

## 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

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

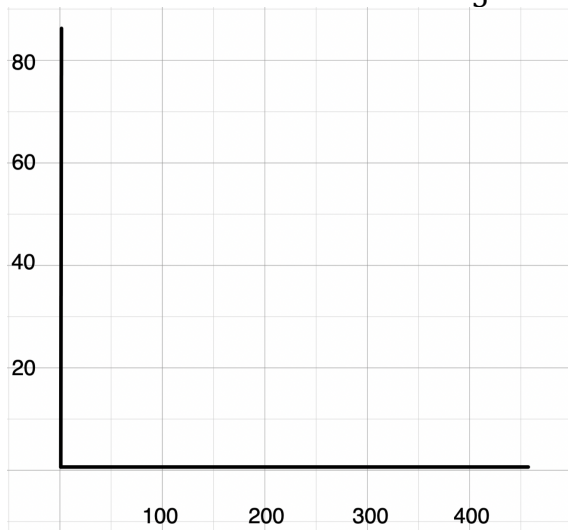
**Example** If the price increases by 10% ( $\% \Delta P = 10\%$ ), the quantity demanded decreases by 25% ( $\% \Delta Q_D = -25\%$ )

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

- Negative sign reflects the Law of Demand
- $\eta_D$  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* → *B*,

$$\Delta Q_D =$$

$$\Delta P =$$

$$\% \Delta Q_D =$$

$$\% \Delta P =$$

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

- $\eta_D$  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  $\eta_D$  the same for *B* → *A*?

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

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

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

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

### Arc Elasticity of Demand

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

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

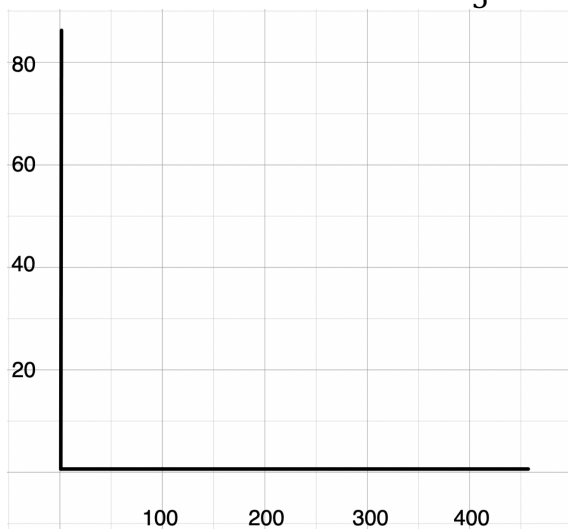
If we want to find,  $\eta_D$  between  $A$  and  $B$  (without specifying from where to where) use **Arc Elasticity by Midpoint method**.

