## Price Elasticity Of Demand And supply

**Elasticity:-**

Proportional or Percentage change in dependent variable due to proportional or percentage change into independent variable is called elasticity.

**Elasticity of Demand:-**

**Introduction:-**

**Alfred Marshall** invented price elasticity of demand only four years after he had invented the concept of elasticity in 1890, he published the concept of elasticity of demand in his book **Principles of Economics.**

**Definition:-**

Proportional or percentage change in Quantity demand due to proportional or percentage change in price is called elasticity of demand.

$Q_d = f(p)$

- It is also knoen as **Price Elasticity of demand.**
- It is denoted by $E_p$ or $E_d$
- Formula:-

  $E_p = E_d = \frac{Percentage\ Change\ in\ Qd}{Percentage\ change\ in\ Price}$

**Mathematical Form:-**

$$E_p = E_d = \frac{Change\ in\ Quantity}{Orignal\ Quantity} \Big/ \frac{Change\ in\ Price}{Original\ Price}$$

$$E_p = E_d = \frac{Change\ in\ Quantity}{Orignal\ Quantity} \times \frac{Original\ Price}{change\ in\ Price}$$

$=\frac{\Delta Qd}{dp} \times \frac{P}{Q}$

Or

$E_p = \frac{dQd}{dp} \times \frac{P}{Q}$

Where

$\frac{dQd}{dp}$ gives marginal demand function

And

$\frac{P}{Q}$ gives average demand function.

**A variety of demand curve:-**

- Result of elasticity of demand is always negative because the relation is negative.
- **Unit Elastic Demand**
  When result is one, then its means that change is normal i.e. by increasing the price P , Q than $Q_d$ decreases in the same ratio.
- **Elastic demand**
  If result is greater then one, it means that $Q_d$ decreases 67% and price increases 22%
- **Inelastic demand**
  If result is smaller then one,it means price increases 22% and $Q_d$ decreases 11%
- **Perfectly Elastic Demand**
  If result is infinite it means that price remains the same and $Q_d$ increases

**Example:-**

**If Q=200- P. Calculate the price elasticity of demand when price is 24.**

Q= 200 – 24

Q= 176

Now,

$E_p = \frac{dQd}{dp} \times \frac{P}{Q}$

$$E_p = \frac{d(200-P)}{dp} \times \frac{24}{176}$$

$$-1 \times \frac{24}{176}$$

$$-\frac{24}{176}$$

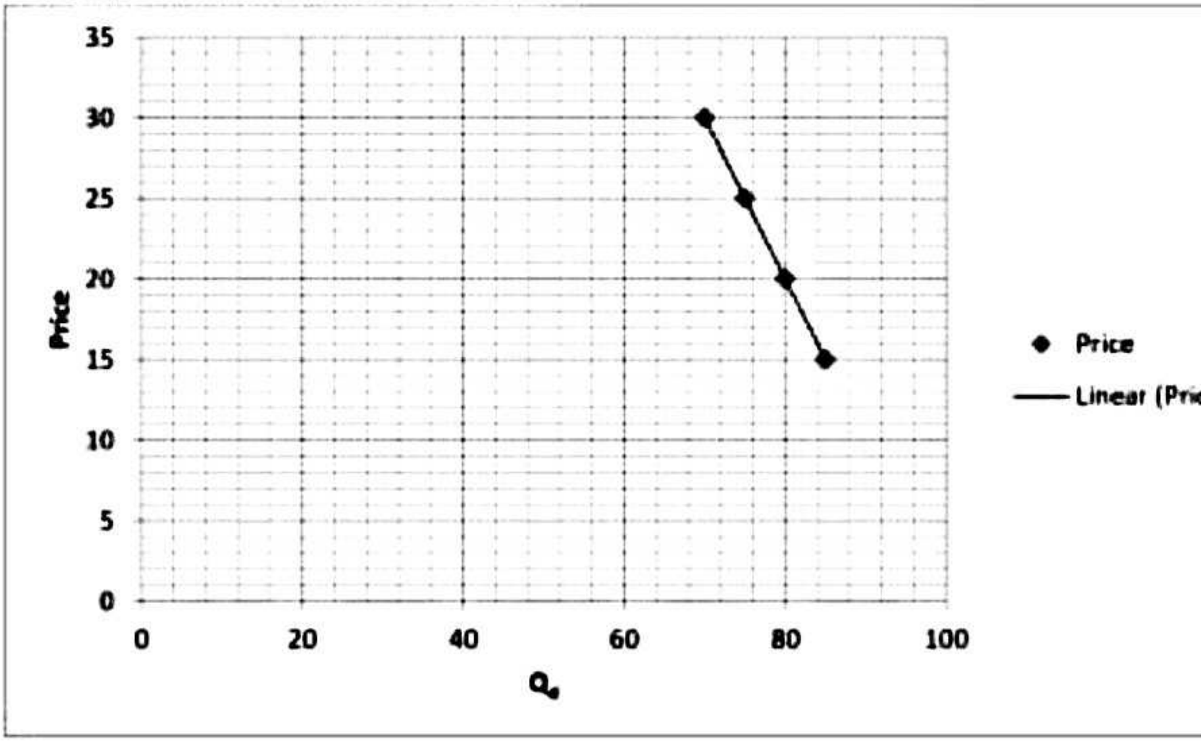
$$E_p \frac{-6}{44}$$

$$E_p \frac{-3}{22}$$

**Graph:-**

| Qd | Price |
|---|---|
| 85 | 15 |
| 80 | 20 |
| 75 | 25 |
| 70 | 30 |

This graph is inelastic of elastic demand.



