Economics, Management and Entrepreneurship

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Lecture – 06
Exercises on Economics

Good morning. Welcome to the sixth lecture on Economics, Management, and Entrepreneurship. In the last 5 lectures, we had covered basics of microeconomics theory. Today, we shall discuss certain exercises on those theories that we had developed in the last 5 classes and it will hopefully give you much more insights into the real life applications of the basic microeconomic theory that we have discussed in the last 5 lectures. I have covered 2 or 3 exercises from relevant to each of the lectures as you will see.

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Exercise 1

Demand function for TV sets is given as

$$Q = -2{,}000\,P + 1{,}000\,Y + 0.01\,POP$$

where,

P:	Price of a TV set
Y:	Disposable income of a person in a year
POP:	Population

(a) Find the demand function and plot the demand curve for TV in a year if *Y* = 16,000 Rs/year/person and *POP* = 900,000,000 persons.
(b) If the price of a TV set is 10,000 Rs per set, find the quantity demanded.
(c) Population remaining same, the disposable income is only 11,000 Rs/year/person. Plot the demand curve.

The first exercise that I take is from the demand supply and market equilibrium lecture. This is a problem on demand function for TV sets is given as Q = - 2000 P + 1000 Y + 0.01 POP, where P is the prize of a TV set, Y is the disposable income of a person in a year, and POP is population. This expression is developed on the basis of (()) (02:09) data and it is assumed that this equation defines the demand function for TV sets. Three questions are asked.

Find the demand function and plot the demand curve for TV in a year, if the disposable income Y is 16,000 per year per person, and POP is 900 million persons. That means Y and POP values are given and we are required to find out relationship containing Q with P. The second part of the question is if the price of a TV set is 10,000 rupees per set find the quantity demanded. The third part is population remaining same the disposable income is 11,000 rupees per year per person instead of 16,000 which was given here.

Suppose that it comes down to 11,000 then plot the demand curve. So first thing is that we are starting with this particular equation something like regression equation where a demand function for Q is a given as a function of P, Y, and POP and we are required to find out relationship containing Q with P for Q with P given the values of Y and POP.

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Solution

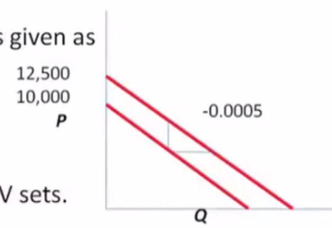
Given the demand function for TV sets as

$$Q = -2{,}000\,P + 1{,}000\,Y + 0.01\,POP$$

$Y = 16{,}000$ Rs/year/person
$POP = 900{,}000{,}000$ persons

(a) The demand function for TV sets is given as

$$Q = -2{,}000\,P + 25{,}000{,}000$$
$$P = 12{,}500 - 0.0005\,Q$$



(b) If $P = 10{,}000$, then $Q = 5{,}000{,}000$ TV sets.

(c) If $Y = 11{,}000$ and $POP = 900{,}000{,}000$,
$Q = -2{,}000\,P + 20{,}000{,}000$ and $P = 10{,}000 - 0.0005\,Q$

It is straight forward what we do to solve the first part of the problem. Firstly, these are given this equation is given and these are the initial values given. The first (()) (04:12) question is find the relationship between Q and P. So if I put values of Y here and of POP here, then I get a constant which is 25 million. So Q is = - 2000 P + 25 million and P thus = 12,500 - 0.0005 Q. So if I plot P against Q it will have a negative slope = - 0.0005 that is what I have shown here - 0.0005 the intercept is 12,500 so this is 12,500 and the slope is - 0.0005.

The second part of the question is (()) (05:25) that if P = 10,000 then what is the value of Q. P we know the relationship between Q and P Q = this so the value of P is given as = 10,000. The estimated value of Q is 10,000 * - 2000 that is - 20,000 when we subtract that from 25,000 this becomes 20 million and we subtract that from 25 which gives us 5 million deficits so that is the second part of the question.

