MGRECON - Class 1 (after class)

What is Managerial Economics?

Managerial Economics:

- studies how i) firms, ii) customers and iii) government agencies interact in markets

  firms maximize profits

  buyers maximize *consumer surplus*

  governments maximize ...

- is partly *descriptive* and partly *prescriptive*
- can provide qualitative and quantitative predictions

Economic Models

Geographical maps are models

Models are used in physics, chemistry, biology, geology, ...

Example: to predict the position of a planet in the solar system,
we can use a model where
the sun and the planets in the solar system are *perfect spheres*,
moving according to Newton's law of gravitation $F = G \cdot \frac{m_1 \cdot m_2}{r^2}$.

Nothing else is in the model: no asteroids, radiations, other galaxies ...

This model yields accurate predictions.

The best models are ***simple***, but capture essential features
of the phenomenon under analysis.

Math Pre-Requisites 1: solve linear equations

1. Solve one linear equation, for one variable in terms of any other variable, Example: solve the following equation for y in terms of x

$$3x + 6y = 12 \quad \rightarrow \; 6y = 12 - 3x$$

$$\rightarrow \; y = \frac{12}{6} - \frac{3}{6}x$$

$$\rightarrow \; y = 2 - \frac{1}{2}x$$

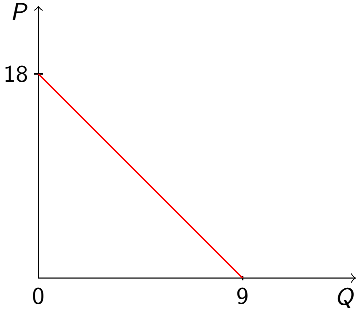
2. Solve **two** linear equations in two unknowns **simultaneously**

$$\left[\begin{array}{c} 3x + y = 13 \\ x - 4y = 0 \end{array}\right] \quad \rightarrow \left[\begin{array}{c} 3x + y = 13 \\ x = 4y \end{array}\right] \quad \rightarrow \left[\begin{array}{c} 3\,(4y) + y = 13 \\ x = 4y \end{array}\right]$$

$$\rightarrow \left[\begin{array}{c} 13y = 13 \\ x = 4y \end{array}\right] \quad \rightarrow \left[\begin{array}{c} y = 1 \\ x = 4 \end{array}\right]$$

Math Pre-Requisites 2: plot a linear function

Plot $\quad P = 18 - 2Q$



1) draw the Cartesian axes

2) find the y-intercept
$Q = 0 \;\rightarrow\; P = 18$

3) find the x-intercept
$P = 0 \quad \rightarrow \quad 0 = 18 - 2Q \quad \rightarrow \quad Q = 9$

4) connect the intercepts

5) check the slope: $-\frac{18}{9} = -2$

Math Pre-Requisites 3: derivatives of polynomials

$\frac{d}{dx}\left(2x^3 + 5x - 7\right) = 6x^2 + 5$

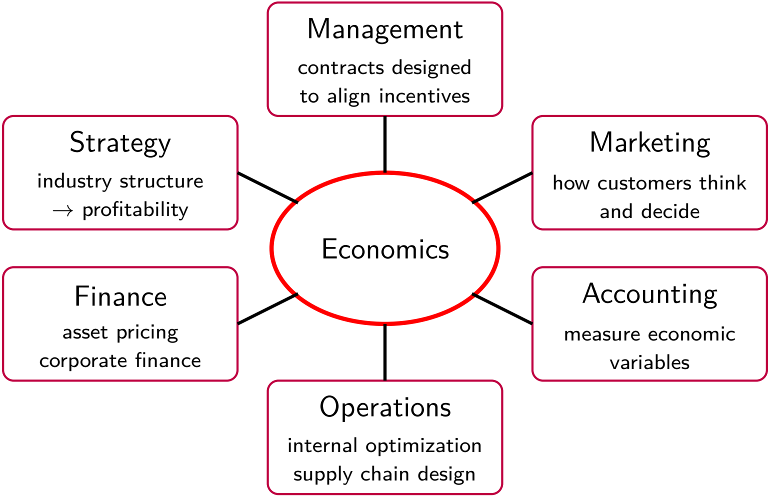
$\frac{d}{dx}\left(x^3 + 8x^2 + 3x - 7\right) = 3x^2 + 16x + 3$

