

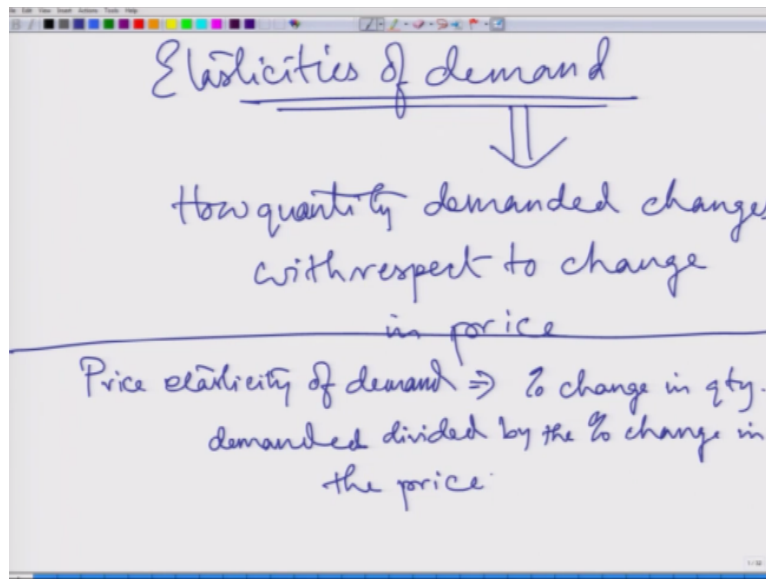
Economics of Health and HealthCare
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Lecture - 08
Price Elasticity of Demand

Hello everyone. In this session, we will discuss about elasticities of demand. So we will start with what is elasticity. So elasticity and the word elastic are very you know close to each other, so when we think of an elastic is that you know pull them in both the sides and we see that way that they are expanding or not. A rubber band is more elastic than an iron rod that is primarily given the pressure or given the you know the force.

The rubber band expands more as compared to an iron rod. So this means that given an effect on something how does that particular matter which is dependent on that effect changes.

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When we talk about elasticity of demand when we talk about elasticities of demand, we are actually talking about how the quantity demanded changes with respect to change in price. Yes, therefore we can state that when in demand my quantity demanded inversely is related with the price that means when price increases quantity demanded falls. In price elasticity of demand, we want to estimate the responsiveness of quantity demanded for a particular commodity to changes in price.

The responsiveness of quantity demanded for a particular commodity because with the commodity to commodity the responsiveness varies with changing unit price. So it is defined as the percentage change in quantity demanded, so price elasticity of demand is defined as the percentage change in quantity demanded divided by or with respect to percentage change in price.

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$$E_p = \frac{\% \text{ change in qty demanded}}{\% \text{ change in price}}$$

$$= \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$E_p = \frac{-2\%}{10\%} = \frac{2}{10} = -0.2$$

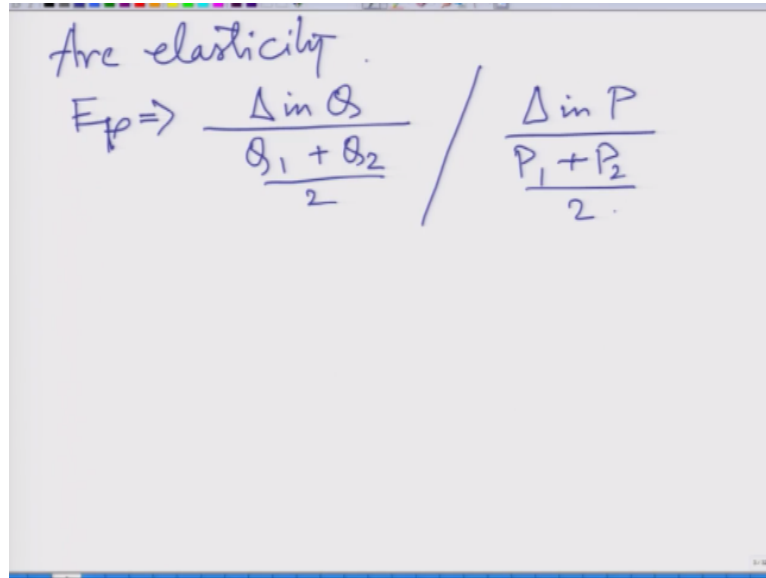
Therefore, this primarily shows that E_p you can keep capital E small p or small e small p or epsilon p whichever way you want to keep it. It shows that percentage change in quantity demanded/percentage change in price. In a simpler way, we can show that percentage change in quantity demanded as total change in the quantity/the quantity total change in price/the initial price that means $\Delta Q/\Delta P \cdot P/Q$.

