

## Chapter 4

## Elasticity

### Price Elasticity of Demand

The law of demand tells us that, other things equal, consumers will buy more of a product when its price declines and less when its price increases. But how much more or less will they buy? The amount varies from product to product and over different price ranges for the same product. It also may vary over time. And such variations matter.

**Elasticity:** is a measure of the percentage change in one variable brought about by a 1 percent change in some other variable.

**Price Elasticity of Demand:** The price elasticity of demand is the percentage change in the quantity demanded of a good in response to a 1 percent change in its price.

تقيس مرونة الطلب السعرية مدى استجابة الكمية المطلوبة من سلعة ما نتيجة لتغير سعر السلعة بنسبة واحد بالمائة.

The responsiveness (or sensitivity) of consumers to a price change is measured by a product's price elasticity of demand. For some products—for example, restaurant meals—consumers are highly responsive to price changes. Modest price changes cause very large changes in the quantity purchased.

For some products—for example, restaurant meals—consumers are highly responsive to price changes. Modest price changes cause very large changes in the quantity purchased. Economists say that the demand for such products is *elastic*. For other products—for example, toothpaste—consumers pay much less attention to price changes. Substantial price changes cause only small changes in the amount purchased. The demand for such products is *inelastic*.

### The Price-Elasticity Coefficient and Formula

Economists measure the degree to which demand is price elastic or inelastic with the coefficient  $E_d$ , defined as:

$$E_d = \frac{\text{Percentage change in quantity demanded of product X}}{\text{percentage change in price of product X}} = \frac{\% \Delta Q}{\% \Delta P}$$

$$E_d = \frac{\text{Change in quantity demanded}}{\text{Original quantity demanded}} \div \frac{\text{change in price}}{\text{original price}} = \frac{\Delta Q}{Q_1} \div \frac{\Delta P}{P_1}$$

$$E_d = \frac{Q_2 - Q_1}{Q_1} \div \frac{P_2 - P_1}{P_1} = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

Example:

You are given market data that says when the price of pizza is \$4, the quantity demanded of pizza is 60 slices. When the price of pizza is \$2, the quantity demanded of pizza is 80 slices. Calculate the price elasticity of demand

$$E_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1} = \frac{80 - 60}{60} \times \frac{4}{2 - 4} = \frac{20}{60} \times \frac{4}{-2} = \frac{80}{-120} = -0.67$$

Midpoint formula for calculating elasticity:

$$E_d = \frac{\text{Change in quantity demanded}}{\text{Sum of quantity}/2} \div \frac{\text{change in price}}{\text{Sum of price}/2}$$

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1 / 2} \div \frac{P_2 - P_1}{P_2 + P_1 / 2} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \div \frac{P_2 - P_1}{P_2 + P_1}$$

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1}$$

Example

Use the midpoint formula for  $E_d$  to calculate the following

Product price	Quantity demanded
\$5	10
\$4	20
\$3	35
\$2	55
\$1	80

1. Calculate price elasticity of demand for the price decrease from \$4 to \$3.

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{35 - 20}{35 + 20} \times \frac{3 + 4}{3 - 4} = \frac{15}{55} \times \frac{7}{-1} = \frac{105}{-55} = -1.9$$

2. Calculate price elasticity of demand for the price increase from \$1 to \$2.

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{55 - 80}{55 + 80} \times \frac{2 + 1}{2 - 1} = \frac{-25}{135} \times \frac{3}{1} = \frac{-75}{135} = -0.55$$

Example

Suppose that the price elasticity of demand for maple syrup has been estimated at -2. If quantity demanded increased by 10 percent, by how much must price have changed?

$$-2 = \frac{10\%}{\% \Delta P} \Rightarrow \% \Delta P = \frac{10\%}{-2} = -5$$

Price must decrease by 5%

67



Elimination of Minus Sign

The price elasticity coefficient of demand  $E_d$  will always be a negative number, because the price and quantity demanded are inversely related.

We will use the absolute value of the elasticity coefficient. (عند حساب قيمة المرونة فإنه يتم اخذ القيمة المطلقة)

## Multiple Choices:

1. The price elasticity of demand measures
  - A. The slope of a budget curve.
  - B. How often the price of a good changes.
  - C. The responsiveness of the quantity demanded to changes in price.
  - D. How sensitive the quantity demanded is to changes in demand.
2. The price elasticity of demand equals
  - A. The percentage change in the quantity demanded divided by the percentage change in the price.
  - B. The change in the quantity demanded divided by the change in price.
  - C. The percentage change in the price divided by the percentage change in the quantity demanded.
  - D. The change in the price divided by the change in quantity demanded.
3. When the price of oranges increases from \$4 to \$6 per bag, the quantity demanded of oranges decreases from 800 to 700. The price elasticity of demand curve over this price range is equal to \_\_\_\_\_. Use the midpoint method for your calculation.
  - A. 3
  - B.  $\frac{3}{7}$
  - C.  $\frac{1}{3}$
  - D.  $\frac{1}{4}$
4. If the price elasticity of demand is 2.5, then a 1 percent increase in price will lead to a
  - A. 2.5 percent increase in the quantity demanded
  - B. 2.5 percent decrease in demand
  - C. 2.5 percent decrease in the quantity demanded
  - D. 2.5 percent increase in demand
5. If the price elasticity of demand is 2 and the quantity demanded increased by 25 percent, then price must have
  - A. increased by 50 percent
  - B. increased by 12.5 percent
  - C. decreased by 50 percent
  - D. decreased by 12.5 percent
6. Given an income elasticity of demand of  $\frac{1}{4}$ , we would expect that
  - A. for a  $\frac{1}{4}$  percent increase in the price, demand will increase by 1 percent
  - B. for a 1 percent increase in the price, demand will increase by  $\frac{1}{4}$  percent
  - C. for a 4 percent increase in the price, demand will decrease by 1 percent
  - D. for a 1 percent increase in the price, demand will decrease by 4 percent

68

Example:

Suppose that the demand for DVD increases by 40%, when price decreases from \$100 to \$90. Calculate the price elasticity of demand (Use the midpoint method for your calculation)

$$E_d = \frac{\% \Delta Q}{\% \Delta P} \quad ; \quad \% \Delta Q = 40\%$$

$$\% \Delta P = \frac{P_2 - P_1}{(P_2 + P_1)/2} = \frac{90 - 100}{(90 + 100)/2} = \frac{-10}{95} = -0.105 = -10.5\%$$

$$E_d = \frac{\% \Delta Q}{\% \Delta P} = \frac{40\%}{-10.5\%} = |-3.8| = 3.8$$

Interpretations of price elasticity of demand

We can interpret the coefficient of the price elasticity of demand as follows:

**Elastic Demand:** Demand is elastic if a percentage change in price results in a larger percentage change in quantity demanded ( $\% \Delta Q > \% \Delta P$ ). Then  $E_d$  will be greater than 1.

