Lecture 2:
Elasticity

September 1, 2025

Overview

1. Administrative stuff
2. Equilibrium
3. Deducing supply and demand shifts from equilibrium outcomes
4. Non-linear demand curves

Overview

1. Administrative stuff
2. Equilibrium
3. Deducing supply and demand shifts from equilibrium outcomes
4. Non-linear demand curves

Elasticity

1. Defining elasticity
2. Useful elasticity terms
3. Why elasticity matters for policy
4. Many kinds of elasticity

Course Administration

1. Ripped from Headlines sign-up cleaned up – please check

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   - email me about changes as needed
   - if you can't work something out, let me know

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2. Problem Set 1 should be turned in
3. Problem Set 2 is posted

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2. Problem Set 1 should be turned in
3. Problem Set 2 is posted
4. Questions on Use Numbers Assignment 1?
5. Any other questions or outstanding issues?

How What You're Learning is Policy-Relevant

Ripped from Headlines presentation(s)

As a reminder, next week
Send the article by Wednesday midnight for approval

Afternoon

Finder	Presenter
Kibin	Elizabeth

Evening

Finder	Presenter
Damen	Charlotte

Today's Ripped from the Headlines

Afternoon

Finder	Presenter
Ali	Jacob

Evening

No one this week! Sign up!

Supply and Demand: Market Equilibrium

Where We Left Off

Demand

1. Price
2. Number of consumers
3. Consumer income or wealth
4. Consumer tastes
5. Prices of other goods

Supply

1. Price
2. Suppliers' costs of production
3. Number of sellers
4. Sellers' outside options

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Supply

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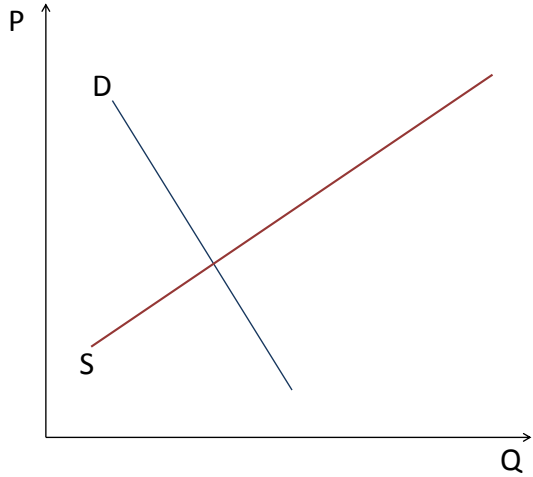
Defining Market Equilibrium

- Point at which consumers' quantity demanded equals producers' quantity supplied
  - $Q^D = Q^S$
- Equilibrium price $\equiv$ price at which quantity supplied equals quantity demanded
  - P such that $Q^D = Q^S$

Defining Market Equilibrium

- Point at which consumers' quantity demanded equals producers' quantity supplied
  - $Q^D = Q^S$
- Equilibrium price $\equiv$ price at which quantity supplied equals quantity demanded
  - P such that $Q^D = Q^S$
- Getting to equilibrium is the work of Adam Smith's invisible hand

Equilibrium in a Graph



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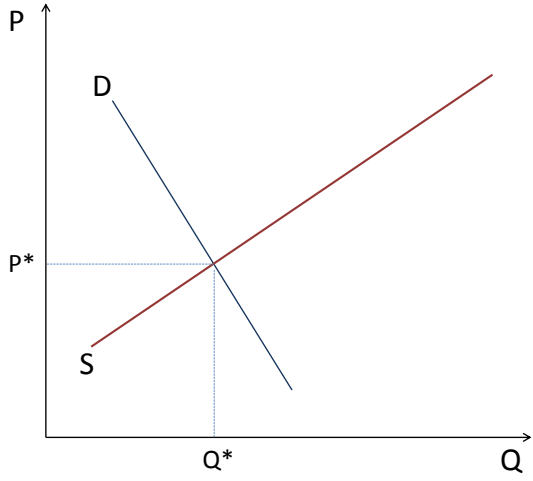

Equilibrium in Algebra: Price

Using our tomato example

$$Q^D = Q^S$$

Equilibrium in Algebra: Price

Using our tomato example

$$\begin{aligned} Q^D &= Q^S \\ 1000 - 200P &= 200P - 200 \end{aligned}$$

Equilibrium in Algebra: Price

Using our tomato example

$$\begin{aligned} Q^D &= Q^S \\ 1000 - 200P &= 200P - 200 \\ 1200 &= 400P \end{aligned}$$

Equilibrium in Algebra: Price

Using our tomato example

$$\begin{aligned} Q^D &= Q^S \\ 1000 - 200P &= 200P - 200 \\ 1200 &= 400P \\ P &= 3 \end{aligned}$$

Equilibrium in Algebra: Quantity

- Before putting pencil to paper, are Q^S and Q^D equal or different?

Equilibrium in Algebra: Quantity

- Before putting pencil to paper, are Q^S and Q^D equal or different? They must be the same.

