is our budget line is supposed this- $P_1x_1 + P_2x_2 \leq M$. Now, we again further assume, we assume that p1 is less than p2.

Now, here if we take this then this is going to be m by p1and this is going to be m by p2 and it will be like this. So, this height is going to be less than this base, but if we plot these indifference curves, these are straight line and these heights and base are going to be seen. So, if we do this, let us do this, we will get like this and this is going to be our optimal point.

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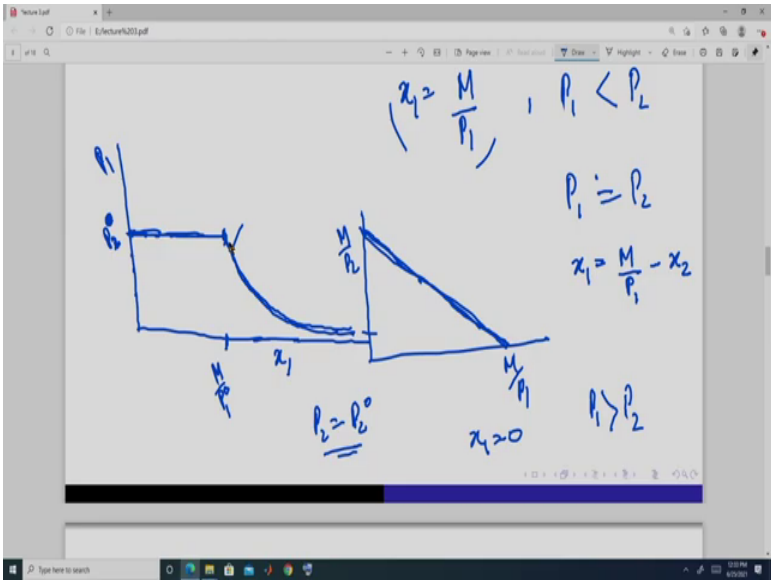

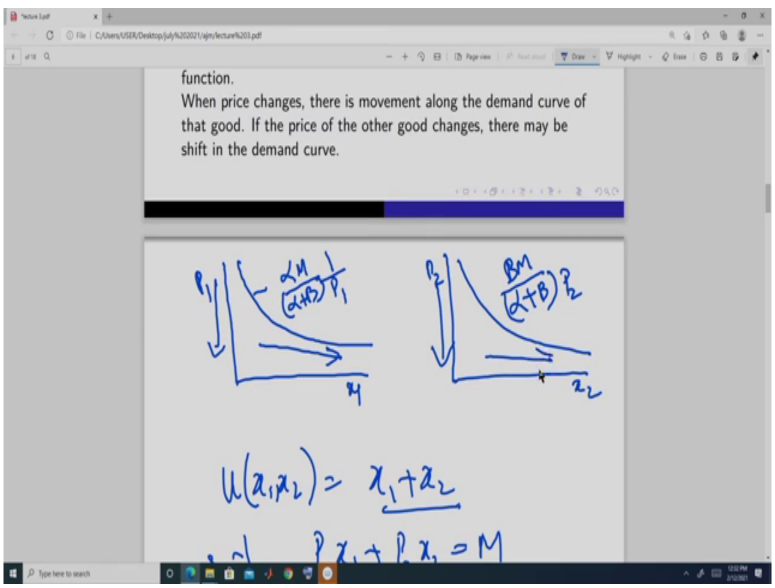

So, we get that x1 is actually this- $x_1 = \frac{M}{p_1}$ when p1 is less than p2. Now, if p1 is equal to p2 in this case you draw the budget line, this height and base are same ,m by p1 is same as m by p2. So, all these points are any points are going to be an optimal point. So, the budget so, the demand curve of firm one is going to be this- $x_1 = \frac{M}{p_1} - x_2$ because p1 is equal to p2 we can cancel it so, you whatever you have bought amount of x2 and what is left, you are going to buy x1.

So, any point like this so, if we and whenever p1 is greater than p2, we get that from same argument we get that x1 is going to be 0. So, if we plot the demand curve, we will get something like this, that suppose this is the p2, okay. So, if p1, p2 is fixed at this level and here in this we are taking p1 and in this axis we are taking x1. So, suppose this amount is m by this when p1 and here this is p2 some p2 dot so this is p1 dot suppose, okay. So, this is the amount it is demanded when or this is the amount demanded and x2 is 0, okay.

Now, when p1 falls below this a at this a when there is a same demand is going to be you can demand anything. So, and when it is less, demand curve is this. So, the demand curve is going to be a it is as the price p1 of good 1 falls, it is going to be something like this. So, this is the demand curve where we have perfect substitutes of good1 keeping price of good 2 fixed at p2 naught, p2 is equal to suppose p2 when it is naught this and we get a demand curve of this nature done.