The third part of the question is if instead of Y which is given as 16,000 rupees per year per person suppose that the disposable income reduces from 16,000 to 11,000, population remaining same then, what is the demand function and what is the demand plot the demand curve. So what we need to do is just put the value of y as = 11,000 and not 16,000 and put POP = 900 million as it was so that gives us a value Q = the coefficient of P does not change, only the constant changes.

It was earlier 25 million now it has become 20 million. So intercept, so P = 10.000 – this. So, the coefficient of Q is - 0.00005. Here also it remains the same. Only the intercepts change from 12,500 it has come down to 10,000 which means that for this reduced disposable income the demand curve is a straight line which is parallel to the original line. This is the original line for Y = 16,000, POP = 900 million persons. So, this is shifted to the left, the slope of this line remaining the same as, 0.00005 negative. This is the first question.

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Exercise 2

Supply function for TV sets is given as

$$Q = 2{,}000\,P - 1{,}000\ \ PC - 50\,PL - 1{,}500\,T$$

where,

PC:	Price of a music set – a competing product, (Rs/set)
PL:	Price of labour, i.e., Labour cost (Rs/person/year)
T:	Tariff on imported TV set (Rs/set)

(a) Find the supply function and plot the supply curve for TV in a year when *PC* = 8,000 Rs/set and *PL* = 80,000 Rs/person/year, and *T* = 2,000 Rs/set.
(b) If the price of a TV set is 10,000 Rs, find the quantity supplied.
(c) Other values remaining same, the value of T changes to 1,000 Rs/set. Plot the supply function.

Now we come to exercise 2. Now, this is an example, where an earlier study has indicated that the supply function for TV sets is given as a function of price of the TV set, price of a competing product such as a music set then the labour cost that is price of labour and the input duty or Tariff on imported TV set. So these are defined here PC, PL, and Tariff and this is the estimated regression equation that relates Q with P, PC, PL, and T.

Three parts of the question are given here. The first part is find the supply function and plot the supply curve for TV in a year when values of PC, PL, and T are given. If the price of TV set is 10,000 rupees, find the quantity supply other values remaining same. If the value of T changes from the earlier value of 2000 rupees to a new value 1,000 rupees then how will this supply function change? Now let us take out this particular exercise.

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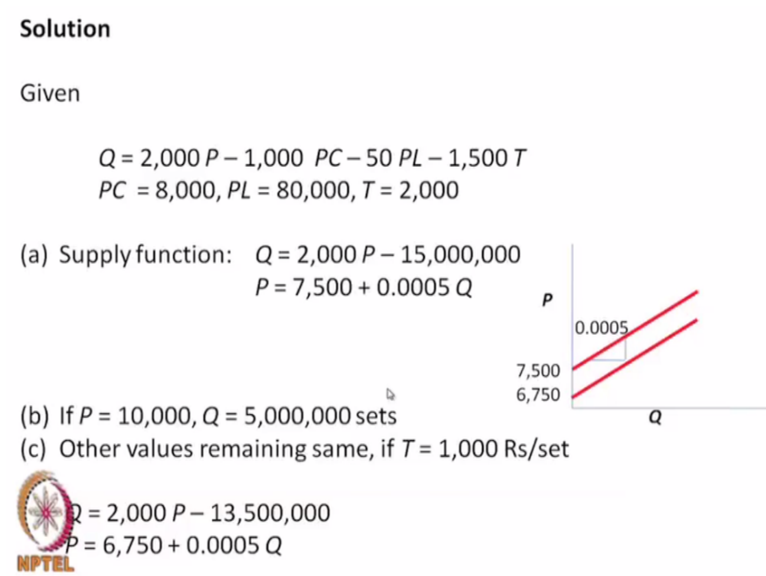

So given the regression equation containing Q. P, PC, PL, T values of PC, PL, and T are given and when I put these values here for PC 8,000, for PL 80,000 for T 2,000 I get the relationship containing Q between Q and P such as this from here I can find P which is 7500 + 0.0005 Q. So the intercept is 7,500 and the slope of this line is 0.0005. So I plot this one here. This curve is the supply curve having a positive slope whose value = 0.0005 and if P = 10,000 if P = 10,000 the value of Q is given as 10,000 * 2,000 that makes it 20 million - 15 million so that gives 5 million sets.