$\frac{d}{dx}\left(-2x^2 + 5x\right) = -4x + 5$

The general rule:

$$
\begin{array}{cccccccccc}
\frac{d}{dx}\,(& a \cdot x^n & + & b \cdot x^{n-1} & + & ... & + & h \cdot x & + \; k &) \\
 & \downarrow & & \downarrow & & & & \downarrow & & \\
= & n\,a \cdot x^{n-1} & + & (n-1)b \cdot x^{n-2} & + & ... & + & h & &
\end{array}
$$

Economics is the "mother" of all business functions



Willingness to Pay

A buyer's **willingness to pay** (WTP) for a good is

the highest price the buyer is willing to pay for that good

In general, a buyer's WTP for a good depends on:

prices of substitute goods ("substitutes") P_S

prices of complementary goods ("complements") P_C

income, wealth, or "purchasing power" I

perceived quality, or "utility" U

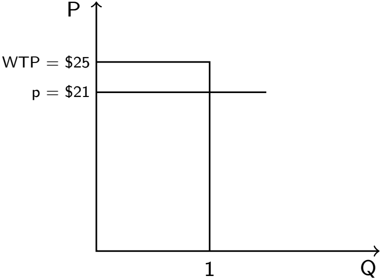
$$WTP = f(\overset{+}{P_S},\ \overset{-}{P_C},\ \overset{+}{I},\ \overset{+}{U})$$

Consumer Surplus

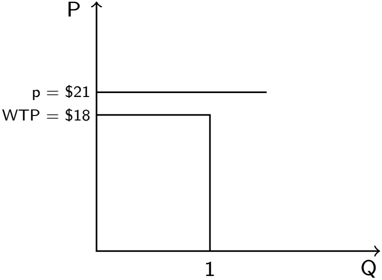
A buyer's **consumer surplus** (CS) is the difference

$$CS = WTP - P$$

Each buyer maximizes her/his own consumer surplus



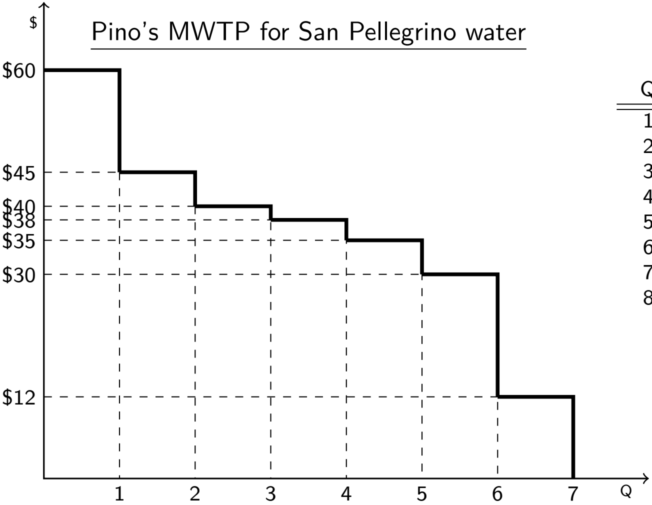
Since WTP > p,
the consumer buys
$\Rightarrow$ CS = $4