So, now, here if you look at this demand curves, you will see that these demand curves are mainly downward sloping in prices, it means what, that as the price decreases, quantity demanded increases, same here as the price decreases quantity demanded increases and this is called the law of demand.

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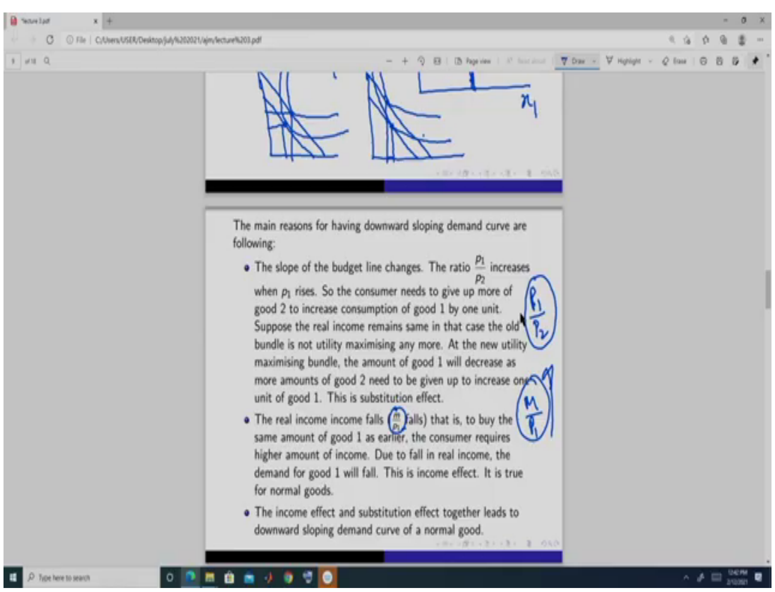

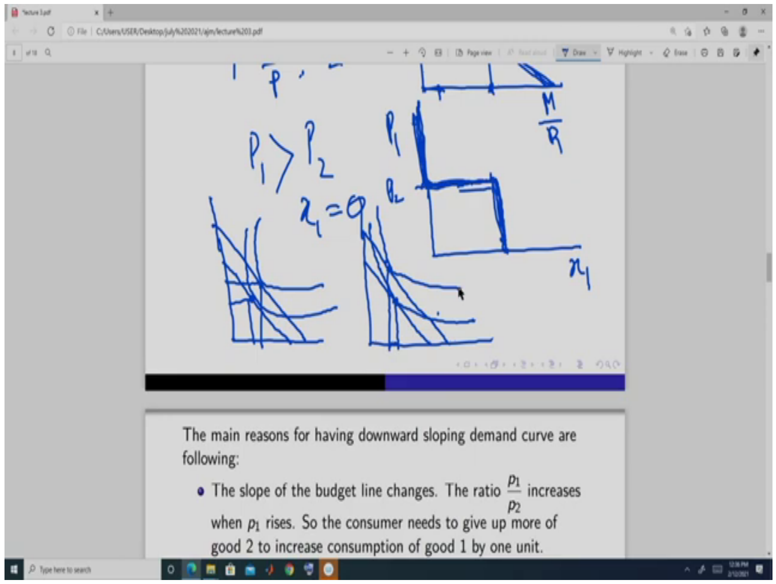

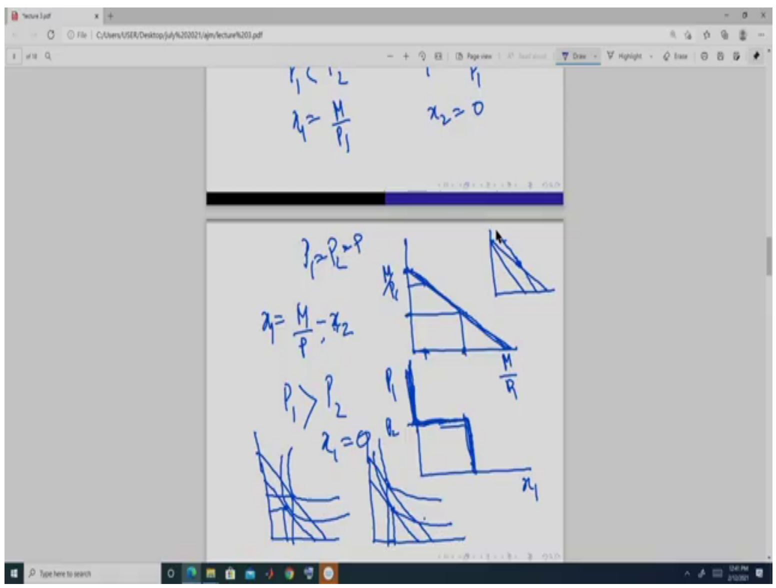

So, the law of demand says that if the good is a normal good, we will come to what is a normal good now just assume that it is a normal good, then if the price increases the quantity demanded should always goes down, given other things constant. What are other things? The other things are price of the other good, income and the taste and preferences here means the utility function is fixed that means the indifference curves are fixed.

