2

Supply and Demand

Introduction

2

Chapter Outline	
2.1	Markets and Models
2.2	Demand
2.3	Supply
2.4	Market Equilibrium
2.5	Elasticity
2.6	Conclusion

Introduction

2

In this chapter, we introduce the **supply and demand** model. We will:

- Describe the basics of supply and demand.
- Use equations and graphs to represent supply and demand.
- Analyze markets for goods and services using the supply and demand model.

Markets and Models

2.1

What is a market?

A market is characterized by a specific:

1. Product or service being bought and sold
2. Location
3. Point in time

Markets **facilitate exchange,** including economic resources and final goods and services.

Markets and Models

2.1

What is the **supply** and **demand** for a good?

- **Supply:** The combined amount of a good that all producers in a market are willing to sell.
- **Demand:** The combined amount of a good that all consumers in a market are willing to buy.

Table 2.1 The Four Key Assumptions Underlying the Supply and Demand Model

1.	We focus on supply and demand in a single market.
2.	All goods sold in the market are identical.
3.	All goods sold in the market sell for the same price, and everyone has the same information.
4.	There are many producers and consumers in the market.

Demand

2.2

What factors influence the **demand** for a good or service?

1. **Price**
2. **Consumer income or wealth**
3. **Prices of other, related goods: substitutes and complements**
4. **Consumer preferences**
5. **Number of consumers**

$$Q^D\ (P, I, Ps, Pc, \mathbf{Pref}, n)$$

Demand

2.2

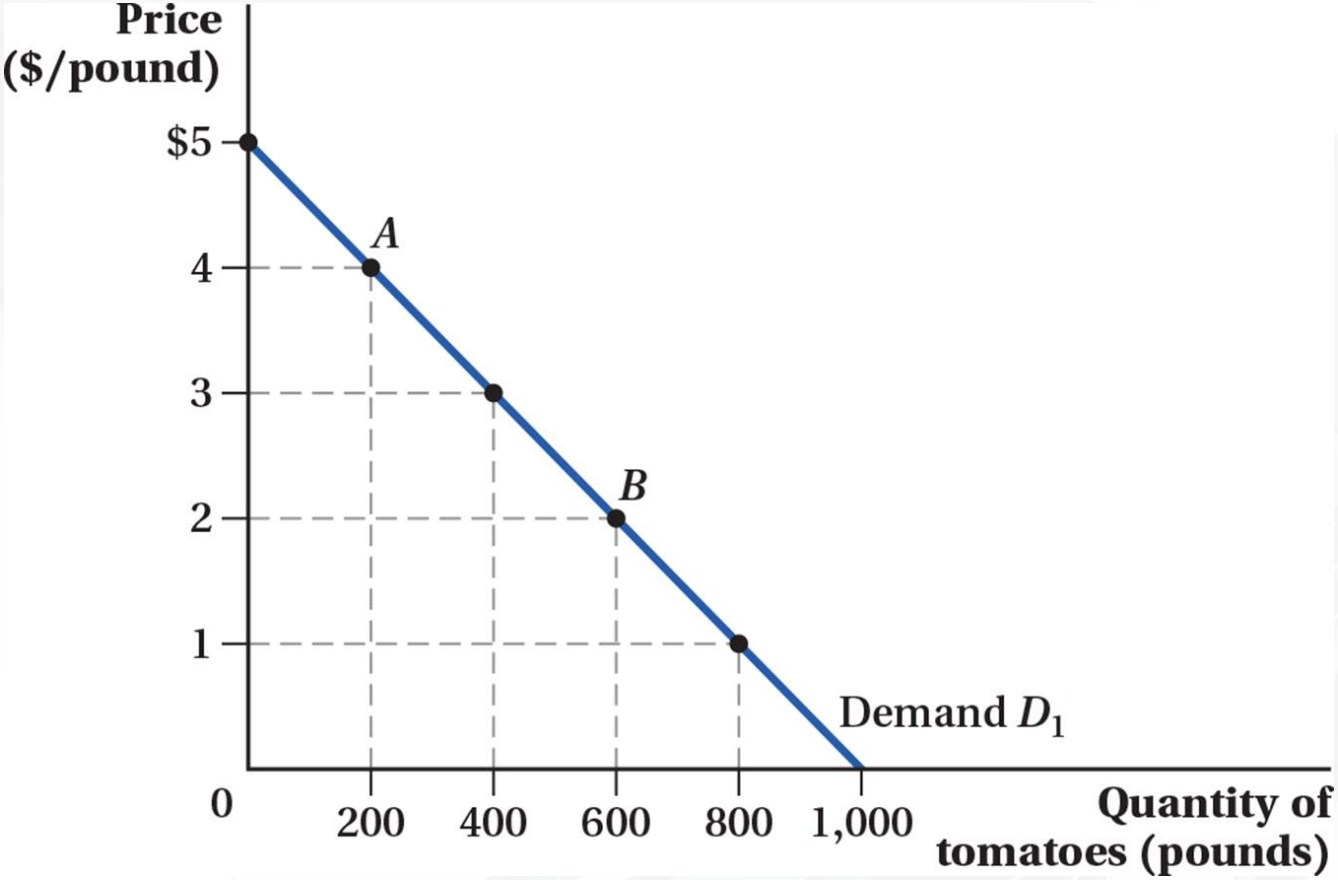
Many factors influence demand for goods and services. Is there one factor that stands out?

- Focus on how the **price** of a good influences the **quantity demanded** by consumers.
- **Demand curve**: Describes the relationship between quantity of a good that consumers demand and the good's price, holding all other factors constant.

Demand

2.2

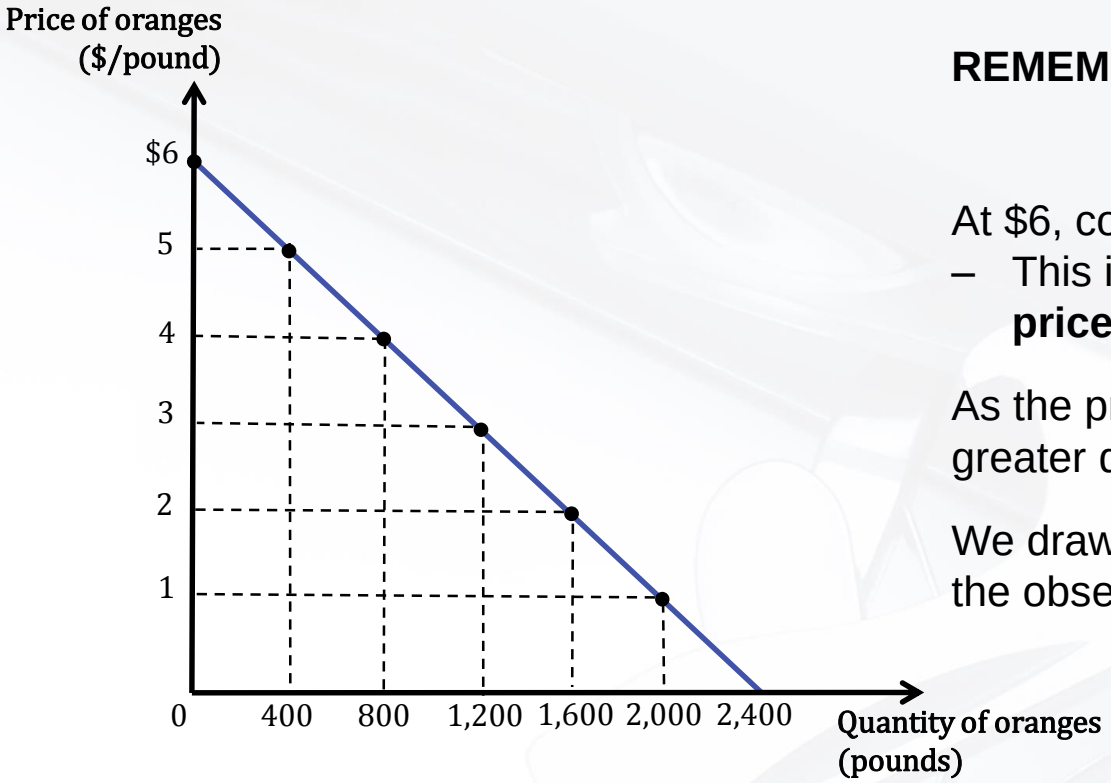
Figure 2.1 Demand for Tomatoes



Demand

2.2

Consider the market for oranges. We want to map out the quantity (in pounds) demanded by local consumers at various prices ($/pound)



REMEMBER TO ALWAYS LABEL GRAPHS!

At $6, consumers demand no oranges
- This is known as the **demand choke price.**

As the price drops, consumers demand a greater quantity of oranges.

We draw a **demand curve** that connects all the observed price-quantity combinations.

Demand

2.2

We can also describe the demand curve mathematically:

The **demand curve** on the previous slide is given as

$$Q^D = 2{,}400 - 400P$$

where Q^D is the quantity of oranges demanded (in pounds) and P is the price of oranges ($/pound).

It is common in economics to plot price on the vertical axis.

- Solving for price as a function of quantity demanded yields the **inverse demand curve**

$$P = 6 - 0.0025Q^D$$

Demand

2.2

What about the other factors that influence demand?

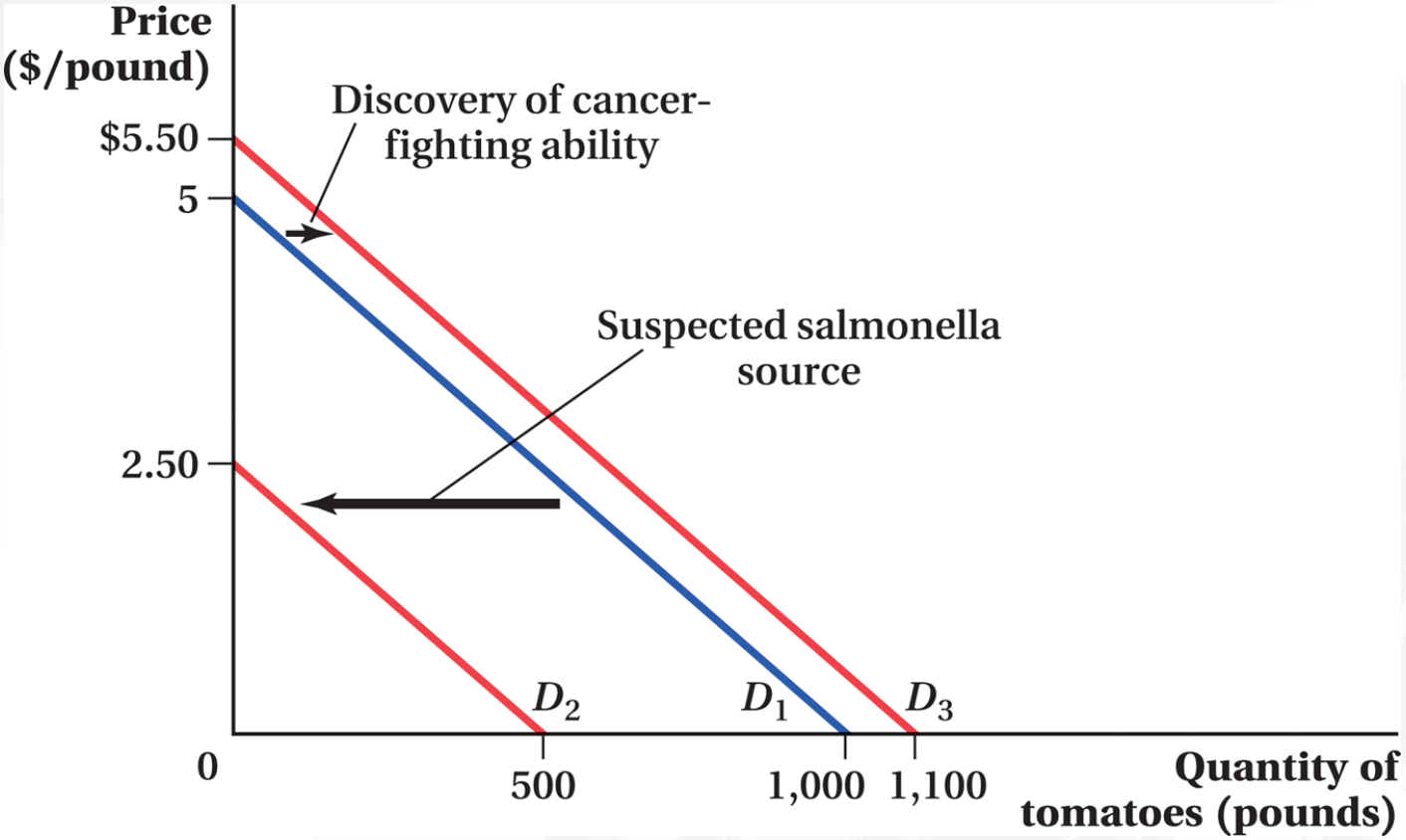
- The demand curve is graphed in two dimensions; all other factors are assumed constant.
  - **Change in quantity demanded**: A movement *along* the demand curve that occurs as a result of a change in the good's price

- If another factor changes, the demand curve will *shift.*
  - **Change in demand:** A shift of the entire demand curve caused by a change in a non-price factor that affects demand

Demand

2.2

Figure 2.2 Shifts in the Demand Curve



Demand

2.2

Why do we treat price differently?