**Inelastic Demand:** if a specific percentage change in price produces a smaller percentage change in quantity demanded ( $\% \Delta P > \% \Delta Q$ ), demand is inelastic. Then  $E_d$  will be less than 1.

**Unit Elasticity:** when the percentage change in price results in a same percentage change in quantity demanded ( $\% \Delta P = \% \Delta Q$ ), demand is unit elastic. Then  $E_d$  will be equal to 1.

$$\left[ \begin{array}{l} \text{if } E_d > 1 \Rightarrow \text{demand elastic} \\ \text{if } E_d < 1 \Rightarrow \text{demand inelastic} \\ \text{if } E_d = 1 \Rightarrow \text{demand unit elastic} \end{array} \right]$$

Multiple Choices:

- When the percentage change in quantity demand is less than the percentage change in the price, then
  - Demand elastic
  - Demand inelastic
  - Supply inelastic
  - Demand unit elastic
- the price of sprite cola rises by 25 percent, causing the quantity demanded to increase by 75 percent, then demand for sprite cola is
  - Elastic
  - Inelastic
  - Unitary elastic
  - Perfectly elastic
- If demand is unitary elastic and price decreases by 30 percent, then we can expect quantity demanded to
  - Increase by 30 percent
  - increase by 60 percent
  - decrease by 30 percent
  - decrease by 30 percent

69



**Example**

Taleen spend all income on water and milk. When milk price \$3 per gallon, Taleen bought 14 gallons of milk. After the price of milk went up to \$6 per gallon, Taleen bought only 6 gallons of milk. Calculate Taleen's midpoint-price elasticity of milk when the price of milk increases from \$3 to \$6 per gallon. Is demand for milk elastic, inelastic or unit elastic?

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{6 - 14}{6 + 14} \times \frac{6 + 3}{6 - 3} = \frac{-8}{20} \times \frac{9}{3} = \frac{-24}{20} = -1.2 \Rightarrow |E_d| = 1.2$$

$E_d = 1.2 > 1 \Rightarrow$  Demand elastic

**Example**

The following table shows the demand and supply schedules for Starbucks coffee. Using the information in the table, calculate the elasticity of demand ( $E_d$ ) between the equilibrium price and the price of \$5. Is the demand elastic or inelastic?

Price of Starbucks coffee	Quantity demanded (per month)	Quantity supplied (per month)
\$5.00	3000	5000
\$4.75	3400	4400
\$4.00	3800	3800
\$3.50	4200	3200
\$3.00	4600	2600
\$2.50	5000	2000

Equilibrium price = \$4; Equilibrium quantity = 3800

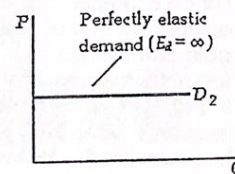
$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{3000 - 3800}{3000 + 3800} \times \frac{5 + 4}{5 - 4} = \frac{-800}{6800} \times \frac{9}{1} = \frac{-7200}{6800} = -1.05 \Rightarrow |E_d| = 1.05 > 1 \text{ elastic}$$

**Perfectly inelastic and perfectly elastic demand curve**

When we say demand is "elastic," we do not mean that consumers are completely responsive to a price change. In that extreme situation, where a small price reduction causes buyers to increase their purchases from zero to all they can obtain, the elasticity coefficient is infinite ( $\infty$ ) and economists say demand is perfectly elastic. A line parallel to the horizontal axis, such as  $D_2$

If  $E_d = \infty \Rightarrow$  demand is perfectly elastic

A horizontal demand curve (line parallel to the horizontal axis), shows perfectly elastic demand graphically.

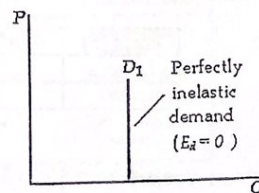


When we say demand is "inelastic," we do not mean that consumers are completely unresponsive to a price change. In that extreme situation, where a price change results in no change whatsoever in the quantity demanded, economists say that demand is perfectly inelastic. The price-elasticity coefficient is zero because there is no response to a change in price. Approximate examples include an acute diabetic's demand for insulin (الأنسولين) or an addict's demand for heroin (هيروين).

هناك حالة خاصة للطلب غير المرنة عندما يكون منحنى الطلب عمودياً حيث لا تستجيب الكمية للتغير في السعر مطلقاً، وتكون قيمة المرونة السعرية صفراً في هذه الحالة، ويسمى الطلب عديم المرونة (perfectly inelastic).

If  $E_d = 0 \Rightarrow$  demand is perfectly inelastic

A vertical demand curve shows perfectly inelastic demand graphically.





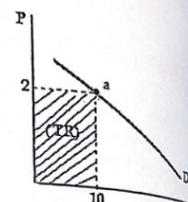
The Total-Revenue Test

The importance of elasticity for firms relates to the effect of price changes on total revenue and thus on profits (total revenue minus total costs).

Total revenue (TR) is the total amount the seller receives from the sale of a product in a particular time period; it is calculated by multiplying the product price ( $P$ ) by the quantity sold ( $Q$ ). In equation form:

$$TR = P \times Q$$

Graphically, total revenue is represented by the  $P \times Q$  rectangle lying below a point on a demand curve. At point  $a$  in Figure, for example, price is \$2 and quantity demanded is 10 units. So total revenue is \$20 (\$2  $\times$  10), shown by the rectangle composed of the gold and orange areas under the demand curve.



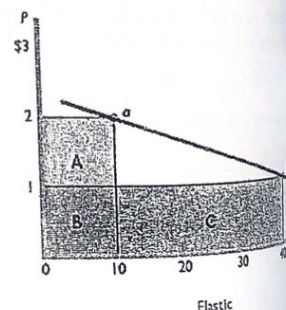
Total revenue and the price elasticity of demand are related. In fact, the easiest way to infer whether demand is elastic or inelastic is to employ the *total-revenue test*. Here is the test: Note what happens to total revenue when price changes. If total revenue changes in the opposite direction from price, demand is elastic. If total revenue changes in the same direction as price, demand is inelastic. If total revenue does not change when price changes, demand is unit-elastic.

