SPEA-V-202

Contemporary Economic Issues in Public Affairs

Demand Curve

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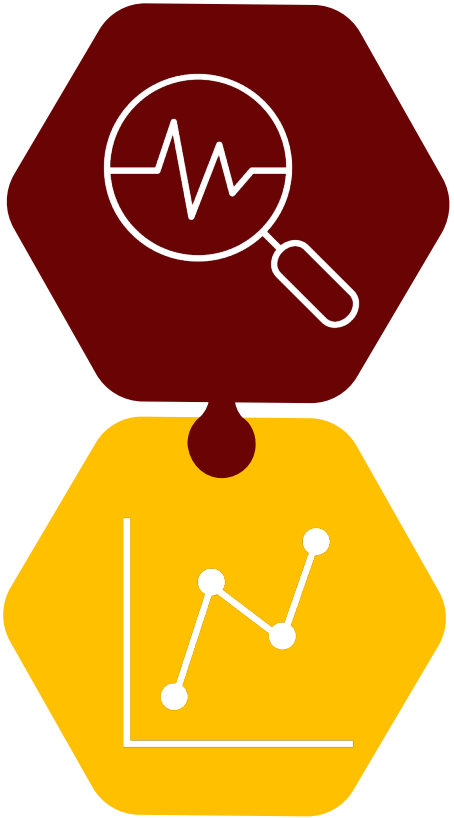
Outline for Today



Consumer Theory and the Demand Curve

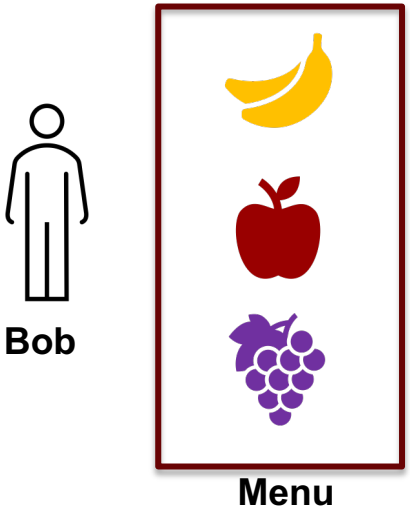
- Basics of decision-making.
- Choice problems.
- Demand functions.

Properties of Demand Functions

- Law of Demand
- Willingness to pay
- Consumer Surplus
- Shifts in Demand
- Elasticities

Consumer Theory

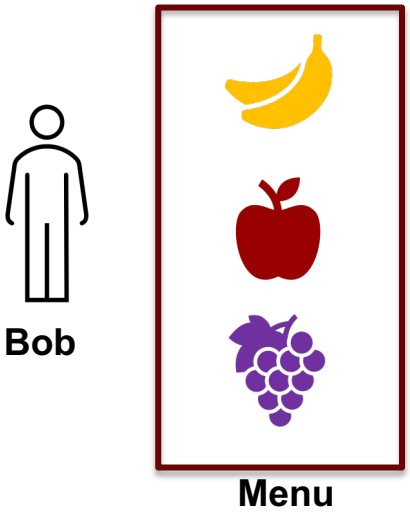
People make decisions all the time. Life is all about decisions. Meet Bob.



- Every decision has two components: a decision-maker, and a menu of alternatives from which he chooses.
- In most cases, decision-makers can rank the alternatives according to their preferences.
- For example, Bob prefers bananas over apples and grapes.
- **Choice Problem:** which fruit will Bob choose from this menu?
- **Economic Rationality:** Bob will choose his favorite alternative. The top of his ranking: bananas.

Consumer Theory

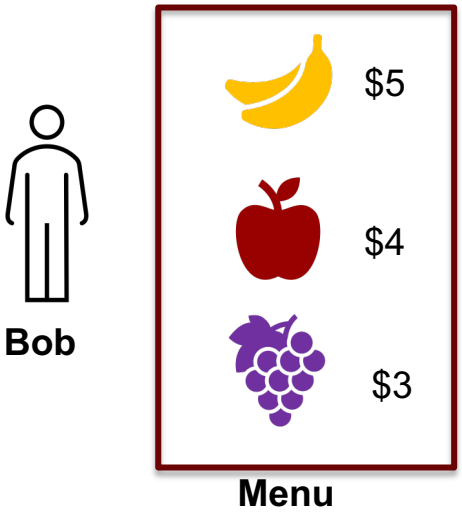
Scarcity adds constraints to decision-making.



- Most decisions are not that simple. There are some limits.
- Scarce resources from your daily life: time and money.
- **Budget:** How much can Bob spend buying fruit?
- **Time:** How many hours does Bob allocate to each activity in his life (e.g. working, studying)?
- With the budget constraint, now Bob also needs to look at the prices from the menu.