1. Price is usually the most important factor influencing demand.
2. Prices in most markets can change easily and often.
3. Price is the one factor of demand that is most likely to also measurably impact the *supply* of a good.
   - Therefore, price ties together the two sides of the model.

Now to the supply side of the model.

Supply

2.3

What factors influence the **supply** of a good or service?

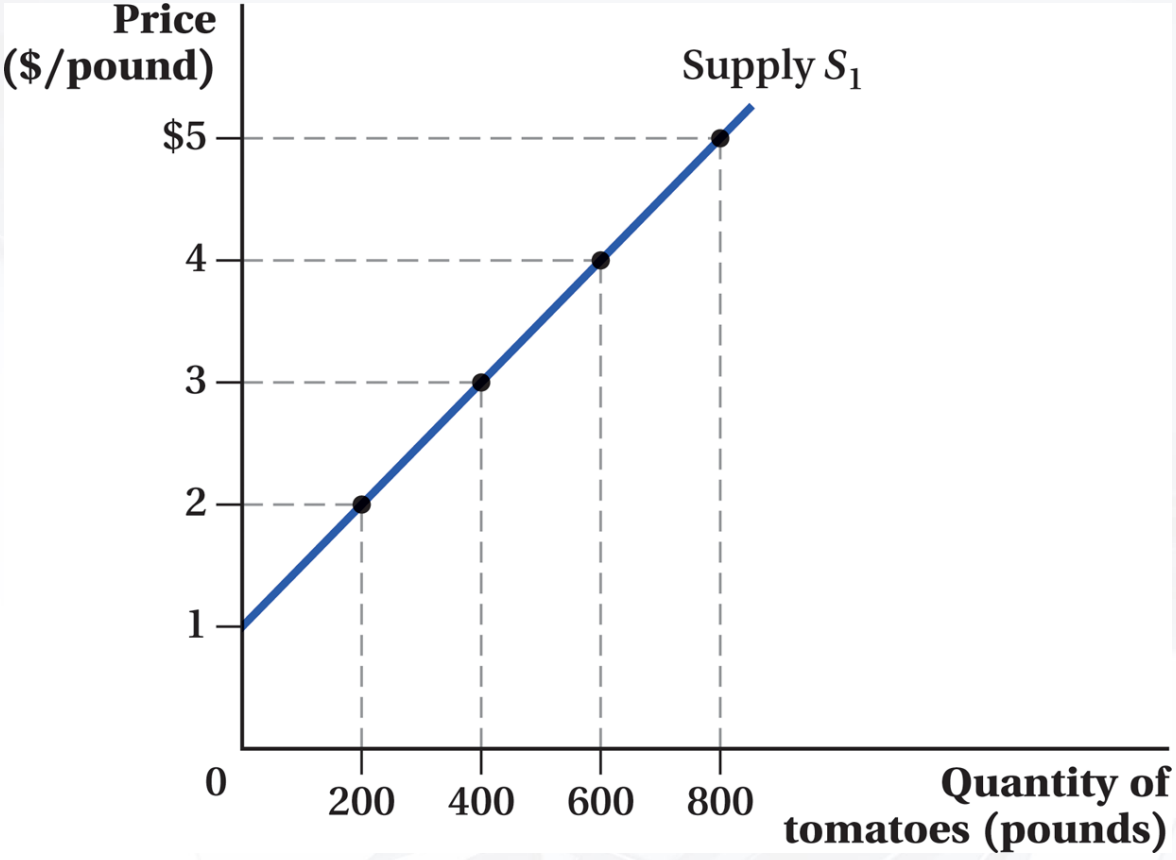
1. **Price**
2. **Production costs:** Includes the processes used to make, distribute, and sell a good (production technology)
3. **Sellers' outside options:** Price of good in other markets and prices of other, related goods
4. **Number of sellers**

$$Q^S(P, Costs, n)$$

Supply

2.3

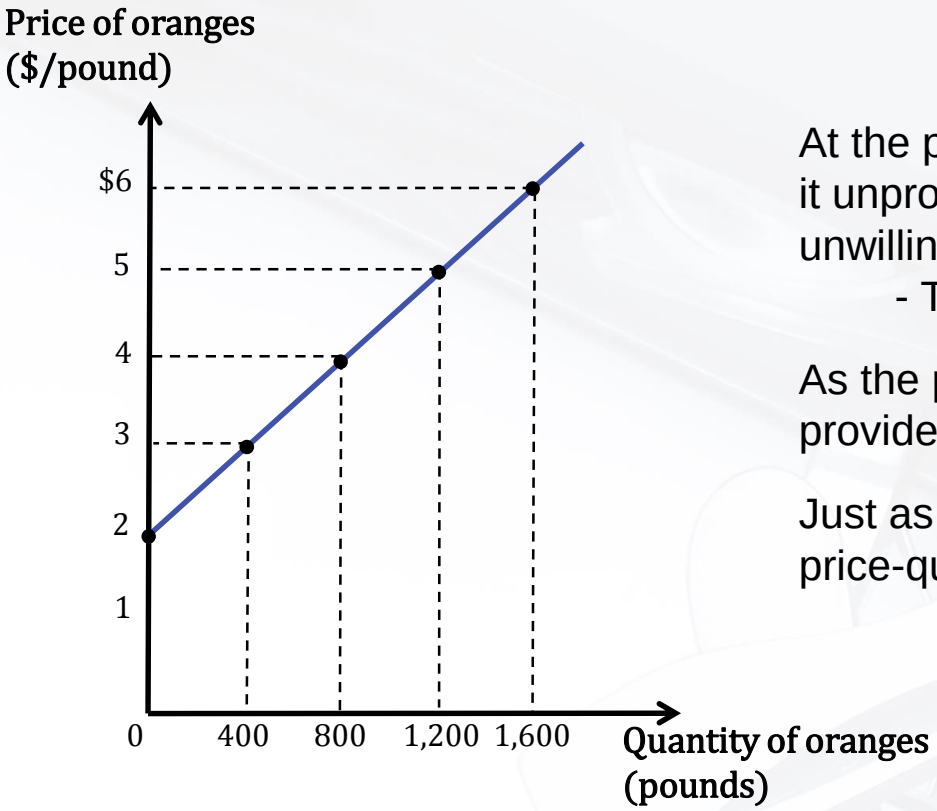
Figure 2.3 Supply of Tomatoes



Supply

2.3

We can describe the relationship between the quantity of oranges supplied (in pounds) and the price ($/pound) with a **supply curve.**



At the price of $2 per pound or less, suppliers find it unprofitable to sell any oranges so they are unwilling to supply any

- This is known as the **supply choke price.**

As the price increases beyond $2, suppliers will provide more and more oranges to the market.

Just as with demand, we connect the observed price-quantity combinations using a **supply curve.**

Supply

2.3

We can also describe the supply curve mathematically:

The **supply curve** on the previous slide is given as

$$Q^S = 400\mathrm{P} - 800$$

where Q^S is the quantity of oranges supplied (in pounds) and P is the price of oranges ($/pound).

Since we plot price on the vertical axis, the **inverse supply curve** is given as

$$P = 2 + 0.0025\,Q^S$$

Supply

2.3

What about the other factors that influence supply?

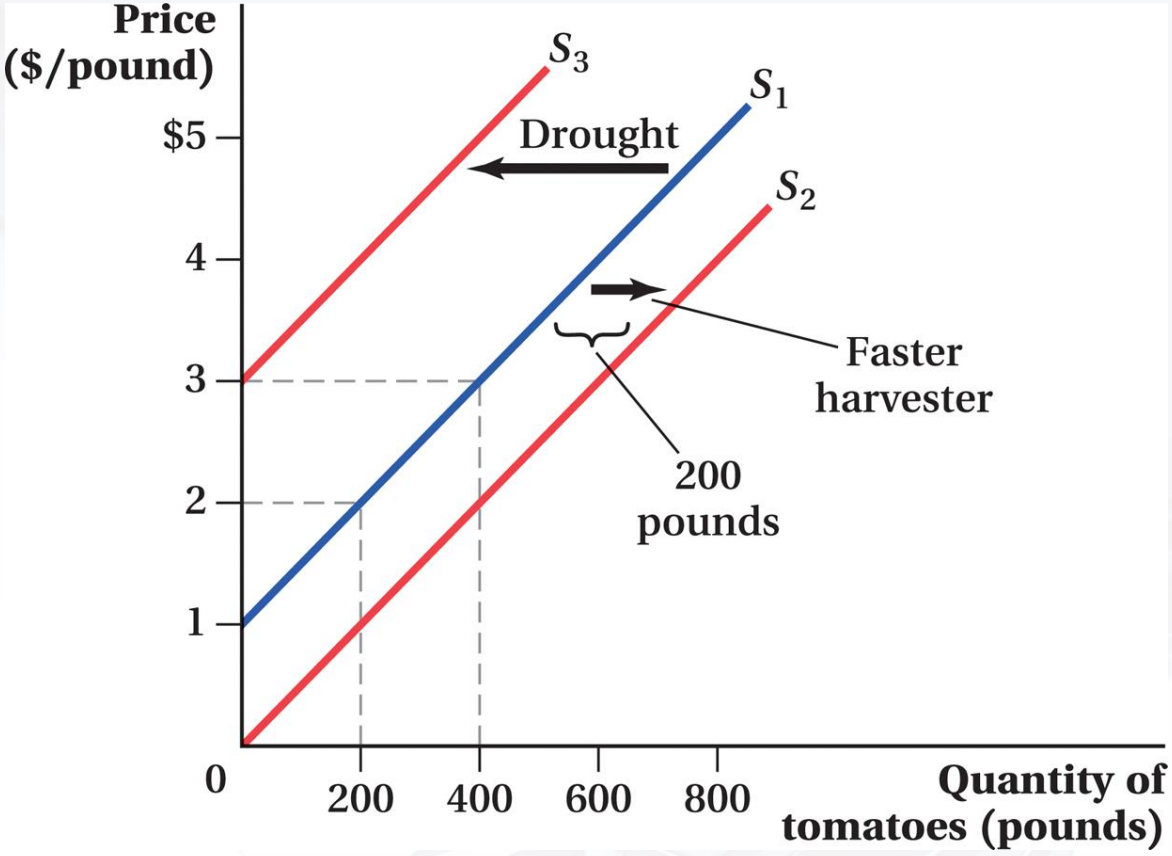
- The supply curve is also graphed in two dimensions; all other factors are assumed constant.
  - **Change in quantity supplied**: A movement *along* the supply curve that occurs as a result of a change in the good's price.

- If another factor changes, the supply curve will *shift.*
  - **Change in supply**: A shift of the entire supply curve caused by a change in a non-price factor that affects supply.

Supply

2.3

Figure 2.4 Shifts in the Supply Curve



Market Equilibrium

2.4

Combining the descriptions of market supply and market demand completes the model.

- Remember, both the supply and demand curves relate the **price** of a good to the **quantity** demanded or supplied.