Since WTP < p,
the consumer does not buy
$\Rightarrow$ CS = $0

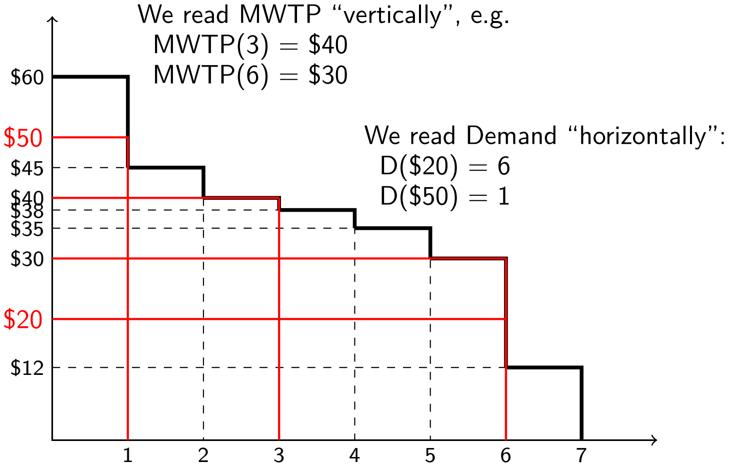
Diminishing Marginal WTP

As we consume more of the same good, we enjoy additional units less and less

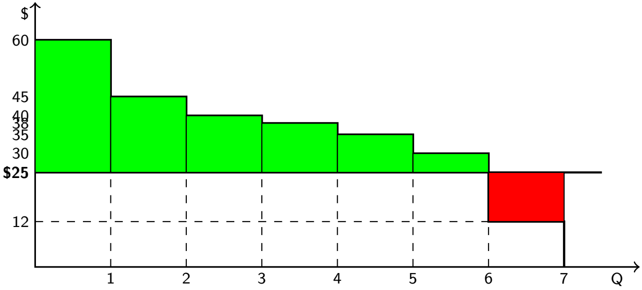


Q	MWTP
1	\$60
2	\$45
3	\$40
4	\$38
5	\$35
6	\$30
7	\$12
8	\$0

Reading a demand curve "horizontally" and "vertically"



Exercise: If the price of water is \$25 per box, how many units does Pino buy?

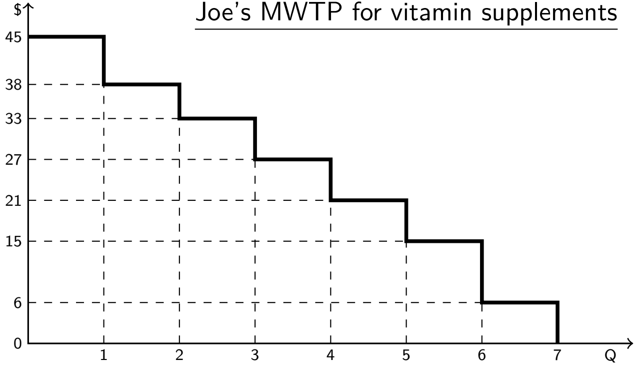


Answer: if we read the demand "horizontally", we see that Pino buys 6 units

$$
\begin{aligned}
CS &= \overbrace{(\$60 - \$25)}^{1^{st}\text{ unit}} + \overbrace{(\$45 - \$25)}^{2^{nd}\text{ unit}} + \overbrace{(\$40 - \$25)}^{3^{rd}\text{ unit}} \\
&\quad + \overbrace{(\$38 - \$25)}^{4^{th}\text{ unit}} + \overbrace{(\$35 - \$25)}^{5^{th}\text{ unit}} + \overbrace{(\$30 - \$25)}^{6^{th}\text{ unit}} \\
&= \$98
\end{aligned}
$$

Buying the 7th unit would decrease Pino's CS by \$13 (\$12 - \$25 = - \$13)

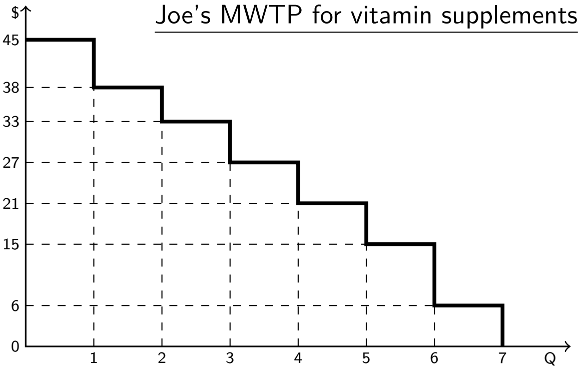
Exercise: fill the table below



Q	MWTP
1	\$45
2	\$38
3	\$33
4	\$27
5	\$21
6	\$15
7	\$6
8	\$0

Option	Q	Total Price	Total WTP	CS	Unit Price
A	2	\$34			
B	3	\$90			
C	6	\$120			
D	7	\$140			

Exercise: Answers



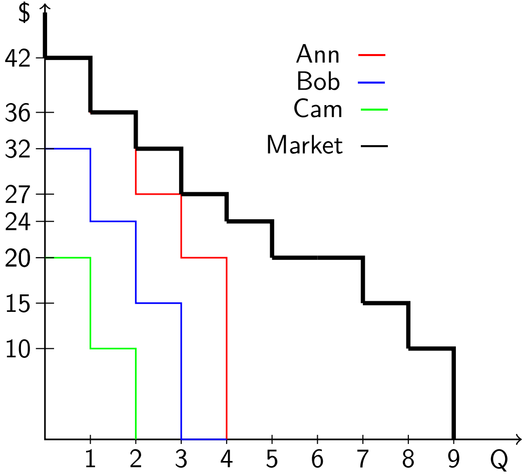
Q	MWTP	Tot. WTP
1	$45	$45
2	$38	$83
3	$33	$116
4	$27	$143
5	$21	$164
6	$15	$179
7	$6	$185
8	$0	$185

Option	Q	Total Price	Total WTP	CS	Unit Price
A	2	$34	$83	$49	$17
B	3	$90	$116	$26	$30
C	6	$120	$179	**$59**	$20
D	7	$140	$185	$45	$20

Market Demand

The **Market Demand** is the *horizontal* sum of all buyers' individual demands.

