Notes on Chapter 4

ELASTICITY

✧ Elasticity measures the degree of responsiveness of a dependent variable to changes in any of the independent variables.

\[
\text{Elasticity} = \frac{\% \Delta \text{the dependent variable} (Y)}{\% \Delta \text{the independent variable} (X)} = \text{Elasticity Coefficient}
\]

✧ Elasticity coefficient includes a sign and a size. Interpret the sign and the size of the coefficient.

✧ Sign shows the direction of the relationship between the two variables. A positive sign shows a direct relationship while a negative sign shows an inverse relationship between the two variables.

✧ Size illustrates the magnitude of this relationship. In other words, it shows how large the response of the dependent variable to the change in the independent variable. Large elasticity coefficient means that a small change in the independent variable will result in a large change in the dependent variable (the opposite is true).

✧ In calculating the elasticity we use the percentage change rather than the change to avoid the difficulty of comparing different measurement units. Elasticity coefficient is a unit-free measure.

✧ Elasticity is an important concept in economic theory. It is used to measure the response of different variables to changes in prices, incomes, costs, etc.

✧ This chapter covers some of the important types of elasticities.
PRICE ELASTICITY OF DEMAND

✧ In the previous chapter we have discussed the movement of the quantity demanded along a given demand curve as a result of change in the price of the good. The direction of the movements reflects the law of demand that shows an inverse (negative) relationship between P and Qd; the lower the price the greater the quantity demanded.

✧ When supply increases while demand stays constant, the equilibrium price falls and the equilibrium quantity increases. But does the price fall by a large amount or a little? And does the quantity increase by large amount or a little? The answer depends on the responsiveness of quantity demanded to a change in price.

✧ We are now going to discuss the question of how sensitive the change in quantity demanded is to a change in price; i.e., we have to know the degree of responsiveness of Qd to a change in P. The response of a change in quantity demanded to a change in price is measured by the price elasticity of demand.

✧ **Price elasticity of demand** (Ed) is an economic measure that is used to measures the degree of responsiveness of the quantity demanded of a good to a change in its price, *when all other influences on buyers’ plans remain the same*. The price elasticity of demand is calculated by dividing the percentage change in quantity demanded by the percentage change in price.

\[
E_d = \frac{\% \Delta Q_d}{\% \Delta P} = \frac{\Delta Q_d}{Q_d} \frac{P}{\Delta P}
\]

✧ Price elasticity of demand is a unit-free measure because it is a ratio of two percentage changes and the percentages cancel out. Changing the
units of measurement of price or quantity keeps the elasticity value the same.

✧ To calculate the price elasticity of demand (Ed): We express the change in price as a percentage of the average price—the average of the initial and new price, and we express the change in the quantity demanded as a percentage of the average quantity demanded—the average of the initial and new quantity.

✧ By using the average price and average quantity, we get the same elasticity value regardless of whether the price rises or falls.

\[
E_d = \frac{\%\Delta Q_d}{\%\Delta P} = \frac{\frac{Q_2 - Q_1}{(Q_2 + Q_1)/2}}{\frac{P_2 - P_1}{(P_2 + P_1)/2}} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_2 + P_1}{Q_2 + Q_1} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_2 + P_1}{Q_2 + Q_1} = -
\]

Where,
Q₁ = the original (the old) quantity demanded,
Q₂ = the new quantity demanded
P₁ = the original (the old) price,
P₂ = the new price
Q_avg = the average quantity,
P_avg = the average price

✧ The formula yields a negative value, because price and quantity move in opposite directions (law of demand). But it is the magnitude, or absolute value, of the measure that reveals how responsive the quantity change has been to a price change.

✧ Thus, we ignore the minus (negative) sign and use the absolute value because it simply represents the negative relationship between P and Q_d
Example:
Suppose $P_1 = 7$, $P_2 = 8$, $Q_1 = 11$, $Q_2 = 10$, then

$$E_d = \frac{10 - 11}{10 + 11} \div \frac{8 - 7}{8 + 7} = -0.71$$

Now how to interpret the elasticity coefficient? What $E_d = -0.71$ means?
It means that if the price of the good increases (decreases) by 1% the quantity demanded of the good decreases (increases) by 0.71%.