**Example:-**

**If Q= 250- 5P Find $E_p$ where P= 40**

Q= 250 – 5 (40)

Q = 250 – 200

Q = 50

Now,

$$E_p = \frac{dQd}{dp} \times \frac{P}{Q}$$

$$E_p = \frac{d(250-5P)}{dp} \times \frac{40}{50}$$

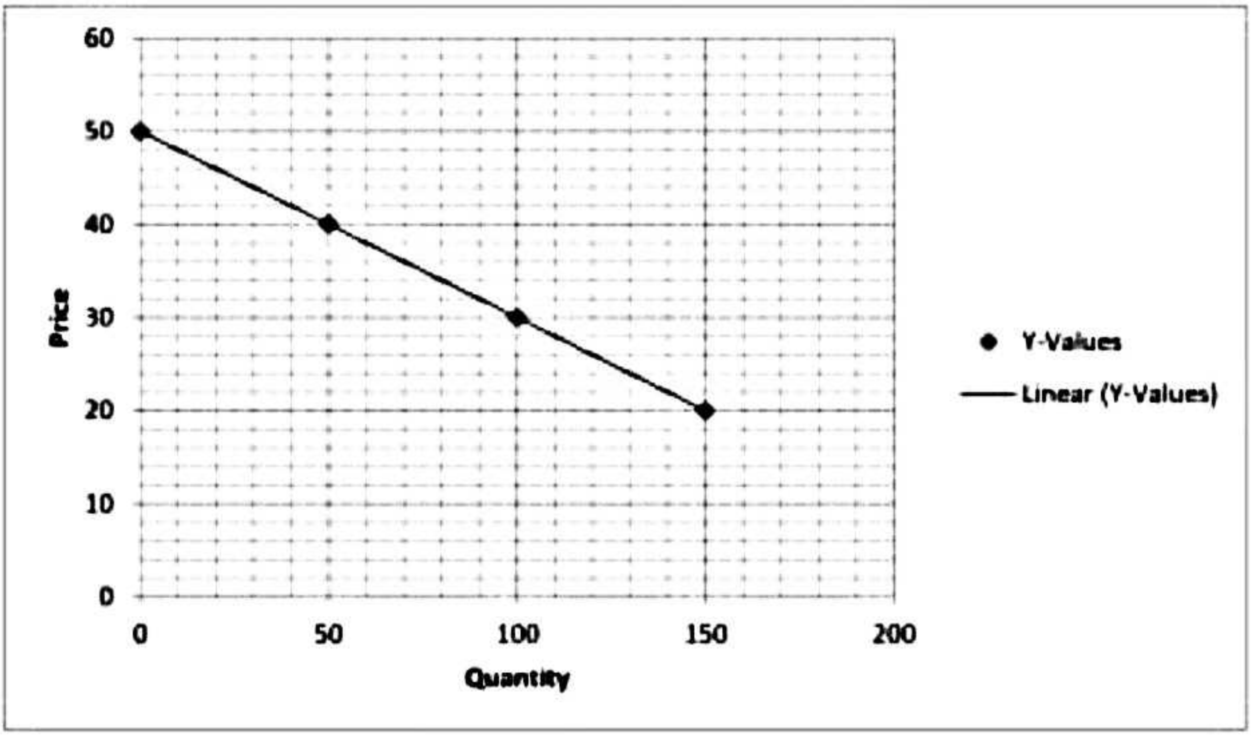
$$E_p = -5 \times \frac{40}{50}$$

$$E_p = -5 \times \frac{4}{5}$$

$$E_p = -4$$

**Graph:-**

| X-Values | Y-Values |
|---|---|
| 150 | 20 |
| 100 | 30 |
| 50 | 40 |
| 0 | 50 |




This Graph is of elastic demand.