Elastic Demand

If demand is elastic, a decrease in price will increase total revenue. Or if demand is elastic, an increase in price will decrease total revenue. Even though a lesser price is received per unit, enough additional units are sold to more than make up for the lower price.

$$\left\{ \begin{array}{l} P \downarrow \Rightarrow TR \uparrow \\ P \uparrow \Rightarrow TR \downarrow \end{array} \right\} \text{ Demand elastic}$$

For an example, look at demand curve  $D_1$  in Figure. We have already established that at point  $a$ , total revenue is \$20 (\$2  $\times$  10), shown as the gold plus orange area (area  $A+B$ ). If the price declines from \$2 to \$1 (point  $b$ ), the quantity demanded becomes 40 units and total revenue is \$40 (\$1  $\times$  40). As a result of the price decline, total revenue has increased from \$20 to \$40. Total revenue has increased in this case because the \$1 decline in price applies to 10 units, with a consequent revenue loss of \$10 (the gold area  $B$ ). But 30 more units are sold at \$1 each, resulting in a revenue gain of \$30 (the brown area  $C$ ). Visually, the gain of the brown area clearly exceeds the loss of the gold area. As indicated, the overall result is a net increase in total revenue of \$20 (\$30 - \$10).

Example:

Price (P)	Quantity (Q)	Total revenue (TR)
\$2	10	$2 \times 10 = 20$
\$1	40	$1 \times 40 = 40$

Price decline from \$2 to \$1 and total revenue increases from \$20 to \$40. So demand is elastic.



Inelastic Demand

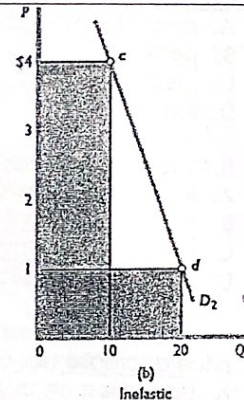
If demand is inelastic, a price decrease will reduce total revenue or a price increase will increase total revenue

$$\begin{cases} P \downarrow \Rightarrow TR \downarrow \\ P \uparrow \Rightarrow TR \uparrow \end{cases} \text{ Demand inelastic}$$

To see this, look at demand curve in the figure. At point c, price is \$4 and quantity demanded is 10  $\Rightarrow$  total revenue is \$40. If the price drops to \$1.5 (point d), total revenue declines to \$30.

Price (P)	Quantity (Q)	Total revenue (TR)
\$4	10	$4 \times 10 = 40$
\$1.5	20	$1.5 \times 20 = 30$

Price declines from \$4 to \$1, and total revenue falls from \$40 to \$22. So, demand is inelastic.

Unit Elasticity

An increase or a decrease in price leaves total revenue unchanged.

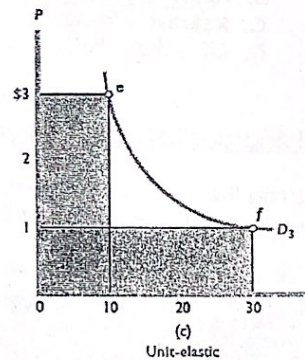
The loss in revenue from a lower unit price is exactly offset by the gain in revenue from the accompanying increase in sales.

$$P \uparrow \text{ or } P \downarrow \Rightarrow TR \text{ unchanged} \Rightarrow \text{demand is unit elastic}$$

To see this, look at demand curve in the figure. At point e, price is \$3 and quantity demanded is 10  $\Rightarrow$  total revenue is \$30. If the price drops to \$1 (point f), total revenue is \$30 (unchanged).

Price (P)	Quantity (Q)	Total revenue (TR)
\$3	10	$3 \times 10 = 30$
\$1	30	$1 \times 30 = 30$

Price declines from \$3 to \$1 and total revenue still 30 (unchanged). So, demand unit elastic.

Price Elasticity of Demand: A Summary

Absolute Value of Elasticity Coefficient	Demand Is:	Description	Impact on Total Revenue of a:	
			Price Increase	Price Decrease
Greater than 1 ( $E_d > 1$ )	Elastic or relatively elastic	Quantity demanded changes by a larger percentage than does price	Total revenue decreases	Total revenue increases
Equal to 1 ( $E_d = 1$ )	Unit or unitary elastic	Quantity demanded changes by the same percentage as does price	Total revenue is unchanged	Total revenue is unchanged
Less than 1 ( $E_d < 1$ )	Inelastic or relatively inelastic	Quantity demanded changes by a smaller percentage than does price	Total revenue increases	Total revenue decreases

## Multiple Choices:

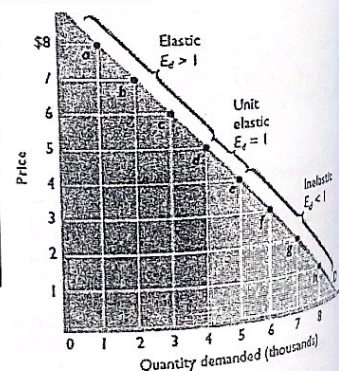
- The price of canned salmon increases; total spending on canned salmon remains unchanged. Canned salmon has a(n) \_\_\_\_\_ demand.
  - perfectly inelastic
  - perfectly elastic
  - unitarily elastic
  - inelastic
- Total revenue will decrease if price \_\_\_\_\_ and demand is \_\_\_\_\_.
  - increases; inelastic
  - increases; unitarily elastic
  - decreases; inelastic
  - decreases; elastic
- An excellent harvest causes apples to fall in price by 10%. Consumers buy 5% more apples. The price decrease has caused consumers to
  - Spend less on apples.
  - Spend more on apples.
  - Reduce the quantity of apples bought. We can't tell what has happened to spending.
  - Increase the quantity of apples bought. We can't tell what has happened to spending.
- Other things the same, if a price change causes total revenue to change in the opposite direction, demand is:
  - Perfectly inelastic.
  - Relatively elastic.
  - Relatively inelastic.
  - Of unit elasticity.

## Price Elasticity along a Linear Demand Curve

Using the total revenue test, when price fall and TR increases, demand is elastic; when price fall and TR unchanged, demand is unit elastic; and when price fall and TR decline, demand is inelastic.

Price Elasticity of Demand for Movie Tickets as Measured by the Elasticity Coefficient and the Total-Revenue Test

Total Quantity of Tickets Demanded:	Price per Ticket	Elasticity Coefficient ( $E_d$ )	Total Revenue, (1) $\times$ (2)	Total-Revenue Test
1	\$8		\$ 8000	
2	7	5.00	14,000	Elastic
3	6	2.60	18,000	Elastic
4	5	1.57	20,000	Elastic
5	4	1.00	20,000	Unit elastic
6	3	0.64	18,000	Inelastic
7	2	0.38	14,000	Inelastic
8	1	0.20	8000	Inelastic



For a down sloping straight line, demand is more elastic at higher price range and inelastic at lower price ranges.