Now, when I say normal good, it mainly means that suppose, I have this budget line and suppose this is my utility function and I have got this. Now suppose income increases, I am at this point, okay. So, this is your new optimal point, when income is increasing in this way budget line has parallelly shifted upward, demand for both good has increased, right.

So, this you can say is a normal good, but suppose the situation is something like this. So, what is happening to the demand for good 1. As the income has increased, demand for good 1 has gone down. So, in this case we say that good 1 is an inferior good when income increases demand for that goes down. So, when we are seeing that it is a normal good then it means that whenever income increases demand for that is going up or it will at least not good down, okay.

So, whenever our consumption bundle is such that both the goods are normal then the law of demand says that if the price of good 1 suppose goes up, then quantity demanded of good 1 is going to go down because price has increased. Keeping other things constant it means that the price of good 2, p2 is fixed, m is fixed and the utility function is also fixed in this case, which means that our tastes and preferences are same, okay.

Now, why do we get such a downward sloping demand curve? One, reason is it is mainly because of two effects and these are called income effect and substitution effect. Income effect says that, suppose your a price is fixed p1and p2 and whenever the price of p1increases, then this ratio that is m by p1, i.e $\frac{m}{p_1}$it falls.

So, it means what? That now, whatever earlier amount of maximum amount of good 1 you could have bought, now, you cannot. So, in real terms, we say that your real income has fallen. So, this has fallen, but you can buy what the maximum amount of good 2 what was earlier, what you were buying, then this we know the way the budget line shifts whenever price of good 1 changes, right.

So, whenever price increases, what happened budget line will shift inward, right and it will shift in such a way that now some of these bundle of good 1 which was earlier affordable now it is not affordable. So, that is why we will reduce our demand for this good 1, okay**.** Because there is an effect of actually in real terms our income has gone down because this- $\frac{m}{p_1}$has fallen, okay, this is income effect.

Another thing is the moment p1 and, p1suppose increases this ratio p1 by p2 what happened, this is what, this is your exchange rate we have done it, it is the slope of the budget line that changes. So, in this case suppose here what is happening? We have like this, now, price of good 1 has suppose in case so, it will be like this.

So, earlier suppose the optimal point was, is at this point now, here, if we look at this point only, this point, the slope is now changing at this point. So, this bundle, whatever I am willing to substitute, if I want to consume one more unit of good 1, how much amount of good 2 I am willing to substitute that is given by the slope of indifference curve. And what I am supposed to substitute that is the exchange rate is given by the slope of the budget line that is this has changed.

Now, what it means that the market is asking you to give up more of good 2, if you want to consume one more unit of good 1. So, that is why what you will do, you will reduce your consumption of good 1. So, this is something called a substitution effect, that moment, the price of good 1 increases, what happened?

The p2 by p1this ratio, that ratio is the exchange rate, that is what if you want to increase one more unit of good 1 how much market is allowing you to reduce the amount of good 2 asking you to reduce the amount of good 2 that is the exchange rate or slope of the budget line. Now, that changes, it actually increases this ratio and once it increases so, it means what you have to now give up more unit of good 2.

So, and you are getting the utilities in the same way. So, you will reduce the consumption of good 1 rather, okay. So, that is why the demand for good 1 decreases when price of good 1 increases and similarly, when the price of good 1 decreases the demand for good 1 is going to go up because the moment the price decreases, it means what? this ratio- $\frac{M}{P_1}$is going to go up. So, your real income is actually increasing.

So, you will demand more of this good and when the price of p1 falls it means what this ratio is going to go down. So, now, your market is asking you to reduce less amount of good 2 to increase one unit of good 1, okay. So, you will consume more of good 1, okay. So, this is the main reason for why a demand curve should always be downward sloping if the goods are normal goods, okay.

Now, we will move from so, what we have done? We have done that the demand for any good is derived, we have derived the demand for any good from a utility maximization problem. Now, we move to the market demand curve. So, we know that suppose these many peoples are there in this market and we know that demand curve of each individuals then what is going to be the market demand curve. Market demand curve means that at each price how much is the total quantity going to be demanded in that market.