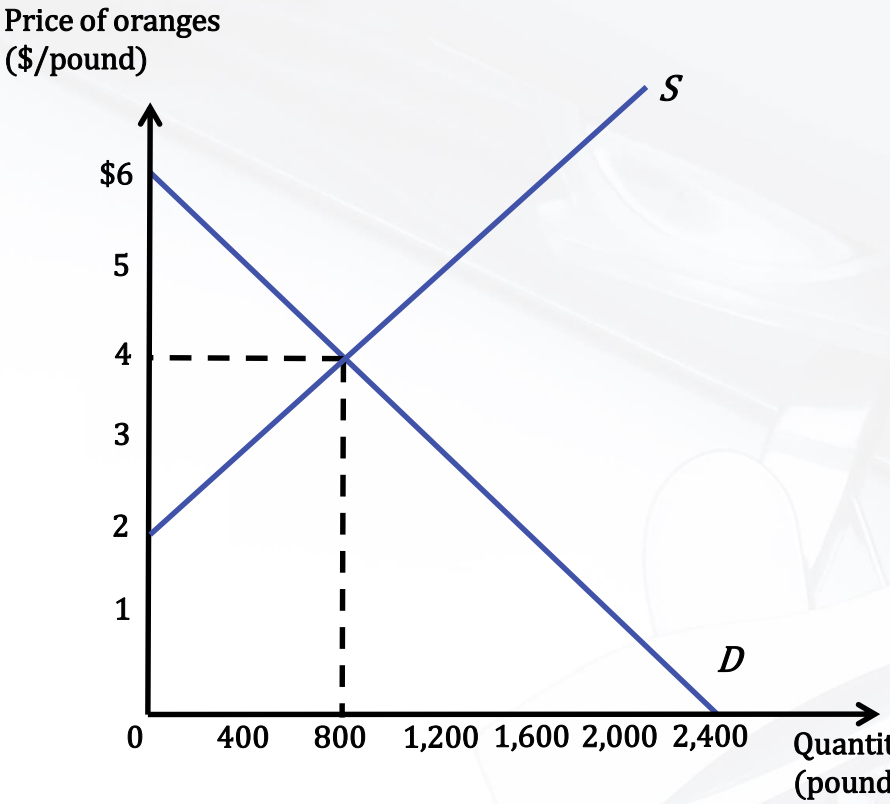
The point at which the supply and demand curves cross is called the **market equilibrium.**

- **Market equilibrium:** Occurs when the price of a good results in the quantity demanded equaling the quantity supplied (Q_e).
  - Q_e → Quantity where $Q^S = Q^D$
- **Equilibrium price:** The only price at which the quantity demanded equals the quantity supplied (P_e)

Market Equilibrium

2.4

Graphically, the equilibrium can be found by plotting the supply and demand curves together.



Demand and supply intersect at the price of $4.00 per pound of oranges, resulting in 800 pounds of oranges being demanded and supplied in the market.

This is the only price that can "clear" the market.

- Higher prices: Quantity supplied exceeds quantity demanded.
- Lower prices: Quantity demanded exceeds quantity supplied.

Market Equilibrium

2.4

The market equilibrium can be identified mathematically.

Returning to the orange example:

$$Q^D = 2{,}400 - 400P \quad \text{and} \quad Q^S = 400P - 800$$

We solve for the ***equilibrium price***, P_e, by setting demand equal to supply ($Q^D = Q^S$)

$$2{,}400 - 400P_e = 400P_e - 800$$

Combining terms containing P_e yields:

$$3{,}200 = 800P_e, \; \boldsymbol{P_e = \$4}$$

To find the ***equilibrium quantity***, Q_e, substitute $P_e = 4$ into either equation, both should yield:

$$\boldsymbol{Q_e = 800}$$

Market Equilibrium

2.4

Why markets move toward equilibrium

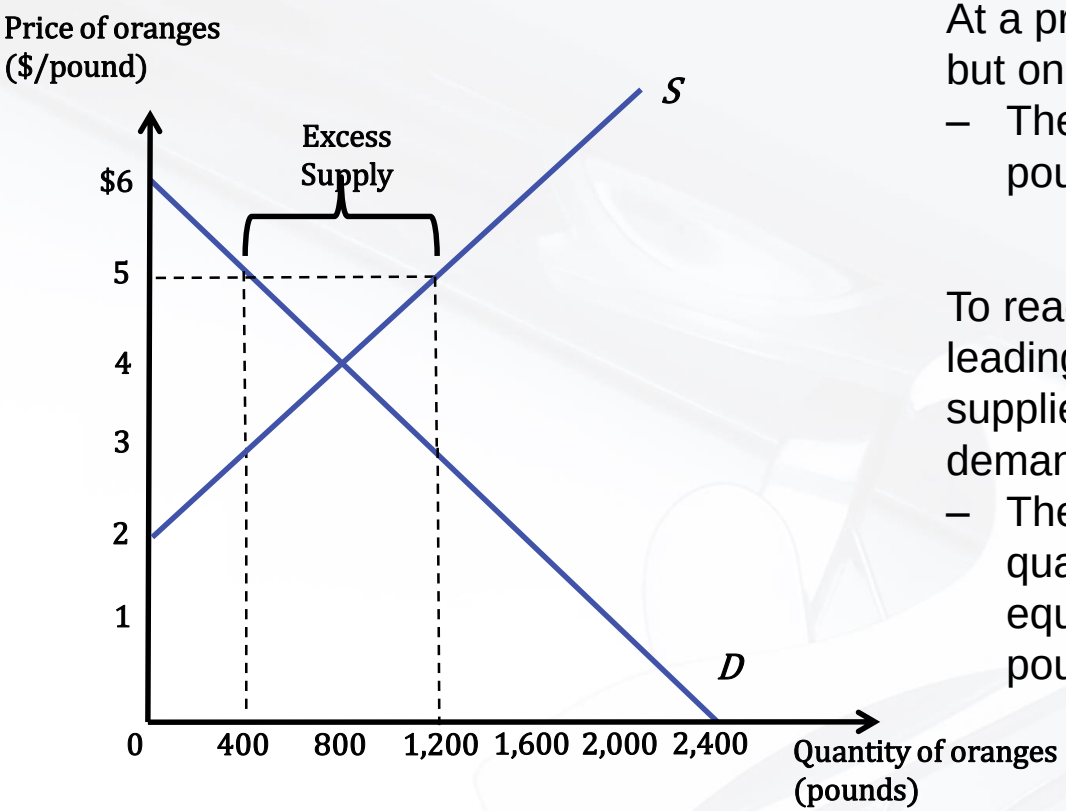
First, if $P > P_e$, quantity supplied will exceed quantity demanded, resulting in **Excess Supply.**

- $Q^S > Q^D$
- Excess supply is also referred to as a surplus.
- To sell their products, producers must lower prices.
  - As *prices* fall, quantity demanded increases and quantity supplied decreases until the market reaches an equilibrium at a lower price.

Market Equilibrium

2.4

Describing **excess supply** graphically



At a price of $5,1,200 pounds are supplied, but only 400 are demanded.

– There is an **excess supply** of 800 pounds.

To reach the equilibrium, prices must fall, leading to a decrease in the quantity supplied, and an increase in the quantity demanded.

– The equilibrium is reached where both quantity demanded and quantity supplied equal 800 pounds at a price of $4 per pound.

Market Equilibrium

2.4

Why markets move toward equilibrium

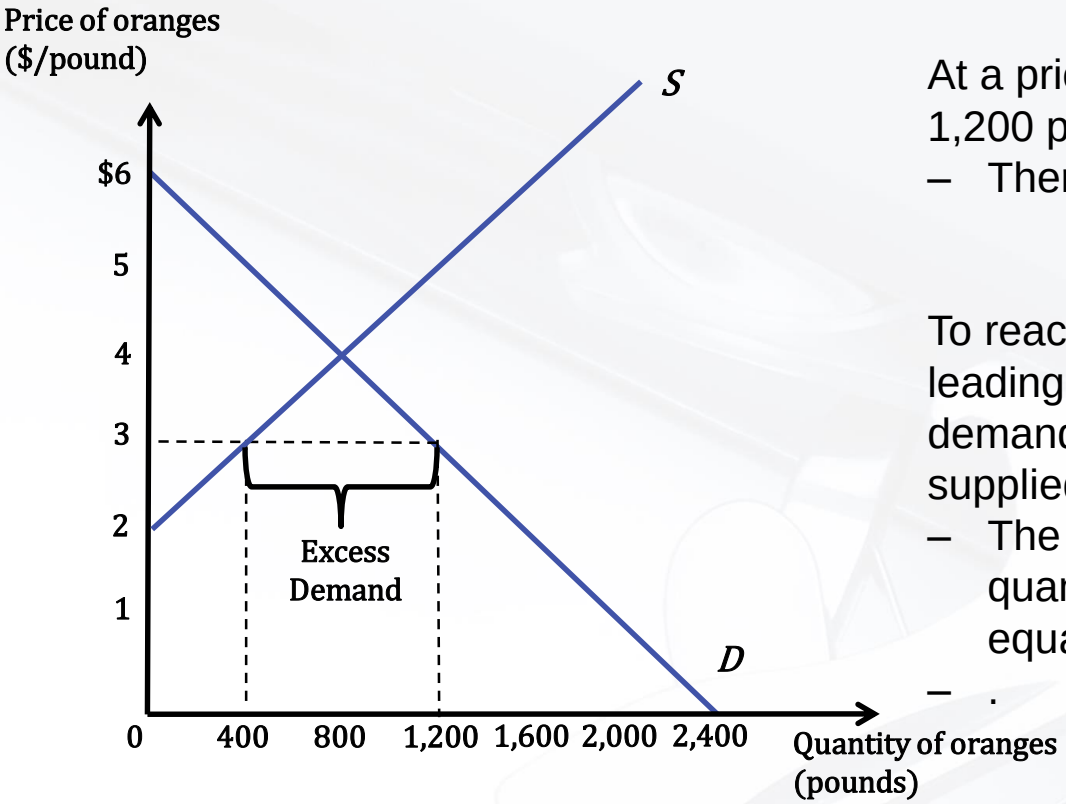
Likewise, if $P < P_e$, quantity demanded will exceed quantity supplied, resulting in **Excess Demand.**

- $Q^D > Q^S$
- Excess demand is also referred to as a shortage.
- The shortage will induce buyers to bid up the price.
  - As prices rise, quantity demanded will fall and quantity supplied will rise until the market reaches equilibrium at a higher price.

Market Equilibrium

2.4

Describing **excess demand** graphically



At a price of $3,400 pounds are supplied, but 1,200 pounds are demanded.

– There is an **excess demand** of 800 pounds.

To reach the equilibrium, prices must rise, leading to a decrease in the quantity demanded, and an increase in the quantity supplied.

– The equilibrium is reached where both quantity demanded and quantity supplied equal 800 pounds at a price of $4 per pound

– .

