2.6 Price elasticity of demand

Part 1 - PED is a measure of the responsiveness of consumers to a change in the price of a particular good. With data from a demand schedule, we can calculate the PED for a good between any two prices. For example, below is a table representing the demand for ski poles in Zurich during the month of December

Price (dollars)	Quantity Demanded
0	200
4	180
8	160
12	140
16	120
20	100
24	80
28	60
32	40
36	20
40	0

1. State the formula for determining PED between two prices

$PED = \frac{\%\Delta Qd}{\%\Delta P}$ or $PED = \frac{(Q2-Q1)\div Q1}{(P2-P1)\div P1}$ where P1 and Q1 are the original price and quantity demanded and P2 and Q2 are the new price and quantity.

2. By how much does the quantity of ski poles demanded decrease for every $1 increase in price of ski poles? How did you determine this value?

For every $1 increase the quantity demanded falls by 5 unit. I determined this because I can see that as the price increases by $4, the quantity always falls by 20 units. Therefore for each $1 increase there are five fewer units demanded.

3. Assume the price of ski poles increases from $4 to $5.
    a. How many ski poles are demanded at $4?

180

b. How many ski poles are demanded at $5?

175

c. By what percentage did the quantity demanded fall?

$$\%\Delta Q = \frac{175-180}{180}\times 100 = 2.7\%$$

d. By what percentage does price rise when it goes from $4 to $5?

$$\%\Delta P = \frac{5-4}{4}\times 100 = 25\%$$

4. Calculate the PED for ski poles between when the price increases from $4 to $5.

PED = $\frac{2.7}{25} = 0.11$

5. Assume price of ski poles increases from $28 to $29.

a. How many ski poles are demanded at $28?

60

b. How many ski poles are demanded at $29?

55

c. By what percentage did the quantity demanded fall?

$$\%\Delta Qd = \frac{55-60}{60}\times 100 = 8.33\%$$

d. By what percentage does price rise when it goes from $28 to $29?

$\%\Delta P = \frac{29-28}{28}\times 100 = 3.57\%$

6. Calculate the PED for ski poles when the price increases from $28 to $29.

$$PED = \frac{8.33}{3.57} = 2.33$$

7. How does the PED for ski poles at high prices compare to the PED for ski poles at low prices? What accounts for this difference?

At higher prices PED is greater than at lower prices. This is explained by the fact that as the price rises, the percentage increase in price resulting from a further $1 rise gets smaller and smaller, while the percentage decrease in quantity gets larger and larger as the quantity gets smaller. Since PED is the % change in Q over the % change in P, the coefficient gets bigger as the price rises.

Logically, ski poles are more expensive and few people have them at high prices, so a relatively small change in the price can lead to a relatively large change in the quantity demanded.

Part 2 - The responsiveness of consumers to price changes depends on many factors, which can be summarized with a useful acronym:

S - the number of substitutes a good has
P - the proportion of consumers' income a good represents
L - whether the good is a luxury or a necessity
A - whether the good is addictive
T - the amount of time consumers have to respond to a price change.

With these determinants of PED in mind, answer the following questions:

8. Assume there are 20 different manufacturers of ski poles. Why would demand for *a particular manufacturers* ski poles be far more elastic than demand for *ski poles in general*? Explain your answer clearly.

This relates to the number of substitutes available for a particular good. While ski poles in general do not have any substitutes (I guess you could use a stick!), a particular brand of ski pole has 19 different substitutes, so consumers will respond greatly to an increase or decrease in the price of that one brand. They can easily switch to a different brand if price rises, or buy more of the cheaper brand if price falls.

9. Assume SMITH manufacturers ski poles and that the number of competitors in the industry has recently increased from 20 to 30.

    a. How does the increase in competition affect consumers' responsiveness to an increase in the price of SMITH ski poles? Explain.

Because there are now more substitutes, demand for SMITH ski poles should become more elastic.

    b. What will happen to the equilibrium price and quantity of ski poles when the number of manufacturers increases?

An increase in the number of firms making ski poles will increase the supply and bring down the equilibrium price and increase the quantity.

    c. Based on your answer to (b), what should happen to the PED for ski poles in general following the increase in the number of manufacturers in the industry?