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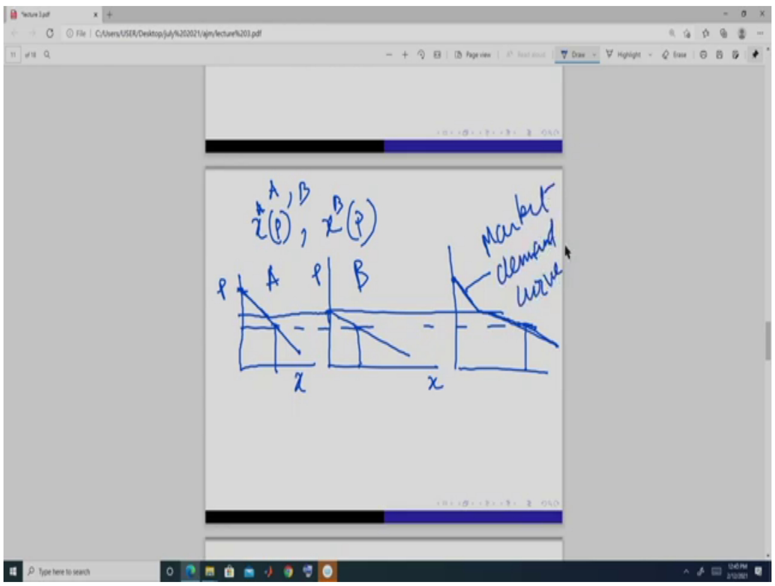

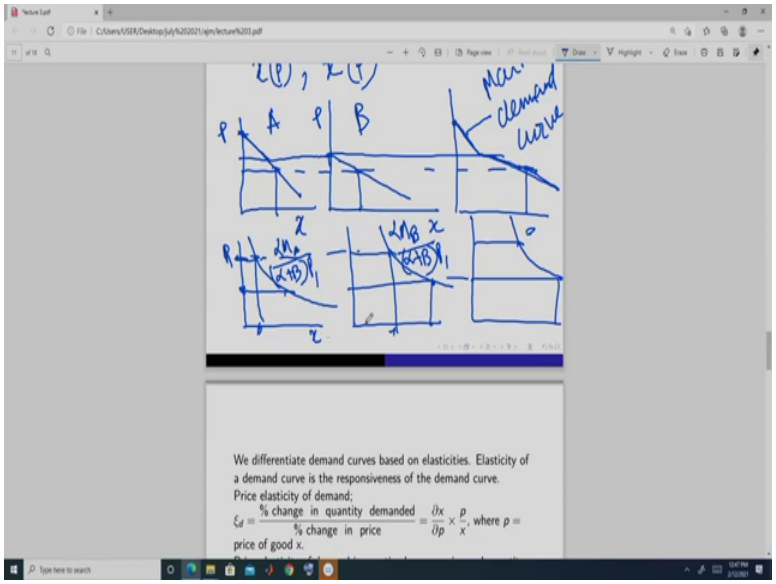

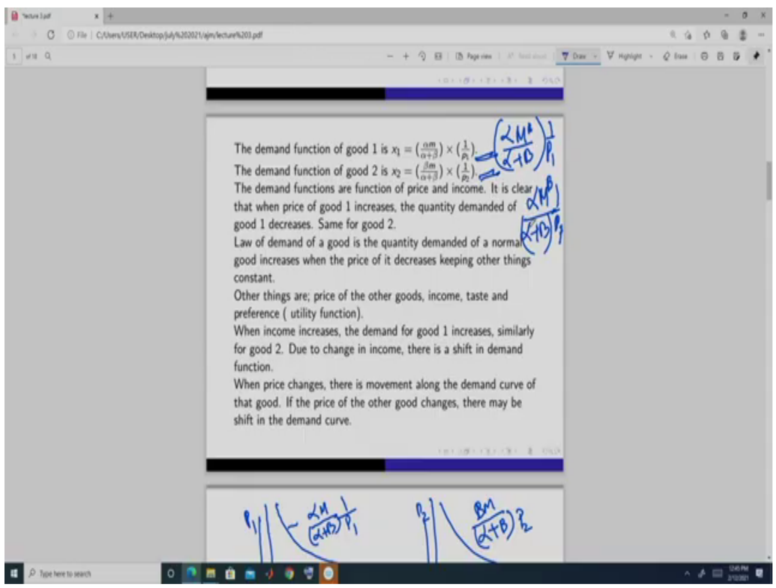

So, what do we do to get the market demand curve? We do something called horizontal summation, and what is this, suppose we have two individual, individual A and individual B. Demand curve demand function of individual A is suppose this- $x^A(P)$, it is some function of income and price and demand curve function of B is this-$x^B(P)$, okay, something like this for suppose this is good A, person A and this is for person B, okay

Now, the market demand curve is at this price what is the demand, only person A is demanding, B is not demanding anything. So, it is like this, so till this price, our demand curve is only this, that is same as this, but after this price we have to add both. So, at this price quantity is this much and this much**,** right. So, this together gives me some amount like this. So, we will get a horizontal curve some like this, this is going to be the market demand curve, okay.