## Multiple Choices:

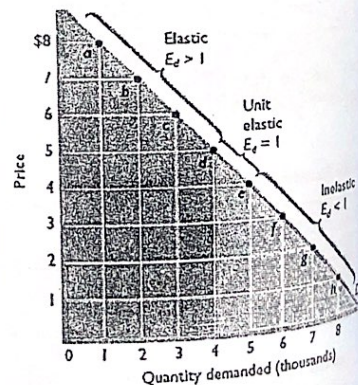
1. The price of canned salmon increases; total spending on canned salmon remains unchanged. Canned salmon has a(n) \_\_\_\_\_ demand.
- perfectly inelastic
  - perfectly elastic
  - unitarily elastic
  - inelastic
2. Total revenue will decrease if price \_\_\_\_\_ and demand is \_\_\_\_\_.
- increases; inelastic
  - increases; unitarily elastic
  - decreases; inelastic
  - decreases; elastic
3. An excellent harvest causes apples to fall in price by 10%. Consumers buy 5% more apples. The price decrease has caused consumers to
- Spend less on apples.
  - Spend more on apples.
  - Reduce the quantity of apples bought. We can't tell what has happened to spending.
  - Increase the quantity of apples bought. We can't tell what has happened to spending.
4. Other things the same, if a price change causes total revenue to change in the opposite direction, demand is:
- Perfectly inelastic.
  - Relatively elastic.
  - Relatively inelastic.
  - Of unit elasticity.

## Price Elasticity along a Linear Demand Curve

Using the total revenue test, when price fall and TR increases, demand is elastic; when price fall and TR unchanged, demand is unit elastic; and when price fall and TR decline, demand is inelastic.

Price Elasticity of Demand for Movie Tickets as Measured by the Elasticity Coefficient and the Total-Revenue Test

Total Quantity of Tickets Demanded	Price per Ticket	Elasticity Coefficient ( $E_d$ )	Total Revenue (1) $\times$ (2)	Total-Revenue Test
1	\$8	5.00	\$ 8000	
2	7	2.60	14,000	Elastic
3	6	1.57	18,000	Elastic
4	5	1.00	20,000	Elastic
5	4	0.64	20,000	Unit elastic
6	3	0.38	18,000	Inelastic
7	2	0.20	14,000	Inelastic
8	1		8000	Inelastic



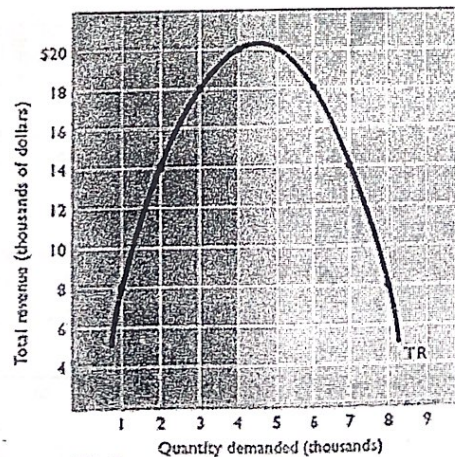
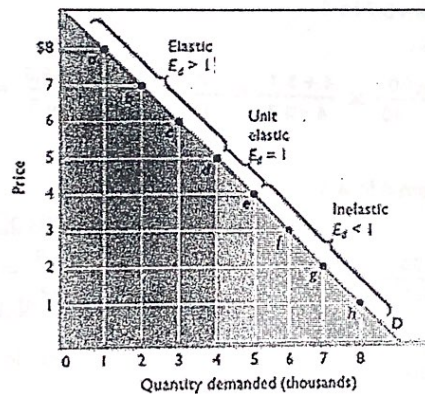
For a down sloping straight line, demand is more elastic at higher price range and inelastic at lower price ranges.

Multiple Choices

- Along a linear demand curve, from top to bottom (higher price levels to lower price levels), elasticity varies from
  - elastic, to unit elastic, to inelastic
  - inelastic, to unit elastic, to elastic
  - unit elastic, to elastic, to inelastic
  - elastic, to inelastic, to unit elastic
- Which of the following is true?
  - On a linear demand curve, the higher the price the more elastic is demand
  - On a linear demand curve, elasticity is constant
  - At the same price demand is more elastic on the steeper demand curve
  - None are true

Price Elasticity and the Total-Revenue Curve

When price falls and TR increases, demand is elastic; when price falls and TR is unchanged, demand is unit elastic; and when price falls and TR declines, demand is inelastic.





Example

Suppose that total demand for wheat is as shown below:

Price per bushel	Quantity demand
3.4	85
3.7	80
4	75
4.3	70
4.6	65

1. Use the point formula for elasticity of demand to determine price elasticity of demand for each of the price changes from \$3.7 to \$4.6. Then Graph the demand data

Price elasticity as price increase from 3.4 to 3.7

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{80 - 85}{80 + 85} \times \frac{3.7 + 3.4}{3.7 - 3.4} = \frac{-5}{165} \times \frac{7.1}{0.3} = \frac{-35.5}{49.5} = |-0.71| = 0.71$$

Price elasticity as price increase from 3.7 to 4

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{75 - 80}{75 + 80} \times \frac{4 + 3.7}{4 - 3.7} = \frac{-5}{155} \times \frac{7.7}{0.3} = \frac{-38.5}{46.5} = |-0.82| = 0.82$$

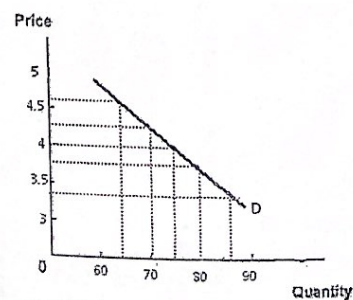
Price elasticity as price increase from 4 to 4.3

$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{70 - 75}{70 + 75} \times \frac{4.3 + 4}{4.3 - 4} = \frac{-5}{145} \times \frac{8.3}{0.3} = \frac{-41.5}{43.5} = |-0.95| = 0.95$$