Equilibrium in Algebra: Quantity

- Before putting pencil to paper, are Q^S and Q^D equal or different? They must be the same.
- How do you find them?
- Using our tomato example

$$Q^D = 1000 - 200P$$

Equilibrium in Algebra: Quantity

- Before putting pencil to paper, are Q^S and Q^D equal or different? They must be the same.
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$$\begin{aligned} Q^D &= 1000 - 200P \\ &= 1000 - 200(3) \\ &= 400 \end{aligned}$$

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$$\begin{aligned} Q^D &= 1000 - 200P \\ &= 1000 - 200(3) \\ &= 400 \end{aligned}$$

$$Q^S = 200P - 200$$

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$$\begin{aligned} Q^S &= 200P - 200 \\ &= 200(3) - 200 \end{aligned}$$

Equilibrium in Algebra: Quantity

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Getting to Equilibrium

That's just the math. The magic is getting there!

- Suppose we are out of equilibrium and $Q^D > Q^S$

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  - Seems like a shortage
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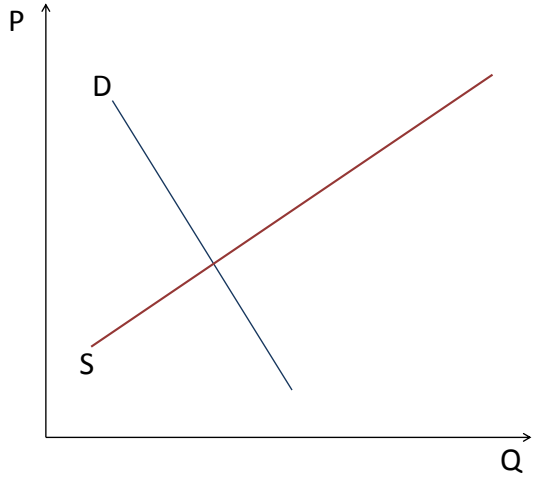
- Suppose we are out of equilibrium and $Q^S > Q^D$
  - Seems like a surplus
  - Price falls until we reach equilibrium

Note that these are all movements along existing curves.

Impact of Shift in Demand

- Suppose that we learn that tomatoes ruin the fluoride on your teeth
- What happens to the demand curve?

Where Does Demand Curve Go?



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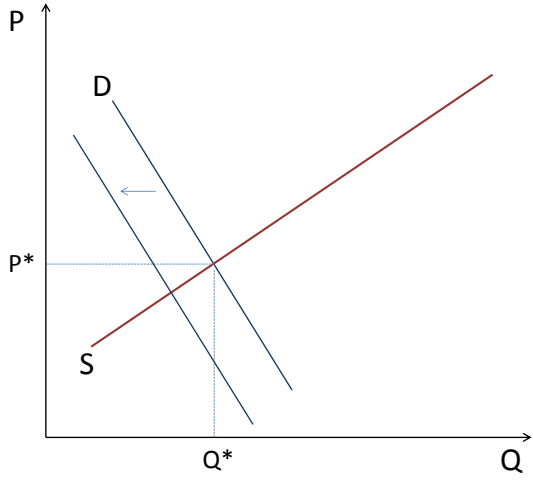

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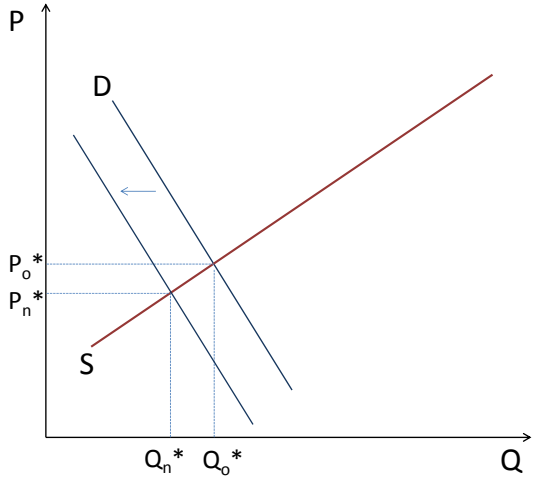

What does this mean for equilibrium?

New Demand Curve

- Assume that for any price, the quantity demanded of tomatoes falls by 500
- $Q^{D,original} = 1000 - 200P$

$$Q^{D,new} =$$

What does this mean for equilibrium?

New Demand Curve

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$$Q^{D,new} = Q^{D,original} - 500$$

What does this mean for equilibrium?

New Demand Curve

- Assume that for any price, the quantity demanded of tomatoes falls by 500
- $Q^{D,original} = 1000 - 200P$

$$\begin{aligned} Q^{D,new} &= Q^{D,original} - 500 \\ &= 1000 - 200P - 500 \end{aligned}$$

What does this mean for equilibrium?

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What does this mean for equilibrium?

Find new equilibrium

As before, set $Q^S = Q^{D,new}$

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What does this mean for equilibrium?

Find new equilibrium

As before, set $Q^S = Q^{D,new}$

$$\begin{aligned} Q^S &= Q^{D,new} \\ 200P - 200 &= 500 - 200P \end{aligned}$$

What does this mean for equilibrium?

Find new equilibrium

As before, set $Q^S = Q^{D,new}$

$$\begin{aligned} Q^S &= Q^{D,new} \\ 200P - 200 &= 500 - 200P \\ P &= 1.75 \end{aligned}$$

Find equilibrium quantities, first $Q^{D,new}$

$$\begin{aligned} Q^{D,new} &= 500 - 200P \\ &= 500 - 200(1.75) \end{aligned}$$

What does this mean for equilibrium?

