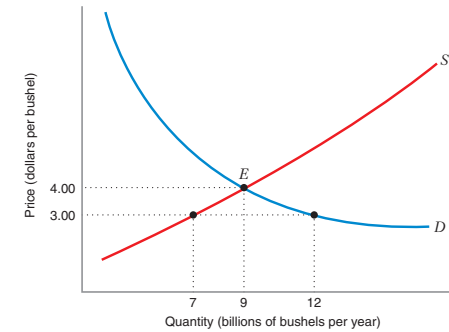


## Agenda

- ▶ Where Are We?
- ▶ Markets (Demand, Supply, Equilibrium)
- ▶ Price Elasticity of Demand
- ▶ Other Elasticities
  - ▶ Income Elasticity of Demand
  - ▶ Cross-Price Elasticity of Demand

## Supply and Demand

### Definition (Perfectly Competitive Market)



## Demand Curves

### Definition (Market Demand Curve)

A curve showing the \_\_\_\_\_ consumers are willing to buy at different prices.

- ▶ Demand Curve consists of both \_\_\_\_\_ and \_\_\_\_\_.
- ▶ Factors that may affect demand: \_\_\_\_\_
- ▶ A given demand curve assumes that all other factors are fixed.
- ▶ **Law of Demand** - The inverse relationship between \_\_\_\_\_, when all other factors are held fixed.

## Supply Curves

### Definition (Market Supply Curve)

A curve showing the total \_\_\_\_\_ willing to sell \_\_\_\_\_ at different prices.

- ▶ **Law of Supply** - The positive relationship between \_\_\_\_\_, when all other factors that influence supply are held constant.
- ▶ **Factors of production** - \_\_\_\_\_

### Market equilibrium

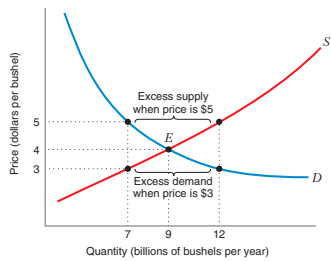
#### Definition (Equilibrium)

A point which there is \_\_\_\_\_ as long as exogenous variables remain unchanged.

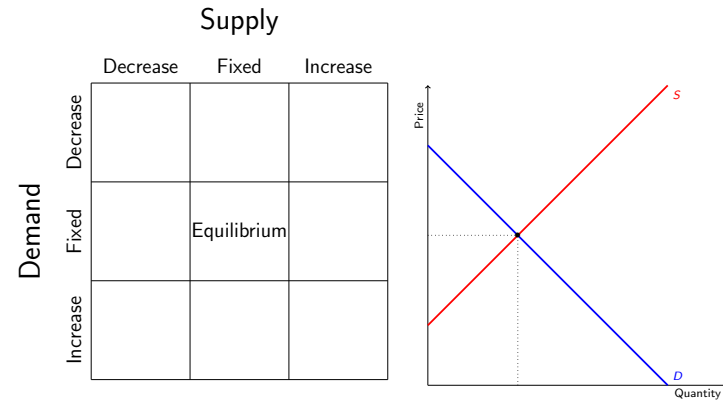
▶ **Excess Supply -**

▶ **Excess Demand -**

▶ **Equilibrium -**



### Changes in Supply and Demand Curves



### Price Elasticity of Demand

#### Definition (Price Elasticity of Demand)

Measure of the \_\_\_\_\_ with respect to price, holding all other determinants of demand constant.

$$\epsilon_{Q,P} \approx \frac{\Delta Q}{Q} \div \frac{\Delta P}{P}$$

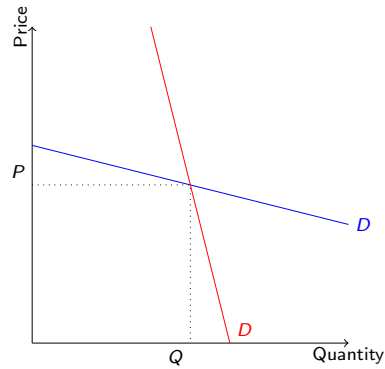
### Elasticity

	Perfectly elastic demand	
	Elastic demand	
	Unitary elastic demand	
	Inelastic demand	
	Perfectly inelastic demand	

### Price Elasticity of Demand

- Which Demand Curve is more Elastic at  $(P, Q)$ ?

$$\epsilon_{Q,P} = \frac{dQ}{dP} \frac{P}{Q} \approx \frac{\Delta Q}{\Delta P} \frac{P}{Q}$$



### Price Elasticity of Demand

- Approximation of Price Elasticity of Demand at point  $(P, Q)$ .