Example
If $P_1 = 15$, $P_2 = 10$, $Q_1 = 30$, $Q_2 = 50$, then $E_d = -1.25$
Which means that if the price of the good changes by 1%, the quantity demanded of that good will change in the opposite direction by 1.25%.

Example
If $P_1 = 4$, $P_2 = 5$, $Q_1 = 25$, $Q_2 = 20$, then $E_d = 1$
If the price of the good changes by 1% the quantity demanded of that good will change in the opposite direction by 1%.

Example:

<table>
<thead>
<tr>
<th>Price($)</th>
<th>Qd (bushels of Wheat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>

What is the $E_d$ if $P$ increases from 6 to 7?

$$E_d = \frac{40 - 60}{60 + 40} \times \frac{7 + 6}{7 - 6} = 2.6$$

A 1% increase in $P$ would result in a 2.6% decrease in $Q_d$. 
Example:
If a rightward shift in the supply curve leads to an increase in $Q_d$ by 10% as a result of a decrease in $P$ by 5%.

a. Calculate $E_d$.

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

b. Interpret $E_d$

$E_d = 2$ means that a decrease in $P$ by 1% results in an increase in $Q_d$ by 2%.

c. What would be the increase in $Q_d$ if $P$ decreases by 4%?

Since $E_d = \frac{\%\Delta Q_d}{\%\Delta P}$, then $\%\Delta Q_d = (E_d)(\%\Delta P) = (-2)(-4\%) = +8\%$,

Thus, a decrease in $P$ by 4% results in an increase in $Q_d$ by 8%.

d. What would be the decrease in $P$ if $Q_d$ increases by 6%?

Since $E_d = \frac{\%\Delta Q_d}{\%\Delta P}$, then $\%\Delta P = \frac{\%\Delta Q_d}{E_d} = \frac{6\%}{-2} = -3\%$.

Thus, if $Q_d$ decreases by 6%, $P$ increases by 3%.

Example:
If $E_d = 3$ and $P \uparrow$ by 2% then $Q_d \downarrow$ by 6%.

Example:
If $P \uparrow$ from $6$ to $7$ and as a result $Q_d \downarrow$ by 40%, calculate $E_d$

$$E_d = \frac{0.40}{7-6} = \frac{0.40}{0.154} = 2.6$$

Note that if you omit the “2” when calculating the average price the result would be 5 (instead of 2.6) which is not the right answer.
**Categories of Demand Elasticity**

✧ The price elasticity of demand can range between zero and infinity.

1. **Elastic Demand ($E_d > 1$)**
   
   Using the absolute value of the price elasticity of demand.
   
   If $E_d = \frac{\% \Delta Q_d}{\% \Delta P} > 1 \Rightarrow \% \Delta Q_d > \% \Delta P \Rightarrow$
   demand is elastic.
   
   Consumers are very responsive to changes in $P$. Demand curve is flatter
   $\Rightarrow 1\%$ change in $P$ results in a more than $1\%$ change in $Q_d$ (in the opposite direction). (if $E_d = 2$ that means if $P \uparrow$ by $1\%$ $Q_d \downarrow$ by $2\%$.)
   
   Examples of elastic goods: cars, furniture, vacations, etc.

2. **Inelastic Demand ($E_d < 1$)**
   
   If $E_d = \frac{\% \Delta Q_d}{\% \Delta P} < 1 \Rightarrow \% \Delta Q_d < \% \Delta P \Rightarrow$ demand is inelastic.
   
   Consumers are not very responsive to changes in $P$.
   