Market Equilibrium

2.4

Figure 2.6 Why P_e is the Equilibrium Price

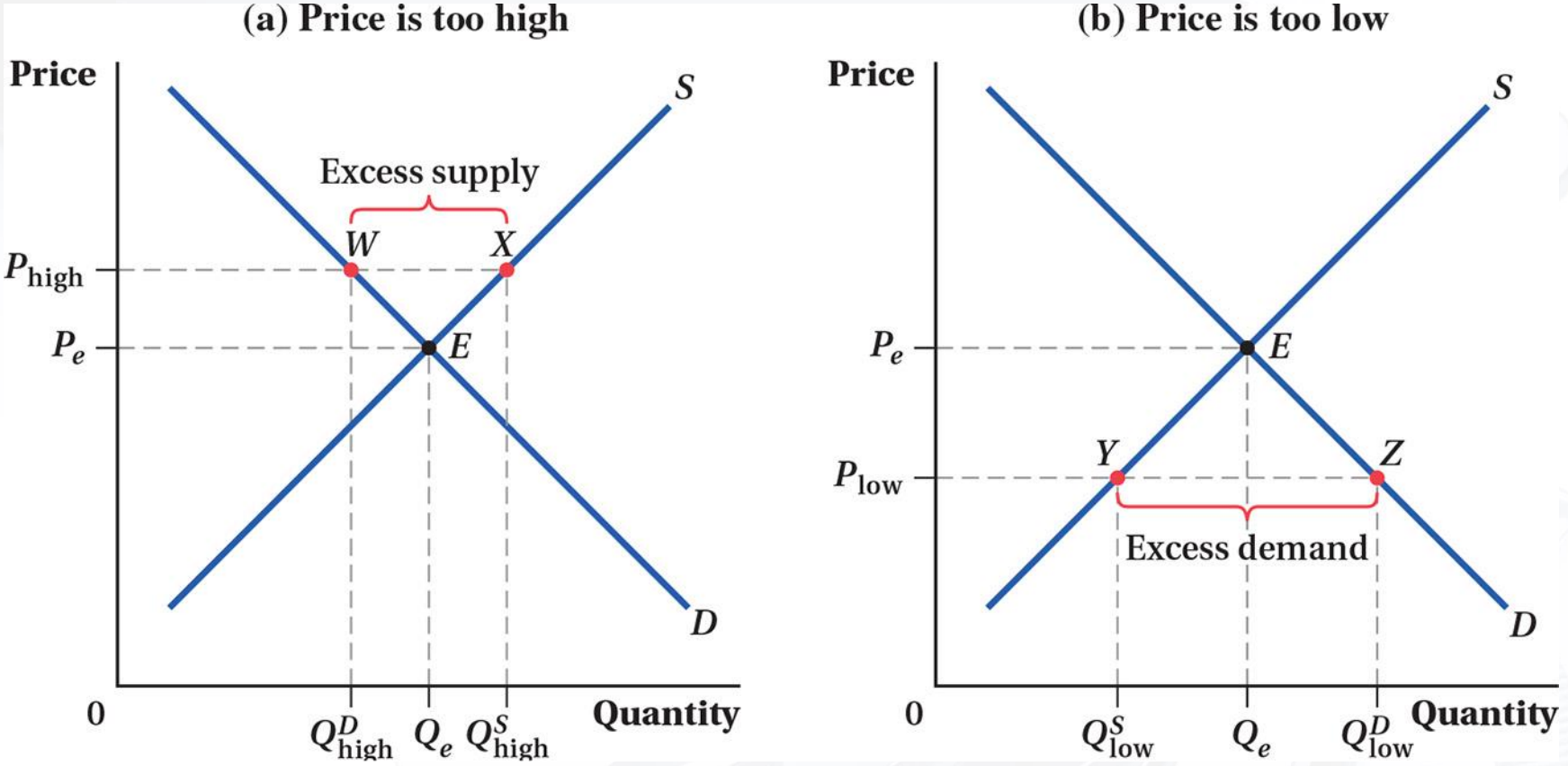


figure it out

The demand and supply for a monthly cell phone plan with unlimited texts can be represented by

$$Q^D = 50 - 0.5P$$

$$Q^S = -25 + P$$

where P is the monthly price, in dollars.

Answer the following questions:

a. If the current price for a contract is $40 per month, is the market in equilibrium?

b. Would you expect the price to rise, fall, or be unchanged?

c. If so, by how much? Explain.

figure it out

a. Two ways to solve the problem:

1. Compute quantity supplied and demanded at a price of $40, or
2. Solve for the equilibrium price, and compare with $40.

Using the first method

$$Q^D = 50 - 0.5\mathrm{P} = 50 - 0.5(40) = 30$$

$$Q^S = -25 + \mathrm{P} = -25 + 40 = 15$$

$Q^D > Q^S$, so the market is not in equilibrium as there is excess demand (shortage).

b. What must happen to price?

Price needs to rise… but by how much?

c. Solve for equilibrium price and quantity (second method)

$$Q^S = Q^D = Q^* => -25 + P^* = 50 - 0.05P^* => \boldsymbol{P^* = \$50},\ \boldsymbol{Q^* = 25}$$

Price must fall by **$10**, and **10** more contracts will be sold

figure it out

Additional figure it out

The demand and supply for monthly gym memberships are given as

$$Q^D = 600 - 10P$$
$$Q^S = 10P - 300$$

where P is the monthly price, in dollars

Answer the following questions:

a. If the current price for memberships is $50 per month, is the market in equilibrium?

b. Would you expect the price to rise or fall?

c. If so, by how much?

figure it out

Additional figure it out

a. Two ways to solve the problem:

1. Compute quantity supplied and demanded at a price of $50, or
2. Solve for the equilibrium price, and compare with $50,

Using the first method

$$Q^D = 600 - 10P = 600 - 10(50) = 100$$
$$Q^S = 10P - 300 = 10(50) - 300 = 200$$

$Q^S > Q^D$, and the market is not in equilibrium as there is excess supply (surplus).

b. What must happen to price?

Price needs to fall… but by how much?

c. Solve for equilibrium price and quantity (second method)

$$Q^S = Q^D = Q^* => 10P^* - 300 = 600 - 10P^* => \mathbf{P^* = \$45},\ \mathbf{Q^* = 150}$$

Price must fall by **$5**, and **50** more memberships are sold.

Market Equilibrium

2.4

What happens to the market equilibrium when there is a *shift* in demand or supply?

Remember the factors that can shift the *demand curve*:

- Number of consumers
- Wealth or income
- Consumer tastes
- Prices of related goods (complements or substitutes)

and those that shift the *supply curve*:

- Number of producers
- Costs of production
- Producer outside options

Market Equilibrium

2.4

In January, 2012, the FDA announced it had detected low levels of *carbendazim*, a potentially dangerous fungicide, in samples of orange juice.

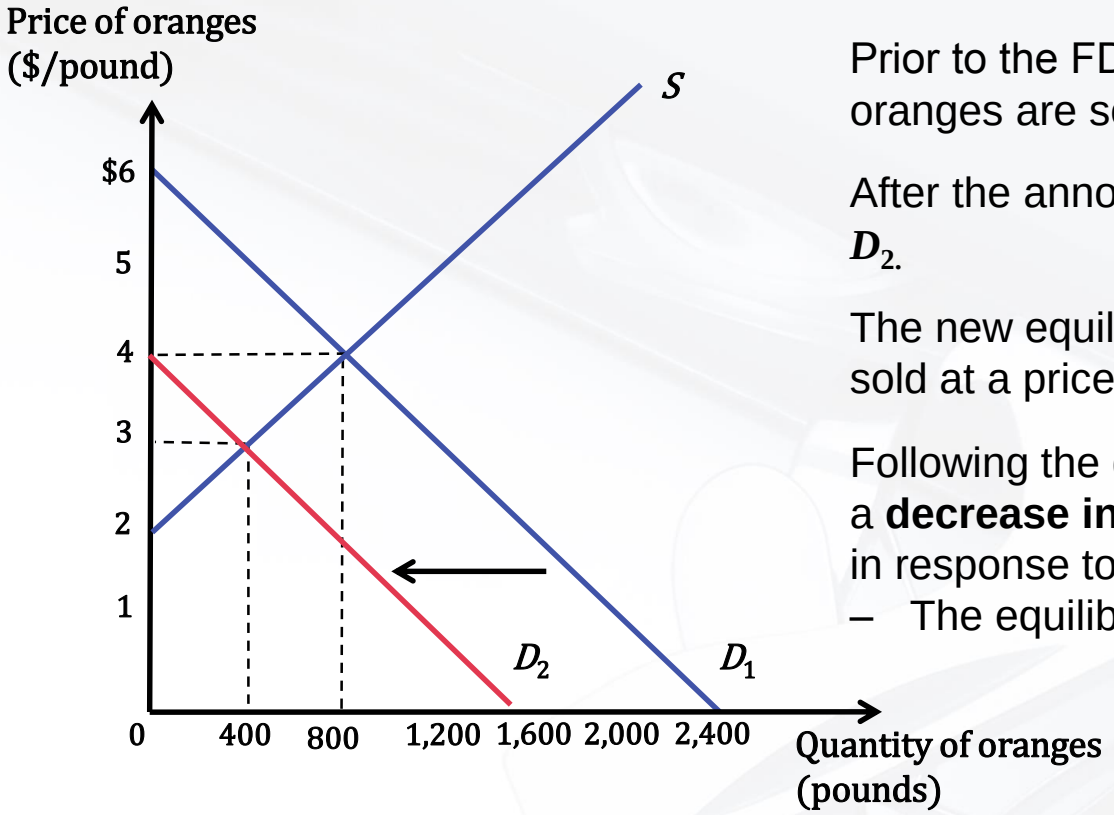
How will this announcement affect the market for oranges?

- **Supply side**—the levels detected were not sufficient to induce action by FDA; assume no impact on supply.
- **Demand side**—bad press can have negative impacts on demand for food products (like the oranges used to make orange juice).
  - **What should happen?**

Market Equilibrium

2.4

We can describe this graphically.



Prior to the FDA's discovery, 800 pounds of oranges are sold at $4 per pound.

After the announcement, demand shifts from D_1 to D_2.

The new equilibrium occurs when 400 pounds are sold at a price of $3 per pound.

Following the decrease in demand, we should see a **decrease in the quantity of oranges supplied** in response to a falling price.

– The equilibrium price falls $1 from $4 to $3.

Market Equilibrium

2.4

In February, 2011, Brazil won a trade dispute with the U.S. regarding imported orange juice, finding the U.S. was unfairly excluding Brazilian suppliers from U.S. markets by use of a tariff.

The result was more orange juice imported from Brazil.

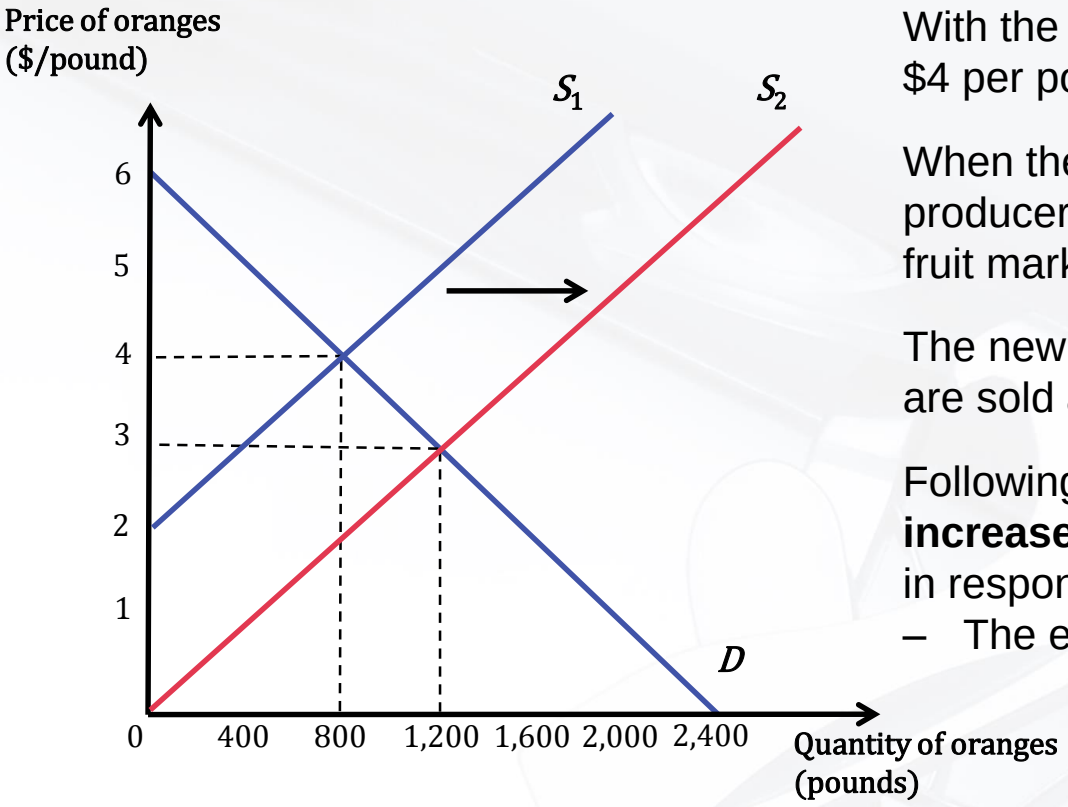
How should this announcement affect the market for oranges?

- **Demand side**—this should not affect demand.
- **Supply side**—the ruling applies to orange juice, not oranges… what is the difference?
  - If applied to oranges, **more sellers**—supply shifts out.
  - As it applies only to orange juice, affects **outside opportunities** of domestic orange producers… what happens?

Market Equilibrium

2.4

We can describe this graphically



With the tariff, 800 pounds of oranges are sold at $4 per pound.

When the tariff is repealed, domestic orange producers shift product from juice processors to fruit markets, supply shifts from S_1 to S_2.