**Example:**

**If $Q = 280 - 5p - 0.4\ P^2$ where $P=20$ Find $E_p$.**

$Q_d = 280 - 5(20) - 0.4(20)^2$

$= 280 - 100 - 0.4(400)$

$= 280 - 100 - 160$

$= 280 - 260$

$= 20$

Now ,

$\frac{dQd}{dp} = \frac{d}{dp}\ (280 - 5P - 0.4P^2)$

$= -5 - 0.8P$

$= -5\ -0.8(20)$

= -5  -16

= -21

Then ,

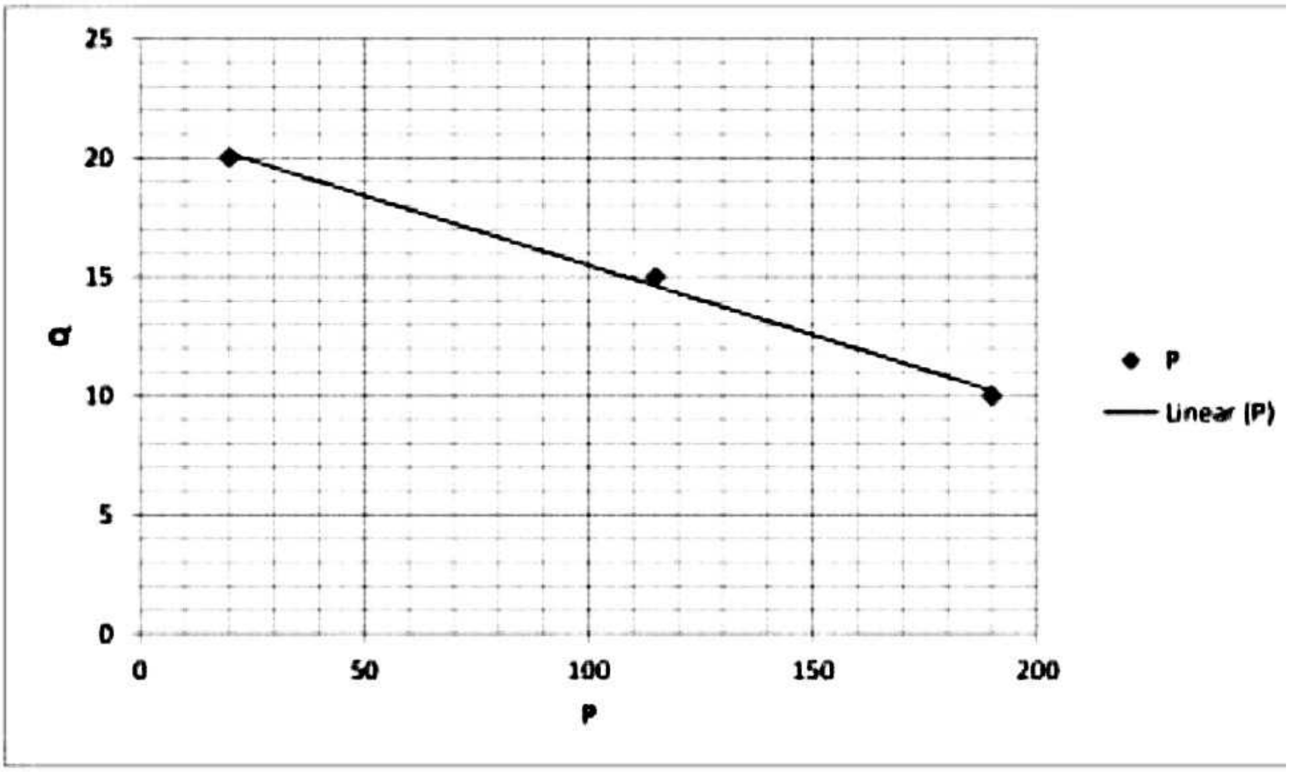
$$E_p = \frac{dQd}{dp} \times \frac{P}{Q}$$

$= -21 \times \frac{20}{20}$

$E_p = -21$

**Graph:**

| Q | P |
|---|---|
| 190 | 10 |
| 115 | 15 |
| 20 | 20 |




**Example:-**

**If Q= 20- 3P$^2$ Where P=2 Find $E_p$**

Q= 20- 3P$^2$

=20- 3(2)$^2$

= 20 – 3(4)