Price elasticity as price increase from 4.3 to 4.6

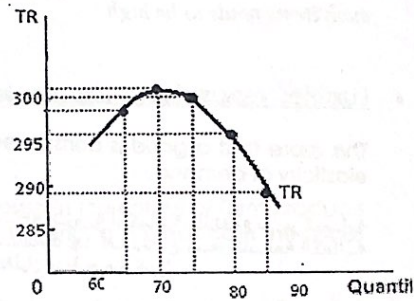
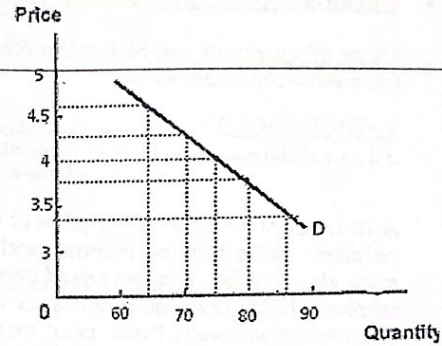
$$E_d = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{65 - 70}{65 + 70} \times \frac{4.6 + 4.3}{4.6 - 4.3} = \frac{-5}{135} \times \frac{8.9}{0.3} = \frac{-44.5}{40.5} = |-1.09| = 1.09$$

Price per bushel	Quantity demand	Elasticity
3.4	85	-
3.7	80	0.71
4	75	0.82
4.3	70	0.95
4.6	65	1.09



2. Calculate total revenue data from the demand table. Graph total revenue below your demand curve.

Price per bushel	Quantity demand	Total revenue
3.4	85	289
3.7	80	296
4	75	300
4.3	70	301
4.6	65	299



### Determinants of Price Elasticity of Demand:

- Substitutability توفر بدائل للسلعة

The larger the number of substitute goods that are available, the greater the price elasticity of demand.

The elasticity of demand for a product depends on how narrowly the product is defined. Demand for Reebok sneakers is more elastic than is the overall demand for shoes. Many other brands are readily substitutable for Reebok sneakers, but there are few, if any, good substitutes for shoes.

بصورة عامة كلما زاد عدد البدائل المتوفرة للسلعة، كلما كان الطلب عليها أكثر مرونة، حيث أن ارتفاع سعر السلعة سيؤدي بالمستهلك لتقليل الكميات المطلوبة منها بصورة كبيرة والانتقال لاستهلاك السلع البديلة. أما عدم وجود بدائل للسلعة فإنه يؤدي بالمستهلك أن يرتبط باستهلاك تلك السلعة حتى لو ارتفع سعرها لعدم وجود بدائل لها.

كلما كان للسلعة بدائل كثيرة وجيدة كلما كان الطلب عليها أكبر مرونة، أو بمعنى آخر كلما عرفنا السلعة تعريفاً ضيقاً، وكلما كان لهذه السلعة بدائل كثيرة وجيدة كلما كان الطلب عليها أكبر مرونة، مثلاً الطلب على الصابون من نوع لوكس أكبر مرونة من الطلب على الصابون بصورة عامة، والطلب على لحم الضأن أكبر مرونة من الطلب على اللحوم بصورة عامة.

26



- نسبة الإنفاق على السلعة من الدخل المستهلك Proportion of Income

Other things equal, the higher the price of a good relative to consumers incomes, the grater the price elasticity of demand.

بصورة عامة فإن الطلب على السلعة يكون أكثر مرونة كلما زادت نسبة الإنفاق على تلك السلعة من دخل المستهلك. فعلى سبيل المثال فإن الإنفاق على ملح الطعام يشكل نسبة قليلة جداً من دخل المستهلك وعليه فإن ارتفاع سعر ملح الطعام لن يؤدي الانخفاض الكمية المطلوبة منه بنسبة كبيرة بل يمكن أن لا تتأثر الكمية المطلوبة منه مطلقاً.

A 10 percent increase in the price of low-priced pencils or chewing gum amounts to a few more pennies relative to one's income, and quantity demanded will probably decline only slightly. Thus, *price elasticity for such low-priced items tends to be low*. But a 10 percent increase in the price of relatively high-priced automobiles or housing means additional expenditures of perhaps \$3000 or \$20,000, respectively. These price increases are significant fractions of the annual incomes and budgets of most families, and quantities demanded will likely diminish significantly. *Price elasticity for such items tends to be high*.

- سلع الرفاهية والسلع الضرورية Luxuries versus Necessities

The more that a good is considered to be a luxury rather than a necessity the grater is the price elasticity of demand.

طبيعة السلعة من العوامل المحددة لمرونة الطلب السعرية، وذلك من حيث كون السلعة ضرورية أو كمالية. فارتفاع سعر السلعة الضرورية لن يؤثر كثيراً على الكمية المطلوبة منها نظراً للحاجة إليها وعدم إمكانية الاستغناء عنها. أما ارتفاع سعر السلعة الكمالية فيؤدي الانخفاض في الكمية المطلوبة منها بصورة واضحة لإمكانية الاستغناء عنها أو التقليل منها بصورة كبيرة.

For example, electricity is regarded as a necessity: it is difficult to get along without it. A price increase will not significantly reduce the amount of lighting. On other hand, jewelry are luxuries. If the prices of jewelry rise, a consumer need not buy them.

- المدى الطويل والمدى القصير Time

Product demand is more elastic the longer the time period under consideration. Consumers often need time to adjust to changes in prices. For example, when the price of a product rises, time is needed to find and experiment with other product to see if they are acceptable.

بصفة عامة فإن مرونة الطلب على سلعة ما في المدى الطويل أعلى بكثير من مرونة الطلب عليها في المدى القصير نظراً لصعوبة التكيف في المدى القصير، خصوصاً بالنسبة لعادات المستهلك الشرائية فمثلاً لو ارتفع سعر زيت الزيتون فإن المستهلك الذي تعود على استهلاك هذه السلعة لن يستطيع الاستغناء عنها في المدى القصير ومن ثم فإن الطلب عليها في المدى القصير سيقبل بنسبة أقل من نسبة ارتفاع السعر وهذا يعني أن الطلب عليها سيكون قليل المرونة، ولكن إذا استمر الارتفاع في سعرها في المدى الطويل فسيحاول المستهلك التكيف مع أنماط استهلاكية أخرى مثل استهلاك زيت الذرة أو السمن النباتي وبالتالي يكون الطلب على زيت الزيتون أكثر مرونة.

#### Multiple Choice:

1. Which of the following is not a determinant of the price elasticity of demand?
  - A. Time to adjust
  - B. Availability of substitute goods
  - C. Whether the good is low-priced or high-priced
  - D. Whether the consumer is low or high income



2. Over time, the demand of a good or service
- becomes more elastic.
  - becomes less elastic.
  - initially becomes more elastic and then becomes less elastic.
  - initially becomes less elastic and then becomes more elastic.
3. The \_\_\_\_\_ the portion of your income spent on a good, the \_\_\_\_\_ is your demand for the good.
- larger; more income elastic.
  - larger; more price elastic.
  - smaller; more price elastic.
  - smaller; more income elastic.
4. Which of the following factors will make the demand for a product more elastic?
- The product has no close substitutes.
  - A very small proportion of income is spent on the good.
  - A long time period has elapsed since the product's price changed.
  - A lower price.