The new equilibrium occurs when 1,200 pounds are sold at a price of at $3 per pound.

Following the increase in supply, we should see an **increase in the quantity of oranges demanded** in response to a falling price.

– The equilibrium price falls $1 from $4 to $3.

Market Equilibrium

2.4

Summary of the effect of a shift in supply or demand on market equilibrium

Table 2.2 Effect of Shifts in Demand and Supply Curves in Isolation

Curve that Shifts	Direction of Shift	Impact on Equilibrium: Price	Impact on Equilibrium: Quantity
Demand Curve	Out (increase in D)	↑	↑
	In (decrease in D)	↓	↓
Supply Curve	Out (increase in S)	↓	↑
	In (decrease in S)	↑	↓

Market Equilibrium

2.4

What determines the *magnitude* of the change in equilibrium price and quantity?

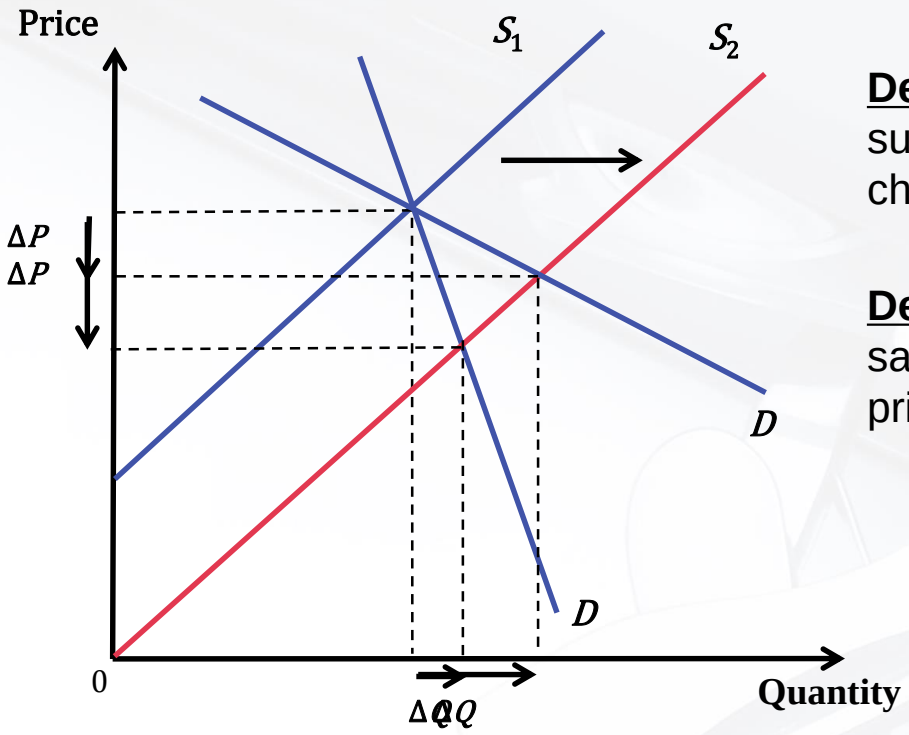
Two important parameters:

1. **Size of the shift**
2. **Slope of the curves**
   - If demand shifts, the slope of the *supply curve* determines the size of the change in equilibrium price and quantity, and vice versa.
   - The size of the change in price is *inversely* related to the size of the change in quantity.

Market Equilibrium

2.4

Consider an outward shift in supply (increase)



Demand has relatively steep slope: Shift in supply results in *large* change in price and *small* change in quantity exchanged.

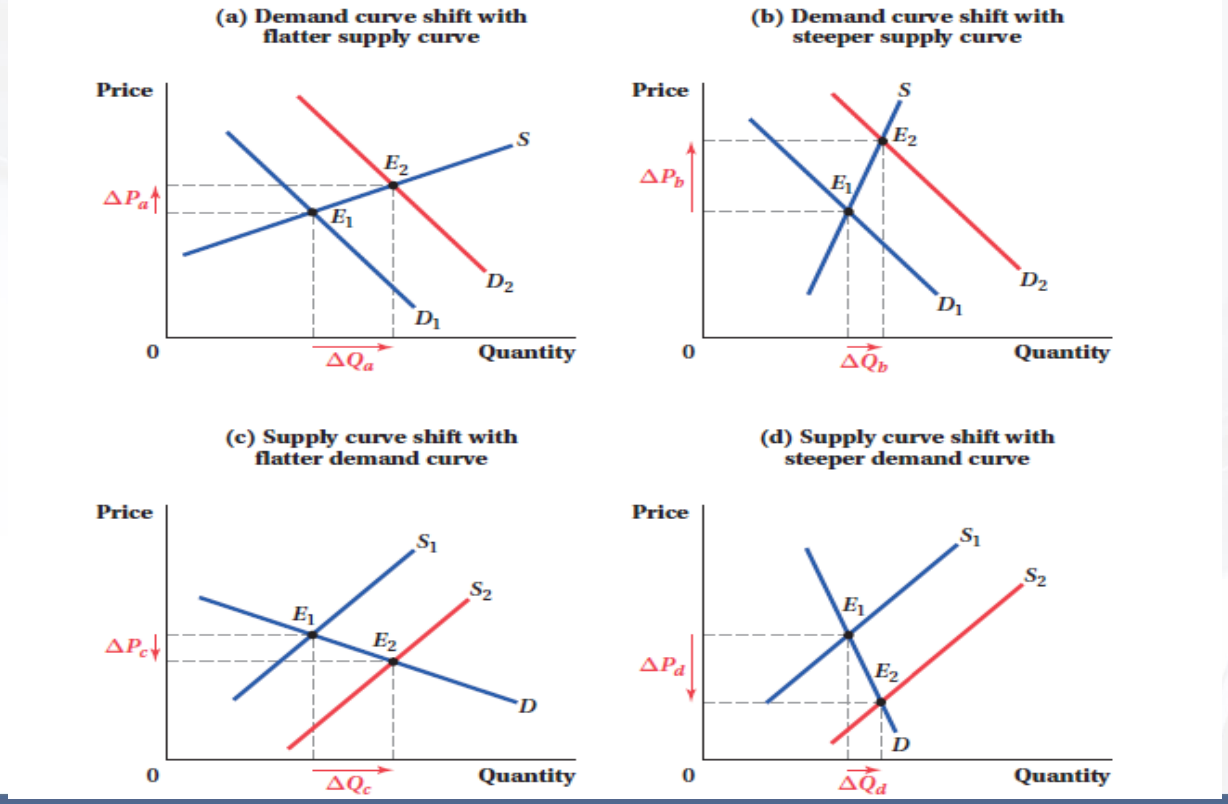
Demand has relatively shallow slope: The same shift in supply results in *small* change in price and *large* change in quantity exchanged.

Market Equilibrium

2.4

Figure 2.10 Size of Equilibrium Price and Quantity Changes, and the Slopes of the Demand and Supply Curves

Figure 2.10 Size of Equilibrium Price and Quantity Changes, and the Slopes of the Demand and Supply Curves



Market Equilibrium

2.4

Sometimes, supply and demand shift simultaneously!

Example:

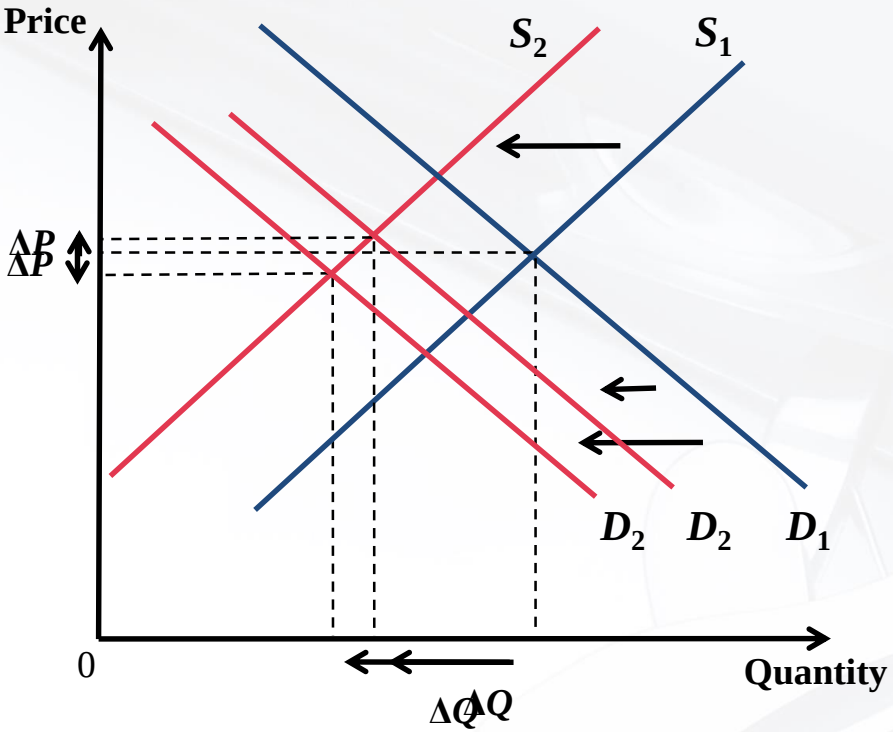
Hurricane Katrina and the New Orleans housing market

- Katrina destroyed many homes. What happens to supply?
- The hurricane displaced thousands of residents, many of which have not returned. What happens to demand?
  - **How will these shifts affect the housing market equilibrium in New Orleans?**

Market Equilibrium

2.4

Hurricane Katrina and the New Orleans housing market



The hurricane shifts both supply and demand inward.

- Per this graph, the result is a large drop in quantity, and a small drop in price.

However, without specific information on shifts and slopes of supply and demand, we cannot know for sure what happens to price.

- Both shifts result in a decrease in quantity.

Example: Consider the same supply shift, but a smaller demand shift;

- **Quantity still falls, but price has now risen slightly!**

Elasticity

2.5

The *slopes* of the supply and demand curves determine how markets respond to shifts in supply and demand.

- **Steep curves:** *Large* changes in price and *small* changes in quantity, all else equal
- **Shallow curves:** *Small* changes in price and *large* changes in quantity, all else equal

Elasticity

2.5

Elasticity

- Unit-less measure that describes the sensitivity of quantity demanded or supplied to changes in price, income, or price of related goods.
- Percentage change in one variable (e.g., quantity) divided by the percentage change in another (e.g., price)

Elasticity

2.5

Price elasticity of demand: Percentage change in quantity demanded divided by percent change in price

$$E^D = \frac{\%\Delta Q^D}{\%\Delta P}$$

Price elasticity of supply: Percentage change in quantity supplied divided by percent change in price

$$E^S = \frac{\%\Delta Q^S}{\%\Delta P}$$

Elasticity

2.5

When price elasticity of demand is **high**…

- Relatively *small* increases in price result in relatively *large* drops in quantity demanded.
- Examples?
  - McDonald's hamburgers, Campbell's Soup, Snickers bar…

When price elasticity of demand is **low**…

- Relatively *large* increases in price result in relatively *small* drops in quantity demanded.
- Examples?
  - Gasoline, tap water, cigarettes …

Elasticity

2.5

What variables affect the elasticity of demand?

1. **Availability of close substitutes**
2. **Breadth of the market**
3. **Type of product**
   - Necessity or luxury item
4. **Percentage of income** spent on the good
5. **Time horizon** of the analysis

What variables affect the elasticity of supply?

1. The ease at which **production capacity** can be expanded
2. **Time horizon** of the analysis

Elasticity

2.5

Terminology

- **Inelastic:** Demand is inelastic if $0 < |E^D| < 1$
- **Unit elastic:** Demand is unit elastic if $|E^D| = 1$
- **Elastic:** Demand is elastic if $|E^D| > 1$
- **Perfectly elastic:** Demand is perfectly elastic if $|E^D| = \infty$
- **Perfectly inelastic:** Demand is perfectly inelastic if $|E^D| = 0$

Important: Elasticities do not have units attached.

- Allows for the comparison across different goods and services in different markets
- Above also used to describe supply.

Elasticity

2.5

Elasticities and Linear Demand and Supply

We often assume demand and supply are linear, so knowing how to calculate the elasticity of a linear curve is important.