And they are essentially if price say price of a particular medicine increases by 10 percent, how much the percentage change in demand takes place? Eventually in a general framework you know the demand should fall because of the increase in price. So we can state that in our example if percentage change in price is 10 percent and that leads to fall in demand by 2% that means it is 2/10 that is 2/100/10/100, so which is eventually 2/10 and which is 0.2.

And it is – that is primarily because price and quantity demanded is inversely proportional. So -0.2, which what does it mean? What is the interpretation? This shows that when price of a particular product say medicine increases by 10%, it results into a fall in demand by 2% that is all. So price elasticity basically a relative quantity shows the relative quantity that is the quantity change in terms of change in price.

So it is a relative measure always negative because price and quantity are inversely proportional or inversely related. So you can eventually ignore the minus sign you know. So we have as I showed in my previous formula that this is as simple as $\Delta Q / \Delta P * P/Q$.

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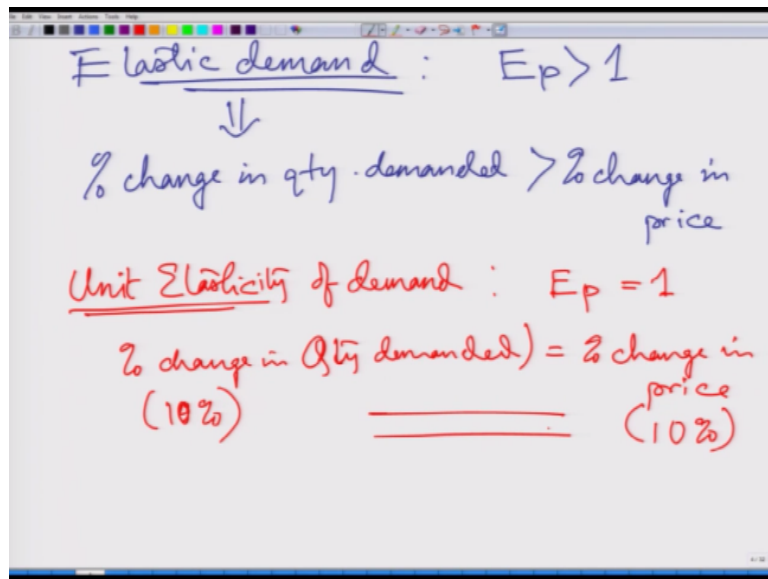


Arc elasticity
 $E_p \Rightarrow \frac{\frac{\Delta \text{in } Q}{Q_1 + Q_2}}{2} / \frac{\frac{\Delta \text{in } P}{P_1 + P_2}}{2}$

We can also have a formula called arc elasticity which is also known as arc elasticity but it eventually shows any kinds of elasticity, price elasticity, income elasticity or whatever but what is the difference in arc elasticity is it shows the same E_p , $E_{small p}$, it shows the change in quantity demanded by this average of those quantities Q_1 and Q_2 . The average of the quantities/change in price and the average of the price.

That means it is considering 2 price points and the average of that you know those two price points, so it takes the arc between those two points. So it is also known as arc elasticity. So the price elasticity arranges you know it can be $-\infty$ to $+\infty$ or you know 0 sorry 0 to $+\infty$, so which eventually shows if I have my say my quantity demanded is increasing at a higher rate as compared to the rate of change in my price then it is an elastic demand.

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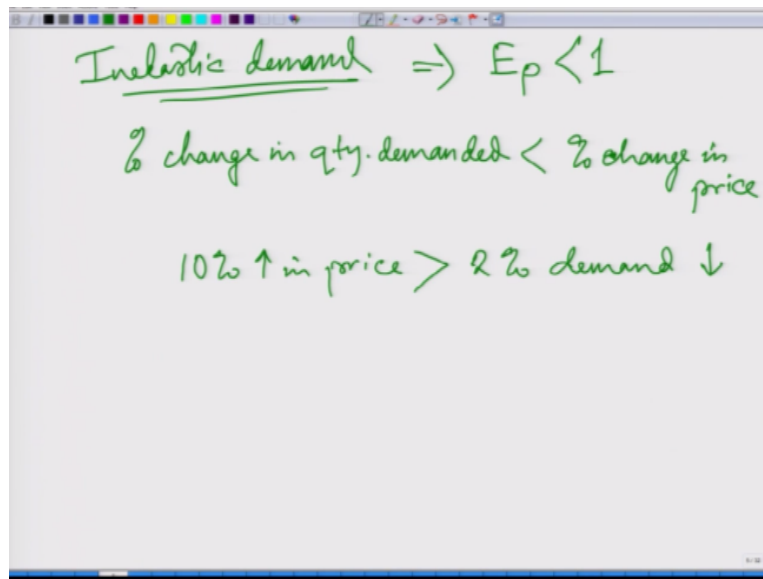
Elastic demand when my price elasticity is > 1 . Yes, now what is this elasticity demand again? When the percentage change in quantity demanded is $>$ the percentage change in price. That means if my price changes by 10%, if my quantity demanded changes by 20% that means you know consumers are responding strongly to those price changes.