= 20 – 12

= 8

Now ,

$$E_p = \frac{dQd}{dp} \times \frac{P}{Q}$$

$$E_p = -6 \times \frac{2}{8}$$

$$E_p = -\frac{12}{8}$$

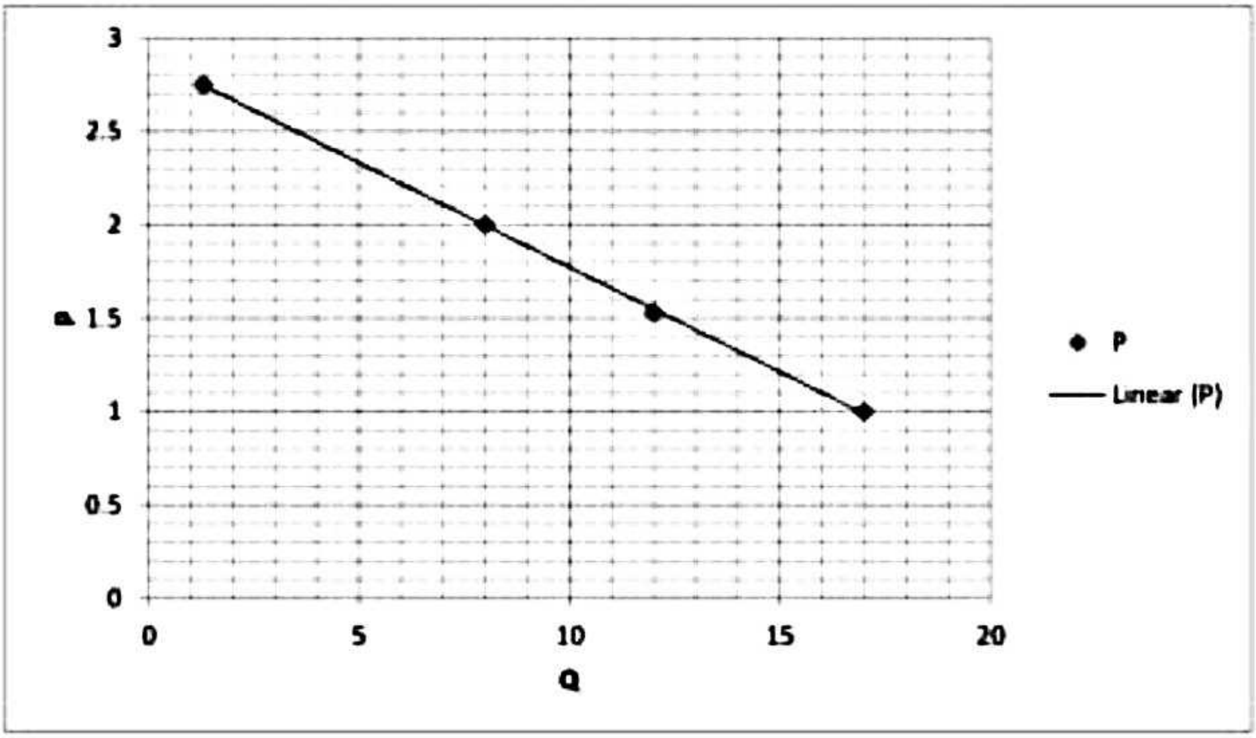
$$E_p = -6 \times \frac{2}{8}$$

$$E_p = -\frac{12}{8}$$

$$E_p = -\frac{3}{2}$$

**Graph:-**

| Q | P |
|---|---|
| 17 | 1 |
| 12 | 1.53 |
| 8 | 2 |
| 1.3 | 2.75 |




**This Graph is of Elastic demand**

**Elasticity of supply:-**

**Introduction:-**

Alfred Marshall invented price elasticity of supply only Four years after he had invented the concept of elasticity. In 1890 he published the concept of Elasticity of demand in his book **Principles of Economics.**

**Definition:-**

Proportional or percentage change in quantity supply due to proportional or percentage changes in price is called elasticity of supply.

$Q_s = f(p)$

- It is also known as **Price elasticity of supply**
- It is denoted by Es or E

**Formula:-**

$E_s = E = \frac{Percentage\ change\ in\ Qs}{percentage\ change\ in\ Price}$

**Mathematical Form:-**

$E_s = E = \frac{Change\ in\ supply}{Original\ supply} \Big/ \frac{Change\ in\ Price}{Original\ price}$

$E_s = E = \frac{Change\ in\ supply}{Original\ supply} \times \frac{Original\ Price}{Change\ in\ Price}$

$E_s = E = \frac{dQs}{dp} \times \frac{P}{Q}$

Where

$\frac{dQs}{dp}$ gives marginal supply function

$\frac{P}{Q}$ gives average supply function

**A variety of supply curves**

**Unit Elastic supply:-**

When elasticity equals 1 price increases 25% and Quantity increase 25 %

**Elastic Supply:-**

When elasticity is greater then 1 price increase 22% and Quantity increases 67%

**Perfectly Elastic supply:-**

When elasticity equals infinity price and Quantity remains same.

**Perfectly Inelastic supply:-**

When elasticity equals zero price increases and quality remain unchanged

**Inelastic supply :-**

When elasticity is less than 1, then price increase 22% and quantity increases 10%

**Example:-**

**If Q=100 +2P where P=25 find $E_s$**

Q = 100 + 2(25)