Now, in our example, where we have derived this demand curve, suppose this is the demand curve- $x_1 = \left(\frac{\alpha m}{\alpha+\beta}\right).\ (\frac{1}{p_1})$ and suppose for person A it is mA alpha plus beta 1 by p1, i.e $\left(\frac{\alpha M^A}{\alpha+\beta}\right).\frac{1}{P_1}$ and for person B it is alpha by B alpha plus beta 1 by p1, i.e $\left(\frac{\alpha M^B}{\alpha+\beta}\right).\frac{1}{P_1}$. So, if we plot them, we will get something like this- p1 will be like this, where we can write it as alpha mA alpha plus beta p1, i.e $\left(\frac{\alpha M_A}{\alpha+\beta}\right).\frac{1}{P_1}$and suppose it is something like this for alpha B alpha plus beta p1, i.e $\left(\frac{\alpha M_B}{\alpha+\beta}\right).\frac{1}{P_1}$ this is for person B and this is for person A.

And if we, when we do the sum, we will get a curve like this and this is going to be the market demand curve. So, what we do is for each price we add the quantities at this price this much is the quantity, at this same price this much is the quantity so, market demand is this plus this. So, we get this much, here at this price we get this much quantity this, this much quantity. So, market demand is something here like this. So, this horizontal summation of each individual demand curve will give us the market demand curve, okay. And we will need the market demand because the firms are going to face the market demand, okay.

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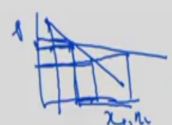
We differentiate demand curves based on elasticities. Elasticity of a demand curve is the responsiveness of the demand curve.

Price elasticity of demand;

$\xi_d = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}} = \frac{\partial x}{\partial p} \times \frac{p}{x}$, where $p =$ price of good x.

Price elasticity of demand is negative because price and quantity demanded is inversely related.

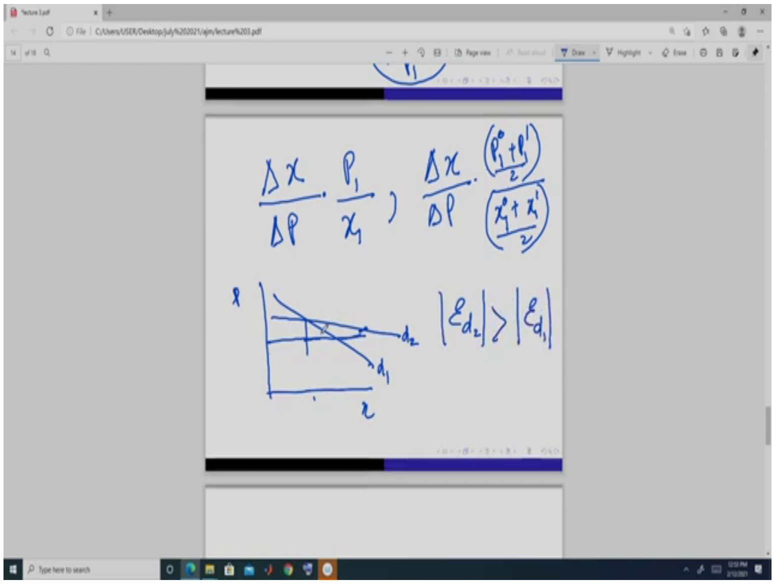
If $|\xi_d| > 1$ then it is elastic demand. If $|\xi_d| < 1$ then it is inelastic demand. If $|\xi_d| = 1$ then it is unitary elastic.



$x_1(P_1, P_2, M)$

$\frac{\partial x_1(P_1,P_2,M)}{\partial P_1} \cdot \frac{P_1}{x_1}$

$\left| \frac{\partial x_1(P_1,P_2,M) / x_1}{\partial P_1 / P_1} \right| = |\mathcal{E}_d|$



Next, we come to another topic and that is the elasticity. Elasticity actually gives you how responsive the demand curve is to, to changes in price. Suppose, you have a demand curve of this is good and this is the price, suppose good 1 and this is the demand curve of one individual, okay or this is the demand curve in this market you can say or you can say suppose here we are plotting two types of good good 1and good 2, this is 1 and another demand is suppose something like this, right.

So, now, when we are changing price suppose the price is here and if we change the price so, at this price quantity demanded is same, but when we decrease the price here quantity demanded has increased by this amount, in this case it has. So, in this case responsiveness is much higher than this for a change in price, right. So, here if we have, say in this case, we have to reduce only this much price to get this much change in a.

But here we have to reduce this much a huge amount of price to get same amount of, so, these things are defined based on something called elasticity, how responsive the demand curve is to change in price. So, this is called the demand elasticity, okay, mainly the price elasticity of demand. Okay. So, when we calculate it as percentage change in quantity demanded divided by percentage change in price.