   Demand Curve is steeper $\Rightarrow 1\% \uparrow$ (or $\downarrow$ ) in $P$ results
   in a less than $1\% \downarrow$ (or $\uparrow$ ) in $Q_d$ (if $E_d = 0.70$ that means if $P \uparrow$ by $1\%$ $Q_d \downarrow$ by $0.7\%$.) or (if $P \uparrow$ by $10\%$ $Q_d \downarrow$ by $7\%$.)
   
   Examples of inelastic goods: medicine, food, etc.
   
   ✧ If the price elasticity is between $0$ and $1$, demand is inelastic.

3. **Unit-Elastic Demand ($E_d = 1$)**
   
   If $E_d = \frac{\% \Delta Q_d}{\% \Delta P} = 1 \Rightarrow \% \Delta Q_d = \% \Delta P \Rightarrow$ demand is
   unit-elastic
1% ↑ in P results in a 1% ↓ in \( Q_d \)

4. **Perfectly Elastic Demand** \( (E_d = \infty) \)

If \( E_d = \frac{\%\Delta Q_d}{\%\Delta P} = \infty \) ⇒ demand is perfectly elastic ⇒ horizontal demand curve ⇒ the same price is charged regardless of \( Q_d \) (perfect competition).

Any price increase would cause demand to fall to zero. Shifts in supply curve results in no change in price.

Examples: identical products sold side by side, agricultural products.

5. **Perfectly Inelastic Demand** \( (E_d = 0) \)

If \( E_d = \frac{\%\Delta Q_d}{\%\Delta P} = 0 \) ⇒ demand is perfectly inelastic ⇒ a vertical demand curve ⇒ demand is completely inelastic. \( Q_d \) remains the same regardless of any change in price. Shifts in supply curve results in no change in \( Q_d \).

Examples: medicine of heart diseases or diabetes such as insulin. A good with a vertical demand curve has a demand with zero elasticity.

✧ We conclude from the five categories above that the more flatter is the demand curve the more elastic is the demand and the more steeper is the demand curve the more inelastic is the demand.
Elasticity along straight line demand curve

- Elasticity of demand ($E_d$) is not the slope of the demand curve.
- For a straight-line (linear) demand curve the slope is constant (i.e., the slope is the same at every point along the curve). It is equal to the change in price over the change in quantity demanded.

\[
\text{Slope} = \frac{\Delta P}{\Delta Q_d}, \quad \text{while elasticity is } E_d = \frac{\% \Delta Q_d}{\% \Delta P}.
\]

- Although the slope is constant, price elasticity varies along a linear demand curve.
- The following equation shows the relationship between the elasticity and the slope of a straight line demand curve

\[
E_d = \frac{\% \Delta Q_d}{\% \Delta P} = \frac{\Delta Q_d}{\Delta P} \cdot \frac{Q_d}{P} = \frac{\Delta Q_d}{\Delta P} \cdot \frac{P}{Q_d} = \frac{1}{\text{slope}} \cdot \frac{P}{Q_d}
\]

Since the slope of straight-line demand curve is constant, \( \frac{1}{\text{slope}} \) is also constant \( \Rightarrow \) elasticity varies as a result of variation of \( \frac{P}{Q_d} \); i.e.

straight-line demand curve elasticity depends on the values of $Q_d$ and $P$

1. When $P = 0$, $E_d = 0$ (perfectly inelastic)
2. When $Q = 0$, $E_d = \infty$ (perfectly elastic)
3. $E_d$ increases as we move upward along a straight-line demand curve (from the inelastic range to the elastic one) (as $P \uparrow$ and $Q \downarrow$)
4. $E_d$ decreases as we move downward along the straight-line demand curve (as $P \downarrow$ and $Q \uparrow$).
Thus, along downward sloping demand curve, demand is elastic when price is high, inelastic when price is low and unit-elastic at the midpoint of the demand curve.