Now the third part of the question is if other values remain same, but only T changes from the given value of 2000 to 1000, then how will the relationship between Q and P changes. The demand curve will have an equation. You put the values here. T = 1000 so Q becomes 2000 P -

13, 500,000 and from here I can find P. The intercept is 6,750 corresponding to the point here 6,750 and the slope is exactly same positive and the value both are same so this line is parallel, but the intercept being lower than the previous value it means that as T is reduced it shifts to the right. So this is the exercise 2.

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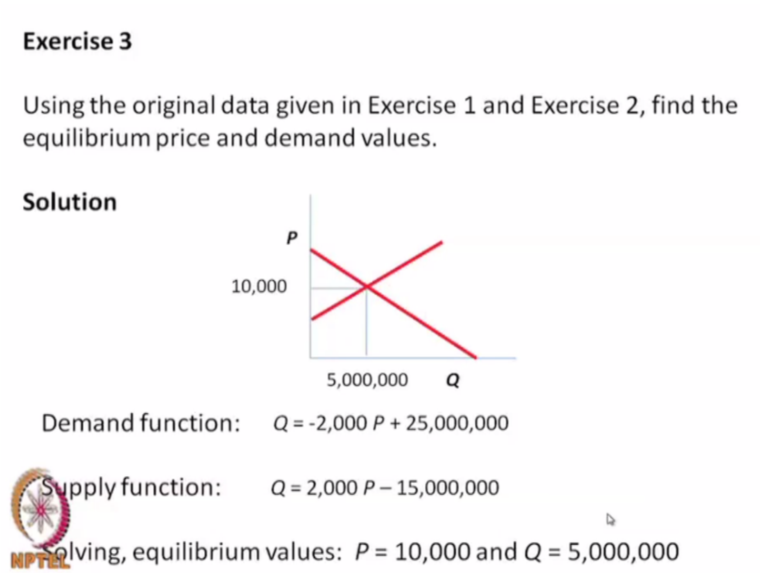

Now we go to exercise 3. Here, we are trying to find out the equilibrium value and there are 2 ways one is floating graphically. This is our demand curve with a negative slope. This is our supply curve that has a positive slope. The point of intersection gives the equilibrium value of price and output. In this case, the value is obtained as 10,000 rupees per set and this is 5 million TV sets in a year. Analytically also one can find this value.

Plot find the demand function that we have already generated which is - 2000 P + 25 million and supply function we have already found out Q = 2000 P - 15 million so equate them at the equilibrium point at the equilibrium and we will get this = this and that will give us a value of Q and P. The equilibrium values of 10,000 for price and 5 million TV sets as the output of the quantity. This is exercise 3.

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Exercise 4

Given the price (P) and output (Q), fill in the remaining columns of the table.

Q	P	TR	MR	AR
0	80			
1	75			
2	70			
3	65			
4	60			
5	55			
6	50			
7	45			
8	40			
9	35			
10	30			

Now we come to exercise 4 in this example this exercise we are given price and output for a particular product in these 2 columns quantity and price and we are required to find out the total revenue, marginal revenue, and average revenue. Now total revenue is nothing but

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Solution

Q	P	TR	MR	AR
0	80	0	-	0
1	75	75	75	75
2	70	140	65	70
3	65	195	55	65
4	60	240	45	60
5	55	275	35	55
6	50	300	25	50
7	45	315	15	45
8	40	320	5	40
9	35	315	- 5	35
10	30	300	-15	30

Q * P is also known as sales or total sales or sales revenue or total revenue. It is just the total amount obtained by selling this amount of this quantity of goods. So nothing is sold, so the revenue is 0, total revenue is 0. One at a price of 75 therefore the revenue is 75 * 1 75. Suppose the price is 70, quantity is 2, so it is 140. If 3, it is 65 these are given so just multiply. So product of Q and P is basically = TR and is found out.