Q=100 + 50

Q= 150

Now,

$E_s = \frac{dQx}{dp} \times \frac{P}{Q}$

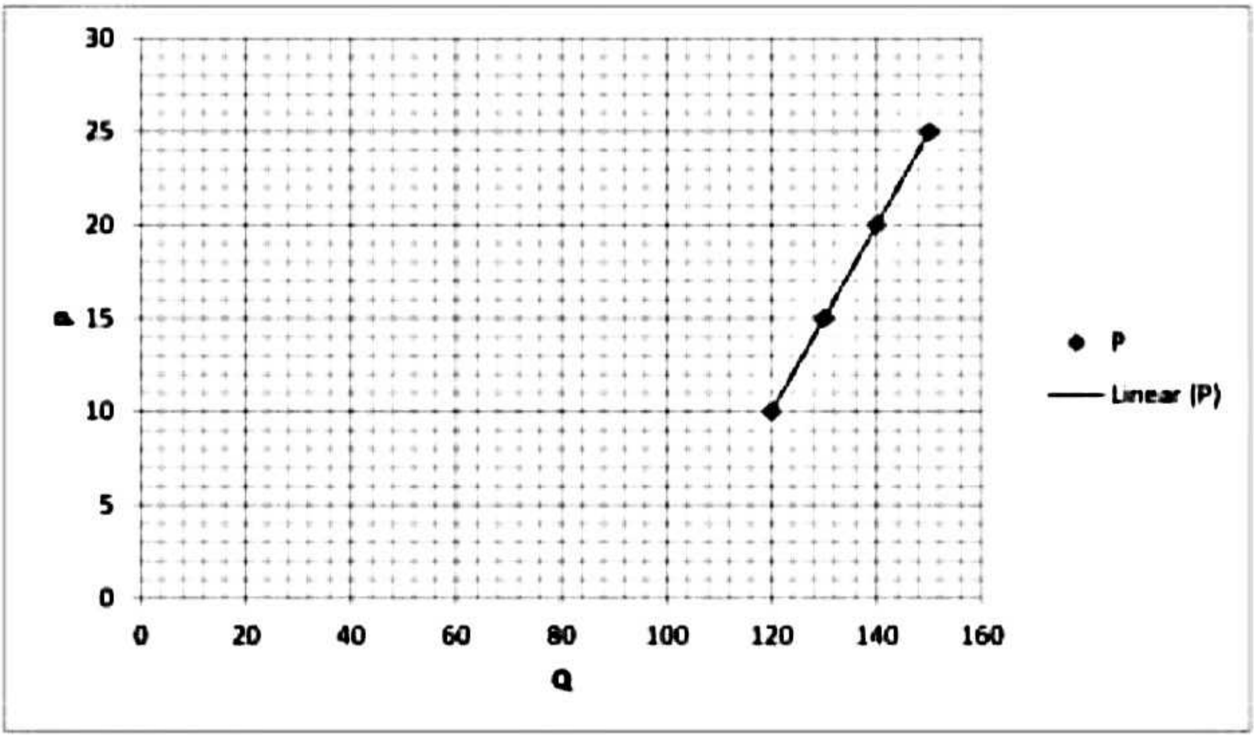
$E_s = 2 \times \frac{25}{150}$

$E_s = \frac{50}{150}$

$E_s = \frac{1}{3}$

**Graph**

| Q | P |
|---|---|
| 120 | 10 |
| 130 | 15 |
| 140 | 20 |
| 150 | 25 |




The graph is inelastic supply

**Example:-**

**If Q = 300 + 5P² Where P=3 find Es**

$Q = 300 + 5(3)^2$

$Q = 300 + 5(9)$

Q = 300 45

Q = 345

Now ,

$E_s = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_s = \frac{d(300+5P2)}{dp} \times \frac{3}{345}$