And you know the quantity demanded has fallen down more as compared to the change in price that is an elastic demand you know when you with a given force your rubber band expands more that is more elastic as compared to an iron rod so that is that elastic demand. So over here total expenditures and prices are negatively related, inversely related in the elastic region of demand curve. We will discuss about that later.

So the total expenditure you know in terms of this to procure that good $P \cdot Q$, P of price of that price and then the total amount of that price $P \times x$ is you know it is inversely related anyways. So the next one is unique elastic demand. What does this means? Unit elasticity of demand better to say yeah. Elastic demand, unit elasticity of demand says when my price elasticity of demand is exactly $= 1$.

That means if my change in price is exactly equal to the change in quantity demanded is exactly equals to the change in price. Then, it shows that there is a unit elasticity of demand. To make it simple percentage change in quantity if this is 10% change in quantity demanded is = percentage change in price. That means this is also 10%. If this too similar, then there is an unit elasticity of demand.

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The next one is inelastic demand. In inelastic demand, we get an elasticity which is <1 . In inelastic demand, we get an elasticity which is <1 that means the percentage change in quantity demanded is $<$ the percentage change in price. Percentage change in quantity demanded is $<$ the percentage change in price. Now over here, we see that if because of 10% rise in price if my demand falls by just say 2% if I take that very first example.

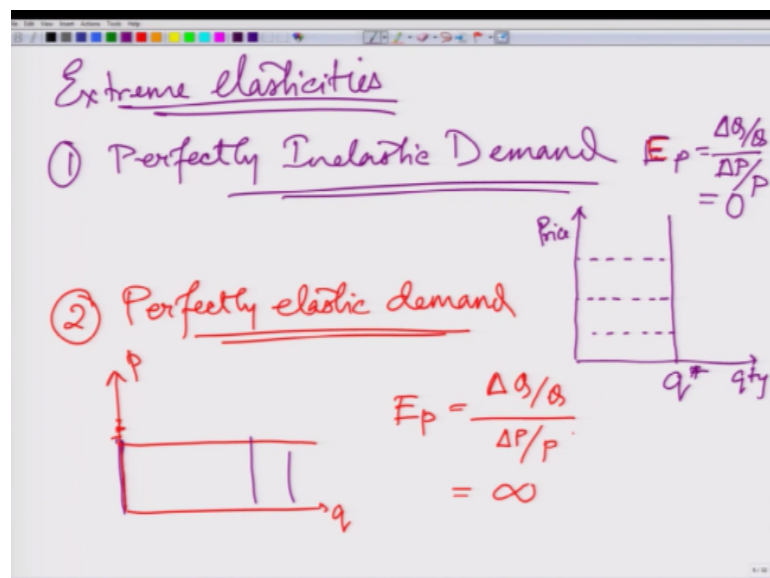
Then, there is an inelastic, so this is 10% change in price is $>$ the 2% change in demand or fall in demand that means there is an inelastic demand. So even if the price is increasing by a large margin the impact on the demand is not that very high. When we can take these examples, so in terms of elastic demand it can be anything you know if the price of a particular medicine increases by 1% or say it 5% my demand falls by 5%.

Then, there is an unit elasticity of demand. In case of elastic demand, if say certain medicines say some protein supplement right and then the price increases by 10% and I think that okay fine I would not take it say it has increased too much I would not take that protein supplement anymore, I will try to get it from my regular diet and that the demand falls by maybe 20, 25%.

Then, there is an elastic demand whereas for some generic medicines you know for some basic medicines what we have to take say paracetamol. If we have fever, we need to take say there is some antacids, basic antacids what we cannot avoid even if the price increases the demand does not fall by that much yes or if there is some life-saving medicines which do not have much of substitutes and all.