This column gives the total revenue for this quantity sold. Now marginal revenue is if quantity increases by 1 then what is the increment of revenue. So from 0 to 1 the increment is 75. 75 - 0 is 75. From 1 to 2 total revenue increases from 75 rupees to 140 rupees so the increment in total revenue is 140 - 75 which is = 65. Similarly, from quantity 2 to 3, the total revenue increases from 140 to 195 giving an increment of 55 that is the marginal revenue.

So the marginal revenue is calculated in this manner and you will see that marginal revenue reduces and becomes negative and even more negative as quantity increases and price reduces. Now average revenue is nothing but total revenue/quantity and in this case, it is same as price. Of course, 75/1 is 75. This AR cannot be found out. Sorry this should not have a 0 there. It should be a hyphen here.

Because 0/0 is nothing. 75/1 is 75. 140/2 is 70, 195/3 is 65, 240/4 is 60, 275/5 is 55, so basically this quantity, this average revenue is same as price excepting for the first one. So this is how we find out total revenue, marginal revenue and average revenue.

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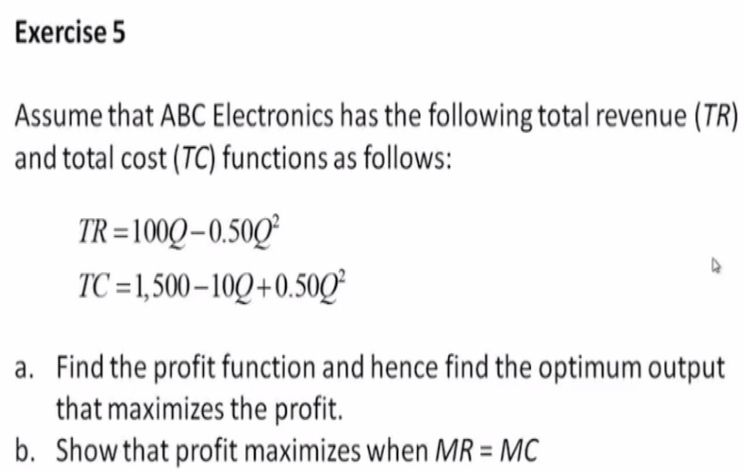

Now, we come to our next exercise and this says, assume that a company with the name ABC electronics has the following total revenue and total cost functions. So total revenue function is given in this fashion and total cost is given in this fashion and where Q is the quantity produced. Find the profit function and hence find the optimum output that maximizes the profit.

Now that we know total revenue and total cost we can find a profit function and we can optimize the profit. We can find out the value of Q that maximizes the profit that is what is the first part of the question? The second part of the question is show that the profit is maximum when the marginal revenue = marginal cost. So this is exercise 5. We go to the solution in this fashion.

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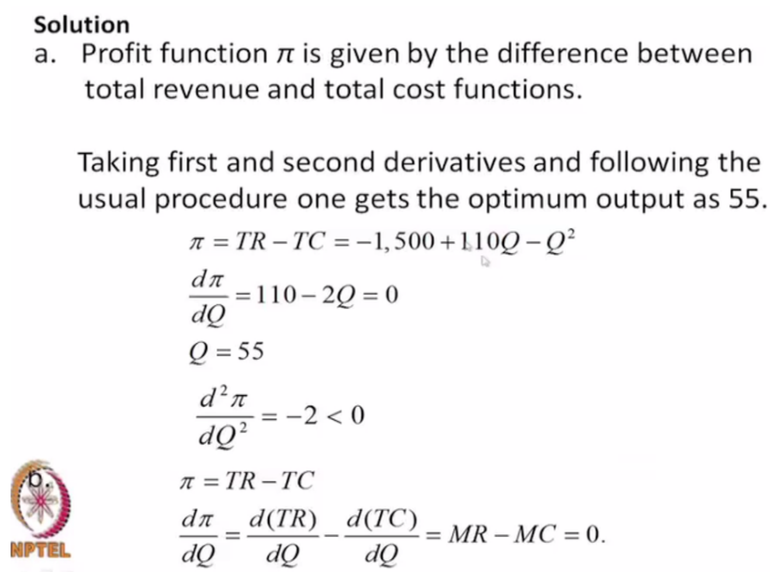

Define first of all that the profit function pi is given by the difference between the total revenue and the total cost. So total revenue - total cost is the total profit made and then we find out profit function and then we differentiate the profit function with respect to Q to find out the optimum value of Q that maximizes profit. So what we do here. This is pi, the profit function is total revenue - total cost so you subtract.