### بعض التطبيقات العملية لمرونة الطلب السعرية Applications of Price Elasticity of Demand

#### Large Crop Yields

The demand for most products is highly inelastic. As a result, increase in the output of farm products arising from a good growing season or from increased productivity tend to depress both the prices of farm products and the total revenue of farmers.

تلجأ بعض الدول أو بعض المنتجين إلى تخفيض العرض من المنتجات الزراعية وذلك سعياً منهم إلى زيادة الإيراد الكلي لهذه المنتجات. والتحليل الاقتصادي لذلك هو أن الطلب على المنتجات الزراعية هو في الغالب طلب غير مرّن ولذلك فإن نقص العرض من هذه المنتجات يسبب ارتفاع السعر، ونظراً لأن الطلب على هذه المنتجات هو غير مرّن فإن الإيراد الكلي للمنتجين سوف يزداد. لذلك نرى أن حكومة مثل حكومة البرازيل تقوم بإتلاف جزء كبير من محصول القهوة بهدف زيادة الإيرادات الكلية لها، حيث أن إتلاف هذا الجزء من محصول القهوة سوف يؤدي إلى انخفاض العرض ومن ثم ارتفاع الأسعار وفي ظل طلب غير مرّن على القهوة فإن الإيرادات سوف تزداد.

#### Excise Taxes

The government pays attention to elasticity of demand when it selects goods and services on which to levy excise taxes. If a \$1 tax is levied on a product and 10,000 units are sold, tax revenue will be \$10,000 ( $1 \times 10,000$ ). If the government rises the tax to \$1.5 but the higher price that results reduces sales to 5000 because of elastic demand, tax revenue will decline to \$75,000 ( $1.5 \times 5000$ ). Because a higher tax on a product with elastic demand will bring in less tax revenue, legislatures tend to seek out products that have inelastic demand such as liquor, gasoline, and cigarettes.

عندما تفكر الدولة في فرض ضريبة معينة فإنها تقوم بفرض هذه الضريبة على السلع التي يكون الطلب عليها غير مرّن، حيث أن ارتفاع أسعار هذه السلع بسبب زيادة الضريبة سوف يؤدي إلى زيادة الإيراد الكلي للدولة (أي زيادة حصة الدولة من الضريبة). ويلاحظ هنا أنه إذا كان الطلب على سلعة ما عديم المرونة فإن المستهلك يتحمل كامل عبء الضريبة، أما إذا كان الطلب على هذه السلعة غير مرّن فإن المستهلك يتحمل معظم عبء الضريبة أما إذا كان الطلب على هذه السلعة مرّن فإن المنتج يتحمل معظم عبء الضريبة، وأخيراً إذا كان الطلب على سلعة ما لا نهائي المرونة فإن المنتج يتحمل كامل عبء الضريبة.

78



Price Elasticity of Supply

Is the percentage change in the quantity supplied of a good in response to a 1 percent change in its price.

قياس مرونة العرض السعرية مدى استجابة الكمية المعروضة من سلع ما نتيجة لتغير سعر السلعة بنسبة واحد بالمائة.

If the quantity supplied by producers is relatively responsive to price changes, supply is elastic. If it is relatively insensitive to price changes, supply is inelastic.

$$E_s = \frac{\text{Percentage change in quantity supplied of product X}}{\text{Percentage change in the price of product X}}$$

$$E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \div \frac{P_2 - P_1}{P_2 + P_1} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1}$$

The price elasticity coefficient of supply  $E_s$  will always be a positive number, because the price and quantity supplied are directly related.

For example, suppose an increase in the price of a good from \$4 to \$6 increase the quantity supplied from 10 units to 14 units. Find the price elasticity of supply from a price increase.

$$E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \div \frac{P_2 - P_1}{P_2 + P_1} = \frac{(14-10)}{(14+10)} \div \frac{(6-4)}{(6+4)} = \frac{4}{24} \div \frac{2}{10} = \frac{4}{24} \times \frac{2}{10} = \frac{40}{48} = 0.83 < 1 \text{ inelastic}$$

Supply is inelastic, if the  $E_s < 1$

Supply is elastic, if the  $E_s > 1$

Supply is unit elastic, if the  $E_s = 1$

Example:

If a rise in the price of oranges from \$7 to \$9 a bushel, increases the quantity of bushels supplied from 4,500 to 5,500 bushels. Is demand for oranges elastic or inelastic?

$$E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{5,500 - 4,500}{5,500 + 4,500} \times \frac{9 + 7}{9 - 7} = \frac{1,000}{10,000} \times \frac{16}{2} = 0.8 > 1 > \text{elastic}$$

Example:

The quantity supplied of new cars increases by 12 percent when the price of a new cars rise from \$20,000 to \$22,000. What is the price elasticity of supply ?

$$\% \Delta P = \frac{P_2 - P_1}{(P_2 + P_1)/2} = \frac{22,000 - 20,000}{(22,000 + 20,000)/2} = \frac{2,000}{21,000} = 9.5\%$$

$$E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{12\%}{9.5\%} = 1.26$$

29



Multiple Choice:

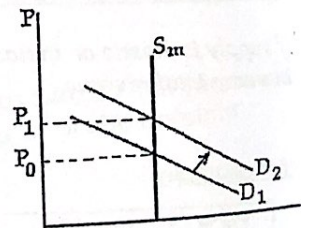
- If the elasticity of supply is 2, this means that if \_\_\_\_\_.
  - the price rises by one dollar, the quantity supplied will rise by two dollars.
  - the price rises by one percent, the quantity supplied will rise by two percent.
  - the price rises by two percent, the quantity supplied will fall by two percent.
  - the price rises by two percent, the quantity supplied will rise by one percent.
- If a 3% decrease in the price of chocolate causes a 2% decrease in the quantity supplied, the
  - demand for chocolate is elastic.
  - demand for chocolate is inelastic.
  - supply of chocolate is elastic.
  - supply of chocolate is inelastic.
- Supply is elastic if
  - a 1 percent change in price causes a larger percentage change in quantity supplied.
  - the good in question is a normal good.
  - the slope of the supply curve is positive.
  - a 1 percent change in price causes a smaller percentage change in quantity supplied.
- If a raise in the price of oranges from \$7 to \$9 a bushel increases the quantity of oranges supplied from 4,000 bushels to 6,000 bushels, then
  - supply of oranges is elastic.
  - supply of oranges is inelastic.
  - demand for oranges is inelastic.
  - demand for oranges is elastic.