Demand is more elastic at high prices and less elastic at lower prices, so as the supply of ski poles increases and equilibrium price falls, the PED for ski poles in general will fall. More people have bought ski poles, so further decreases in the price will have a relatively limited effect on the quantity demanded.

10. Explain why skiers in Switzerland (a high income country) have a very different PED for ski poles than consumers in India (a lower income country).

Skiing is not considered a luxury in Switzerland, since incomes are high and it is relatively easy and affordable activity to do. To buy a set of ski poles would require using a very small proportion of a typical consumer's income.

In India, skiing is more of a luxury, so consumers are more responsive to price changes. Since average incomes are much lower, buying a set of ski poles would require a much larger proportion of a typical consumer's income.

For these reasons, we can predict that demand for ski poles will be more inelastic in Switzerland and more elastic in India.

11. In some communities, skiing is a way of life. Why are consumers in these communities less responsive to changes in the price of ski poles than those who live in communities far from the mountains and only ski while on vacation?

If skiing is a way of life, this implies that ski poles are a necessity. An consumer in such a community will need ski poles, and therefore may be less responsive to price changes than someone who does not need ski poles or can simply rent them once a year while on vacation.

12. Explain why the demand for goods like cigarettes and illegal drugs tends to be more inelastic than demand for soft drinks or ice cream.

These goods are highly addictive, so consumers are often willing to pay almost any price for them. This explains why we hear about drug dealers offering people “free samples” of addictive drugs (even very expensive ones). The dealer hopes that once the person tries the drug, he may try it again, and once addicted the dealer can start charging very high prices for the drug and the addict will pay! It also explains why governments love to place high taxes on cigarettes. Since many smokers are addicts, they will be willing to pay the high prices the tax creates and the government, therefore, will enjoy very high amounts of tax revenue.

Part 3 - Practicing PED calculations: Using the simple equation for PED, answer each of the following questions.

13. Assume the price of cigarettes increases by 50% due to a new law that raises the tax on cigarettes.

    a. In the short run, PED for cigarettes is 0.3. By what percentage will the quantity demanded fall following a 50% increase in the price? Show your work.

$$0.3 = \frac{\%\Delta Qd}{50}$$
$$0.3(50) = \%\Delta Qd$$
$$\%\Delta Qd = 15\%$$

The quantity demanded will fall by 15% in the short-run when the price rises by 50%

    b. In the long-run, PED for cigarettes is 0.8. By what percentage will the quantity demanded fall in the long-run? Show your work.

$$0.8 = \frac{\%\Delta Qd}{50}$$
$$0.8(50) = \%\Delta Qd$$
$$\%\Delta Qd = 40\%$$

The quantity demanded will fall by 40% in the long-run when the price rises by 50%

    c. Explain why PED for cigarettes is more elastic in the long-run than in the short-run.

While demand is highly inelastic in the short-run due to the addictive nature of tobacco, demand for cigarettes is more elastic in the long-run because some smokers will decide to quite seeing as their habit has become so much more expensive. Additionally, people who may have started to smoke when cigarettes were cheaper will be deterred from starting

smoking, reducing the number of smokers over time.

14. Recently a draught caused a sharp decline in the corn harvest, reducing supply. The price per bushel jumped from $40 to $70, while quantity fell from 12 million to 9 million bushels.

    a. Calculate the PED for corn

$$PED = \frac{(9-12)\div 12}{(70-40)\div 40} = \frac{0.25}{0.75} = 0.33$$

    b. Is demand for corn elastic or inelastic between these prices? How do you know?

Demand is inelastic. The percentage change in the quantity demanded (25%) was smaller than the percentage change in the price (75%), giving us a PED coefficient of less than 1. Consumers are relatively unresponsive to the increase in corn prices.

    c. Calculate the total amount spent on corn before the draught

Consumers demanded 12 million bushels at a price of $40 per bushel. Therefore total expenditures equaled 12m x $40 = $480 million

    d. Calculate the total amount spent on corn after the draught.

Consumers demanded 9 million bushels at a price of $70 per bushel. Therefore total expenditures equaled 9m x $70 = $630 million

    e. Overall were farmers hurt or helped by the draught? Explain?