When we subtract the 2 we get this that is - 1500 + 110 Q - Q square. So this is a function of Q. So take the first derivative d pi/dQ we get 110 - 2 Q put that = 0. So this is the necessary condition for a function to be maximum or minimum. The first derivative must be = 0 and that gives the value of Q = 55. To find out whether this value of Q minimizes or maximizes pi, we go to the second derivative.

Second derivative is - 2 which is < 0 it means that at this value of Q pi must be maximum. So the first part of the question which is find the profit function it is subtracting TC from TR which is this and the optimum value of Q that maximizes profit is 55. We have tested that it gives the maximum value. The second part of the question was that show that at that optimum point MR = MC.

It is very straight forward. Pi = profit = total revenue - total cost which is written here. If I take the first derivative with respect to Q which we have done here that is nothing but first derivative of TR - first derivative of TC. The first derivative of TR with respect to Q is nothing but MR and the first derivative of TC with respect to Q is nothing but marginal cost and since d pi/dQ has to be = 0 when it is maximum MR must to be = MC. So it is very straight forward this is the second part of this exercise.

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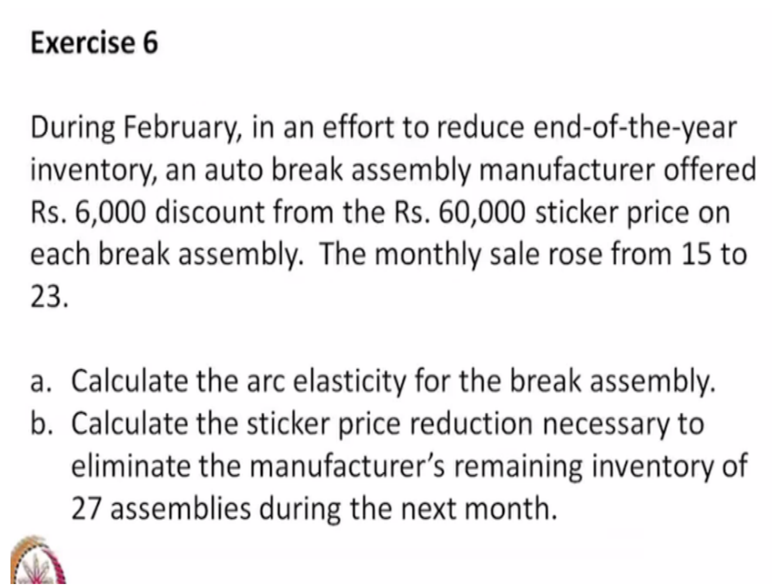

To exercise 6, this exercise deals with arc elasticity. Now, if you read this exercise during February, in an effort to reduce the end-of-the-year inventory, an auto break assembly manufacturer offered rupees 6,000 discount from the existing rupees 60,000 sticker price, on each break assembly. The monthly sale rose from 15 to 23 on account of this price discount. Now you see that the change is something like 10% which is higher than 5%.

And if you recall whenever there is a price change of more than 5% we go for computing the arc elasticity of demand. The question therefore is given. So the question therefore is given is to calculate the arc elasticity for this break assembly and the second part is quite interesting it says calculate the sticker price reduction necessary to eliminate the manufacturer's remaining inventory of 27 assemblies during the next month.