$E_s = 10P \times \frac{3}{345}$

$E_s = 10(3) \times \frac{3}{345}$

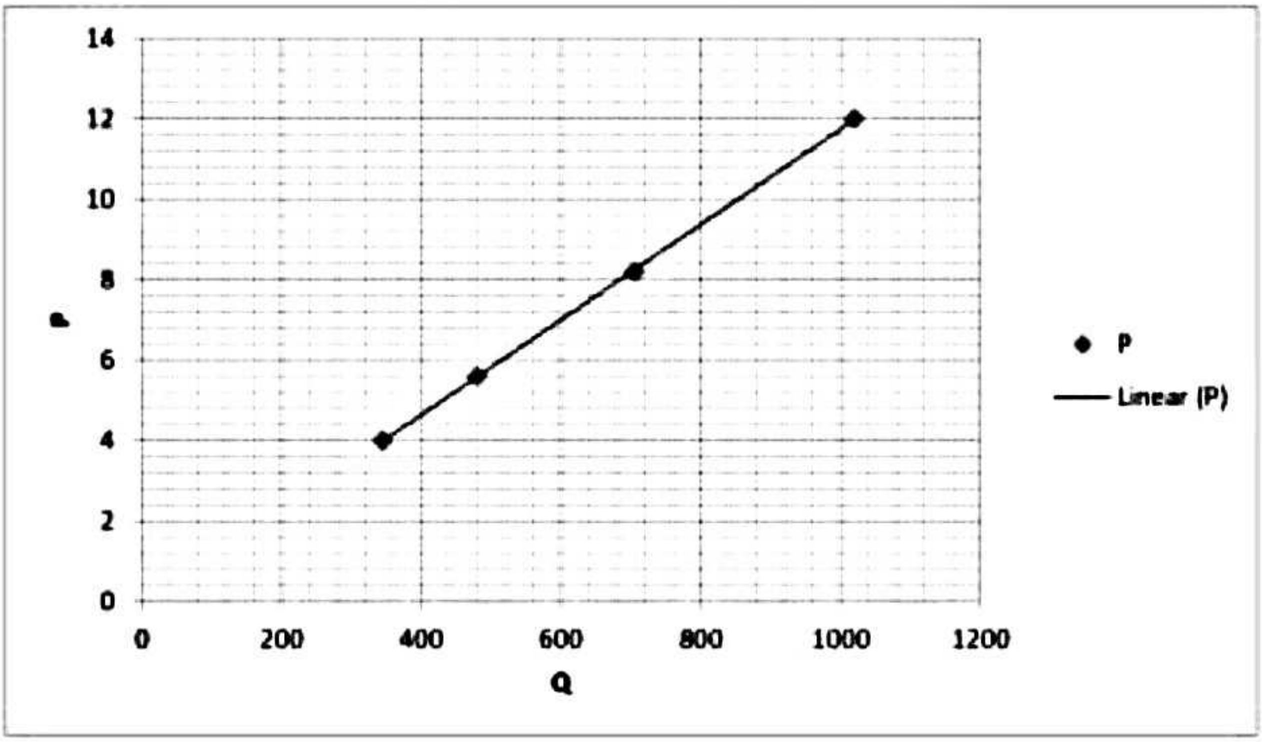
$E_s = 30 \times \frac{3}{345}$

$E_s = \frac{90}{345} = \frac{18}{69}$

$E_s = \frac{6}{23}$

**Graph**

| Q | P |
|---|---|
| 345 | 4 |
| 480 | 5.6 |
| 705 | 8.2 |
| 1020 | 12 |




**Example:-**

**If $Q = 200 + 2P + 0.1P^2$ where $P = 20$ Find $E_s$**

$Q = 200 + 2(20) + 0.1(20)^2$

$Q = 200 + 40 + 0.1(400)$

Q= 200 + 40 + 40

Q= 280

Now,

$E_s = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_s = \frac{d(200+2P+0.1P2)}{dp} \times \frac{20}{Q280}$

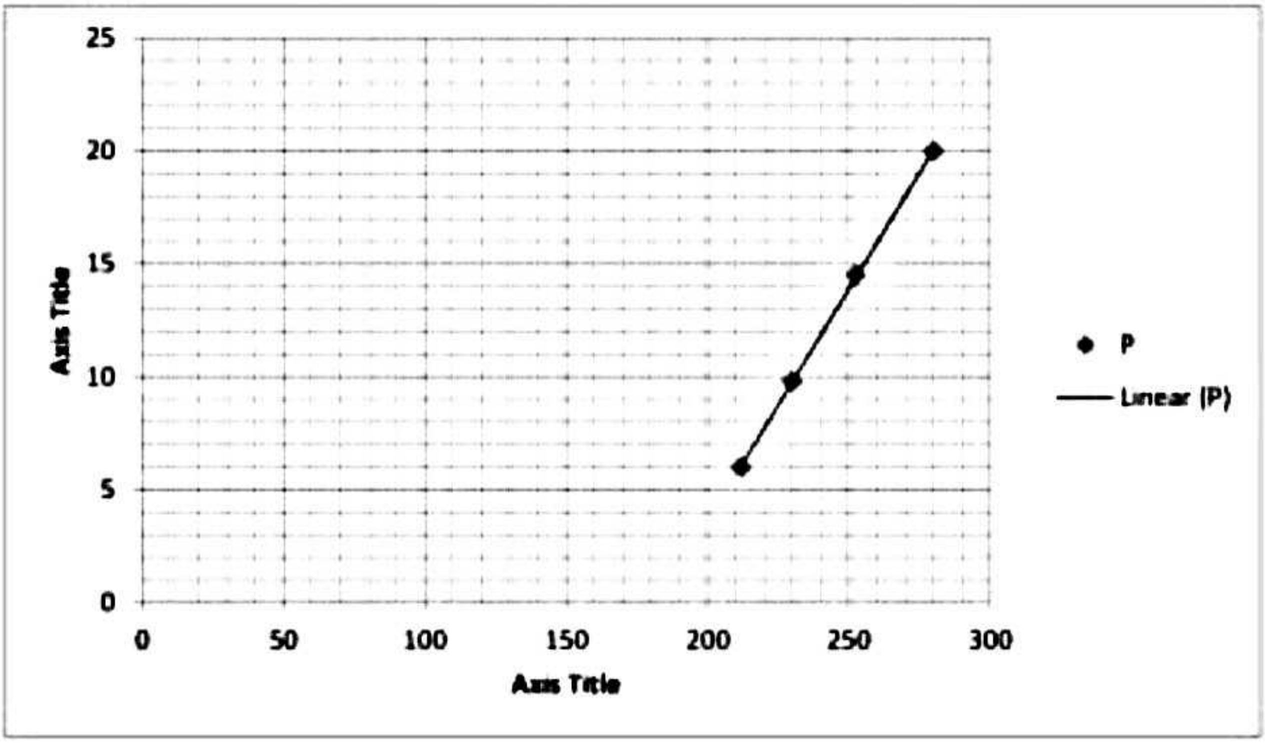
$E_s = 2 + 0.2\ (20) \times \frac{2}{28}$

$E_s = 2 + 4 \times \frac{1}{14}$

$E_s = \frac{6}{14}$

**Graph:-**

| Q | P |
|---|---|
| 212 | 6 |
| 230 | 9.8 |
| 252.5 | 14.5 |
| 280 | 20 |




This Graph is inelastic supply

**Example**

**If Q= 84+$P^2$ Where P=8 find $E_s$**

Q= 84 + $(8)^2$

Q = 84 + 64

Q= 148

Now,

$E_s = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_s = \frac{d(84+P2)}{dp} \times \frac{8}{148}$