**PRICE ELASTICITY AND TOTAL REVENUE**

- Total revenue (TR) equals the total amount of money a firm receives from the sales of its product and is found by multiplying the price they receive times the quantity that they sell. TR = P * Q.
- TR is affected by changes in both P and Qd. But as we know by now the law of demand states that an ↑ in P will result in a ↓ in Qd.
- Thus, an increase in P may or may not lead to greater TR. This depends on which effect is the largest, price effect or the effect of quantity demanded.
- The size of the price elasticity of demand coefficient, tells us which of these two effects is largest.
- If demand is elastic (Ed > 1) ⇒ %ΔQd > %ΔP
  - 10 %↑ in P results in more than 10 %↓ in sales ⇒ TR ↓
  - 10 %↓ in P results in more than 10 %↑ in sales ⇒ TR ↑
- If demand is inelastic (Ed < 1) ⇒ %ΔQd < %ΔP
  - 10 %↑ in P results in less than 10 %↓ in sales ⇒ TR ↑
  - 10 %↓ in P results in less than 10 %↑ in sales ⇒ TR ↓
- If demand is unit elastic (Ed = 1) ⇒ %ΔQd = %ΔP
  - 10 %↑ in P results in 10 %↓ in sales ⇒ TR does not change
  - 10 %↓ in P results in 10 %↑ in sales ⇒ TR does not change

<table>
<thead>
<tr>
<th></th>
<th>E&gt;1</th>
<th>E&lt;1</th>
<th>E = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR ↑</td>
<td>↓</td>
<td>↑</td>
<td>-</td>
</tr>
<tr>
<td>P ↓</td>
<td>↑</td>
<td>↓</td>
<td>-</td>
</tr>
</tbody>
</table>
This table shows that:

- When $E_d > 1$, $P$ and TR move in the opposite direction (negative relationship)
- When $E_d < 1$, $P$ and TR move in the same direction (positive relationship)
- When $E_d = 1$ TR is maximum.

The impact of a price change on TR depends on the $E_d$. The rises or falls in TR as price increases (or decreases) depend on $E_d$. Hence, TR varies along a linear downward sloping demand curve.

**Graphical Illustration of the relationship between TR, P, and $E_d$**

[Graph showing demand and TR curves with $E_d > 1$, $E_d = 1$, and $E_d < 1$]
When the price is equal to zero, as it is where demand intersects the quantity axis, or when the quantity demanded equals zero, as it is when the demand intersects the price axis, total revenue must equal zero. Thus, when a firm either sells none of its goods or sells its good for a zero price, they bring in zero revenue. If the firm moves away from either of these intersection points then their total revenue must increase. Total revenue continues to rise as the firm moves away from the intersections until it reaches a maximum at the midpoint.

For a price increase, total revenue rises when demand is inelastic and falls when demand is elastic.

Examples

With a linear DC, TR increases and then decreases when P increases (or when P decreases)

To max TR, set price at unitary elastic price

If a company wants to ↑ its TR when $E_d = 0.75$, it should ↑ P

If a company wants to ↑ its TR when $E_d = 1.5$, it should ↓ P

If $E_d = 1$, an ↑ in P by 15%, ⇒ $Q_d$ ↓ by 15%, ⇒ TR will not change

What is the impact on total revenue when price decreases from 30 to 25 in the table below:

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>

From the graph to the right

a. calculate $E_d$

b. When P increases what would happen to TR?

$E_d = 1$ and TR remains the same.

The area (0-5-a-20) = the area (0-4-b-25)
FACTORS THAT INFLUENCE THE PRICE ELASTICITY OF DEMAND

✧ Demand for some goods and services is elastic whereas for other goods and services is inelastic.
✧ Elasticity does not only differ from one good to another but also it may differ for a particular product at different prices.
✧ The elasticity of demand is computed between points on a given demand curve. Hence, the price elasticity of demand is influenced by all determinants of demand.
✧ We can summarize the main factors that affect $E_d$ as:

1. Availability and closeness of Substitutes
   ✧ When a large number of substitutes are available, consumers respond to a higher price of a good by buying more of the substitute goods and less of the relatively more expensive one. So, we would expect a relatively high price elasticity of demand for goods or services with many close substitutes, but would expect a relatively inelastic demand for goods with few close substitutes.
   ✧ Example:
     Dell computer, for example, has many substitutes. So its price elasticity of demand is highly elastic because the consumers can easily shift to the other substitutes if the price of Dell computer increases.
   ✧ Example:
     Pepsi and Coke are very close substitutes. So, the availability of Pepsi makes the price elasticity of demand of Coke very high. Any increase in the price of Coke will result in a huge shift of consumers to Pepsi’s purchase.
   ✧ Furthermore, the broader the definition of the good, the lower the elasticity since there is less opportunity for substitutes. The narrower the
definition of the good the higher the elasticity, since there are more substitutes.

✧ Example:
A buyer who likes Japanese cars and has relative preference for Toyota products may have higher price elasticity of demand for Camry than the price elasticity of demand for Toyota cars. His price elasticity of demand for Toyota cars is higher than the price elasticity of demand for Japanese cars. And his price elasticity of demand for Japanese cars is higher than the price elasticity of demand for cars in general. Why?

✧ Example:
Consider the relative price elasticity of demand for a good such as apples compared to a good such as fruits. What is the difference between apples and fruits? Apples are, of course, a fruit but so are lots of other goods as well. Hence, more substitutes exist for apples than exist for the broader category of fruits. We have already determined that as the number of substitutes increase then so does that goods relative price elasticity of demand.

2. Proportion of Income Spent on the Good

✧ The higher the proportion of income spent on the good, the higher the elasticity of demand. Expensive good take a greater proportion of an individual’s income than the inexpensive goods; so expensive good are more elastic.

✧ Example:
Consider the price elasticity of demand for a good such as a pen compared to that for a good such as a car. One of the big differences between these two types of goods is that the price of a pen is small as a proportion of the income while the price of a car is typically a large percentage of income. Doubling the price of pens will not, therefore, have a big impact on one’s
income. However, doubling the price of cars will have a large impact on one’s income. Thus, the demand for high-priced goods such as cars tends to be more price elastic than the demand for low-priced goods such as bread or salt.

3. **The Time Elapsed Since Price Change (Length of Time)**
   - Consumers often have more possibilities for substitutes for a good when a longer time period is considered.
   - **Example:**
     Consider what happens as the price of a good such as gasoline doubles. People respond to the higher price by decreasing their use of gas. However, in just a short time period it is more difficult to do this than in a longer period. Essentially, the longer the time period people have to adjust, the more alternatives they can find to reduce their consumption of gas. For example, they might be able to move closer to work, buy a more fuel-efficient car, use public transportation, arrange with friends to go in on car, etc.
   - Thus, in short run, the response is very limited $\Rightarrow$ demand is less elastic; over time, demand tends to be more elastic because time is available to search for substitutes and adjust to the new situation

4. **Necessary vs. Luxury goods**
   - Demand for necessary goods, goods that are critical to our everyday life and have no close substitute, is relatively inelastic (food, medicine).
   - Demand for luxury goods, goods with many substitutes and we would like to have but are not likely to buy unless our income jumps or the price declines sharply, is relatively elastic (cars, traveling to foreign countries for vacation).
   - Nevertheless, what is one person's luxury is another person's necessity
THE INCOME ELASTICITY OF DEMAND

✧ The income has an impact upon demand.
✧ Recall that the relationship between income and demand may be direct or inverse, depending on whether the good is a normal good or an inferior good.
✧ Income Elasticity of Demand (\( E_Y \)) measures the responsiveness of \( Q_d \) of a good to a change in income. It is the percentage change in quantity demanded divided by percentage change in income.

\[
E_Y = \frac{\% \Delta Q_d}{\% \Delta Y} = \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{Y_2 - Y_1}{Y_2 + Y_1}
\]