In analyzing the impact of time on elasticity, economists distinguish among the immediate market period, the short run, and the long run.

Price Elasticity of Supply: The Market Period

Market period: is the period that occurs when the time immediately after a change in market price is too short for producers to respond with a change in quantity supplied.

In the immediate market period there is insufficient time to change output, and so supply is perfectly inelastic.

Price Elasticity of Supply: The Short Run

The short run: is a period of time too short to change plant capacity but long enough to use the fixed sized plant more or less intensively.

أن مفهوم المدى القصير في الاقتصاد لا يرتبط بفترة زمنية محددة، وإنما يرتبط بإمكانية تغيير جميع العناصر الإنتاجية أو عدم إمكانية ذلك. فالمدى القصير يمثل فترة زمنية ليست كافية لتغيير كمية جميع العناصر الإنتاجية، وبالتالي فإن كمية بعض هذه العناصر الإنتاجية تظل ثابتة خلال تلك الفترة.

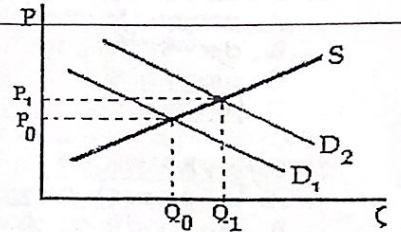
فصاحب المنجرة على سبيل المثال، يستطيع أن يزيد عدد الكراسي الخشبية التي ينتجها عن طريق زيادة كمية الخشب التي يستخدمها وعدد العمال الذين يوظفهم، وكمية الزيوت والدهان التي يستعملها. ولكنه لا يستطيع أن يزيد كمية جميع هذه العناصر خلال فترة زمنية



قصيرة. فإذا كان باستطاعته، على سبيل المثال، أن يزيد عدد العمال وكمية الخشب خلال ساعات أو أيام قليلة، فإنه سيحتاج إلى فترة زمنية طويلة لزيادة الطاقة الإنتاجية للمصنع ( لتجهيز المباني، والقيام بالتوسعة اللازمة للمصنع و استيراد وتركيب الماكينات).

In the short run plant capacity is fixed, but changing the intensity of its use can alter output; supply is therefore more elastic.

The outcome of an increase in demand from  $D_1$  to  $D_2$  is a smaller price rise and an increase in quantity from  $Q_1$  to  $Q_2$ .



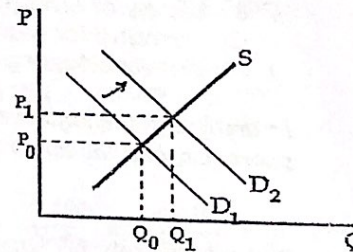
### Price Elasticity of Supply: The Long Run

The long run: is a time period long enough for firms to adjust their plant size and for new firms to enter (or existing firms to leave) the industry.

أما المدى الطويل فهو يمثل فترة زمنية طويلة بما يكفي لتغيير كمية جميع العناصر الإنتاجية بالزيادة أو النقص.

In the long run all desired adjustment, including changes in plant capacity, can be made, and supply becomes still more elastic.

The outcome of an increase in demand from  $D_1$  to  $D_2$  is a smaller price rise and a larger output increase.



### Price elasticity of supply and Total Revenue

If supply is elastic or inelastic, a decrease in price will decrease total revenue. Or an increase in price will increase total revenue.

For example

Price (P)	Quantity (Qs)	Total revenue (TR)
\$2	40	$2 \times 40 = 80$
\$1	10	$1 \times 10 = 10$

$$E_s = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{(40 - 10)}{(40 + 10)} \times \frac{(2 + 1)}{(2 - 1)} = \frac{30}{50} \times \frac{3}{1} = \frac{90}{50} = 1.8 > 1 \text{ elastic}$$

As price increase from \$1 to \$2, total revenue increase from \$10 to \$80, and the supply is elastic

Price (P)	Quantity (Qs)	Total revenue (TR)
\$5	120	$5 \times 120 = 600$
\$1	80	$4 \times 80 = 320$

$$E_s = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 + P_1}{P_2 - P_1} = \frac{(100 - 80)}{(100 + 80)} \times \frac{(5 + 1)}{(5 - 1)} = \frac{20}{180} \times \frac{6}{4} = \frac{120}{720} = 0.16 < 1 \text{ inelastic}$$

As price increase from \$1 to \$5, total revenue increase from \$320 to \$600, and the supply is inelastic

Multiple Choice:

- If the price elasticity of supply for a product equals  $\frac{1}{2}$ , as its price rises the
  - total revenue increases
  - quantity supplied does not change.
  - total revenue does not change.
  - total revenue decrease
- A vertical supply curve indicates an elasticity of supply that equals
  - 0
  - infinity
  - 1
  - 1

Income Elasticity of Demand

The income elasticity of demand equals the percentage change in the quantity demanded of a good in response to a 1 percent change in income.

$$E_i = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in the income}}$$

$$E_i = \frac{\% \Delta Q}{\% \Delta I} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{I_2 + I_1}{I_2 - I_1}$$

Example

Last year, Jaber bought 50 pounds of hamburger when the household income was \$40,000. This year, the household income was only \$30,000 and Jaber bought 60 pounds of hamburger. All else constant Jaber's income elasticity of demand for hamburger is

$$E_i = \frac{\% \Delta Q}{\% \Delta I} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{I_2 + I_1}{I_2 - I_1} = \frac{(60 - 50)}{(60 + 50)} \times \frac{(30,000 + 40,000)}{(30,000 - 40,000)} = \frac{10}{110} \times \frac{70,000}{-10,000} = \frac{70}{-110} = -0.63$$

Example

If the income elasticity of demand for chocolate candies is 1.2, what percentage change in income is necessary to reduce the amount of chocolate candies demanded by 15%?

$$E_i = \frac{\% \Delta Q}{\% \Delta I} \rightarrow 1.2 = \frac{-15\%}{\% \Delta I} \rightarrow \% \Delta I = \frac{-15\%}{1.2} = 12.5\% \quad (\text{decrease income by } 12.5\%)$$

Example

The income elasticity is +2 and income increases by 20%. Sales were 5000 units, what will they be now?

$$E_i = \frac{\% \Delta Q}{\% \Delta I} \rightarrow 2 = \frac{\% \Delta Q}{20\%} \rightarrow 40\% = \frac{Q_2 - Q_1}{(Q_2 + Q_1)/2} \rightarrow 40\% = \frac{Q_2 - 5000}{(Q_2 + 5000)/2}$$

$$Q_2 - 5000 = 20\% Q_2 + 1000 \rightarrow Q_2 - 6000 = 20\% Q_2 \rightarrow 0.8 Q_2 = 6000 \rightarrow Q_2 = 7,500$$



### Normal Goods

The income elasticity coefficient  $E_i$  is positive ( $E_i > 0$ ), meaning that more of them are demanded as income increases. Such goods are called normal or superior goods.