$E_s = 2P \times \frac{8}{148}$

$E_s = 2(8) \times \frac{8}{148}$

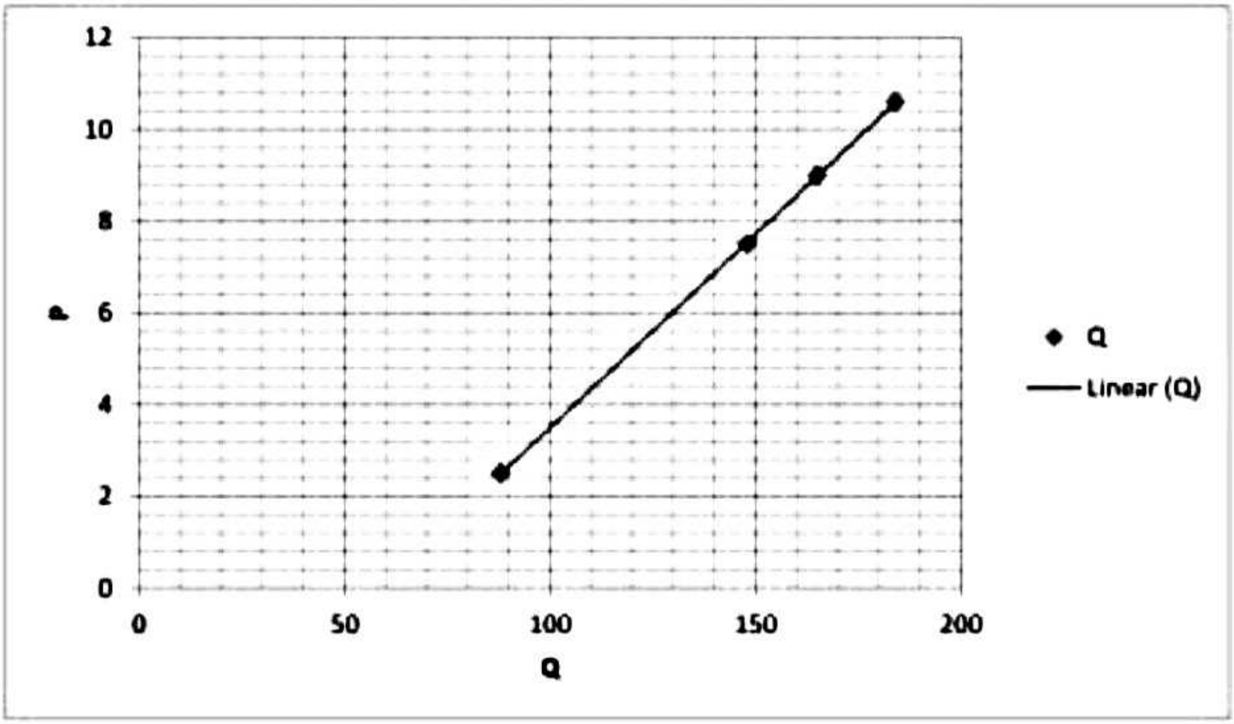
$E_s = 16 \times \frac{8}{148}$

$E_s = \frac{128}{148}$

$E_s = \frac{32}{37}$

**Graph:-**

| P | Q |
|---|---|
| 88 | 2.5 |
| 165 | 9 |
| 148 | 7.5 |
| 184 | 10.6 |




**Example**

**If $Q_s = 200 + 4P^2$ and $Q_d = 250 - 9P - 4P^2$**

**Find P , Q, $E_d$ and Es**

**As we Know that**

$Q_s = Q_d$

$200 + 4P^2 = 250 - 9P - 4P^2$

$4P^2 + 4P^2 + 9P = 250 - 200$

$8P^2 + 9P - 50 = 0$

Applying Quadratic formula

$$P = \frac{-9 \pm \sqrt{9^2 - 4(8)(-50)}}{2(8)}$$

$$P = \frac{-9 \pm \sqrt{1681}}{16}$$

$$P = \frac{-9 \pm 41}{16}$$

$P = \frac{-9+41}{16}$ , $P = \frac{-9-41}{16}$

$P = \frac{32}{16}$ , $P = -\frac{50}{16}$

$P = 2$ , $P = -\frac{25}{8}$

**P= 2**

Now putting value in both equations

$Q_s = 200 + 4(2)^2$ $Q_d = 250 - 9(2) - 4(2)^2$

$Q_s = 200 + 4(4)$ $Q_d = 250 - 18\ 4(4)$

$Q_s = 200 + 16$ $Q_d = 250 - 18 - 16$

$Q_s = 216$ $Q_d = 216$

**Q=216**

Now ,

$E_d = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_d = \frac{d(250-9P-4P2)}{dp} \times \frac{2}{216}$

$E_d = -9 - 8P \times \frac{2}{216}$

$E_{sd} = \frac{2(-9-8P)}{216}$

$E_d = \frac{-18-16P}{216}$

$E_d = \frac{-18-16(2)}{216}$

$E_d = -\frac{50}{216}$

So , Elasticity of demand is equal to $-\frac{50}{216}$

Now,

$E_s = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_s = d(200 + 4P^{2)} \times \frac{2}{216}$