Find new equilibrium

As before, set $Q^S = Q^{D,new}$

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Find equilibrium quantities, first $Q^{D,new}$

$$\begin{aligned} Q^{D,new} &= 500 - 200P \\ &= 500 - 200(1.75) \\ &= 150 \end{aligned}$$

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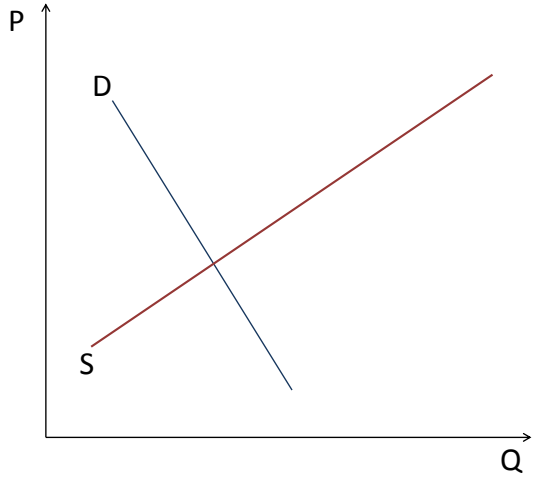
We find

- Price falls
- Equilibrium quantity falls

Impact of Shift in Supply

- Suppose that the drought in California ends, and California can now produce more tomatoes
- What happens to the supply curve?

Where Does Supply Curve Go?



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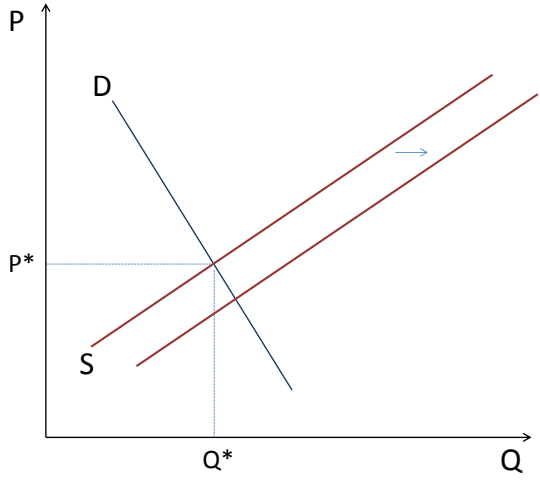

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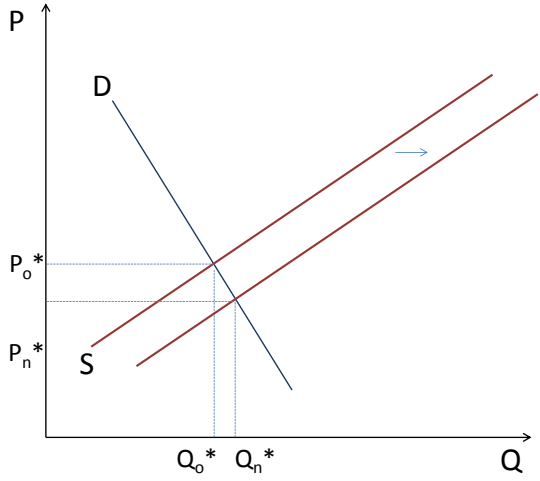

Algebra: Impact of Shift in Supply

- Suppose that we learn that ADM develops a tomato that ripens more quickly, increasing yields
- For any price, the quantity supplied of tomatoes increases by 400
- Recall $Q^{S,original} = 200P - 200$
- Then

$$Q^{S,new}$$

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$$Q^{S,new} = Q^{S,original} + 400$$

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- Then

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Equilibrium: Impact of Shift in Supply

How do we find the new equilibrium?

Equilibrium: Impact of Shift in Supply

How do we find the new equilibrium? Set $Q^{S,new} = Q^D$

$$Q^{S,new} = Q^D$$

Equilibrium: Impact of Shift in Supply

How do we find the new equilibrium? Set $Q^{S,new} = Q^D$

$$\begin{aligned} Q^{S,new} &= Q^D \\ 200P + 200 &= 1000 - 200P \end{aligned}$$

Equilibrium: Impact of Shift in Supply

How do we find the new equilibrium? Set $Q^{S,new} = Q^D$

$$\begin{aligned} Q^{S,new} &= Q^D \\ 200P + 200 &= 1000 - 200P \\ P &= 2 \end{aligned}$$

Equilibrium: Impact of Shift in Supply

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Find equilibrium quantities, first Q^D

$$\begin{aligned} Q^D &= 1000 - 200P \\ &= 1000 - 200(2) \end{aligned}$$

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How do we find the new equilibrium? Set $Q^{S,new} = Q^D$

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Find equilibrium quantities, first Q^D

$$\begin{aligned} Q^D &= 1000 - 200P \\ &= 1000 - 200(2) \\ &= 600 \end{aligned}$$

Equilibrium: Impact of Shift in Supply

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Then $Q^{S,new}$

$$Q^S = 200P + 200$$

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Then $Q^{S,new}$

$$\begin{aligned} Q^S &= 200P + 200 \\ &= 200(2) + 200 \\ &= 600 \end{aligned}$$

Therefore

- Price falls
- Equilibrium quantity increases

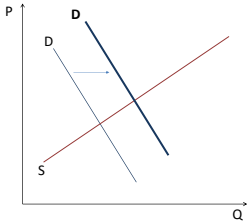
What Can You Conclude About Supply and Demand Changes from Changes in P^* and Q^*?