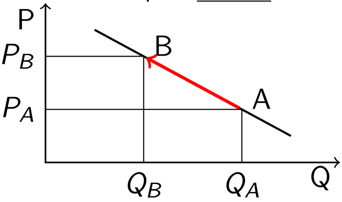
	MWTP		
Q	Ann	Bob	Cam
1	$42	$32	$20
2	$36	$24	$10
3	$27	$15	$0
4	$20	$0	$0



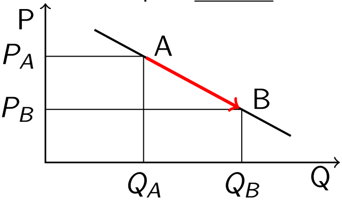
Movements along the Demand vs. Demand Shifts

$$Q_D = f(P; P_S, P_C, I, U)$$

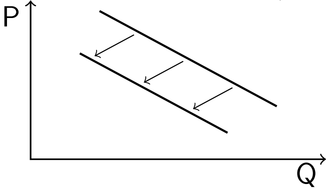
<u>Movement along</u> the demand, due to a price <u>increase</u>



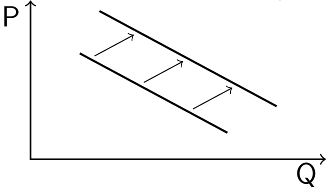
<u>Movement along</u> the demand, due to a price <u>decrease</u>



Demand shift <u>inward</u>, due to $P_S \downarrow$, $P_C \uparrow$, $I \downarrow$, and/or $U \downarrow$,



Demand shift <u>outward</u>, due to $P_S \uparrow$, $P_C \downarrow$, $I \uparrow$, and/or $U \uparrow$,



Exercises

1. As the temperature rises in Dallas,
   what happens to the demand for insect repellents?

   $Q_D = f(P; P_S, P_C, I, \boxed{\text{U}})$
   The demand shifts out

2. If the price of iPhones goes up,
   what happens to the the demand curve for iPhone cases?

   $Q_D = f(P; P_S, \boxed{P_C}, I, U)$

   The demand shifts in

3. If the price of vanity plates goes down,
   what happens to the demand of vanity plates ?

   The demand goes up
   this is a **movement along** the demand curve
   $Q_D = f(\boxed{\text{P}}; P_S, P_C, I, U)$

Linear Demand and its Inverse

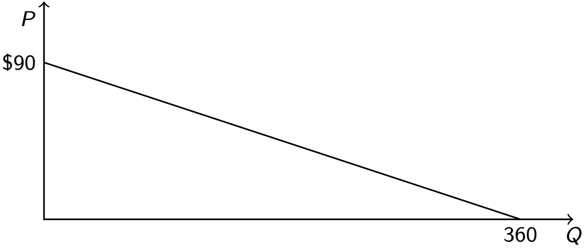
We often work with **linear estimates** of demand curves.
Example: the estimated demand for a good is

$$Q = 360 - 4 \cdot P$$

if P goes up by 1,
Q goes down by 4 units

$$\begin{aligned} P &= \frac{360}{4} - \frac{1}{4} \cdot Q \\ &= 90 - 0.25 \cdot Q \end{aligned}$$

to sell 1 more unit,
P must decrease by 0.25



In general:

Do not confuse

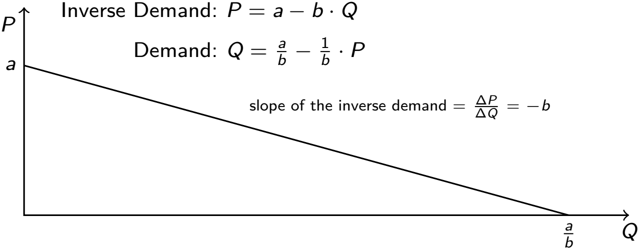
$$\frac{\Delta Q}{\Delta P} = -\frac{1}{b}$$

if P goes up by 1,
Q goes down by $\frac{1}{b}$

vs.