So if there is some life-saving medicines even if the price increases I am bound to consume them. Therefore, even if the price increases by a large margin the quantity demanded does not really fall by that extent yes. So in elastic demand our elasticity is >1 . For unit elasticity, it is $=1$ and for inelastic demand it is <1 . What about the extreme elasticities?

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These extreme elasticities are when the demand is absolutely elastic or the demand is extremely elastic. So what happens in case of a when they are extremely inelastic, so the first example can be price perfectly elastic demand, perfectly in elastic demand. So it shows the rigidity in terms of the demand. so what happens even if my price changes the demand does not fall or does not get impacted.

So even if my price increases, the demand does not change at all. So no matter what the price the quantity demanded remains unchanged and if I can draw then it will be a vertical line where if whatever the price is my quantity is remaining unchanged at q star. This is the perfectly inelastic demand and in this perfectly inelastic demand it shows zero responsiveness right.

And in the next one when we have again perfectly elastic demand, then with slightest change in price with slightest change in price, the increase in price, the demand leads to 0. Therefore, in a perfectly elastic demand we have a horizontal straight line perfectly so even if my price increases by little at this point, at this point my demand is 0. At this with this minute changes my demand becomes 0.

So this is price, this is quantity and this shows a perfectly elastic demand and in case of a perfectly elastic demand you know so over here this is change in quantity/ change in price yes and change in quantity becomes you know so again over here I am sorry E_p change in quantity by change in price I am not showing the arc elasticity.

I am just showing you the general formula, the easier formula you know where we have this simple Q and P not the average of quantity and average of price. So over here, it is infinite elasticity, over here this is 0 yes because ΔQ is 0, so anything divided like 0 divided by anything will be 0 right, ΔQ is 0 and over here ΔQ is enormous because you know that quantity is changing.

The quantity is changing from this much to this much you know from here to here with slightest change in price, so in that slightest change in price if we can consider that you know tending to 0, so it tends to infinity because anything divided by zero is infinity, so infinite elasticity. So what happens in terms of elasticity and total revenue?

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Elasticity & Total Revenue

$TR = P \times Q$

① Elastic demand \Rightarrow negative relationship b/w changes in TR & changes in price

$P_1 = 5$ $P_2 = 10$
 $Q_1 = 100$ $Q_2 = 25$

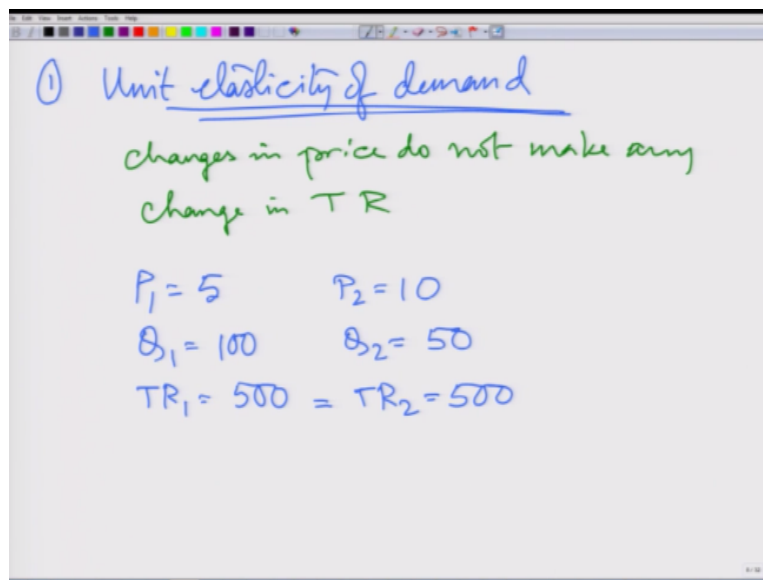
$TR_1 = 5 \times 100$ $TR_2 = 10 \times 25$
 $TR_1 = 500$ $TR_2 = 250$
 $P_1 < P_2$ $Q_1 > Q_2$

So when we try to find the relationship between price elasticity of demand and total revenue yes, how do I get total revenue? Total revenue is nothing but the price of a particular commodity * the quantity demanded of that particular commodity or quantity sold of that particular commodity. So when number 1, when demand is elastic there is a negative relationship between total revenue and price or you can say changes in total revenue and changes in price.