Deducing Changes to Supply and Demand from Changes in P and Q

- Assume only supply or demand changes
- Suppose that we observe a decrease in the price of coffee
- And suppose that we also observe an increase in the quantity of coffee consumed
- What can we assume happened to supply and demand?
- Work through problem step-by-step with your neighbor

All Four Different Cases: Want $P \downarrow$ and $Q \uparrow$

(a) Demand increases



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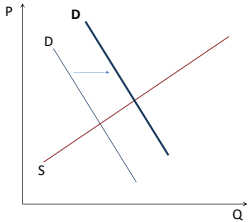
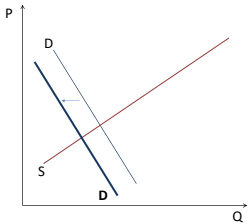


(b) Demand decreases



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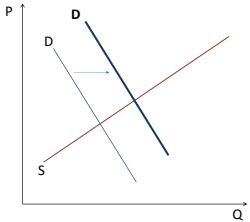

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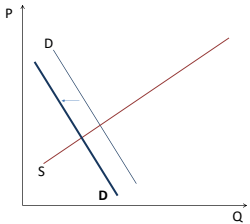
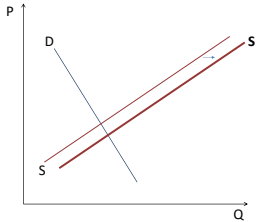


(c) Supply increases



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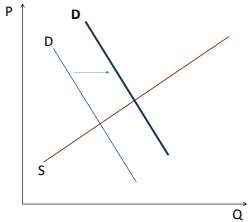

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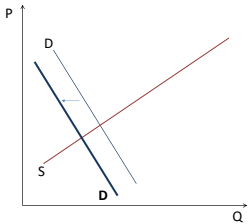

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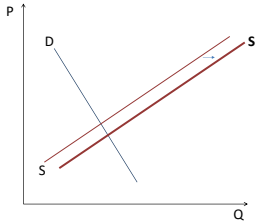
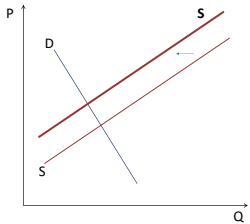


(d) Supply decreases



Deducing Changes to Supply and Demand from Changes in P and Q

Assume only supply or demand changes and that (1) prices decrease and (2) quantity of vanilla increases

- Prices decrease
  - Consistent with decrease in demand
  - Consistent with increase in supply
- Quantity increases
  - Consistent with increase in demand
  - Consistent with increase in supply
- $\rightarrow$ Demand constant, supply increased.

Vanilla: Supply and Demand

Supply and Demand in the Market for Natural Vanilla

1. In the "beginning"
   - no substitutes for natural vanilla
   - creating vanilla is incredibly labor-intensive

Supply and Demand in the Market for Natural Vanilla

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2. And then synthetic vanilla is invented
   - fewer people want natural vanilla

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   - some producers switch to making other things

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4. Then people don't like synthetic vanilla
   - $\rightarrow$ more people want natural vanilla
   - it takes a farmer three years to get a vanilla bean after he decides you want one

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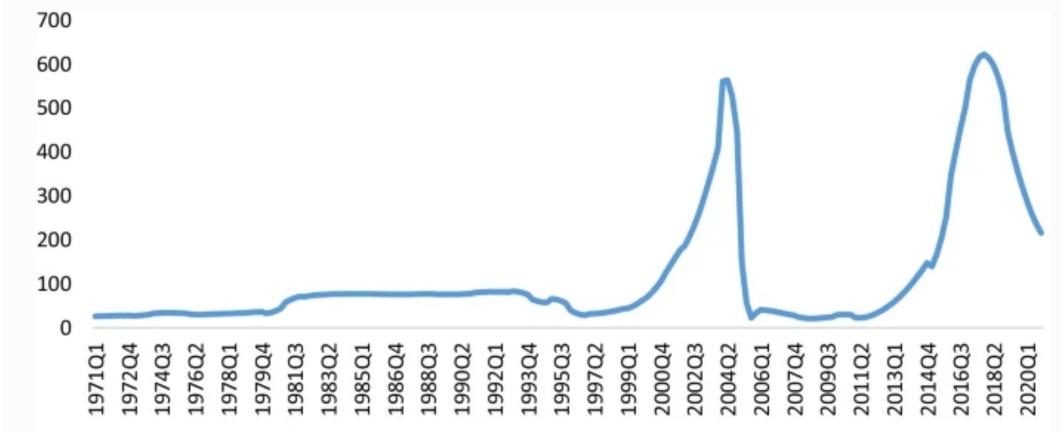
4. Then people don't like synthetic vanilla
   - $\rightarrow$ more people want natural vanilla
   - it takes a farmer three years to get a vanilla bean after he decides you want one
5. Finally, more beans arrive
   - farmers are finally able to make more
   - see here (July 2020) and here (Dec 2019)

"The Best Remedy for High Prices is High Prices"



Kahn et al, "Are there bubbles in the vanilla market?" *Agricultural and Food Economics*, 2022. [article]

Demand Curves Are Not Linear

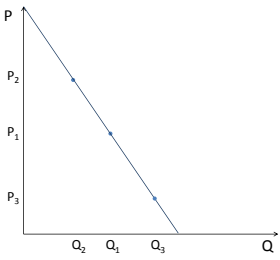
Demand Curves are Not Linear

1. What do we mean by linear?
2. Implications of linear curve
3. Building a non-linear curve
4. Example of why the shape matters

What Do We Mean By Linear?