✧ \( E_Y > 1 \) ⇒ Demand is income elastic and the good is normal. \% \( \Delta Q_d > \% \Delta Y \) (A small percentage change in income results in a large percentage change in \( Q_d \))
✧ \( 0 < E_Y < 1 \) ⇒ Demand is income inelastic and the good is normal. \% \( \Delta Q_d < \% \Delta Y \) (A large percentage change in income results in a small percentage change in \( Q_d \))
✧ \( E_Y < 0 \) (negative) ⇒ the good is an inferior good.
✧ Income elasticity is higher for luxury goods (such as jewelry, vacations, etc), ⇒ \( E_Y > 1 \)
✧ Income elasticity is lower for necessary goods (such as food, medicines, clothes, housing, etc.) ⇒ \( 0 < E_Y < 1 \) (positive)
✧ **Examples:**
  o If people’s average income increased from BD300 to BD350 per month and as a result their purchase of orange juice increased from 5000 liters to 5800 liters per month, so \( E_Y = 0.96 \).
  o The increase in income by 10% results in an increase in the \( Q_d \) of orange juice by 9.6% (since the sign is positive this means the orange juice is a normal good. People buy more of it when their income increases.
o If income ↑ by 5% and Qd ↑ by 10% ⇒ E_Y = +2 ⇒ normal good
o If people’s average income increased from BD300 to BD350 per month and as a result their purchase of used mobiles decreased from 400 units to 300 units per month, so E_Y = -1.86.

o The increase in income by 10% results in a decrease in the Q_d of used mobiles by 18.9%. Since the sign is negative this means the mobile is an inferior good. People buy less of it when their income increases.

o If income ↑ by 5% and Q_d ↓ by 10% ⇒ E_Y = -2 ⇒ inferior good
THE CROSS ELASTICITY OF DEMAND

✧ The decision to buy a good depends not only on its price but also on the price and availability of other goods (substitutes or complements).

✧ We know that as the price of a related good changes, the demand for the good will also change. What we want to know here is how much will quantity demanded rise or fall as the price of the related good changes. That is, how elastic is the demand curve in response to changes in prices of related goods.

✧ Cross elasticity measures the responsiveness of Qd of a particular good to changes in the prices of its substitutes and its complements.

✧ If X and Y are two goods, the cross elasticity of demand is the percentage change in Qd of good X to the percentage change in price of good Y

\[
E_{xy} = \frac{\% \Delta Q_x}{\% \Delta P_y} = \frac{\frac{Q_{2x} - Q_{1x}}{Q_{1x} + Q_{2x}} \times \frac{P_{2y} - P_{1y}}{P_{2y} + P_{1y}}}{\frac{Q_{2y} - Q_{1y}}{Q_{1y} + Q_{2y}} \times \frac{P_{2y} - P_{1y}}{P_{2y} + P_{1y}}}
\]

✧ When the cross elasticity of demand has a positive sign, the two goods are substitute goods.

✧ When the cross elasticity of demand has a negative sign, the two goods are complementary goods

✧ The size of cross elasticity of demand coefficient is primarily used to indicate the strength of the relationship between the two goods in question.

✧ Example:

If \( P_{1x} = 20, \) \( P_{2x} = 30 \)

\( Q_{1y} = 200 \) \( Q_{2y} = 250 \)

\( Q_{1z} = 150 \) \( Q_{2z} = 140 \)

Determine the relationship between X and Y, and the relationship between X and Z

\( E_{xy} = 0.556 \Rightarrow X \) and Y are substitutes

\( E_{xz} = -0.172 \Rightarrow X \) and Z are complements
PRICE ELASTICITY OF SUPPLY

- When demand increases, the equilibrium price rises and the equilibrium quantity increases. But does the price rise by a large or a little amount? And does the quantity increase by large or a little amount? The answer depends on the responsiveness of quantity supplied to a change in price.