Why so? That is primarily because if just let us take an example, a very easy example, that when elastic demand is elastic what happens? My price I will change the color, say my price increases from 5 to 10 rupees, $p_1=5$, $p_2=10$. That means it has increased twice right, increase by twice. So what happens if my quantity demanded at price p_1 at price 5 was say 100 units, my quantity demanded after the rise in price falls down to 25 units yes.

So the total revenue 1 when my price was 5 rupees was 500, $5*100$, total revenue 2 is 250, $10*25$ 250. So your total revenue 1 is $>$ your total revenue 2 where price in 1 is $<$ price in 2. So the total revenue and price in a case of elastic demand has a negative relationship where in case of unit elasticity when there is unit elasticity in case of unit elasticity of demand what we find is the changes in price, do not actually make any change in total revenue.

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So changes in price do not make any change in total revenue. Why so? It is simple. If my price increases from 5 to 10 rupees increase by twice, my quantity falls from 100 to 50. How? It increases by twice, it falls by $1/2$, $1/2$ which is if you take the reciprocal are same that means there is an unit elasticity. So what happens with TR_1 is 500 $5*100$, TR_2 is 500 that means they are similar.

So even if price falls or price increases, the change is just exactly being equal, so it adjusts with the price, the total revenue becomes same and hence change in price do not have any impact on the total revenue. The next is when demand is inelastic.

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③ Inelastic demand \Rightarrow +ve relationship b/w
change in price & change in TR

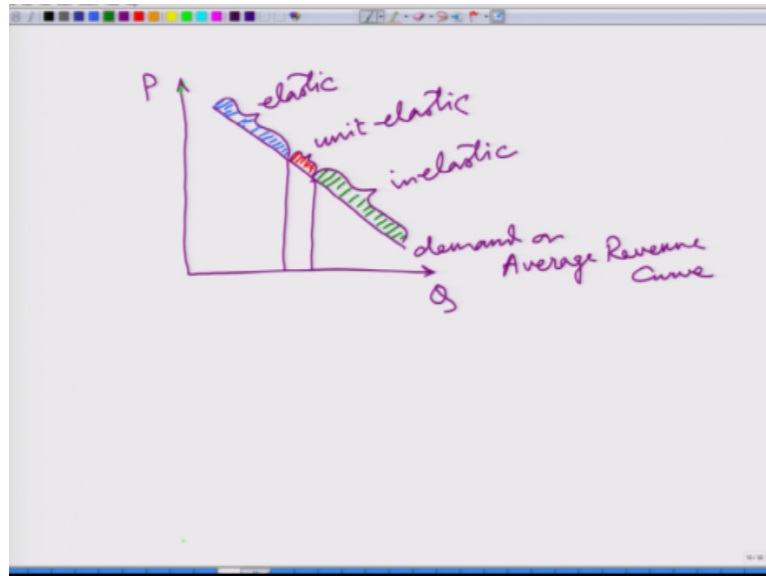
$P_1 = 5$	$P_2 = 10$	
$Q_1 = 100$	$Q_2 = 75$	
$TR_1 = 500$	$TR_2 = 750$	} +ve relationship
P_1	P_2	

So when demand is inelastic, it gives you a positive demand I mean positive relationship between change in price and change in total revenue. How does it happen let us see? Pretty simple, again I will take an example when price 1 from 5 increases to 10 twice. Quantity 1 does not fall that by half you know. So if it was 100 units, quantity demanded now becomes only 75 units you know.

So decreases by 25%, so what happens over here that my total revenue 1 is 500, total revenue 2 is 750, so total revenue 2 is $>$ total revenue 1 whereas price 1 or price 2 is $>$ price 1. So that means this 2 is moving in the same direction total revenue and price change in price and change in total revenue when change in price is increasing in inelastic demand, change in total revenue is also increasing.

So we have a positive relationship or positive association okay. So this is all about the relationship between total revenue and price. So if we are moving towards the relationship between price elasticity of demand and total revenue and we draw kind of a demand curve then we see. I will take a different color.