$$\frac{\Delta P}{\Delta Q} = -b$$

to sell 1 more unit,
P must go down by $-b$



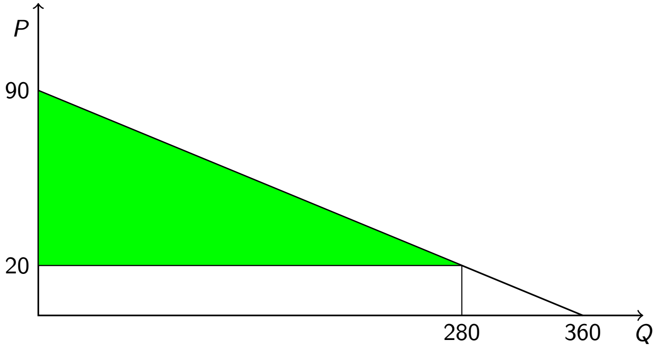
Aggregate Consumer Surplus

If the price is \$20, the quantity sold is

$$Q = 360 - 4 \cdot 20 = 280$$

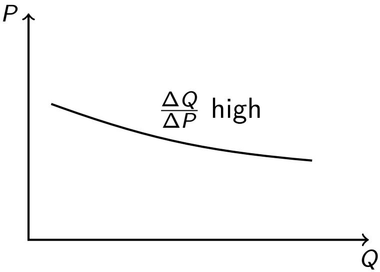
and the aggregate consumer surplus is

$$CS = \frac{1}{2}(90 - 20)\,280 = \$9800$$

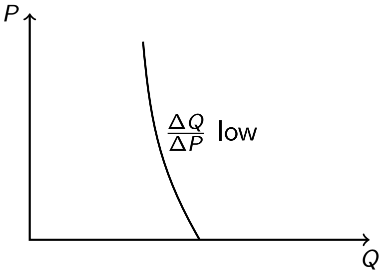


Measuring the Sensitivity of Demand to Price

It is often useful to measure the *sensitivity* of demand to price



a "flat" demand curve



a "steep" demand curve

The slope by itself is *not* a reliable indicator of sensitivity, because it depends on the *units* of measure we use for P (e.g. dollars vs. euros) and Q (e.g. kilos vs. tons)

Price Elasticity of Demand

The **price elasticity of demand** is
the ***percentage*** change of Q divided by the ***percentage*** change of P

$$E_P = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

E_P is a "unit-free" (negative) number

E_P is <u>specific to a point</u> on the demand curve:

- we say that "demand is "**elastic**" (at a particular point)" to mean that $|E_P| > 1$ (at that point)

- we say that "Demand is "**inelastic**" (at a particular point)" to mean that $|E_P| < 1$ (at that point)

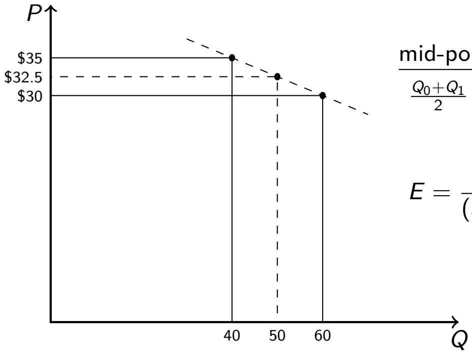
E_P is more accurate for smaller changes of P and Q

Computing E_p with the two-point formula

If we only have two points on the demand curve,
we can use the **two-point formula** to estimate the elasticity

$$E = \frac{\frac{Q_1 - Q_0}{(Q_1+Q_0)/2}}{\frac{P_1 - P_0}{(P_1+P_0)/2}} \quad \text{(divide by mid-point values)}$$

Example In response to a price increase from $P_0 = \$30$ to $P_1 = \$35$,
the number of vanity plates sold in one year has gone down from $Q_0 = 60\,000$ to $Q_1 = 40\,000$



mid-point values:

$$\frac{Q_0+Q_1}{2} = 50, \quad \frac{P_0+P_1}{2} = 32.5$$

$$E = \frac{(40-60)/50}{(35-30)/32.50} = -2.6$$

Remarks on the Two-point formula

The two-point formula uses the mid-point as "base" because the simpler formulas

$$\frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1} \quad \text{or} \quad \frac{(Q_2 - Q_1)/Q_2}{(P_2 - P_1)/P_2}$$

give different answers: percentage changes depend on the starting value.