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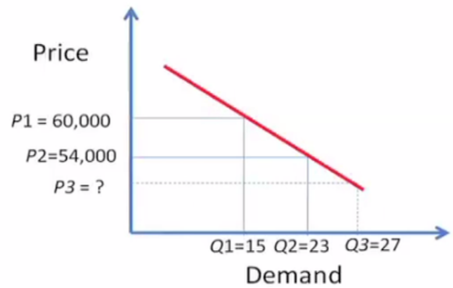
Solution



a. $$E_P = \frac{Q_2 - Q_1}{(Q_2 + Q_1)/2} \div \frac{P_2 - P_1}{(P_2 + P_1)/2} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{(P_2 + P_1)}{(Q_2 + Q_1)}$$

$$E_P = \frac{23 - 15}{54,000 - 60,000} \times \frac{54,000 + 60,000}{23 + 15} = -4$$

$$-4 = \frac{27 - 15}{P_2 - 60,000} \times \frac{(P_2 + 60,000)}{(27 + 15)} \Rightarrow P_2 = 52,000$$

$$P_2 - P_1 = 52,000 - 60,000 = -8,000 \text{ (Price reduction)}$$

Come to the solution part. This is the diagram that shows the situation. Now, this is the demand function for the auto break assembly. Now, the operating point is here that initially the price was 60,000 and the quantity demanded in the market were just 15 and the manufacturer reduced the price by giving a discount of 6,000 rupees bringing down the price from 60,000 to 54,000 and that resulted in an increase in the value of Q2.

Now this reduction is as you can see is 10% quite high therefore arc elasticity calculation is relevant here rather than point elasticity calculation and according to our equation for arc elasticity it is the change in the quantity by the average quantity/change in the price/the average price which results in this expression Q2 - Q1/P2 - P1 and P2 + P1/Q2 + Q1. This division by 2 cancels out.

So we have price elasticity of demand that is arc elasticity is given by this expression. Now put the values of Q2, Q1, P2, P1, etc and we get a value of arc elasticity as = - 4. Now the second part of the question is at the end of the month there are 27 break assemblies available if the arc elasticity is - 4 then what should be the price at which it can be sold so that all the 27 can be sold out that means if this Q3 is 27 what is the value of P3. So we use the same relationship except in that instead of P2 we now write.

We do not take the old value of P2, this actually is P3. So instead of P2 it should be P3, P3 and P3 and P3, therefore this changes should be done. So I am just putting these values here so this expression gives a value of P3 = 52,000, P3 - P1 = - 8000 that means a further discount of 8000 rupees per break assembly should be given and that will enable the manufacturer to sale out its remaining 27 inventory break assemblies. So this is example 6 or exercise 6.

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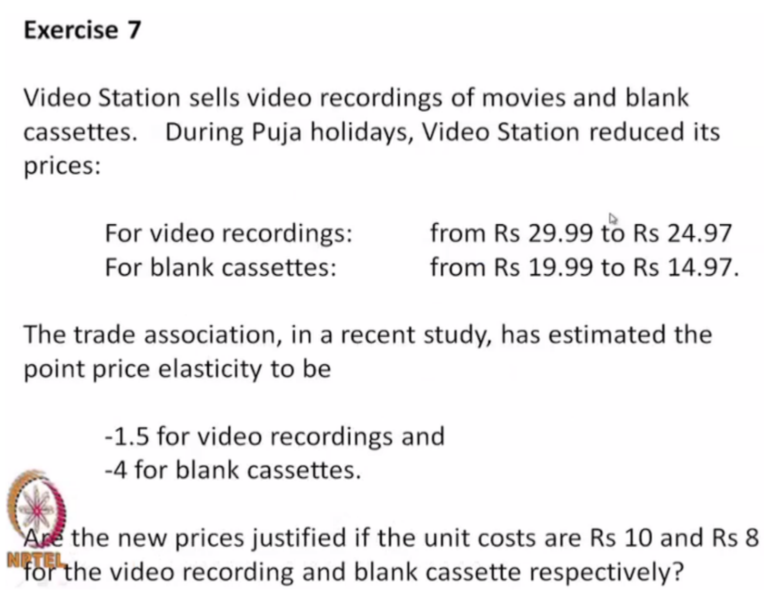

Now we go to exercise 7. Exercise 7 is likewise quite interesting. It says that video station sells video recordings of movies and also sells blank cassettes for home recording. Now during Puja holidays, video station reduced its prices as follows: For video recording it reduced its price from rupees 29.99 to rupees 24.97 and for blank cassettes it reduced its price from rupees 19.99 to rupees 14.97.