$$\epsilon_{Q,P} \approx$$

- Price Elasticity of Demand at point  $(P, Q)$ .

$$\epsilon_{Q,P} =$$

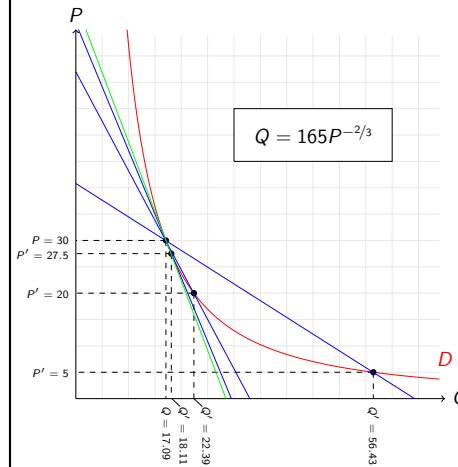
### Exercise

- Calculate the Elasticity of the following Demand Curves at  $P = 1, 60, 104, 120$

- $Q = 260 - 2P$

- $Q = 165P^{-2/3}$

### Calculating PED



- At  $P = 30$ ,

$$Q = 165 \cdot 30^{-2/3} = 17.09$$

- Elasticity approximations

$P'$	$Q'$	$\epsilon_{Q,P}$
5	56.43	
20	22.39	
27.5	18.11	

- Exact Elasticity

$$\epsilon_{Q,P} = \frac{dQ}{dP} \frac{P}{Q} =$$

### Linear Demand Curve

- ▶ Linear Demand Curve
- ▶ Price Elasticity of Demand for Linear Demand

$$\epsilon_{Q,P} = \frac{dQ}{dP} \frac{P}{Q} =$$

- ▶ Notes about linear demand curves:
  - ▶ Elasticity approximation is equal to exact elasticity for all  $P'$ .
  - ▶ When  $Q$  is close to 0 ( $P$  is large), the curve is \_\_\_\_\_.
  - ▶ When  $P$  is close to 0 ( $Q$  is large), the curve is \_\_\_\_\_.

### Constant Elasticity Demand Curve

- ▶ Constant Elasticity Demand Curve
- ▶ Price Elasticity of Demand for Constant Elasticity Demand

$$\epsilon_{Q,P} = \frac{dQ}{dP} \frac{P}{Q}$$

=

=

=

- ▶ Elasticity approximation is more accurate the closer  $P'$  is to  $P$ .

### Price Elasticity of Demand

Product	PED
Salt	
Fresh Tomatoes	
Airline Travel, Short-Run	
Airline Travel, Long-Run	
Foreign-Travel, Long-Run	
Toothpicks	
Automobiles, Short-Run	
Automobiles, Long-Run	
Gasoline, Short-Run	
Gasoline, Long-Run	
Restaurant Meals	
Physician services	

- ▶ Some important factors
- ▶ Market Level vs. Brand-Level
- ▶ Total Revenue

Source: Economics: Private and Public Choice, James D. Gwartney and Richard L. Stroup, eighth edition 1997

### Income Elasticity of Demand

$$\epsilon_{Q,I} = \frac{dQ}{dI} \frac{I}{Q}$$

Product	Estimated $\epsilon_{Q,I}$	Product	Estimated $\epsilon_{Q,I}$
Potatoes		Flour	
Milk		Apples	
Fresh peas		Oranges	
Peaches		Eggs	
Cream		Margarine	
Butter		Onions	

## Exercise

- ▶ Consider the following market:
  - ▶ Supply curve is  $Q^S = 2P$
  - ▶ Demand curve is  $Q^D = 20 - 3P + 5I$
  - ▶ Consumer's income is  $I = 3$
- ▶ Find the market equilibrium.
- ▶ Find the income elasticity of demand at the market equilibrium.
- ▶ What is the income elasticity of demand when  $I = 25$  and  $Q = 10$ .

## Solution

- ▶ Find the market equilibrium.

## Cross-Price Elasticity of Demand

$$\epsilon_{Q_i, P_j} = \frac{\partial Q_i}{\partial P_j} \frac{P_j}{Q_i}$$

- ▶ **Demand Substitutes** -
- ▶ **Demand Complements** -

## Cross-Price Elasticity of Demand: Exercise

- ▶ Consider the following demand and supply relationships in the market for golf balls:

$$Q^D = 120 - 8P_{GB} - 4P_T$$

$$Q^S = 18 + 4P_{GB} - 10P_R$$

where  $P_T$  is the price of titanium, a metal used to make golf clubs, and  $P_R$  is the price of rubber.

