

Chapter 7 Elasticities of Demand

Quantity demanded can change due to price, income or prices of other goods, etc. Thus we have 3 kinds of Elasticities of Demand.

1. Price Elasticity of Demand
2. Income Elasticity of Demand
3. Cross-Price Elasticity of Demand

1. Price Elasticity of Demand measures how sensitive the demand is to a change in price.

Example:

Price of Pepsi = 10 bahts, → 5 million cans sold
= 20 bahts → 3 million cans sold

Price of Toyota = 1,000,000 bahts → 1,000 units sold.
= 1,000,010 bahts →

Does this mean that the demand for Toyota is not as sensitive to change in price compared to the demand for Pepsi?

Price Elasticity of Demand is the percentage change of the quantity demanded per 1 percentage change in price

$$\eta_D = \frac{\% \Delta Q_D}{\% \Delta P} = \frac{\text{Percentage change of } Q_D}{\text{Percentage change of } P}$$

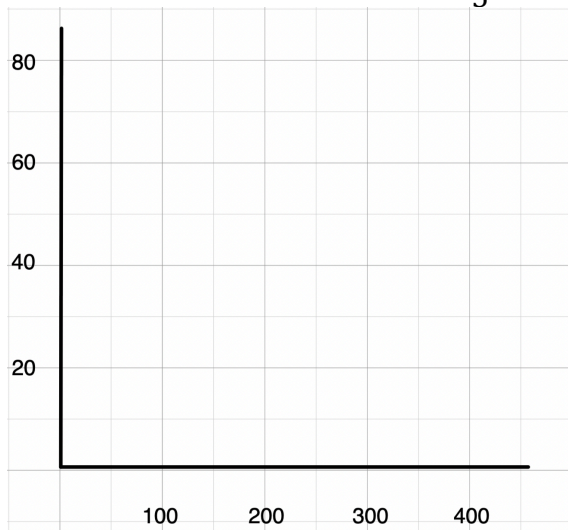
Example If the price increases by 10% ($\% \Delta P = 10\%$), the quantity demanded decreases by 25% ($\% \Delta Q_D = -25\%$)

$$\eta_D = \frac{\% \Delta Q_D}{\% \Delta P} = \frac{-25}{10} = -2.5$$

- Negative sign reflects the Law of Demand
- η_D does not have unit
- $\eta_D = -2.5$ means that if the price increases by 1%, the quantity demanded decreases by 2.5%

Example

$$\text{Demand: } P = 70 - \frac{1}{5} Q_D$$



Consider two points, A and B on the demand

$$A = (150, 40), Q_1 = 150, P_1 = 40$$

$$B = (100, 30), Q_2 = 100, P_2 = 30$$

From $A \rightarrow B$,

$$\Delta Q_D =$$

$$\Delta P =$$

$$\% \Delta Q_D =$$

$$\% \Delta P =$$

$$\eta_D = \frac{\% \Delta Q_D}{\% \Delta P} =$$

- η_D from A to B is given by:

$$\eta_D = \frac{1}{\text{Slope } Q_1} \frac{P_1}{Q_1}$$

where P_1 and Q_1 are price and quantity demanded at A .

- Is η_D the same for $B \rightarrow A$?

$$\eta_D = \frac{\% \Delta Q_D}{\% \Delta P} =$$

- η_D from $B \rightarrow A$ is given by:

$$\eta_D = \frac{1}{\text{Slope } Q_2} \frac{P_2}{Q_2}$$

where P_2 and Q_2 are price and quantity demanded at B .

Arc Elasticity of Demand

From $A \rightarrow B$, $\eta_D = \frac{1}{\text{Slope } Q_1} \frac{P_1}{Q_1} = -1.33$.

