

# Principles of Economics

## Discussion Session 2: Elasticity

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February 14, 2026

# Slope vs Elasticity

We want to describe the effect of a change in price on quantity.

Two options:

## ① Slope:

- Ratio of the *absolute* change in  $f(x)$  to the *absolute* change in  $x$ .
- Interpretation: "If  $x$  increases by 1, then  $f(x)$  increases by  $m$ ."  
"If  $x$  increases by 2, then  $f(x)$  increases by  $2m$ ."
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$$m = \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

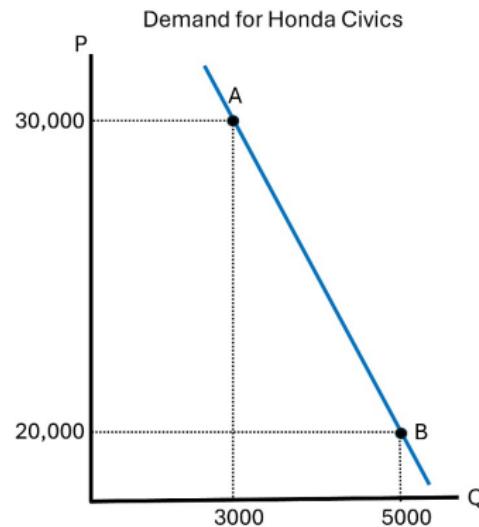
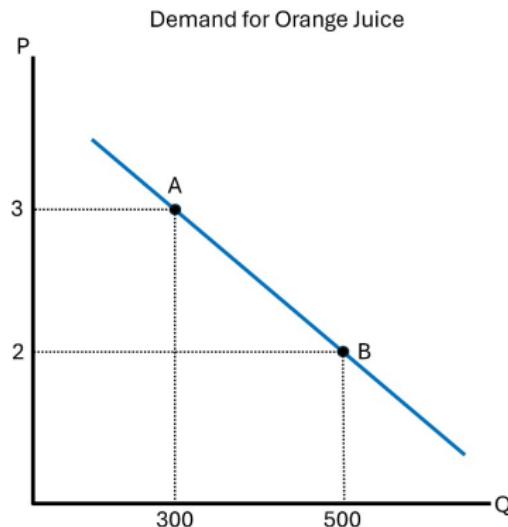
## ② Elasticity:

- Ratio of the *proportional* change in  $f(x)$  to the *proportional* change in  $x$ .
- Interpretation: "If  $x$  increases by 1%, then  $f(x)$  increases by  $\varepsilon\%$ ."  
"If  $x$  is multiplied by 2, then  $f(x)$  is multiplied by  $2\varepsilon$ ."
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$$\varepsilon = \frac{\left( \frac{f(x_2) - f(x_1)}{\text{midpoint}(f(x_1), f(x_2))} \right)}{\left( \frac{x_2 - x_1}{\text{midpoint}(x_1, x_2)} \right)}$$

## So why use elasticity?

Elasticity allows us to compare markets where prices/quantities are quite different:



- Slopes:  $m_{OJ} = -200$ ,  $m_{HC} = -0.2$
- Elasticities:  $\epsilon_{OJ} = 1.25$ ,  $\epsilon_{HC} = 1.25$
- How do we interpret these numbers? ("If  $P$  increases by 1, then...")

## More interpretation

- If demand is elastic ( $\varepsilon > 1$ ), then a change in  $P$  causes a proportionately **large** change in  $Q$ .
- If demand is inelastic ( $\varepsilon < 1$ ), then a change in  $P$  causes a proportionately **small** change in  $Q$ .
- If demand is unit-elastic ( $\varepsilon = 1$ ), then a change in  $P$  causes a proportionately **equal** change in  $Q$ .

## Exercise 1: Price Elasticity of Demand

Suppose the current price of coffee sold at Hillside Cafe is \$5 per cup. However, the cafe announced this Friday that the price of coffee per cup will be \$3. The cafe expects that after reducing the price, the number of cups sold will increase from 200 to 400.

- ① Using the midpoint formula, calculate the price elasticity of demand for coffee between \$5 and \$3. Is the demand elastic, inelastic, or unit elastic?
- ② What will happen to the total revenue of Hillside Cafe? Please answer by calculating the change in total revenue and explain why.
- ③ In which direction do you expect the total revenue will change if Hillside Cafe cuts the price during the final week? Why?
- ④ *Bonus:* What is the elasticity of demand at the revenue-maximizing price?

## Exercise 1: Price Elasticity of Demand

Solution:

- ①  $\frac{4}{3}$ . Elastic.
- ② Total revenue changes from \$1000 to \$1200. Lowering the price will increase revenue if demand is relatively elastic.
- ③ Total revenue will decrease as the seller lowers the price when the demand is inelastic.
- ④ *Bonus:* Revenue is maximized when  $\varepsilon = 1$ !  
If  $\varepsilon < 1$ , the seller can increase revenue by increasing the price, which increases  $\varepsilon$ .  
If  $\varepsilon > 1$ , the seller can increase revenue by decreasing the price, which decreases  $\varepsilon$ .  
Thus, revenue is maximized when  $\varepsilon = 1$ .

## Exercise 2: Price Elasticity of Supply

Suppose Catherine and Jae work at Hillside Cafe with an hourly wage of \$15. Both of them work 4 hours per day. Now the manager wants to extend the operating hours and announces to increase the wage to \$20. Catherine is willing to work 6 hours with the new wage offered, but Jae only wants to work 5 hours.

- ① Using the midpoint formula, calculate the price elasticity of supply for Catherine and Jae between \$15 and \$20.
- ② What should Catherine's supply curve look like? What about Jae's?

## Exercise 2: Price Elasticity of Supply

Solution:

- ① Catherine:  $\frac{7}{5}$ ; Jae:  $\frac{7}{9}$
- ② Since Catherine's supply is elastic while Jae's supply is inelastic, Catherine's supply curve should be flatter than Jae's.