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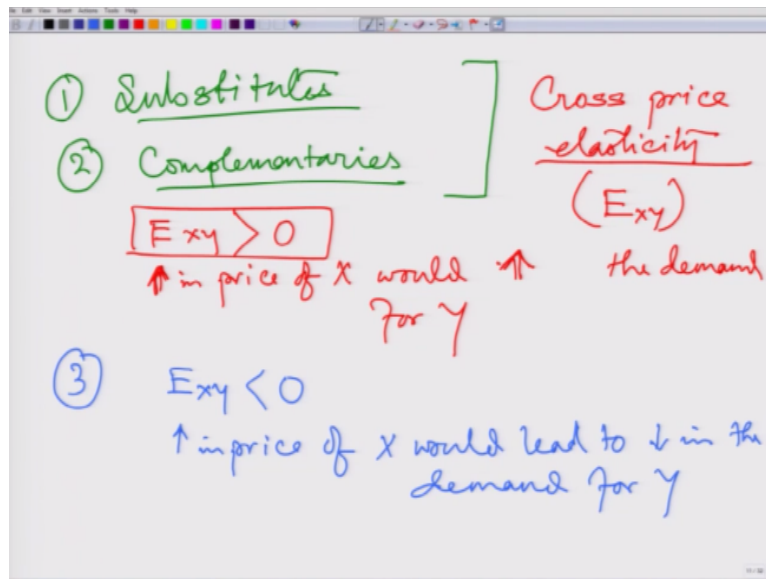


So over here it is the quantity, over here is the price and at this we have an elastic demand, at this we have an unit elastic demand and at this part we have an inelastic demand yes and then we can see that demand or average revenue curve. This is my demand or average revenue curve yes and this pretty well shows that in this region where it is blue with the change rise in price, the total revenue will fall.

At this region which is red with the rise in price the total revenue would not really change and with this region which is green with the rise in price because it is inelastic with the rise in price the total revenue will increase. Therefore, now till now we were discussing about the change in quantity with the change in price, change in total revenue with the change in price. When we are looking at the change in total revenue.

We are looking at the revenue derived from selling that particular commodity where else if I now look at the change in price of a related commodity of a related good, how does my you know the quantity demanded changes you know? So what happens when we talk about related commodities if you can go back to the earlier sessions then if you remember then we have two kinds of commodities which we are really interested in.

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One is substitute goods and two are complementaries yes. So what happens when we have a substitute good, these kinds of elasticity is known as cross price elasticity and given as E_{xy} cross price elasticity. That means if the price changes in x what happens with the quantity demanded or if the price changes in y what happens with the quantity demanded for x and this x and y can be either substitute goods or complementary goods.

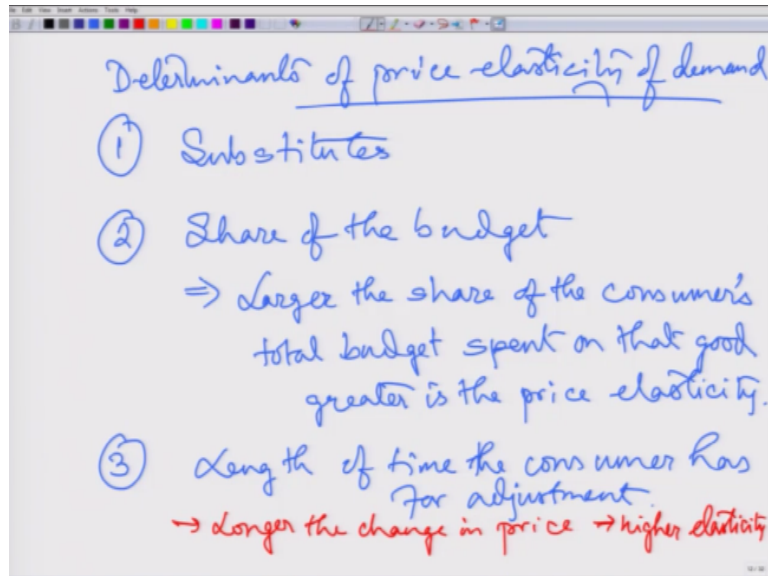
Now if they are substitute goods that means if we can take the same example of Iodex and Amrutanjan that if the price of Iodex increases the demand for Amrutanjan also increase because the price of Amrutanjan increases, the demand for Amrutanjan falls and those who used to take Amrutanjan they will shift to Iodex. Therefore, for substitute our E_{xy} is >0 yes as increase in the price of x would increase the demand for y yes.

So both of them are moving towards the same direction, increase and increase so naturally it is increase and increase, so they are positively associated. In case of complementary goods, E_{xy} is negative because this cross price elasticity says if the price of x increases, the demand for x falls and if the demand for x falls, the demand for y will also fall because without x y cannot find its market as they are complementary to each other complements.

So therefore it would be negative, so rise in price of x would lead to fall in the demand for y that means price of contact-lens if it increases, the demand for contact lens solution will also fall. So this is what we generally identify from our cross price elasticity in terms of substitutes and complementary goods. The price elasticity of demand hence can be affected by these commodities you know whether there is a substitute good or a complimentary good.