The equation for price elasticity (demand or supply):

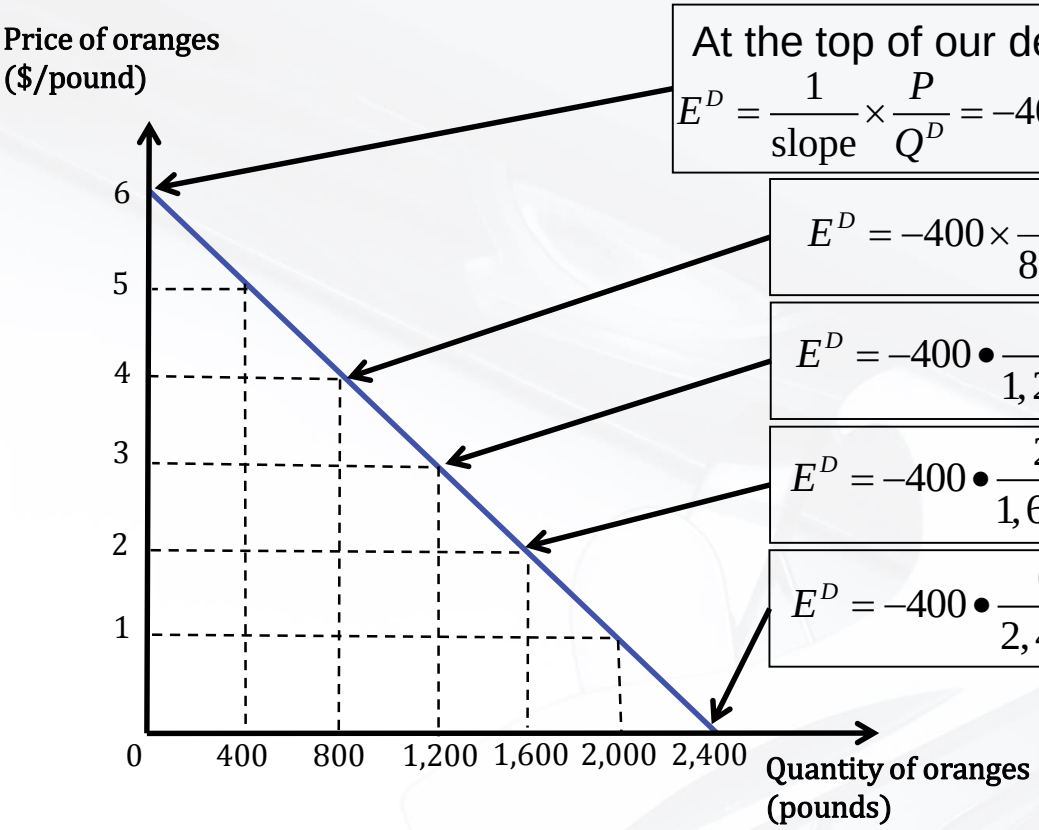
$$E = \frac{\%\Delta Q}{\%\Delta P} \quad \text{or} \quad E = \frac{\Delta Q / Q}{\Delta P / P}$$

Moving up or down a linear supply or demand curve, the ratio $\Delta Q/\Delta P$ is equal to $1/\text{slope}$; note, the slope is for the inverse supply or demand curve.

- Rewriting the formula above:

$$E = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q}{\Delta P} \bullet \frac{P}{Q} = \frac{1}{\text{slope}} \bullet \frac{P}{Q}$$

Price Elasticity of Demand for a Linear Demand Curve



At the top of our demand curve,

$$E^D = \frac{1}{\text{slope}} \times \frac{P}{Q^D} = -400 \times \frac{6}{0} = -\infty$$ (perfectly elastic)

$$E^D = -400 \times \frac{4}{800} = -2$$ (elastic)

$$E^D = -400 \bullet \frac{3}{1,200} = -1$$ (unit elastic)

$$E^D = -400 \bullet \frac{2}{1,600} = -0.5$$ (inelastic)

$$E^D = -400 \bullet \frac{0}{2,400} = 0$$ (perfectly inelastic)

Elasticity

2.5

As you move down a demand curve, demand becomes *less elastic* (i.e. more inelastic).

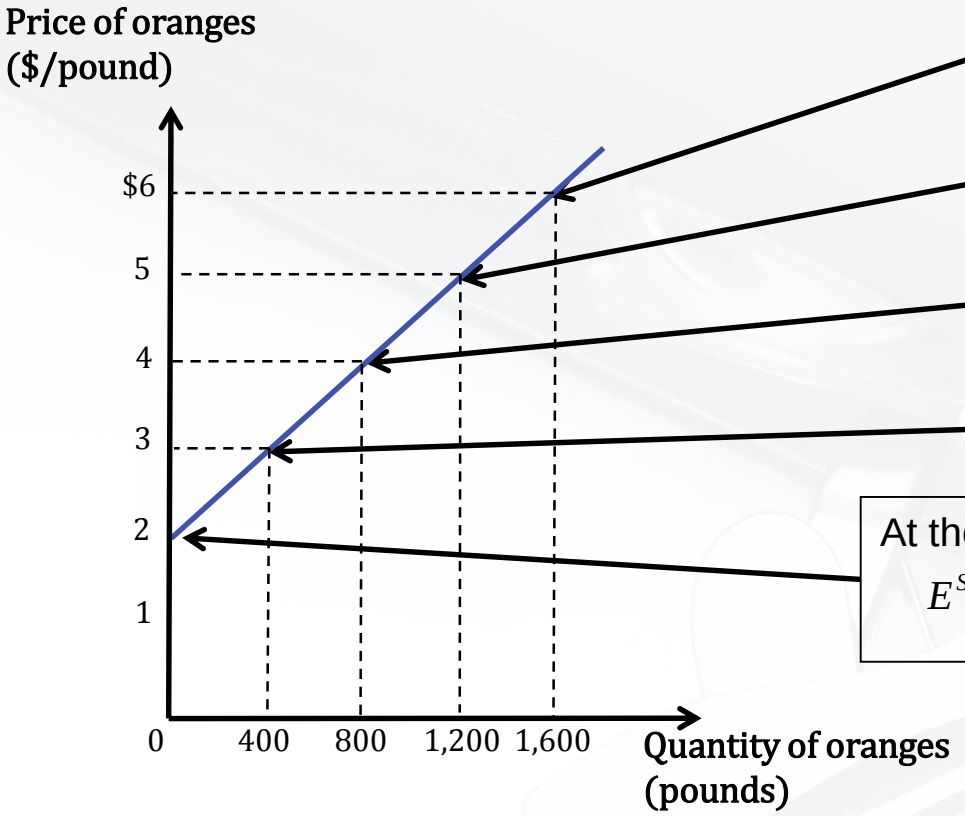
- Eventually perfectly inelastic at the horizontal axis

$$E^D = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D}$$

Slope is constant along the demand curve.

P/Q falls as you move down the demand curve.

Price Elasticity of Supply for a Linear Supply Curve



$E^S = 400 \bullet \frac{6}{1,600} = 1.5$ (elastic)

$E^S = 400 \bullet \frac{5}{1,200} = 1.67$ (elastic)

$E^S = 400 \cdot \frac{4}{800} = 2$ (elastic)

$E^S = 400 \cdot \frac{3}{400} = 3$ (elastic)

At the bottom of the supply curve,

$E^S = \frac{1}{\text{slope}} \bullet \frac{P}{Q^S} = 400 \bullet \frac{2}{0} = \infty$ (perfectly elastic)

Elasticity

2.5

Perfectly *Inelastic* Demand and Supply

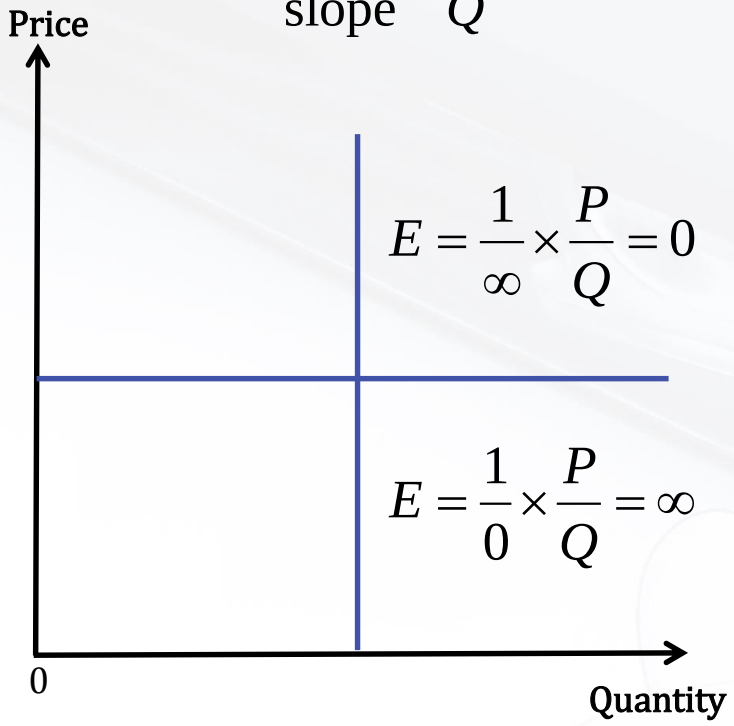
- Implies quantity demanded/supplied does not change in response to a change in price.
- Example?
  - Life-saving drugs (near-perfectly inelastic demand)

Perfectly *Elastic* Demand and Supply

- Implies the quantity demanded/supplied is *infinitely* responsive to miniscule changes in price.
- Example?
  - Commodity crops (near-perfectly elastic demand)

Elasticity

$$E = \frac{1}{\text{slope}} \times \frac{P}{Q}$$



When is demand/supply **perfectly inelastic** ($E = 0$)?

- When the slope of demand/supply is infinite

When is demand/supply **perfectly elastic** ($E = \infty$)?

- When the slope of demand/supply is zero

Elasticity

2.5

Income elasticity of demand: Percentage change in quantity demanded divided by the percentage change in income

$$E_I^D = \frac{\%\Delta Q^D}{\%\Delta I} = \frac{\Delta Q^D / Q^D}{\Delta I / I}$$

The sign of E_I^D depends on the type of product:

- E_I^D is negative for **inferior goods** ($E_I^D < 0$).
  - Consumption *decreases* with increases in income.

- E_I^D is positive for **normal goods** ($E_I^D > 0$).
  - Consumption *increases* with increases in income.
    - **Necessities** → $0 < E_I^D < 1$
    - **Luxury Goods** → $1E_I^D > 1$

Elasticity

2.5

Cross-price elasticity of demand: Percent change in quantity demanded of one good divided by the percent change in price of another good

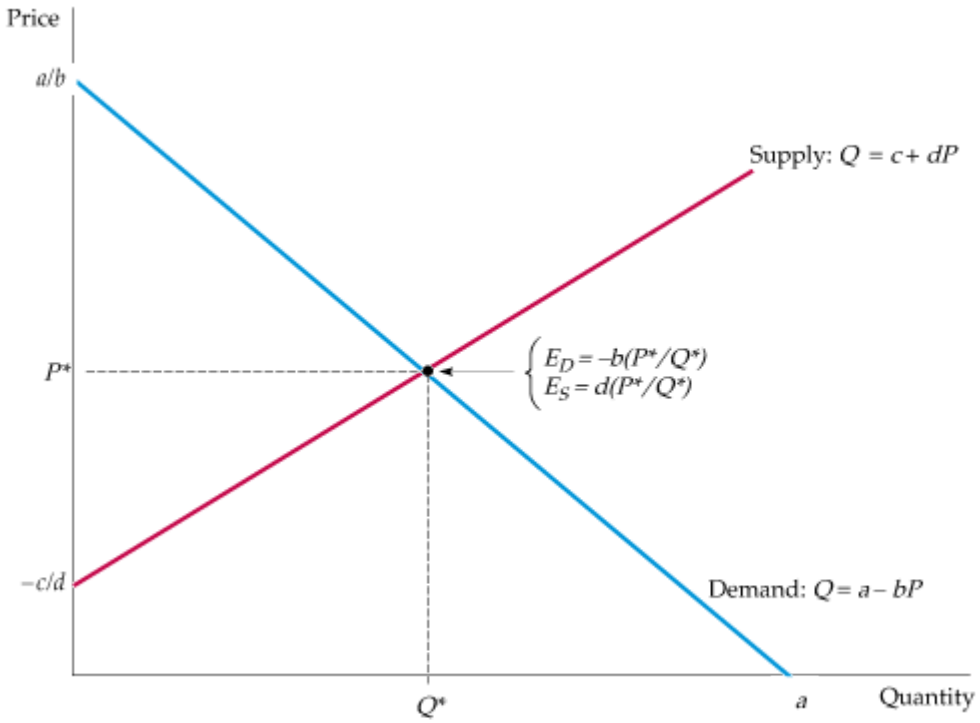
$$E_{XY}^{D} = \frac{\%\Delta Q_X^D}{\%\Delta P_Y} = \frac{\Delta Q_X^D / Q_X^D}{\Delta P_Y / P_Y}$$

where *X* and *Y* are different products that may be related.