From $B \rightarrow A$, $\eta_D = \frac{1}{\text{Slope } Q_2} \frac{P_2}{Q_2} = -2.5$

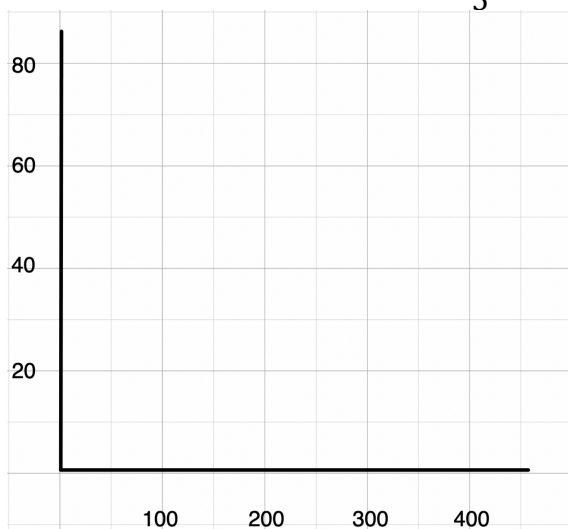
If we want to find, η_D between A and B (without specifying from where to where) we use

Average price = $\bar{P} = \frac{P_1 + P_2}{2}$

Average Quantity = $\bar{Q} = \frac{Q_1 + Q_2}{2}$

$$\eta_D = \frac{1}{\text{Slope } \bar{Q}} \frac{\bar{P}}{\bar{Q}} = \frac{1}{\text{Slope } \bar{Q}} \frac{\bar{P}}{\bar{Q}} = \frac{1}{\text{Slope } Q_1 + Q_2} \frac{P_1 + P_2}{Q_1 + Q_2}$$

$$\text{Demand: } P = 70 - \frac{1}{5} Q_D$$

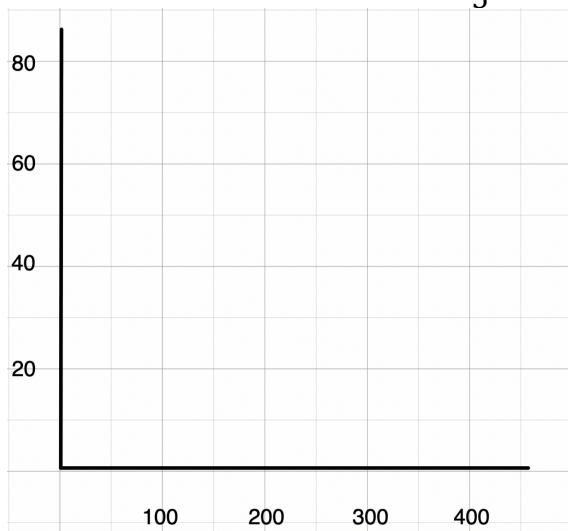


This is called *Arc Elasticity by Midpoint method*.

Point Elasticity of Demand Price elasticity at a point
 $A = (Q_1, P_1) = (150, 40)$.

$$\begin{aligned}\eta_D &= \left(\frac{1}{\text{Slope at } A} \right) \frac{P_1}{Q_1} \\ &= \frac{1}{\frac{dP}{dQ_D}} \frac{P_1}{Q_1} \\ &= \frac{dQ_D}{dP} \frac{P_1}{Q_1} = 1.33\end{aligned}$$

$$\text{Demand: } P = 70 - \frac{1}{5} Q_D$$



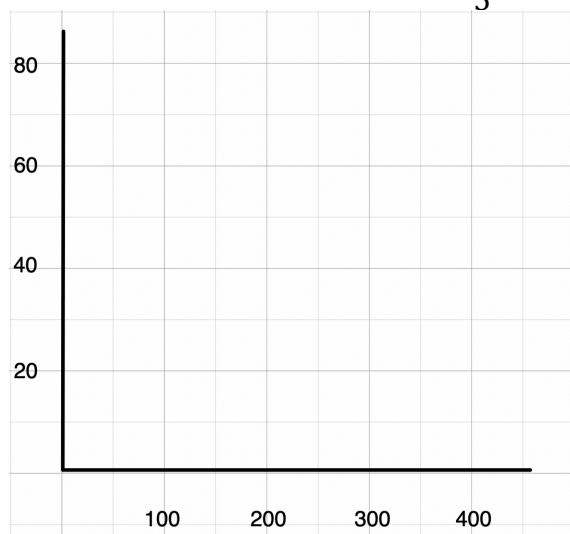
- Point Elasticity of a Nonlinear Demand curve.