So while we are talking about the determinants of price elasticity of demand, the first thing should come to our mind whether there is any close substitute yeah.

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So the determinants of demand, the first thing should come to our mind is whether there is any close substitutes. If there is a close substitute what will happen, even if there is a rise in price I just do not care, I move to the other commodity falling you know because rising price I do not take that medicine anymore, I move to the other substitute and there are plenty of substitutes you can see, the compositions are same but the product are very, very similar kind of name you know.

So all these you know these pain balms (()) (30:42) Volini, this, that Moov, they are basically by large they are similar yeah Moov. So the price change in one medicine can heavily impact its business because there are close substitutes, they will move to those substitutes. Similarly, if there is a complementary good and I need to keep in mind if there is a change in the price then I need to identify that because of the change in price of that other demand how much my you know my elasticity will be suffered with my demand will be suffered.

The share of budget greater that it shows that how much out of my total budget, how much I share for a particular commodity yes, say if my grocery or if for my medical expenses how much I spent behind medicines or out of all the medicines how much I spent behind a particular type of medicine yes.

So if there is a larger share or larger share of consumer's total budget spent on that particular good, total budget spent on that particular good larger will be the elasticity on that commodity greater is the price elasticity because if price increases I am already spending too much out of my entire budget for a particular commodity, if price increases then I am actually consuming more and more.

I cannot afford that because I also need to get other stuffs, so eventually if I spend a larger share of my budget for a particular commodity and the commodities price rises, I have to think over and then probably I will cut down on that particular product in a manner that which increases the elasticity which has an elastic demand, so my demand for that commodity will be decreasing more as compared to the rise in price.

The length of time allowed for adjustment you know today the price rises I do not come to know or you know I have gone to a market, I need salt or I need a medicine, the price has suddenly increased yesterday or maybe sometimes back I have no idea but I had to take that medicine alright, that day my medicine is over I have to take that medicine every day or that time somebody in my family is ill right.

So I need to take that medicine and I do not have time for adjustment, so what I will do, the longer so I will just write it down, time or length of time the consumer has for adjustment. So the longer any change in price persists, the greater is the elasticity of demand because what happens if longer the change in price persists, larger is the elasticity or higher elasticity yes. So that means now I have so immediately probably I could not alter my decision.

I went on to get that medicine, I waited for some time it did not you know decrease, so I will change my decision. I will shift to other commodities yeah because if the price does not really come down within our time which I give it to adjust the price or I expect it to adjust its price, if the price does not fall during that period of time I will not continue consuming that particular product.

I will move to other products, so maybe many consumers because we finally look at the market demand and many consumers after a certain while may not continue with that particular product and even if the price has increased by 10% slowly at the shorter point of

time, it may be inelastic that those who had to buy they still bought, they had no idea, they did not research about other alternatives or they did not think of really about that.

Or many of them were loyal kind of loyal to that particular brand, so they did not move but for a longer period of time every individual is rational, so they have to think over their decision to continue buying that particular commodity and eventually the fall in demand for that price if the price change persist for a longer period of time, it decreases by more than 10% making this as an elastic demand.

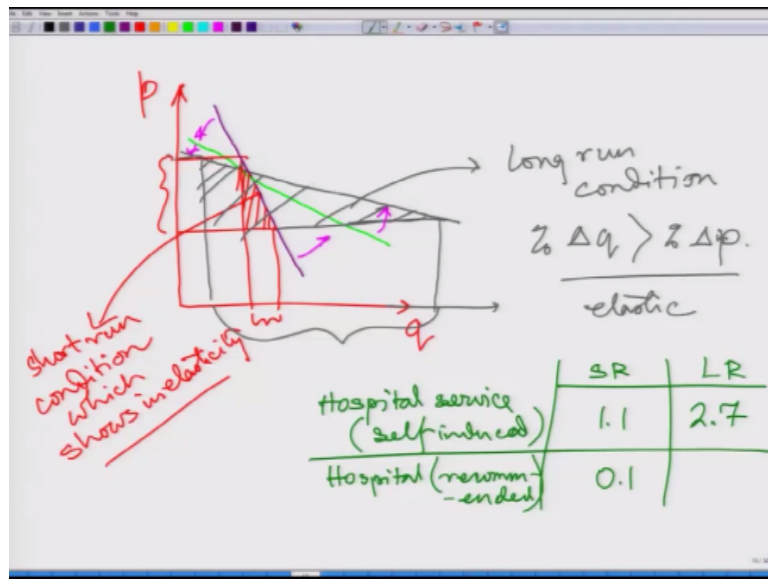
So in the shorter period of time, it may be inelastic but in the longer period of time it is of course elastic and then the second is that how to define now this short-run and long-run. It is not like a production process or something. So the short-run in this concept where I can adjust my demand given a certain change in prices, the short-run is basically where the consumer is unable to adjust their demand.