- A linear function can be written as $y = mx + b$
- If b is zero ($y = mx$), then a 5-unit change in $x \rightarrow 5*m$-unit change in y
- If b is not zero, this isn't exactly true. However, the slope is always the same everywhere

Implications of a Linear Demand Curve



- There is a price sufficiently high that no one wants to consume the good
- At a price of zero, there is a finite quantity demanded
- Implies that many small changes in price always have the same impact as an equivalent large change in price
- This may be quite wrong

Where a Demand Curve Comes From

Thanks to Hal Varian's textbook

Let's assume we're interested in the market for apartments in a medium-sized college town. Further assume that

- there are two types of apartments: near and far from university
- near apartments are better
- if you don't get an apartment near, you can get one far at a known fixed price
- all apartments are identical
- each person wants only one apartment

We are interested in the price of the near apartments.

Putting Together a Demand Curve

- Reservation price is the "maximum willingness to pay for something"
- What is the highest reservation price of anyone in this market? $\rightarrow$ this is the top of the demand curve
- As we lower the price one dollar, how many additional people want an apartment? This is Q
- Another dollar? This is the next (Q, P) on the curve

Putting Together a Demand Curve: In Pictures

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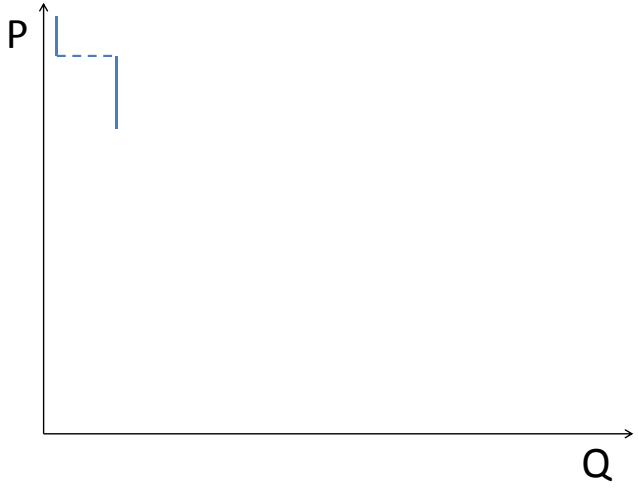

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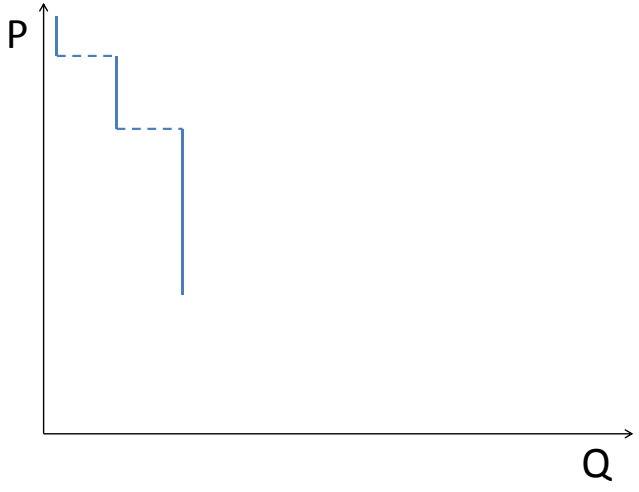

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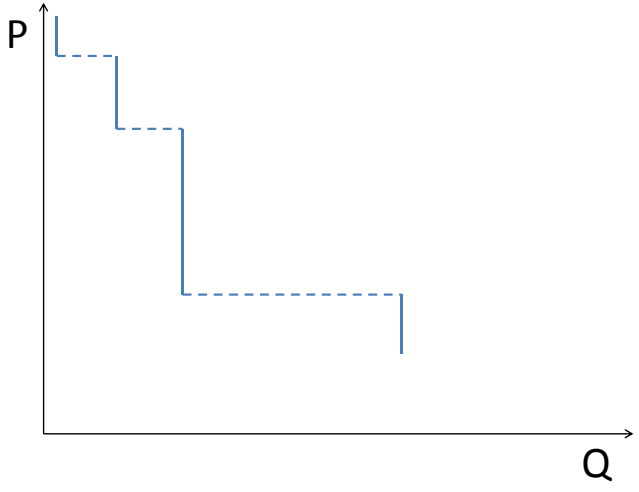