- a) If  $P_R = 3$  and  $P_T = 6$ , calculate the equilibrium price and quantity of golf balls.
- b) At the equilibrium values, calculate the price elasticity of demand and the price elasticity of supply.
- c) At the equilibrium values, calculate the cross-price elasticity of demand for golf balls with respect to the price of titanium. What does the sign of this elasticity tell you about whether golf balls and titanium are substitutes or complements?

### Cross-Price Elasticity of Demand: Exercise

- ▶ Equilibrium:
  
- ▶ Price Elasticity of Demand:
  
- ▶ Price Elasticity of Supply:
  
- ▶ Cross-Price Elasticity of Demand:

### Short-Run vs. Long-Run

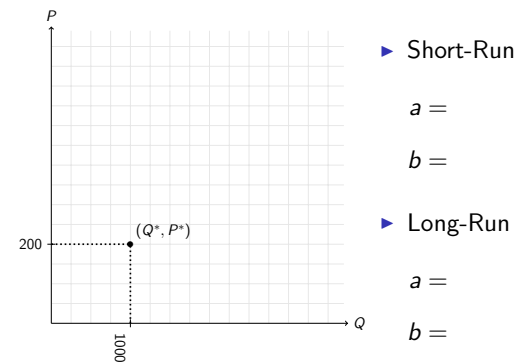
- ▶ **Short-Run:**
  
- ▶ **Long-Run:**
- ▶ Goods with greater elasticity in long-run:
  
- ▶ Goods with smaller elasticity in long-run:

### Example

- ▶ Assumptions:
  - ▶ Demand Curve is linear,  $Q = a - bP$ .
- ▶ Information:
  - ▶ Equilibrium price and quantity,  $P^*$  and  $Q^*$ .
  - ▶ Price elasticity of Demand:  $\epsilon_{Q,P}$
- ▶ Fact #1
  
- ▶ Fact #2

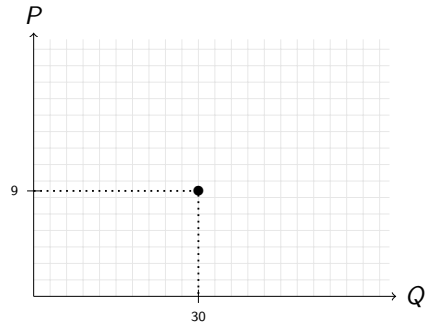
### Example

- ▶ Exercise: We saw that for airline tickets, the Short-Run elasticity was  $\epsilon_{Q,P} =$  and the Long-Run elasticity was  $\epsilon_{Q,P} =$ .
- ▶ Suppose that we observe  $P^* = 200$  and  $Q^* = 1000$ .
- ▶ Calculate the SR and LR demand curves.



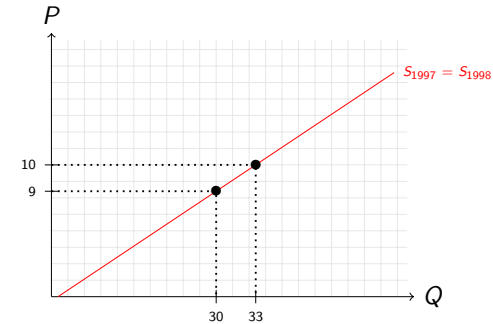
Example #2: Market for Crushed Stone

- ▶ Between 1995 and 1997, the market was uneventful with  $P = 9$  and  $Q = 30$ .



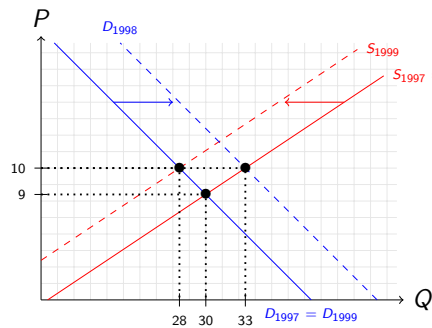
Example #2: Market for Crushed Stone

- ▶ In 1998, there was a 1 year burst of highway building, with  $P = 10$  and  $Q = 33$ .
  - ▶ Effect: Increased demand for crushed stone.



Example #2: Market for Crushed Stone

- ▶ In 1999, the burst was over. New union contract raised wages of workers.  $P = 10$  and  $Q = 28$ .
  - ▶ Effect #1: Reduced demand for crushed stone.
  - ▶ Effect #2: Reduced supply of crushed stone.



- ▶ Important Assumptions
  - ▶ S and D are linear
  - ▶ S and D shifts are isolated
- ▶ What Can We do Now
  - ▶ Estimate Elasticities
  - ▶ Forecast Future Prices
- ▶ Exercise: Calculate Elasticity of  $D^{1999}$ .