Consumer Theory

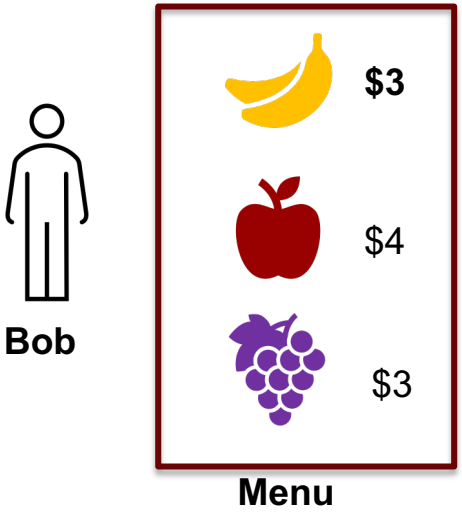
Bob's choice problem now is slightly different.



- **Choice Problem:** choose your preferred alternative subject to your budget constraint.
- **Economic Rationality:** Bob will choose his favorite alternative from the part of the menu that he affords.
- Suppose Bob only has $4 to buy fruit.
- While he prefers bananas, now he can't afford them.
- **If he is economic-rational, he will buy apples.**

Consumer Theory

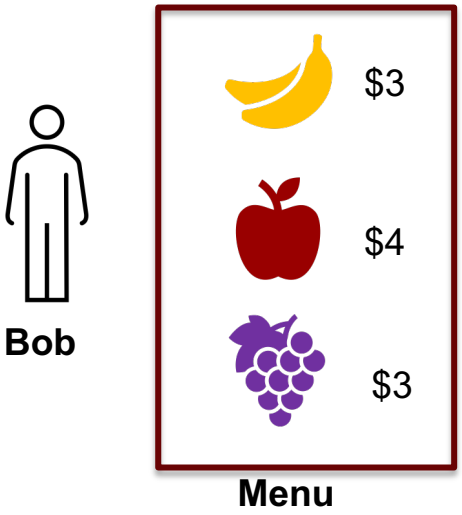
Changes in the environment can modify human behavior.



- Suppose the price of bananas decreases to $3.
- For example, there is a subsidy for banana production or new technology that improves banana production.
- Bob reacts to this change in the menu. Now he can buy his preferred alternative.
- **If he is economic-rational, he will buy bananas.**

Consumer Theory

In real life, we cannot observe people's preferences. We can't look inside their minds.



- If we assume individuals are rational and react to price changes, then we can make inferences about their preferences.
- Recall Bob's example: when bananas were $5, he chose apples over grapes and bananas. From that we know that he prefers apples over grapes.
- When the price of bananas dropped, he chose bananas over apples and grapes.
- His behavior **reveals** his preferences.

Demand Curve

- If we assume people behave like Bob (i.e. maximizing their preferences subject to their budget constraint), we can describe such preferences through a **demand curve** or **demand function.**

- This function reflects Bob's:

  1. **Willingness to buy:** he derives benefits (utility) from consuming the good.

  2. **Ability to buy:** the amount he buys is within his budget constraint.

- **Law of Demand:** the higher the price, the lower the quantity demanded.

  - *Caeteris Paribus:* as the good gets more expensive, you are less likely to buy it.

  - **Key implication:** the inverse demand function is negatively sloped.