I have to go for a doctor I have to you know I am ill, I have to visit a doctor and even if the price increases of that hospital or the doctor's consultation charges increases I do not do anything, I cannot do anything but if it happens you know or nothing has happened to me, I just came to know that the doctor or the hospital has increased its charges, I can think over that and when I am falling ill or what I will do.

I will do a little bit of search and then probably people who have found some other doctors will consult if that doctor is good. So we can shift to that other doctor when you know something happens to my family or I need to visit a doctor because I have been given a time. So in the short-run, the consumer cannot change, it is a too short time to adjust their demand after getting to know that the price has changed.

A longer duration, long run is basically a period long enough where you can decide upon whether you will continue buying the product or getting the services from a particular service provider or not.

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It is your choice, so in the short-run as I said that it is basically inelastic, so even if the price changes, the quantity demanded does not change much so in the short-run it can be elastic, so you can see it is steeper you know. So over here it is quantity, over here it is price, so even if the quantity you know the price change by a large margin, the change in quantity is smaller. So that means over here this is a short-run condition yeah.

So this is a short-run condition which shows inelasticity yes where else whereas when we have time to adjust you know slowly my demand curve gets shifted like this and then further like this where you can see with the same amount of price change or I will just remove this, with the same amount of price change from here to here, from here to here you know my quantity demanded falls from here to here.

So this is the change in price when it is gray and this shows this particular duration shows a long-run condition where the change in quantity is greater than or the percentage change in quantity is greater than the percentage change in price. So that means now it is an elastic condition in the longer run. So these particular curves shifts or pivots this way yes this way. So it pivots this from steep it gets flatter.

So some basic examples of price elasticities of demand for selected goods can be safe for us, hospital service which is self-induced, so a hospital service which is self-induced, self-induced means when I decide that okay I will go for you know some basic medical check-up yeah and in the short-run and in the long-run. So in the short-run, the self-induced hospital service can be close to unit elastic or slightly elastic whereas for long-run it will be 2.7.

That if a certain hospital or a certain diagnostic center is charging too high I would not go to them right. I have six months' time to figure out another one or you know every six years or every one year if I do, so I can (FL) take time and then slowly decide that whether I will go for this hospital service because it is a self-induced or not.

Eventually, if my hospital service is not self-induced, if my hospital service is recommended or referred by a doctor or referred by a doctor then what I do the short-run it should be it is close to almost inelastic. That means I cannot do anything, even the price is more the doctor has suggested me an immediate surgery, I have to go right. I just cannot bother about them mostly you know.

So on a rational point of view, so it can be almost inelastic that the price increase does not have any change on the quantity demanded whereas over the period of time if the doctor says that okay you have say one-month time before the surgery, I can probably decide on which particular hospital services or which kind particular hospital I will refer to do my surgery. So similarly we have to think these types of example can be in several ways you know, the private clinics again, it can be close to unit elasticity.

At the short-run, the elastic price elasticity of demand whereas over the long-run it can be around 2 or 2.5 based on different people, different problems, different countries, different you know every socio-economic condition therefore and say for an example if i want a transportation for a vacation purpose and generally you know kind of plan of vacation, so in short-run that transportation can have you know elastic demand.

And the elasticity increases with long-run whereas in case of emergency if I need a taxi or something to say in case of a pregnancy or something in short-run it will be inelastic 0.4 or 0.5 whereas in long-run it will still be not very elastic, not highly elastic, it will be unit elasticity, it can be slightly >1 or slightly <1 you know, even if it is a long-run I can figure out a transportation arrangement.

So all these you know there can be several types of examples where you know eventually it can be so for this taxi service in case of emergency it can be or in the short-run it can be inelastic whereas in the long-run where even if it is an emergency even if there is a pregnant

lady in my home and I know that within 7 days she can have that labour pain, she has to get to a hospital for the delivery.

So I know those 7 days, so I can arrange a transportation facility. So that goes as even if it is an emergency but I still have some time. So that can go to an elastic demand, you know from inelasticity it moves to elasticity so what we learnt just by this diagram. Thank you.