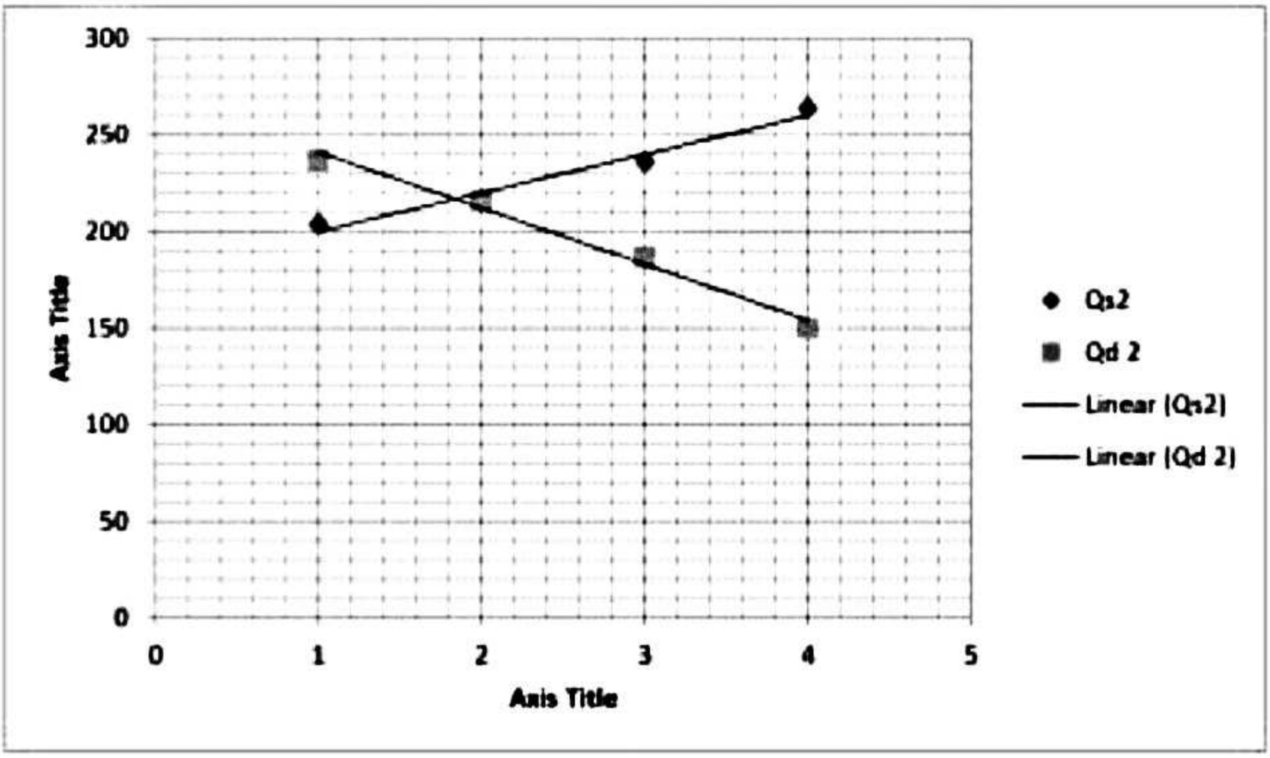
$E_s = 8(2) \times \frac{2}{216}$

$E_s = \frac{32}{216}$

So ,Elasticity of supply is equal to $\frac{32}{216}$

**Graph**

| P | Qs2 | Qd 2 |
|---|---|---|
| 1 | 204 | 237 |
| 2 | 216 | 216 |
| 3 | 236 | 187 |
| 4 | 264 | 150 |




**Example :-**

**If $Q_d = 15 - 4P$ and $Q_s = 6P - 1$**

**Find P, Q , $E_p$ and $E_s$**

As we know that

$Q_d = Q_s$

$15 - 4P = 6P - 1$

$15 + 1 = 6P + 4P$

$16 = 10P$

$P = \frac{16}{10}$

$P = \frac{8}{5}$

Allow Putting the value of P in both equations

$Q_d = 15 - 4\left(\frac{8}{5}\right)$ $Q_s = 6\left(\frac{8}{5}\right) - 1$

$Q_d = 15 - \frac{32}{5}$ $Q_s = \frac{48}{5} - 1$

$Q_d = \frac{75-32}{5}$ $Q_s = \frac{48-5}{5}$

$Q_d = \frac{43}{5}$ $Q_s = \frac{43}{5}$

$Q = \frac{43}{5}$

Now,

$E_d = \frac{dQd}{dp} \times \frac{P}{Q}$

$E_d = \frac{d(15-4P)}{dp} \times \frac{8/5}{43/5}$

$E_d = -4 \times \frac{8}{43}$

$E_d = -\frac{32}{43}$

Now,

$E_s = \frac{dQs}{dp} \times \frac{P}{Q}$

$E_s = \frac{d(6P-1)}{dp} \times \frac{8/5}{43/5}$

$E_s = 6 \times \frac{8}{43}$

$E_s = \frac{48}{43}$

**Graph**

| P | Qs | Qd |
|---|---|---|
| 1.4 | 7.4 | 9.4 |
| 1.6 | 8.6 | 8.6 |
| 1.8 | 9.8 | 7.8 |

| | | | |
|---|---|---|---|
| | 2 | 11 | 7 |