So, if we are given a demand curve like this- x(p), p like this, suppose this is demand curve there are some other variables also. So, this is suppose p1 and it is something like this- $x_1(P_1, P_2, M)$, then if we want to find the price elasticity of good 1 then what we do, we take, this is what?, i.e $\frac{\delta x_1(P_1, P_2, M)}{\delta P_1}$ this is the slope of demand curve. If we change price slightly how much quantity demanded is going to change, multiplied like this- $\frac{\delta x_1(P_1, P_2, M)}{\delta P_1} . \frac{P_1}{x_1}$.

So, here this term- $\frac{\delta x_1(P_1, P_2, M)}{x_1}$ this is percentage change in quantity demanded divided by this term- $\frac{\delta P_1}{P_1}$ this is percentage change in price or if you are looking at suppose change from this unit of price to this unit of price you can do it in this way. That is changes in quantity demanded divided by changes in price p1, this one- $\frac{\delta x}{\delta P} . \frac{P_1}{x_1}$ and this you can take the initial price or you can take average of these two price, both are possible.

So, this is suppose initial price plus like this. So, this here this is again percentage change, this also you can say a percentage change, okay. Now, here we can categorize demand function in terms of elasticities. Now, suppose the elasticity now this elasticity see here since the demand curve is always downward sloping, so this slope is always going to take a negative value for a normal good.

So, what do we do? We generally take the absolute value of this and we would call this as elasticity of demand is generally represented in this form- $\frac{\frac{\delta x_1(P_1, P_2, M)}{x_1}}{\frac{\delta P_1}{P_1}}$, okay. So, because what do we want to see that we know that since we are looking at only the normal goods, so, it is always going to be downward sloping. So, all of them will going to take negative value. So, that is why we make them positive by taking only the absolute path.

Now, if the absolute value of this elasticity is greater than 1, we say it is elastic, if it is less than 1we call it inelastic. And if it is equal to 1, we call it unitary elastic. And you can look at these things like suppose your, something like this, this is your demand curve and your demand curve is this. This is more elastic than this, because when you change a price, the same amount. quantity demanded is changing in this case much more. So, if this demand curve is suppose d2 and this is d1, then elasticity of d2 is definitely going to be greater than elasticity of d1, right.

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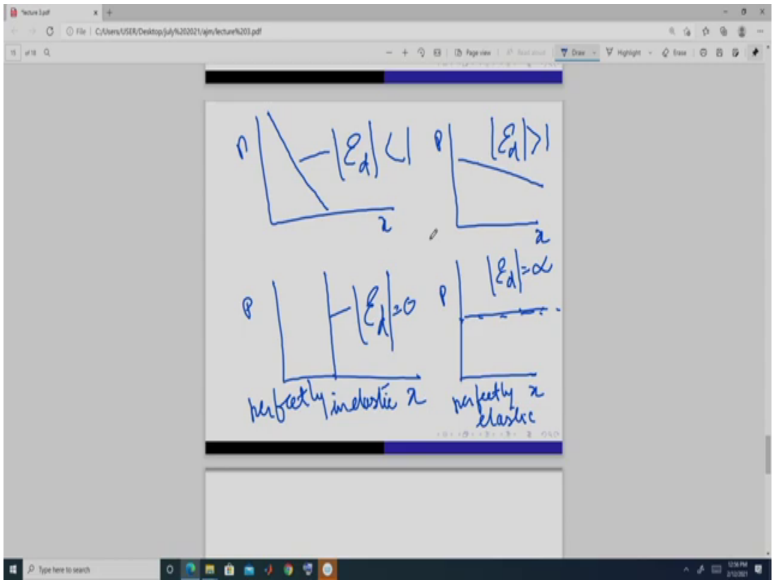

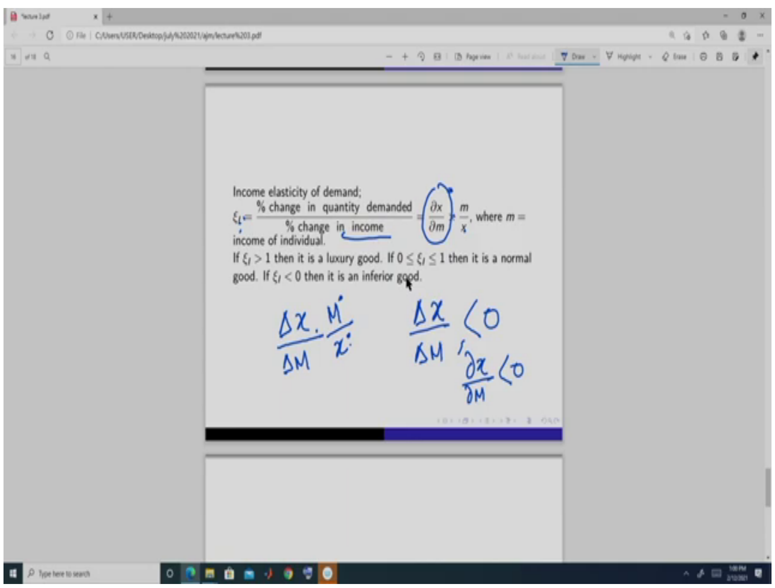

And if our demand curves are something like this, then these are generally inelastic demand curve where elasticity is generally less than 1. And if we take a demand curve of this nature then the elasticity is generally elastic and it is greater than 1, okay. And from here actually, you can see that if we take the demand curve is of this nature suppose whatever may be the price, quantity demanded is fixed, okay, this is when elasticity is actually 0, it is perfectly inelastic.