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

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

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

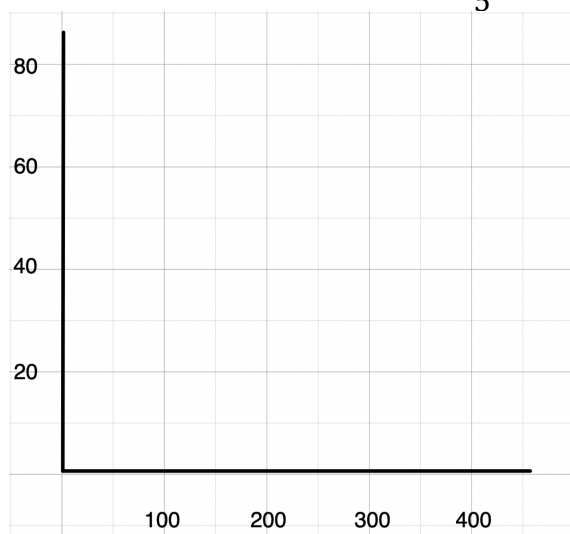
Demand:  $P = 70 - \frac{1}{5} Q_D$



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

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

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

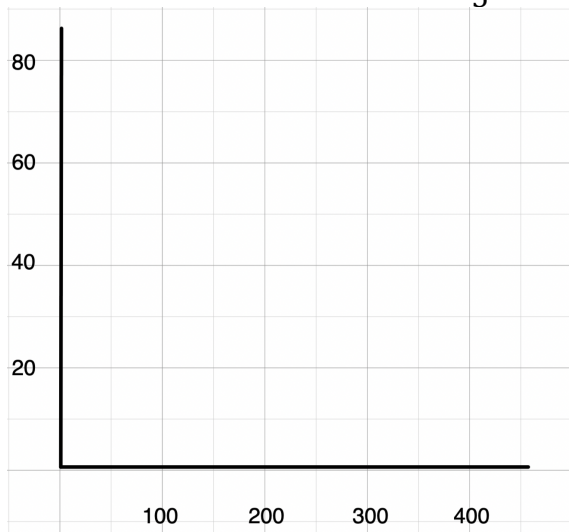


### Elastic and Inelastic Demand

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

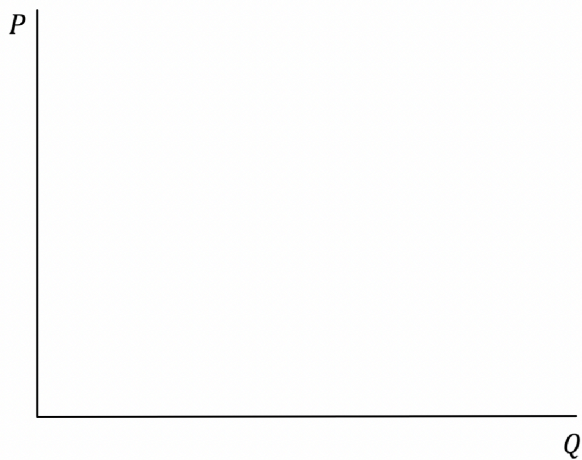
### Point Elasticity of along a Linear Demand Curve

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



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

### Point Elasticity of a Nonlinear Supply curve



**Price Elasticity of Demand** depends on the availability of substitutes

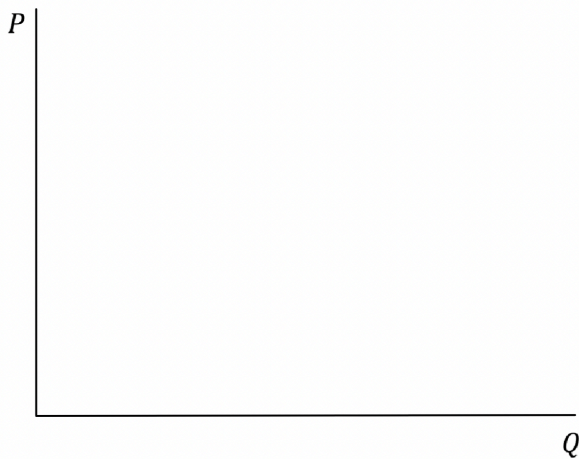
1. A product and a group of products
2. Short-run and Long-run adjustments

### Extreme Cases

1. Demand is Perfectly Elastic



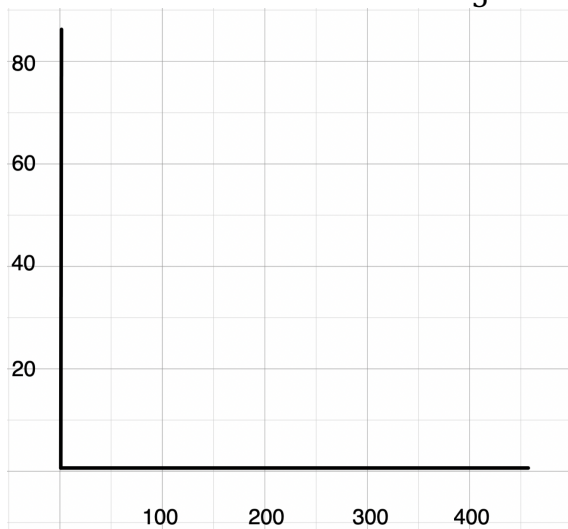
2. Demand is Perfectly Inelastic



### 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<sub>D</sub></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  $Y$ .