Example:

if Q increases from 10 to 15, the percentage change is 50%.

if Q decreases from 15 to 10, the percentage change is -33.3%.

As ΔQ and ΔP increase, the accuracy of the mid-point formula decreases.

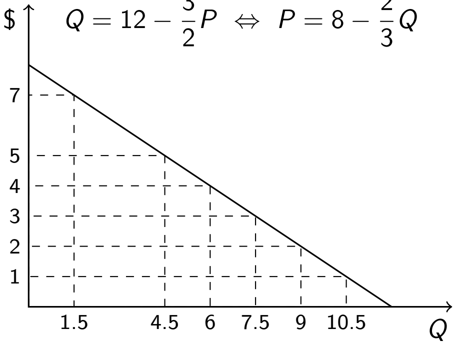
Computing E_p with a linear demand

If the (inverse) demand is linear, i.e. $P = a - b \cdot Q$ (a and b are given numbers), we can use the formula

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = -\frac{1}{b} \cdot \frac{P}{Q}$$

Exercise

$$Q = 12 - \frac{3}{2}P \;\Leftrightarrow\; P = 8 - \frac{2}{3}Q$$



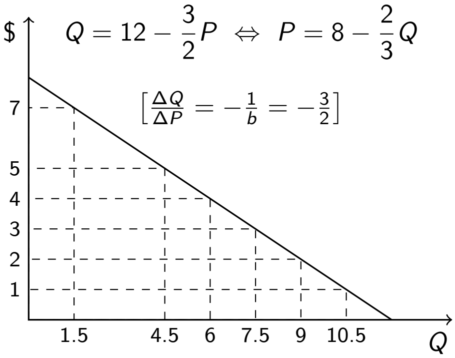
P	Q	$E_P = -\frac{3}{2} \cdot \frac{P}{Q}$
7	1.5	
5	4.5	
4	6	
3	7.5	
2	9	
1	10.5	

Computing E_p with a linear demand: Answers

If the (inverse) demand is linear, i.e. $P = a - b \cdot Q$ (a and b are given numbers), we can use the formula

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = -\frac{1}{b} \cdot \frac{P}{Q}$$

Exercise



P	Q	$E_P = -\frac{3}{2} \cdot \frac{P}{Q}$
7	1.5	-7
5	4.5	-1.66
4	6	-1
3	7.5	-0.6
2	9	-0.33
1	10.5	-0.14

Computing E_p with a linear demand

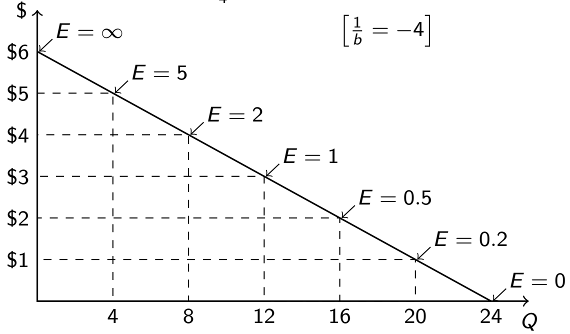
If demand is linear $P = a - bQ$, we can use the formula

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = -\frac{1}{b} \cdot \frac{P}{Q}$$

Exercise

$$P = 6 - \frac{1}{4} \cdot Q \quad \Leftrightarrow \quad Q = 24 - 4 \cdot P$$

$$\left[\frac{1}{b} = -4\right]$$



P	Q	$\lvert E\rvert = 4 \cdot \frac{P}{Q}$
6	0	$4 \cdot \frac{6}{0} = \infty$
5	4	$4 \cdot \frac{5}{4} = 5$
4	8	$4 \cdot \frac{4}{8} = 2$
3	12	$4 \cdot \frac{3}{12} = 1$
2	16	$4 \cdot \frac{2}{16} = 0.5$
1	20	$4 \cdot \frac{1}{20} = 0.2$
0	24	$4 \cdot \frac{0}{24} = 0$

Two-point Elasticity vs. Point Elasticity

Which formula should we use to compute elasticities?

If we have only two data points (P_A, Q_A) and (P_B, Q_B), we use the **two-point** formula

$$E = \frac{\dfrac{Q_B - Q_A}{(Q_A + Q_B)/2}}{\dfrac{P_B - P_A}{(P_A + P_B)/2}}$$

If we have a linear (inverse) demand $P = a - b \cdot Q$, we use the **point-elasticity** formula

$$E = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = -\frac{1}{b} \cdot \frac{P}{Q}$$