The sign of E_{XY}^{D} depends on the relationship between the products:

- E_{XY}^{D} is negative for **complements** ($E_{XY}^{D} < 0$).
  - Consumption of good *X decreases* with an increase in the price of a related good *Y,* and vice versa.
- E_{XY}^{D} is positive for **substitutes** ($E_{XY}^{D} > 0$)
  - Consumption of good *X increases* with an increase in the price of a related good *Y*, and vice versa.
- E_{XY}^{D} is equal to zero for unrelated goods ($E_{XY}^{D} = 0$).

Reconstructing **LINEAR** Demand and Supply equations from equilibrium observations and elasticity estimates



Given data for the equilibrium price and quantity P^* and Q^*, as well as estimates of the elasticities of demand and supply E_D and E_S, we can calculate the parameters c and d for the supply curve and a and b for the demand curve. (In the case drawn here, $c < 0$.) The curves can then be used to analyze the behavior of the market quantitatively.

Reconstructing **LINEAR** Demand and Supply equations from equilibrium observations and elasticity estimates

$$Demand: Q = a - bP$$

$$Supply: Q = c + dP$$

- ***Step 1:***

$$E = (P/Q)(\Delta Q/\Delta P)$$

$$Demand: E_D = -b(P^*/Q^*)$$

$$Supply: E_S = d(P^*/Q^*)$$

- ***Step 2:***

$$a = Q^* + bP^*$$

$$c = Q^* - dP^*$$

Conclusion

2.6

This chapter has introduced one of the most basic models in economics: the **Supply and Demand** model.

Forthcoming chapters:

- Examine the factors of production underlying supply.
- Introduce consumer theory, which underlies market demand.
- Examine situations in which assumptions fail to reflect reality (e.g., the impact of uncertainty).

In **Chapter 3**, we will discover how consumers and producers benefit from markets, and examine the impact of government regulation on market outcomes.

figure it out

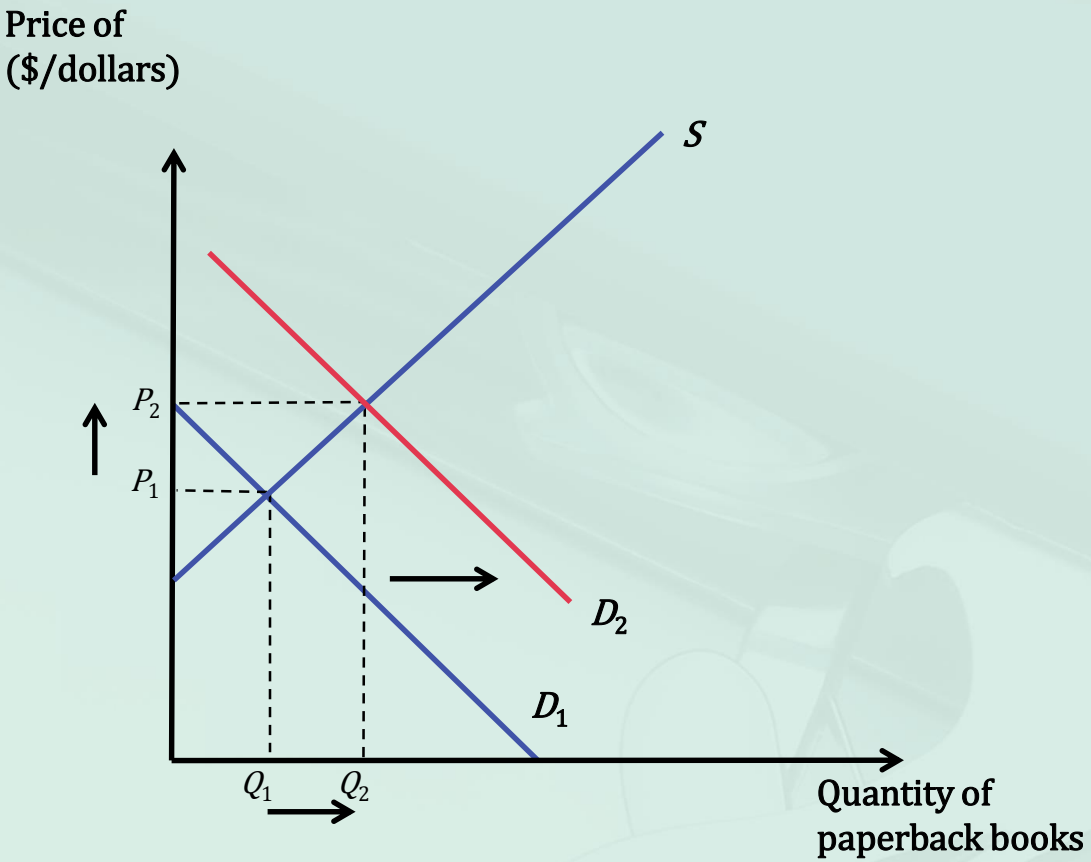
Draw a standard supply and demand diagram of the market for paperback books in a small coastal town.

Answer the following questions:

a. Suppose a hurricane knocks out electrical power for an extended time. Unable to watch television or use a computer, people must resort to reading books for entertainment. Using the supply and demand diagram, show what will happen to the equilibrium price and quantity of paperback books in the small coastal town.

b. Does this change reflect a change in demand or a change in the quantity demanded?

figure it out



a. The initial equilibrium occurs at a price of P_1 and quantity Q_1.

When the hurricane hits and people want more books because they can't watch television or use the computer, demand shifts outward.

The new equilibrium price is P_2, and the new quantity is Q_2.

– So, price and quantity exchanged have both increased.

b. This represents a **change (or shift) in demand.**

figure it out

Additional figure it out

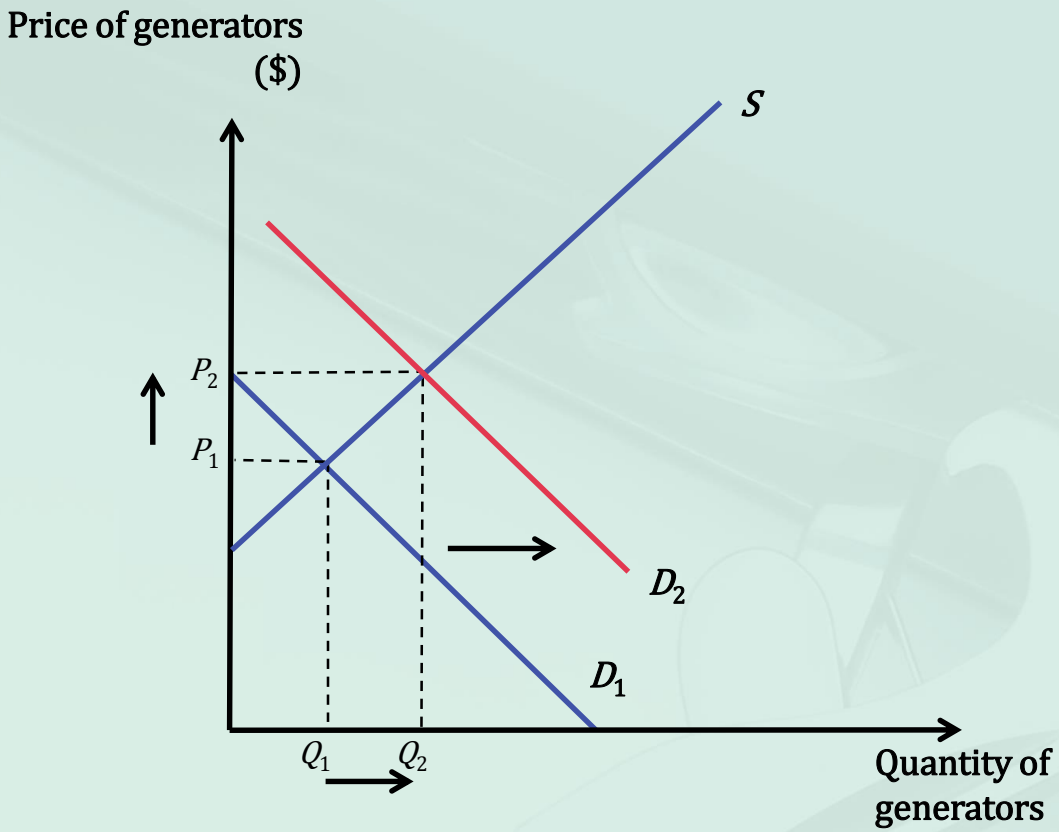
Draw a standard supply and demand diagram of the market for generators in Tampa, Florida.

Answer the following questions:

a. Suppose a hurricane watch is issued, and some residents expect to lose power. Using the supply and demand diagram, show what will happen to the equilibrium price and quantity in the Tampa market for generators.

b. Does this change reflect a change in demand or a change in the quantity demanded?

figure it out



a. The initial equilibrium occurs at a price of P_1 and quantity Q_1.

When the hurricane watch is issued, the demand for generators shifts outward.

The new equilibrium price is P_2, and the new quantity is Q_2.

– So, price and quantity have both increased.

b. This represents a **change (or shift) in demand**.

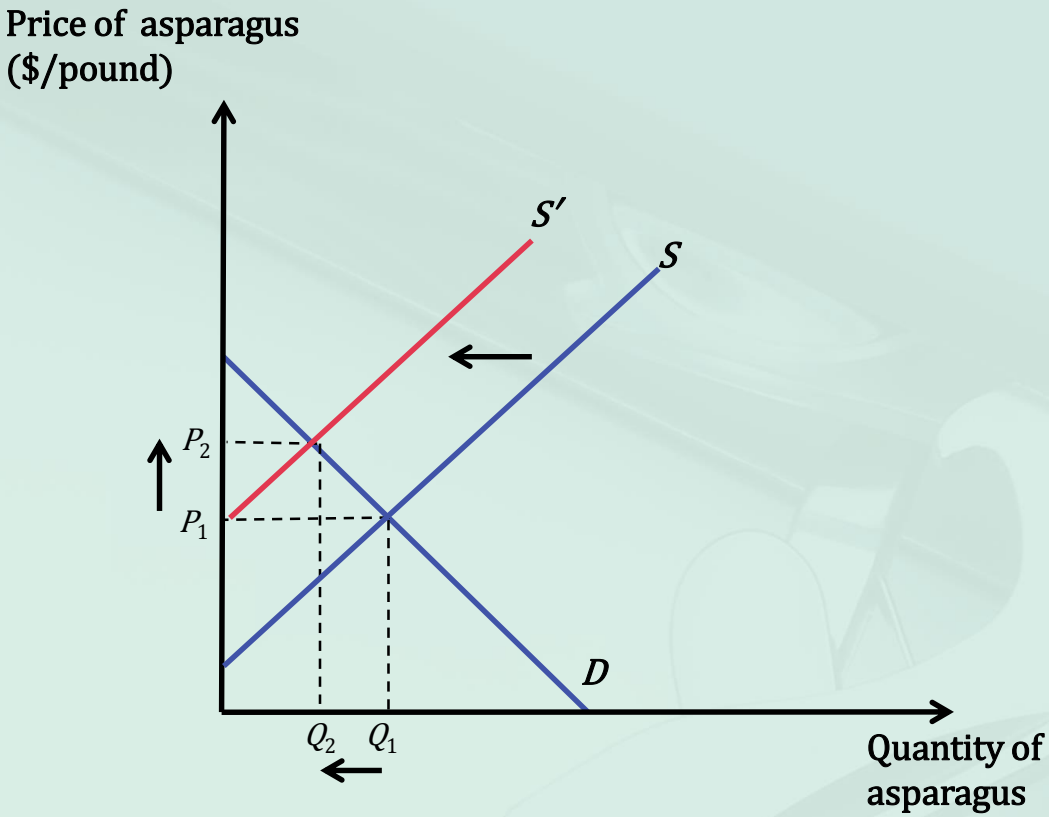
figure it out

Last month, you noticed the price of asparagus rising, and you also noted that there was less asparagus being sold than in the prior month.