### Inferior Goods

The income elasticity coefficient  $E_i$  is negative ( $E_i < 0$ ), meaning that less of them are demanded as income increases. Such goods are called inferior goods.

### Multiple Choice:

- A 10 percent decrease in income decreases the quantity demanded of compact discs by 3 percent. The income elasticity of demand for compact discs is
  - 10
  - 3.3
  - 0.3
  - 0.3
- If the income elasticity of demand for Cheer detergent is -3, then a
  - 12 percent fall in income leads to a 4 percent rise in the quantity demanded
  - \$1,000 fall in income leads to a 3,000-unit rise in the quantity demanded
  - 12 percent fall in income leads to a 36 percent rise in the quantity demanded
  - 12 percent rise in income leads to a 36 percent rise in the quantity demanded
- Average income increases from £20,000 to £22,000. Quantity demanded per year increases from 5000 to 6000 units. Which of the following is correct?
  - Demand is price inelastic
  - The good is inferior
  - The good is normal
  - Income elasticity is -2
- For an inferior good with a downward sloping demand curve:
  - The price elasticity of demand is negative; the income elasticity of demand is negative.
  - The price elasticity of demand is positive; the income elasticity of demand is negative.
  - The price elasticity of demand is negative; the income elasticity of demand is positive.
  - The price elasticity of demand is positive; the income elasticity of demand is positive.

### Cross Elasticity of demand مرونة الطلب التقاطعية

The cross-price elasticity of demand measures the percentage change in the quantity demanded of a good (say, X) in response to a 1 percent change in the price of another good (say, Y).

$$E_{xy} = \frac{\text{Percentage change in quantity supplied of product X}}{\text{Percentage change in the price of product Y}} = \frac{\% \Delta Q_x}{\% \Delta P_y}$$

$$E_{xy} = \frac{Q_{x2} - Q_{x1}}{Q_{x1}} \div \frac{P_{y2} - P_{y1}}{P_{y1}} = \frac{Q_{x2} - Q_{x1}}{Q_{x1}} \times \frac{P_{y1}}{P_{y2} - P_{y1}}$$

8/3



The coefficient of cross elasticity of demand may be either positive or negative.

Example

Suppose that the number of units of good X fall 6 percent when the price of good Y falls 4 percent. What is the cross elasticity of demand between goods X and Y?

$$E_{xy} = \frac{\% \Delta Q_x}{\% \Delta P_y} = \frac{-6\%}{-4\%} = 1.5$$

Example

If the Botany Co. lowers printer price from \$150 to \$120 and finds that students increase their quantity demanded for paper from 400 to 600. Calculate the cross price elasticity of demand between printer and paper.

$$E_{xy} = \frac{Q_{x2} - Q_{x1}}{Q_{x2} + Q_{x1}} \times \frac{P_{y2} + P_{y1}}{P_{y2} - P_{y1}} = \frac{600 - 400}{600 + 400} \times \frac{120 + 150}{120 - 150} = \frac{200}{100} \times \frac{270}{-30} = \frac{54000}{-3000} = -1.62$$

Substitute Goods

If cross elasticity of demand is positive, meaning that sales of good X move in the same direction as a change in the price of good Y, then goods X and Y are substitutes.

Complementary Goods

When cross elasticity is negative, we know that X and Y go together; an increase in the price of one decrease the demand for the other. So the two are complementary goods.

Independent Goods

A zero or near zero cross elasticity suggests that the two products being considered are unrelated or independent goods.

Multiple Choice:

- When two goods are substitutes for each other, the cross elasticity of demand
  - Will be negative.
  - Will be zero
  - Will be positive
  - May be either positive or negative.
- If the price of orange juice rises the demand for grapefruit juice will increase, then the cross price elasticity between orange juice and grapefruit juice will be
  - Positive
  - Negative
  - Zero
  - Infinity



3. Suppose that when the price of good X changes, the quantity of good Y remains the same. We would expect the cross elasticity of demand to be

- A. Negative
- B. Zero
- C. Positive
- D. Either positive or negative.

4. When the price of chicken is \$2, the quantity demanded for hamburger is 50 units; when the price of chicken is \$3, the quantity demanded of hamburger is 60 units. The cross-price elasticity of demand between chicken and hamburger is

- A. -50/110
- B. 10
- C. 1/10
- D. 5/11

#### Questions:

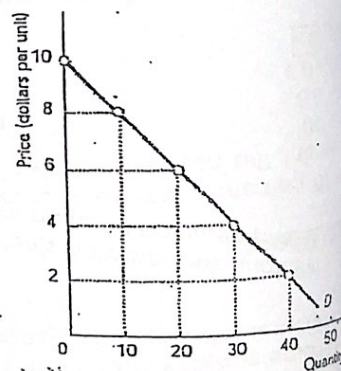
1. A fall in the price of lemons from \$10.5 to \$9.5 per bushel increases the quantity demanded from 19,200 to 20,800 bushels. What is the price elasticity of demand?

2. Dema's income has just risen from \$950 per week to \$1,050 per week. As a result, she decides to increase the number of movies she attends each month by 5 percent. Calculate the income elasticity of demand?

3. A 20 percent decrease in the price of a Pepsi decreases the demand for a Coca-Cola from 130 units to 120 units. The cross elasticity of demand between a Pepsi and Coca-Cola is?

4. Use the following figure illustrates a linear demand curve to answer the following

- a. Calculate the price elasticity of demand if the price falls from \$8 to \$6. Is demand elastic or inelastic?
- b. Using total revenue test to indicate if demand is elastic, inelastic or unitary elastic when price increase from \$4 to \$6.
- c. Calculate the price elasticity of demand if the price increase from \$8 to \$10. Is demand elastic or inelastic?
- d. Calculate total revenue data from the demand curve. Graph total revenue curve.



5. The cross-price elasticity of demand for Coke with respect to the price of Pepsi has been estimated to be 0.7. When the price of coke is \$2, demand for Pepsi is 90 units. If the prices of coke decrease to \$1.5 how will that affect the demand for Pepsi?

85