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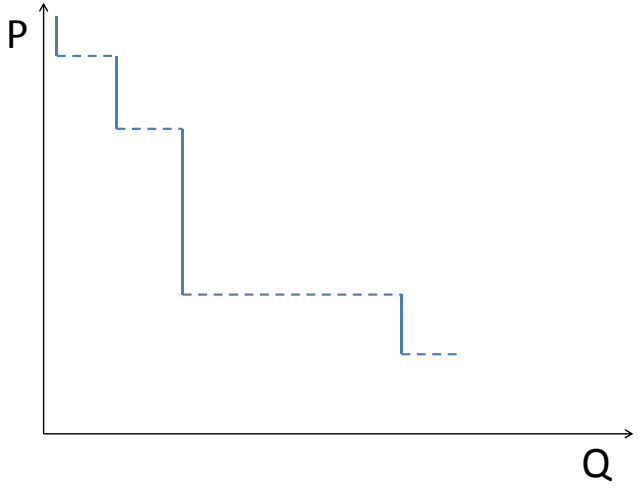

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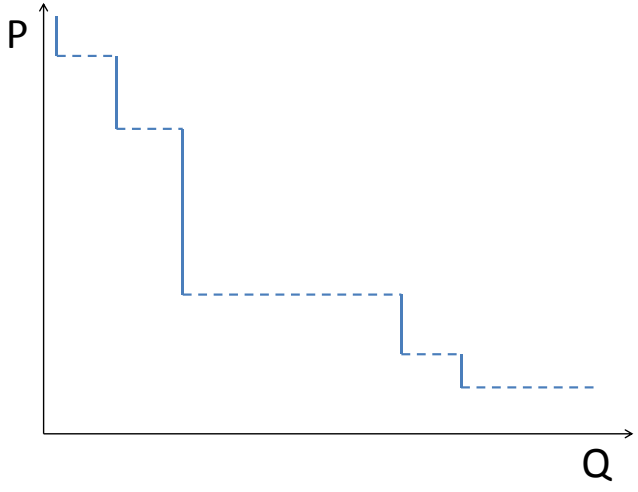
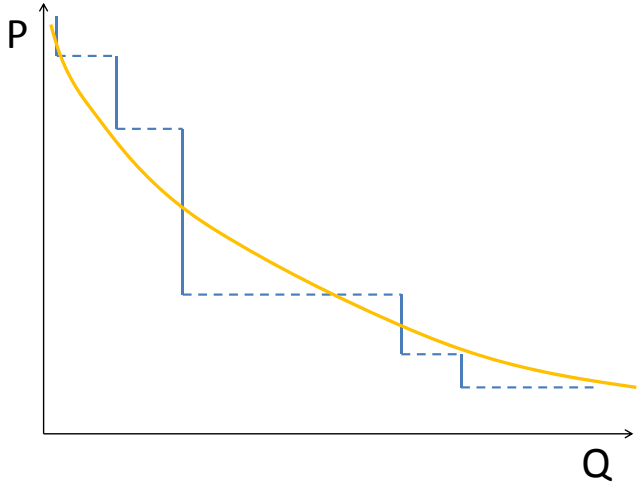


With Many Steps, Imagine a Curve



Why Do We Care About the Shape of This Curve?

- Hold on a few minutes
- Elasticity determines shape of the curve
- Elasticity determines how consumers respond to policy movements

Defining Elasticity

Small Math Aside: Absolute Value

- "How far a number is from zero"
- We write $|a|$ – the vertical bars are the absolute value sign

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- Absolutely crucial for policy decisions
- Formally, percentage change in one value relative to percentage change in another

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- Absolutely crucial for policy decisions
- Formally, percentage change in one value relative to percentage change in another
- In math, elasticity is

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

- Δ is capital Greek letter delta, denoting change

Price Elasticity of Demand

- How responsive are consumers to a change in price?

$$E_D = \frac{\%\Delta Q_D}{\%\Delta P}$$

- Is $E_D > 0$? or ≤ 0?

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- The larger the number of substitutes,

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- If the number of substitutes for this product is large, what does this mean for $|E_D|$?
- The larger the number of substitutes, the more consumers can choose a different product when price increase
- More substitutes $\rightarrow$ bigger $|E_D|$

Price Elasticity of Supply

- How responsive are producers to a change in price?