- Elasticity of supply measures the responsiveness of quantity supplied to a change in the price of a good when all other influences on selling plans remain the same.

\[
E_s = \frac{\% \Delta Q_s}{\% \Delta P} = \frac{\frac{Q_2 - Q_1}{\overline{P}_2 - \overline{P}_1}}{\overline{P}_2 + \overline{P}_1} = \frac{Q_2 - Q_1}{\overline{Q}_2 + \overline{Q}_1} \frac{\overline{P}_2 - \overline{P}_1}{\overline{P}_2 + \overline{P}_1} = \frac{Q_2 - Q_1}{\overline{Q}_2 + \overline{Q}_1} \times \frac{\overline{P}_2 - \overline{P}_1}{\overline{P}_2 + \overline{P}_1} = \frac{Q_2 - Q_1}{\overline{Q}_2 + \overline{Q}_1} \times \frac{\overline{P}_2 - \overline{P}_1}{\overline{P}_2 + \overline{P}_1}
\]

- Elasticity coefficient is positive to show the direct relationship between P and Qs.

- Example:

Suppose you have the following data

\[
P_1 = 20 \quad Q_1 = 10
\]

\[
P_2 = 30 \quad Q_2 = 13
\]

\[
E_s = \frac{13 - 10}{13 + 10} \div \frac{30 - 20}{30 + 20} = 0.65
\]

Supply Elasticity Categories

1. If \( E_s > 1 \); \( \% \Delta Q_s > \% \Delta P \) (if \( P \) ↑ by 1%, \( Q_s \) ↑ by more than 1%) ⇒ supply is elastic

2. If \( E_s < 1 \); \( \% \Delta Q_s < \% \Delta P \) (if \( P \) ↑ by 1%, \( Q_s \) ↑ by less than 1%) ⇒ supply is inelastic
3. If $E_s = 1; \% \Delta Q_s = \% \Delta P$ (if $P \uparrow$ by 1%, $Q_s \uparrow$ by 1%) $\Rightarrow$ supply is unit elastic

4. If $E_s = \infty$, supply is perfectly elastic with horizontal supply curve. The same price is charged regardless of $Q_s$. Any price decrease would cause supply to fall to zero. Shifts in demand curve results in no change in $P$.

5. If $E_s = 0$, supply is perfectly inelastic with a vertical supply curve. $Q_s$ remains the same regardless of any change in price. Shifts in demand curve results in no change in $Q_s$.

Factors that influence elasticity of supply

Price elasticity of supply depends on:

1. **Resource substitution possibilities**
   - In general, the supply of most goods and services has elasticity between zero and infinity.
   - The easier it is to substitute among the resources used to produce a good or service, the greater is its elasticity of supply.
   - If the resources of a good are common and available, the supply is more elastic and supply curve is almost horizontal (wheat and corn)
   - When goods can be produced in different countries, the supply is more elastic and supply curve is almost horizontal (sugar, beef, computers)
If the resources of a good are unique, the supply of that good is highly inelastic and the supply curve is vertical. (Paintings)

2. Time Frame for Supply Decision

- The more time that passes after a price change, the greater is the elasticity of supply.
- We distinguish between three time frames of supply:
  
a. **Momentary Supply (MS)**: Immediate response of producers to price change. In general, when price changes, most goods usually have a perfectly inelastic momentary supply with a vertical supply curve. No matter what is the price, production decision is already made earlier and it is difficult to change factors of production and technology immediately. (for example the production of agricultural products such as grains and fruits)
  
b. **The SR supply curve (SS)** is more elastic than momentary supply but is less elastic than long term supply. It shows how the quantity supplied responds to price changes when only some factors and technology affecting production are possible to change. The short response is a sequence of adjustments: firms may increase or decrease the amount of labor force and number of work hours. Firms may plan additional training to the new workers or may buy new tools and equipments.

  Short run supply curve slopes upward because producers can change quantity supplied in response to price changes quickly.

  
c. **The long run supply curve (LS)** is usually highly elastic. It shows the response of quantity supplied to price change after all necessary adjustments and changes in factors of production and technology (building new plants, expanding the existing plants, training new worker)