The trade association in a recent study has estimated the point price elasticity to be as follows: For video recording it has found out a value of - 1.5 and for blank cassettes it found out a value of - 4. Now in the right of this trade association's recommendations are estimated values of the point elasticities. are the new prices justified meaning these prices that the video station is now charging is it justified if the unit cost of manufacturing that is unit cost of preparing a video recording and having a blank cassette are rupees 10 and rupees 8 respectively. This is the question. Is it justified?

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Solution

Recall the relationship between MR, P and ε_P:

$$MR = \frac{dTR}{dQ} = \frac{d(PQ)}{dQ} = P + \frac{dP}{dQ}Q = P(1 + \frac{dP/P}{dQ/Q}) = P(1 + \frac{1}{(dQ/Q)/(dP/P)}) = P(1 + \frac{1}{\varepsilon_P})$$

At the equilibrium, MR = MC. Hence, the equilibrium prices at which this relationship will hold are the following:

$$10 = P_v\left((1 + \frac{1}{-1.5})\right) \Rightarrow P_v = 30$$

$$8 = P_c\left((1 + \frac{1}{-4})\right) \Rightarrow P_c = 10.67$$

Since $|\varepsilon_P| > 1$, the demands are elastic. New prices are Rs 24.97 and Rs 14.97. Hence, both price decisions are incorrect. Price of video recordings should be set at Rs 30 and that of cassettes at Rs 10.67.

Now recall the relationship between the marginal revenue, price, and point price elasticity epsilon P. Marginal revenue = d/dQ of TR that is unit change in Q brings in how much change in the total revenue. Total revenue is nothing but price * quantity PQ and as we know P is a function of Q so if you take the derivative it is first function as it is into the derivative of the second so, P * derivative of the second means, d/dQ which is 1 + derivative of the first function, which is dP/dQ * Q. So MR = this which is = P1 + dP/dQ keep it like this.

And here it is Q/P is take P here and Q here, so it becomes dP/P, dQ/Q and this is nothing but P taken outside 1 + 1/dQ/Q/dP/P and this by definition is the point price elasticity of demand that means a small change in P, a fractional change in P gives rise to how much fractional change in Q that is epsilon P. So, the relationship between marginal revenue, price and elasticity are these things. Now at the equilibrium as we already have seen marginal revenue = marginal cost.

Hence the equilibrium prices at which this relationship will hold are the following: As you know marginal cost for video recording is given as rupees 10 that will be = price of video recording * 1 + 1/epsilon P, so 1 + 1/- 1.5, the value that the trade association has estimated. Now if I solve this equation I get the value of price of video recording which is 30 rupees whereas the new prices that the company is charging is only 24.97 that means this reduction is not justified.

Now we go for the blank cassettes. Blank cassettes the marginal cost for the company for blank cassette is rupees 8. Using the same relationship with the new value of epsilon P as estimated by the trade association which is = - 4. The value of the blank cassettes would be the price should be set up 10.67 therefore setting rupees 8 is the setting the price as rupees 14.97 is also not justified it should be reduced to 10.67 whereas for video recording it should be increased to rupees 30.

So the new prices that the company is charging are not justified. Now you can see from this example that elasticity knowing the value of elasticity helps in fixing the prices. Now we got to the next example.

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Exercise 8

Annual sales of Babu Restaurant are as follows (in thousand rupees)

00	01	02	03	04	05	07	07	09	10	11
284	266	287	315	353	384	427	462	520	575	568

a. Calculate the annual rate of growth (assuming constant growth rate) with annual compounding.
b. Make a 5-year forecast.