Elastic and Inelastic Demand

Demand is Elastic when $|\eta_D| > 1$
Demand is Inelastic when $|\eta_D| < 1$.

Point Elasticity of along a Linear Demand Curve

$$\text{Demand: } P = 70 - \frac{1}{5} Q_D$$



$$\eta_D = \frac{dQ_D}{dP} \frac{P}{Q_D}$$

Price Elasticity of Demand depends on the availability of substitutes

1. A product and a group of products
2. Short-run and Long-run adjustments

Extreme Cases

1. Demand is Perfectly Elastic



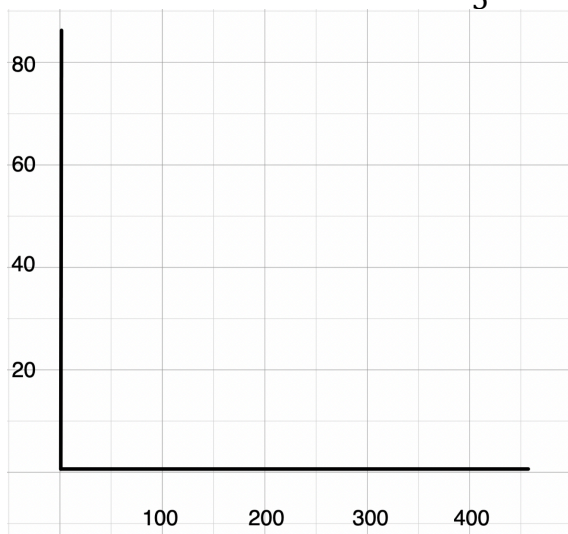
2. Demand is Perfectly Inelastic



Price Elasticity of Demand and Total Revenue

- If BTS Skytrain want to increase its revenue, BTS would want to increase or decrease its fares?
- If Toyota wants to increase its revenue, Toyota would increase or decrease its price?

$$\text{Demand: } P = 70 - \frac{1}{5} Q_D$$



At $D = (Q_3, P_3) = (300, 10)$

$$\eta_D = \frac{dQ_D}{dP} \frac{P_3}{Q_3} =$$

- If the price increase by 1%, the revenue decreases by % . Thus the total revenue

Example $P = 10, Q_D = 300 \Rightarrow TR =$
 $P = 11, Q_D = 295 \Rightarrow TR =$

- Quantity Demand can change due to
 1. Price \Rightarrow Price Elasticity of Demand $\eta_D = \frac{\% \Delta Q_D}{\% \Delta P}$
 2. Income
 3. Price of other Goods

2. Income Elasticity of Demand is the percentage change of quantity demanded per one percentage change in income.

$$\eta_I = \frac{\% \Delta Q_D}{\% \Delta I}$$

- While the price is unchanged, income increases from 30,000 to 40,000 bahts a month,

<i>I</i>	<i>Q_D</i>
30,000	100
40,000	120

$$\begin{aligned} \% \Delta Q_D &= \\ \% \Delta I &= \\ \eta_I &= \frac{\% \Delta Q_D}{\% \Delta I} = \end{aligned}$$

- Income Elasticity of Demand will classify a product to be normal (Necessary or Luxury) or Inferior.

Normal		Inferior
$\eta_I \geq 0$		$\eta_I < 0$
Necessary	Luxury	
$0 \leq \eta_I \leq 1$	$\eta_I > 1$	

What is wrong with this statement:

“Even with the higher price of cooking gas, the consumption still remains almost the same because cooking is a *necessary* product.”

3. Cross Price Elasticity of Demand is the percentage change of the quantity demanded of X per 1 percentage change of price of Y .

Let X be Pepsi and Y Coke.

Q_X	P_Y
30m	10
35m	12

$$\eta_{XY} = \frac{\% \Delta Q_X}{\% \Delta P_Y} =$$

$\eta_{XY} > 0 \Rightarrow X$ is a substitute of Y

$\eta_{XY} < 0 \Rightarrow X$ and Y are complementary— X is consumed together with Y .