And so, this is and if we get something like this, demand curve is suppose, of this nature then elasticity is actually infinity. So, it is perfectly elastic than we demand any amount at this price, this amount or this amount or this amount, right. So, if we slightly change increase the price the quantity demanded becomes 0 and here even if we reduce, it does not make any difference because at this price anything can be demanded, okay. So, this is called perfectly elastic.

And so, if a demand curve is more closer to this vertical line, then it means that the elasticity is less so, it is inelastic, so, less than 1 and if it is more closer to the horizontal line, then it is it means that elasticity is more elastic it is elasticity is greater than 1, okay. So, these things we may require in the course, because specially when we do the monopoly, we will see the how the price is determined in a market it depends a lot on the price elasticity of demand. Okay.

Next, we do something called an income elasticity. Income elasticity is given by this formula that is- percentage change in quantity demanded divided by percentage change in income. So, given your demand curve, we know it is always going to be a function of income. So, if you change the income, so, how the demand is going to respond and then we convert it into percentage change. So, it is you can look at it is this changes in quantity demanded by changes in income and then income divided by - $\frac{\delta x}{\delta m} \cdot \frac{m}{x}$.

So, this is something called a at a point if we slightly change the income how slightly the quantity demanded is good, or we can convert it into this- $\frac{\delta x}{\delta m} \cdot \frac{m}{x}$, okay. So, this is changes in quantity demanded due to changes in income and this is the initial income and the initial quantity demanded, okay. So, this is now, if this takes a positive value, then it is not an inferior good and when it can take a negative value it is when this $\frac{\delta x}{\delta m}$ is negative, or this term is negative, this is what it means.

It means if you increase income by how much amount quantity is going to increase this. Now, if this is negative then it means what if you increase income this much decrease, if you decrease this then this must increase, then only this is a, so, this is only when we have an inferior good **or** then when our income increases, we reduce the consumption of that good and we get also in marginal terms, we get this to be negative.

And we would call those goods whenever, if we have a demand curve and that demand curve is such that whenever we increase the income and if the quantity demanded decreases, then we say that it is an inferior good. And if this income elasticity is greater than 1 that is, if the income changes by 1 percentage unit, then the amount of quantity demanded, if that increases by more than 1 percent then we say that it is a luxury good.

And when there is 1 percent increase in income, the quantity demanded it increases by more than 1 percent then we say it is a luxury good. And if it lies between 0 and 1we say it is a normal good that is whenever if there is a 1 percent increase in income and the quantity demanded that increases, but it lies between less than 1 percent or less than equal to 1 percent and if it is greater than 0, then we say it is normal good, okay.

So, this is how we classify goods in these three terms if we look at normal, inferior and luxury. Another is elastic, the good is elastic in demand the price elasticity is when it is greater than 1, we say it is inelastic when price elasticity of demand is less than 1, okay.

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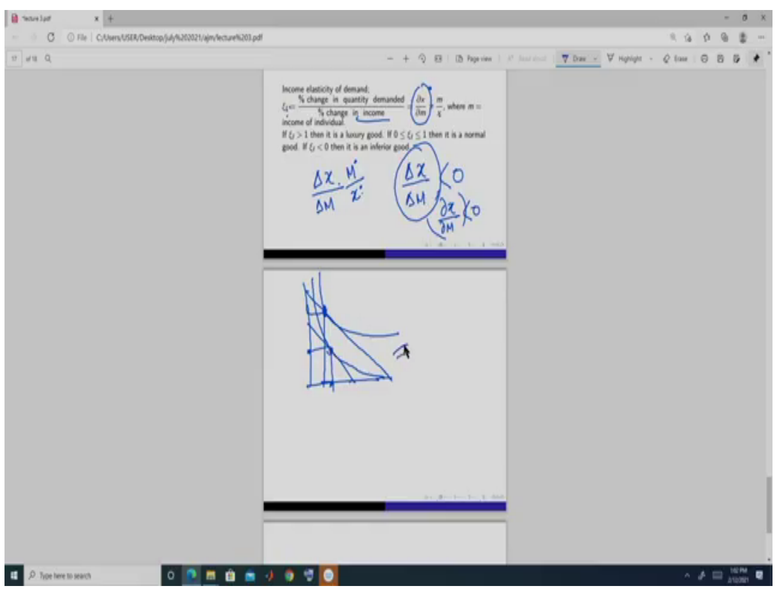

And now here in this case, I just simply I should give you one example simply to see that what actually it means. I have already shown it suppose we have this, now suppose income increases by this much amount and for some reason our optimal point is this. This is the optimal demand for good 1 and this is for good 2 when income increases from such that the budget curve, budget lines shift from this line to this line, demand for good 1 optimal bundle is this, so demand for good 1 has gone down. So, this is negative or you can say this is negative. So, this is an example of inferior good, okay.