$$E_S = \frac{\%\Delta Q_S}{\%\Delta P}$$

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- Is $E_S > 0$? or < 0? $E_S > 0$
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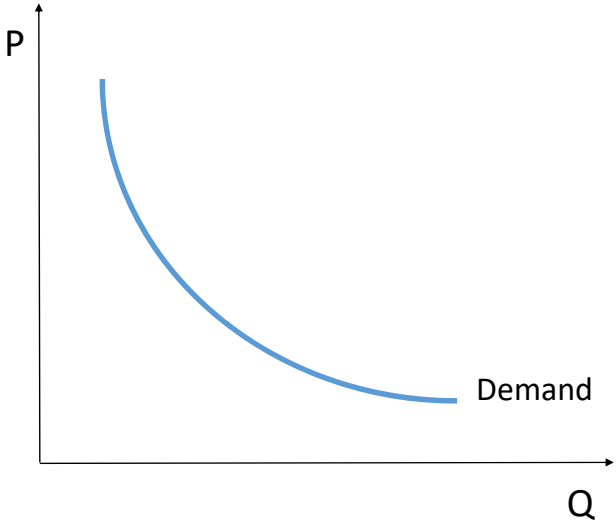
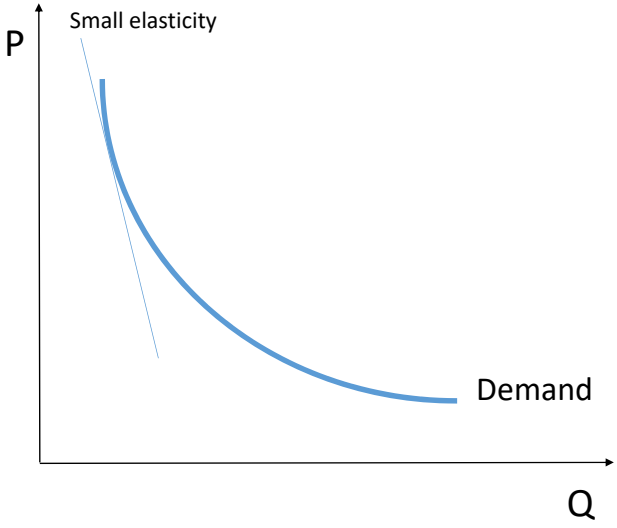
- The more easily the producer can decrease production, the larger $|E_S|$

Elasticity with Non-Linear Demand Curves



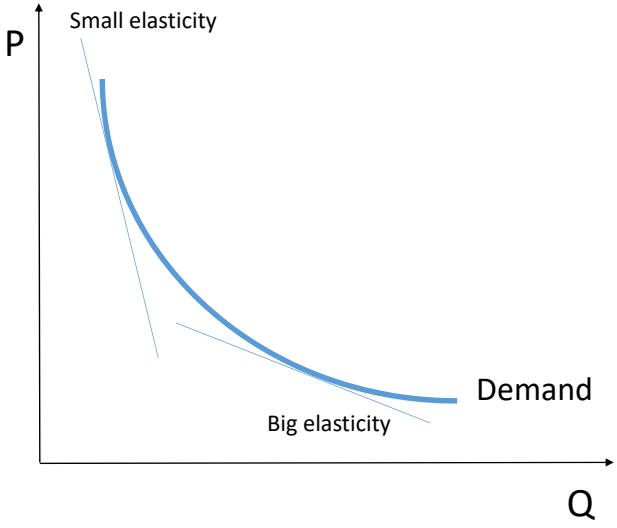
A non-linear demand curve

For Non-Linear Demand Curves, Elasticity is the Slope



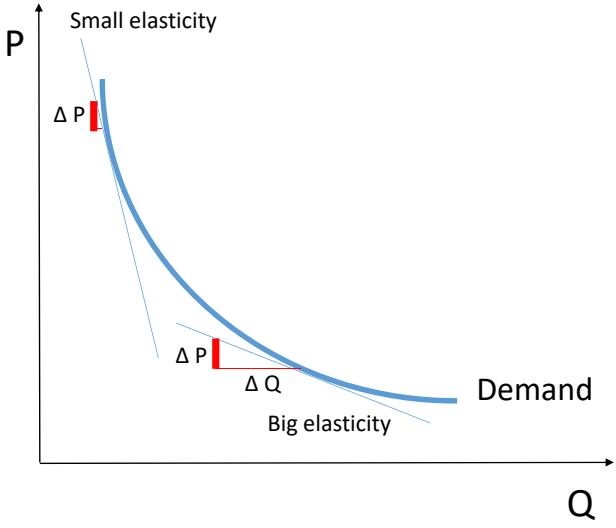
When prices are high, demand is relatively inelastic, or smaller in absolute value

For Non-Linear Demand Curves, Elasticity is the Slope



When prices are low, demand is more elastic, or larger in absolute value

For Non-Linear Demand Curves, Elasticity is the Slope



The more vertical line gives a smaller change in quantity for the same change in price

For Linear Demand Curves, Elasticity is **Not Exactly** the Slope

- But we won't pay too much attention to this oddity
- And we won't worry about the particular formula for linear demand curves

Calculating Changes from Elasticity

A problem to work on with your neighbor

- Suppose that the price elasticity of demand for peaches is -0.82
- Recall that

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

- If the price of peaches increases by 5%, how much does the quantity of peaches consumed change?
- If the quantity of peaches consumed increases by 5%, by how much has the price of peaches changed?

Working Through an Elasticity Calculation

If the price of peaches increases by 5%, how much does total peach consumption change?

$$E_D = -0.82$$

$$E_D = \frac{\%\Delta Q}{\%\Delta P}$$

Working Through an Elasticity Calculation

If the price of peaches increases by 5%, how much does total peach consumption change?