Answer the following question:

Using a supply and demand diagram, what can you infer about the behavior of the supply and demand for asparagus?

figure it out



The initial equilibrium occurs at a price of P_1 and quantity Q_1.

What change in supply or demand would result in prices rising *and* quantity exchanged falling?

A negative shift in supply!

– The new price is P_2, and the new quantity is Q_2.

This represents a **change (or shift) in supply** followed by a change in the **quantity demanded**.

– Both Decrease

figure it out

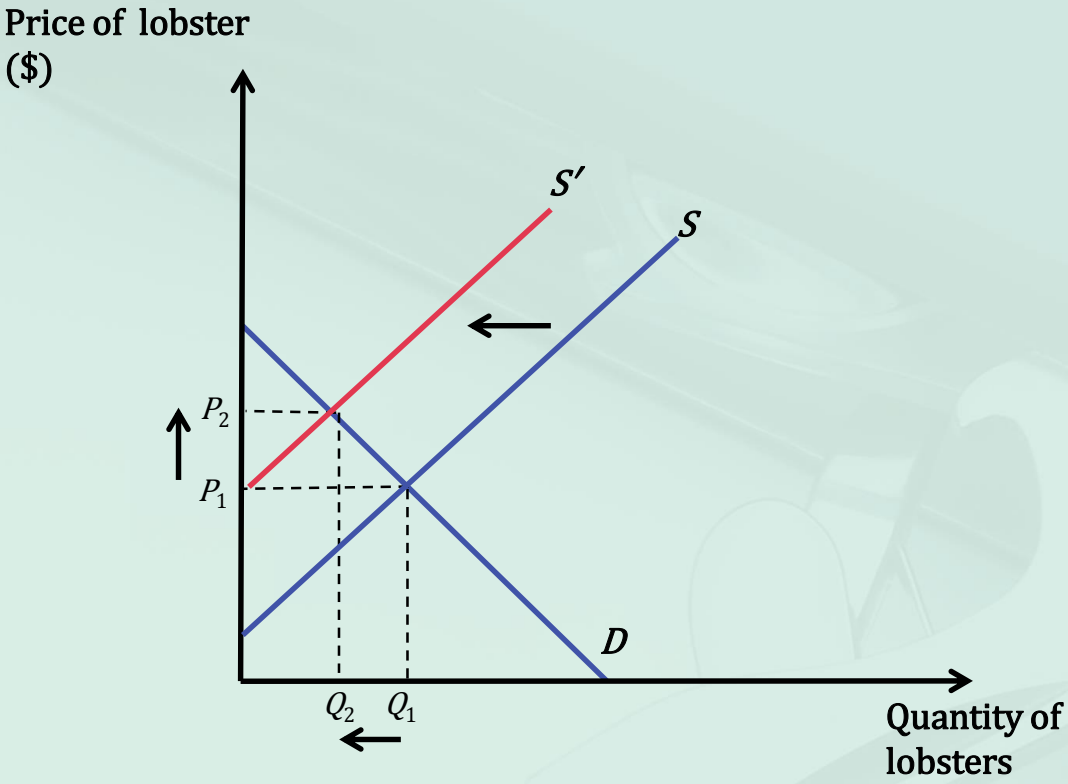
Additional figure it out

This summer, you noticed the price of lobster in your supermarket rising, and also that there was much less lobster being sold.

Answer the following question:

Using a supply and demand diagram, what can you infer about this market?

figure it out



The initial equilibrium occurs at a price of P_1 and quantity Q_1.

What change in supply or demand would result in prices rising *and* quantity exchanged falling?

A negative shift in supply!

– The new price is P_2, and the new quantity is Q_2.

This represents a **change (or shift) in supply** followed by a change in the **quantity demanded**.

– Both Decrease

figure it out

Suppose that the supply of lemonade is represented by:

$$Q^S = 40P$$

where Q is measured in pints and P is measured in cents per pint.

Answer the following questions:

a. If the demand for lemonade is $Q^D = 5{,}000 - 10P$, what is the current equilibrium price and quantity?

b. Suppose that a severe frost in Florida raises the price of lemons, and thus the cost of making lemonade. In response to the increase in cost, producers reduce the quantity supplied of lemonade by 400 pints at every price. What is the new equation for the supply of lemonade?

c. Compute the new equilibrium price and quantity of lemonade after the frost.

figure it out

a. To solve for the equilibrium price and quantity, we need to equate quantity demanded and supplied.

$$Q^D = Q^S \rightarrow 5{,}000 - 10P = 40P$$

$$50P = 5{,}000 \rightarrow \boldsymbol{P^* = 100 \text{ cents}}$$

$$Q^{\boldsymbol{D}} = 5{,}000 - 10(100) = \boldsymbol{4{,}000 \text{ pints}}$$

$$Q^{\boldsymbol{S}} = 40(100) = \boldsymbol{4{,}000 \text{ pints}}$$

b. Quantity supplied has fallen by 400 pints at every price, so the supply curve is shifting left

$$Q_2^S = Q^S - 400 \rightarrow \boldsymbol{Q_2^S = 40P - 400}$$

c. To solve for the new equilibrium price and quantity, we set $\boldsymbol{Q^D = Q_2^S}$:

$$5{,}000 - 10P_2 = 40P - 40$$

$$50P_2 = 5{,}400 \rightarrow \boldsymbol{P_2 = 108 \text{ cents}}$$

$$Q^{\boldsymbol{D}} = 5{,}000 - 10(108) = \boldsymbol{3{,}920 \text{ pints}}$$

$$Q_2^S = 40(108) - 400 = \boldsymbol{3{,}920 \text{ pints}}$$

figure it out

Going back to the previous example of gym memberships

$$Q^D = 600 - 10P$$
$$Q^S = 10P - 300$$

Now, suppose the town opens a new community center with a pool and a weight room. As a result, consumers demand 200 *fewer* gym memberships at every price.

Answer the following questions:

a. Write down the new demand equation

b. What do you expect to happen to the equilibrium price and quantity (remember, previously $P^* = \$45$, $Q^* = 150$)?

c. Compute the new equilibrium price and quantity.

figure it out

Additional figure it out

a. Quantity demanded has fallen by 200 at every price.

$Q^D_{\text{new}} = Q^D_{\text{old}} - 200 \rightarrow (600 - 10P) - 200$

$$\boldsymbol{Q^D_{\text{new}} = 400 - 10P}$$

b. What should happen to the equilibrium price and quantity?

We should see a **fall** in both equilibrium price and equilibrium quantity as the demand curve has shifted in.

c. Solving for the new equilibrium price and quantity:

$Q_S = Q^D_{\text{new}} \rightarrow 10P^* - 300 = 400 - 10P^*$

$20P^* = 700, \boldsymbol{P^* = \$35}$

$Q^D_{\text{new}} = 400 - 10(35) = 50 \text{ memberships}$

$Q^S = 10(35) - 300 = 50 \text{ memberships}$

$\boldsymbol{Q^* = 50}$

As expected, price has fallen (by $10), and the quantity of memberships sold has fallen as well (by 100).

figure it out

The demand for gym memberships in a small town is given as

$$Q^D = 360 - 2P$$

where Q is the number of monthly members and P is the monthly membership rate.

Answer the following questions:

a. Calculate the price elasticity of demand when the price of gym memberships is $50 per month.

b. Calculate the price elasticity of demand when the price of gym memberships is $100 per month.

c. Based on your answers to a. and b., what can tell about the relationship between price and the price elasticity of demand along a linear demand curve?

figure it out

a. The price elasticity of demand is given as

$$E^D = \frac{\Delta Q^D / Q^D}{\Delta P / P} = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D} = \frac{1}{\text{slope}} \times \frac{P}{Q^D}$$

To find the slope of the demand curve, it is easiest to rearrange the equation in terms of P:

$$Q^D = 360 - 2P \rightarrow 2P = 360 - Q$$

$$P = 180 - 0.5Q, \text{ so the slope } = -0.5$$

Now we know the price and slope, all we need is the quantity demanded at the price of $50:

$$Q^D = 360 - 2P \rightarrow 360 - 2(50) = \mathbf{260}$$

Using the formula above, $E^D = \frac{1}{-0.5} \times \frac{50}{260} = -0.385$

figure it out

b. When the price is $100 per month:

$$Q^D = 360 - 2(100) \rightarrow Q^D = 160$$

The slope is unchanged because it is linear.

At a price of $100 using the elasticity formula,

$$E^D = \frac{1}{-0.5} \times \frac{100}{160} = -1.25$$

c. From a. and b.

We can see that as price rises along a linear demand curve, demand moves from being inelastic (|−0.385|<1) to elastic (|−1.25| >1)

figure it out

Additional figure it out

The demand for movie tickets in a small town is given as

$$Q^D = 1{,}000 - 50P$$

Answer the following questions:

a. Calculate the price elasticity of demand when the price of tickets is $5.

b. Calculate the price elasticity of demand when the price of tickets is $12.

c. At what price is the price elasticity of demand **unit elastic?**

d. What happens to the price elasticity of demand as you move down a linear demand curve?

figure it out

a. The price elasticity of demand is given as

$$E^D = \frac{\Delta Q^D / Q^D}{\Delta P / P} = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D} = \frac{1}{\text{slope}} \times \frac{P}{Q^D}$$

At \$5, $\frac{\Delta Q^D}{\Delta P} = -50$ is constant (linear demand curve).

At a price of \$5, $\frac{P}{Q^D} = \frac{5}{1{,}000 - 50 \times (5)} = \frac{1}{150}$

Therefore, $E^D = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D} = -50 \times \frac{1}{150} = -0.33333$

And, demand is:

Inelastic

figure it out

b. What happens to the price elasticity of demand if the price of tickets increases to $12?

At a price of $12, $\frac{P}{Q^D} = \frac{12}{1{,}000 - 50 \bullet (12)} = \frac{3}{100}$

Therefore, $E^D = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D} = -50 \times \frac{3}{100} = -1.5$

And, demand is:

Elastic

figure it out

c. At what price is demand unit elastic ($E^D = -1$)?

To solve for the correct price, use the equation for elasticity of demand :

$$-1 = -50 \times \frac{P}{1{,}000 - 50P}$$

Multiply both sides by $1{,}000 - 50P$:

$$50P - 1{,}000 = -50P$$

Combining the terms, yields a price of **$P = \$10$**

d. What happens to the elasticity of demand as you move *down* a linear demand curve?

Demand becomes ***less elastic*** or ***more inelastic.***

figure it out

Suppose the price elasticity of demand for cereal is −0.75 and the cross-price elasticity of demand between cereal and the price of milk is −0.9.

Answer the following question:

If the price of milk rises by 10%, what would have to happen to the price of cereal to exactly offset the rise in the price of milk and leave the quantity demanded of cereal unchanged?

figure it out

Step 1 is to see what happens to the quantity of cereal demanded when the price of milk rises by 10%.

Using the given cross-price elasticity

$$\frac{\%\Delta Q_{\text{cereal}}}{\%\Delta P_{\text{milk}}} = -0.9 \rightarrow \frac{\%\Delta Q_{\text{cereal}}}{10} = -0.9$$

$\%\Delta \boldsymbol{Q}_{\text{cereal}} = -9$**, when the price of milk rises by 10%, the quantity demanded of cereal falls by 9%.**

Step 2 is to consider how to offset this decline with a change in price of cereal. (e.g. what must happen to the price of cereal to cause the quantity of cereal demanded to *rise* by 9%?).

Using the given own-price elasticity

$$\frac{\%\Delta Q_{\text{cereal}}}{\%\Delta P_{\text{cereal}}} = -0.75 \rightarrow \frac{9}{\%\Delta P_{\text{cereal}}} = -0.75$$

$\%\Delta \boldsymbol{P}_{\text{cereal}} = -12$**, meaning the price of cereal would have to fall by 12% to exactly offset the effect of a rise in the price of milk on the quantity of cereal demanded.**