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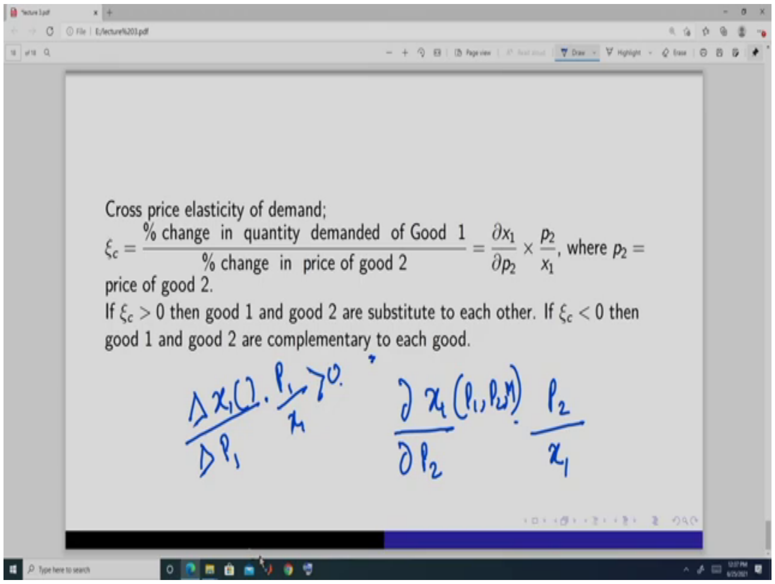

Now, we will look at cross elasticity of demand. Cross elasticity of demand means that if suppose there are two good, good 1 and good 2, if I vary the price of good 2, how much there is change is going to be in the demand of good 1. So, that is how responsive is the demand of good 1. So, if suppose these good 1 and good 2 are substitutes.

So, if price of good 2 increases, then the demand for good 1 should also rise because when the price of good 2 increases, then the demand for good 2 is going to go down and so, people will substitute to good 1 and so, the demand for good 1 is going to go up. So, whenever this goods are substitute cross elasticity is positive, price of good 2 has gone up. So, demand for good 1 has gone up.

But if the goods are complimentary, then when the price of good 2 increases, then the demand for good 2 is going to go down. So, demand for good 1 is also going to go down because they are complimentary in nature. So, it is negative and we calculate this based on this- $\frac{\delta x_1}{\delta p_2} . \frac{p_2}{x_1}$. So, we will have the demand curve. So, demand curve is this- $\frac{\delta x_1(P_1, P_2,M)}{\delta P_2} . \frac{P_2}{x_1}$which is a function of p1, which is a function of p1, p2, and it should be a function of m also, then we take this derivative partial with respect to p2 and this is p2 divided.

And or if we look at in terms of difference, it will be difference in x1 divided by difference in price of x divided by this or we can take the average of these prices- $\frac{\Delta x_1}{\Delta P_1}.\frac{P_1}{x_1}$. So, this is going to be positive when we have substitute goods and this is going to be negative when we have complimentary goods, okay.

Now, whenever this is positive, it means that when price of good 1 increases, demand for good 2 also increases. So, when price of good 1 increases, it means what, demand for good 1 is going to go down and cross elasticity suppose that the demand it is positive. So, the demand for good 2 is increasing. So, it means, that good 1 and good 2 are substitutes because, whenever the price of one good increases, we try to substitute it with some other goods which are now whose price has not gone up.

Similarly, when the cross elasticity is negative, that is when the price of good 1 has suppose increases and increased and the demand for good 2 has also gone down it means what, it means that price of good 1 has increased. So, the demand for good 1 is going down. So, at the same time a good, which is complimentary to good 1, it is demand is also going to go down. So, that is why whenever cross price elasticity is negative, we say that these 2 goods are complimentary in nature.

It is something like this, then when the price of suppose ink increases, then at the same time the demand for pen is also fountain pen is also going to go down. So, this is what we are going to cover in consumer behavior. So, what we have done, we have done that we know how to get a demand curve from a utility maximization and once we know the demand for a good from there, we can find out the market demand curve by doing a horizontal submission.

And then we also know how to classify the demand different demand curves like in terms of price elasticity, in terms of income elasticity and also in terms of cross price elasticity. So, in this course, we will only need this much of consumer behavior. So, from next class we will start the second module and that is the production and cost, okay. Thank you.