The next example, next exercise, this exercise is on demand estimation and demand forecasting. We start with a very simple example where we show that the annual sales exercise is like this. Annual sales of Babu restaurant are as follows in thousand rupees: Starting from annual sales so some year, let us say 2000, this is 2001, 2002 like that up to 2011 and 284 thousand rupees, 266 etc follows like this and we are required to find out the annual rate of growth assuming a constant growth rate with annual compounding. Make a 5-year forecast.

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Solution

a. The following equation expresses the growth situation:

$Q_t = Q_0(1+g)^t$, where g is the annual growth rate.

Hence,

$$568 = 284(1+g)^{10} \Rightarrow 2 = (1+g)^{10} \Rightarrow \ln 2 = 10(1+g) \Rightarrow g = 0.0718$$

b. The five-year hence sales forecast is thus given as:

$Q_{15} = 284(1+0.0718)^{15} = 803.436$ thousand rupees.

So basically we are assuming that here that the growth of sale quantity sold at time t follows a power function, follows a growth such as this Q0 * 1 + g to the power t. Q0 is the sale in the year 2000 and g is the annual growth rate and to the power t. So this is the annual growth rate that means in the starting from 2000, 2001 sale is expected to be 2000 sale * 1 + g. 2002 sale will be 2000 sale * 1 + g to the power 2 so on and so forth. So from here suppose that we put the 2011 value as 568 and 2000 figure as 284 and t is 10.

Then this is the relationship from here we get 2 = 1 + g to the power 10, therefore ln 2 = 10 ln 1 + g. There is a mistake here there should be 10 ln 1+ g and that gives a value g = 0.0718. So this is the annual growth rate that is 7.18% and suppose that we are asked to find out or estimate 5-year hence sale forecast of the annual sales of Babu restaurant then it will be given as Q15 as 284 * 1 + g is 0.0718 to the power 15 and that is 803.436 thousand rupees.

So this is a very simple example of sales forecast that at any time the sale QT is defined as a compounded annual growth function.

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Exercise 9

The operations manager of a TV set manufacturing company believes that sales of its products in any month S_t increase by the same percentage as income I_t during the previous year.

a. Write an equation for sales forecast.
b. This month, sales totaled Rs500,000, while family disposable income increased from Rs25,000 to Rs26,000. Forecast the next year's sales.

Solution:

a. $S_{t+1} = S_t + S_t(\frac{I_t - I_{t-1}}{I_{t-1}}) + u$

$$S_{t+1} = S_t + (1+(\frac{I_t - I_{t-1}}{I_{t-1}})) = 500{,}000(1+(\frac{26{,}000-25{,}000}{25{,}000})) = 500{,}000 \times 1.04 = 520{,}000$$

Now we take another exercise on demand forecasting another simple example. The operations manager of a TV set manufacturing company believes that sales of its products in any month St increase by the same percentage as income It during the previous year. Write an equation for sales forecast. This month, sales totaled rupees 500 thousand while family disposable income increased from rupees 25,000 to rupees 26,000 forecast the next year's sales.

So for the first part of the question is, write an equation for sales forecast. The problem statement says that the operation manager believes that the sales of its product in month, St increases by the same percentage as income It. So we shall write St + 1 as = St + the change in S. The change in S as mentioned here is some fraction of St and that some fraction is nothing but as income percentage change. The income percentage change is It - t - 1/It - 1.

This is the fractional change which is same for St. So, the expression U is the (()) (39:46) the random error. So St + 1 is St + St * this fraction which is same as now the next part of the question is if the values are given you just put the values here. We put 500,000 is the St which is taken outside so it is 1+ 26,000 and it increased from 25 to 26 so 26 - 25/25 and that resulted in a value of 520,000 rupees that is the next year's sales.

So today, we have seen some applications, some exercises on basic microeconomic theory and also on demand forecasts. In the next lecture, we shall take some more exercises on production and then we switch over to cost benefit analysis, break-even analysis, and further in our forthcoming lectures next few lectures we shall study various aspects of costing, accounting, and engineering economy. Thank you very much.