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\begin{aligned}
E_D &= -0.82 \\
E_D &= \frac{\%\Delta Q}{\%\Delta P} \\
-0.82 &= \frac{\%\Delta Q}{5}
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Therefore

$$\%\Delta Q = -0.82 * 5 = -4.1$$

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Therefore

$$\%\Delta P = \frac{5}{-0.82} = -6$$

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Drawing Perfectly Inelastic and Perfectly Elastic Demand and Supply

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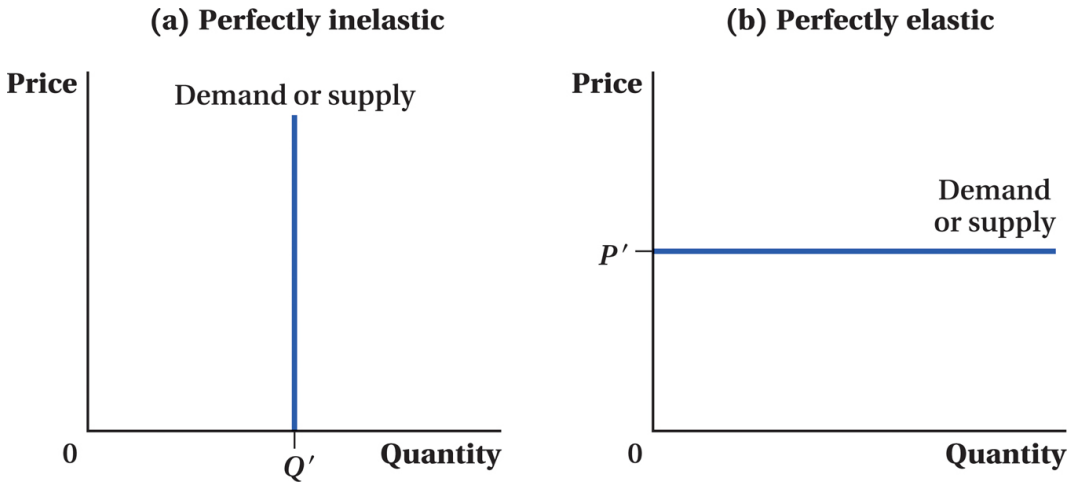

Time Horizon Matters for Elasticity

- Over short time horizons, the behavior of people and firms can be pretty inelastic
- In the long run, everything is elastic

Elasticity and Policy

Impacts from Demand-Side Incentives

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$25k to first-time homebuyers

- From Harris campaign
- (paired with subsidies to housing suppliers)

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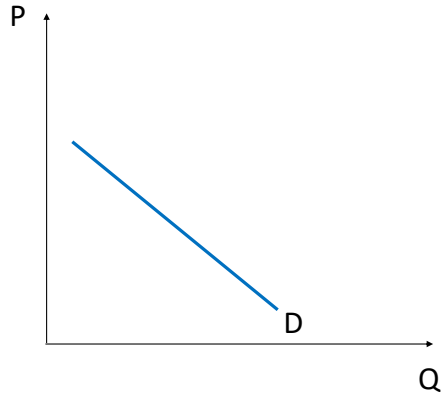

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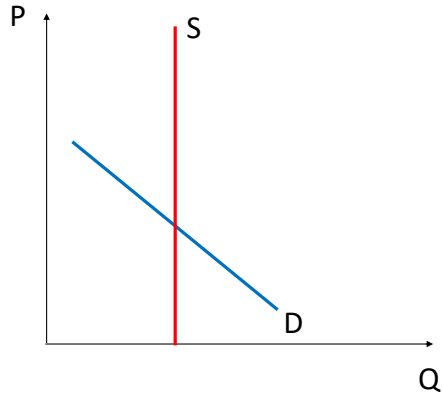

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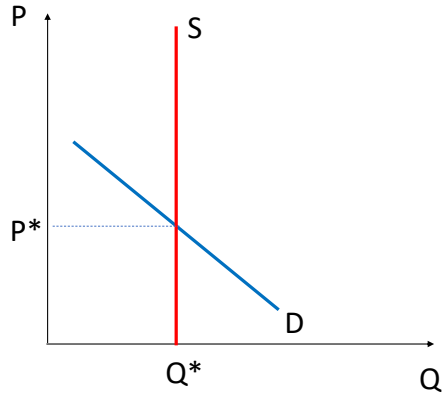

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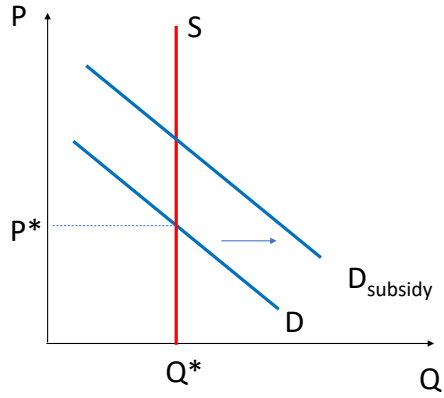

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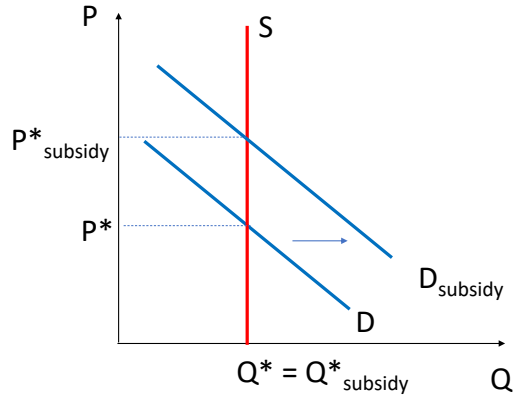

Next Class

- GLS, Chapter 3, but not 3.4 or 3.5
- Problem Set 2 is due
- Use Numbers 1 of 2 is due
- Bring your Use Numbers 1 of 2 answers for class discussion
- Send Ripped from Headlines by Wed. midnight