It appears farmers were helped by the draught! Even though they produced less corn, the inelastic demand from consumers meant that at the higher prices they ended up spending more on corn. So although overall production was down, revenues for corn farmers were up!

15. Apples are currently selling for 3 CHF per kilogram and apple consumers are spending 1.5 million CHF per year. Lower taxes on imported apples push the price down to 2 CHF per kilogram, and as a result total expenditures on apples falls to 1.2 million CHF.

    a. How many kilograms of apples were being bought prior to the decrease in import taxes?

Consumers spent 1.5 million CHF, and price was 3 CHF per kilogram. Therefore, the quantity of kgs sold was 1.5m / 3 = 0.5m, or 500,000 kgs

    b. How many kilograms of apples are being bought after the kgin import taxes?

Consumers spent 1.2 million CHF and price was just 2 CHF per kilogram. Therefore, the quantity of kgs sold was 1.2m / 2 = 0.6m, or 600,000 kgs

c. Without solving for PED, determine whether demand for apples is inelastic, unit elastic or elastic. How did you determine this?

A decrease in the price of apples caused consumers to spend less on the apples. If consumers were highly responsive to price changes we would expect their expenditures to increase when price decreased. But the amount spent actually fell when price decreased, indicating that consumers are relatively *unresponsive* to price changes; in other words, demand for apples must be *inelastic.*

d. Now calculate the PED for apples using the prices given and the quantities you determined in parts a) and b). Does your calculation support your answer to part c)?

P1 = 3 CHF
P2 = 2 CHF
Q1 = 500,000
Q2 = 600,000

$$PED = \frac{(600{,}000-500{,}000)\div 500{,}000}{(2-3)\div 3} = \frac{0.2}{0.33} = 0.6$$

The PED calculation supports my answer to part c). The percentage increase in the quantity demanded was smaller than the percentage decrease in price. The *total revenue and expenditure test* of elasticity helped me determine that demand was inelastic before doing the calculations simply by looking at how expenditures (equal to apples farmers' revenues) decreased when price decreased.

Part 4 - PED and Linear Demand Equations - IB Higher Level only

16. The weekly demand for airline tickets between Zurich and London is represented by the equation Qd = 2000 - 5P. The price of tickets recently increased from $200 to $250.

a. Calculate the original quantity demanded (at $200)

Qd = 2000 - 5(200) = 1000

b. Calculate the new quantity demanded (at $250)

Qd = 2000 - 5(250) = 750

c. Calculate the PED for tickets from Zurich to London between $200 and $250

$$PED = \frac{(750-1000)\div 1000}{(250-200)\div 200} = \frac{0.25}{0.25} = 1$$

d. Describe the PED for plane tickets when the price rises from $200 to $250 and explain how airlines revenues are likely affected by the price increase..

Demand is *unit elastic*. This means the quantity demanded fell by the same percentage that

the price rose. Airline revenues should not be affected. Consumers will spend the same amount at $250 that they did at $200 (the total revenue test helps us determine this).

e. What is the PED for plane tickets if the price rises again from $250 to $300?

Q1 = 750
Q2 = 2000 - 5(300) = 500

$$PED = \frac{(500-750)\div 750}{(300-250)\div 250} = \frac{0.33}{0.2} = 1.65$$

f. Why does the PED change when the price of plane tickets rises?

PED increased because the percentage change in the quantity is increasing while the percentage change in the price is decreasing. Consumers are becoming more responsive as the price rises because the higher price represents a greater proportion of the typical consumer's income.

17. Assume the demand for plane tickets changes to Qd = 2000 - 4P

a. Calculate the PED for plane tickets when the price rises from $200 to $250.

Q1 = 2000 - 4(200) = 1200
Q2 = 2000 - 4(250) = 1000

$$PED = \frac{(1000-1200)\div 1200}{(250-200)\div 200} = \frac{0.167}{0.25} = 0.67$$

b. How does this value compare to the PED you calculated in 15(c)?

A PED of 0.67 is less than a PED of 1. Demand is less elastic than it was in the original equation.

c. What is the relationship between the 'b' variable in the demand equation and PED?

The 'b' variable in the demand equation is indicative of the responsiveness of consumers to price changes. The smaller the 'b' variable, the less responsive consumers are to price changes, so the PED is lower when the 'b' variable is lower.