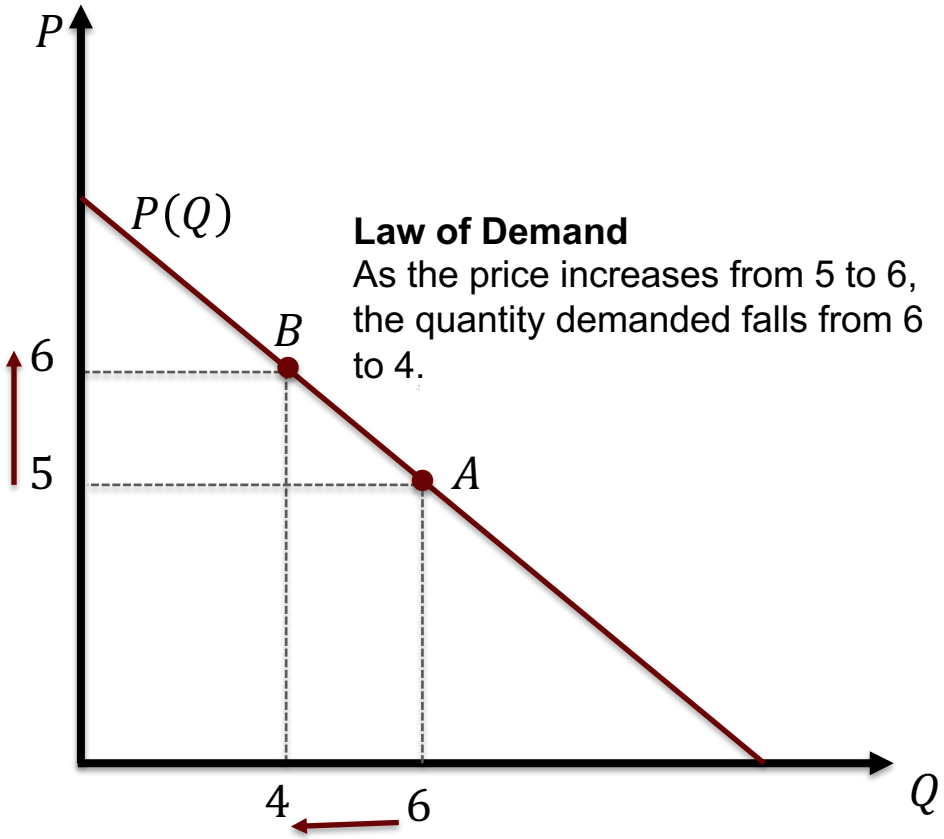
Demand Curve

- Economic theory: price determines quantity demanded and consumed.

$$Q_d(P)$$

- However, supply and demand diagrams always show prices (independent variable) on the y-axis and quantities (dependent variable) on the x-axis.
- Contrary to what you are used to do in math.
- Historical convention thanks to Alfred Marshall.
- **Key Takeaway:** supply and demand diagrams **always** show inverse demand functions.

$$P(Q)$$



Law of Demand
As the price increases from 5 to 6, the quantity demanded falls from 6 to 4.

Demand as Function

- We can write the demand for some good x (e.g. bananas) as function Q that depends on the price P of (bananas).

$$Q(P) = a - bP$$

- The demand function represents the **quantity Q** you are willing and able to buy at any given **price P.**

- The **inverse demand function** is to write **prices** as a function of **quantities.**

$$P(Q) = c - dQ$$

- If you know demand function, you can get the inverse demand function just by rearranging terms.

Demand as Function

- **Example:** suppose Bob's demand for bananas is given by:

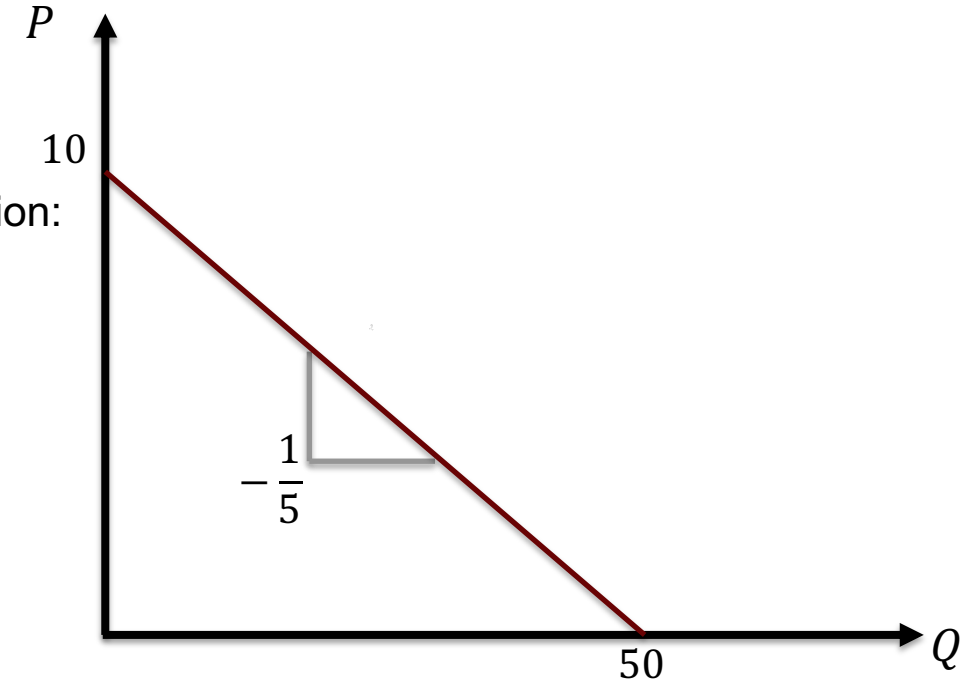
$$Q(P) = 50 - 5P$$

- Just need to do some algebraic manipulation:

$$Q - 50 = -5P$$

$$-\frac{Q - 50}{5} = P$$

$$P = 10 - \frac{1}{5}Q$$

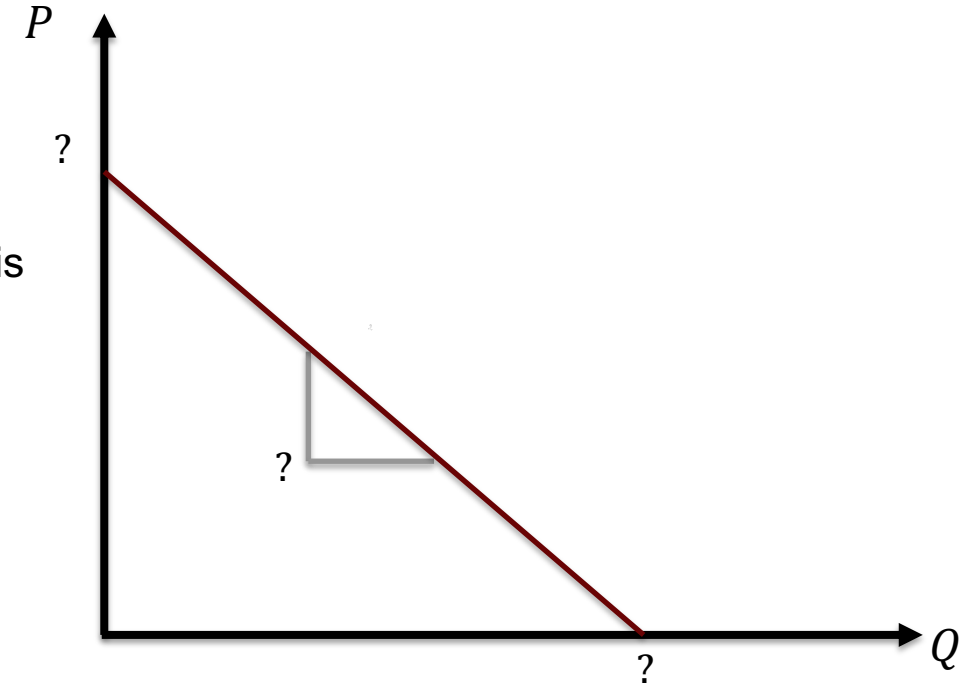


Demand as Function

- **Class Activity**: suppose Bob's demand function for bananas is given by

$$Q(P) = 10 - 3P$$

- Write its inverse demand function and plot its graph. Identify the intercepts in both axis and the slope.



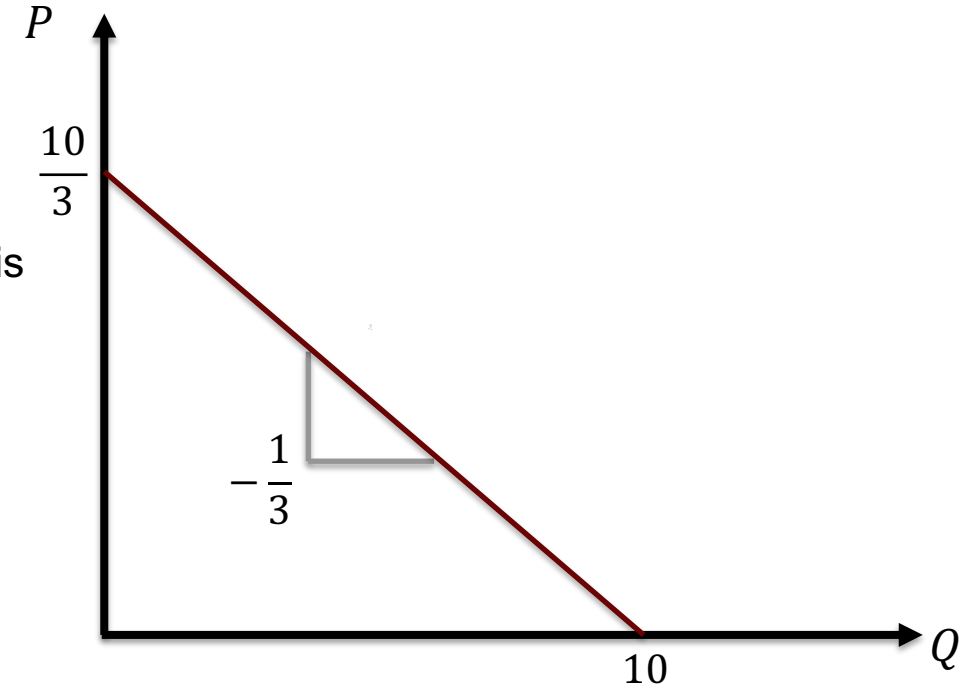
Demand as Function

- **Answer**: suppose Bob's demand function for bananas is given by

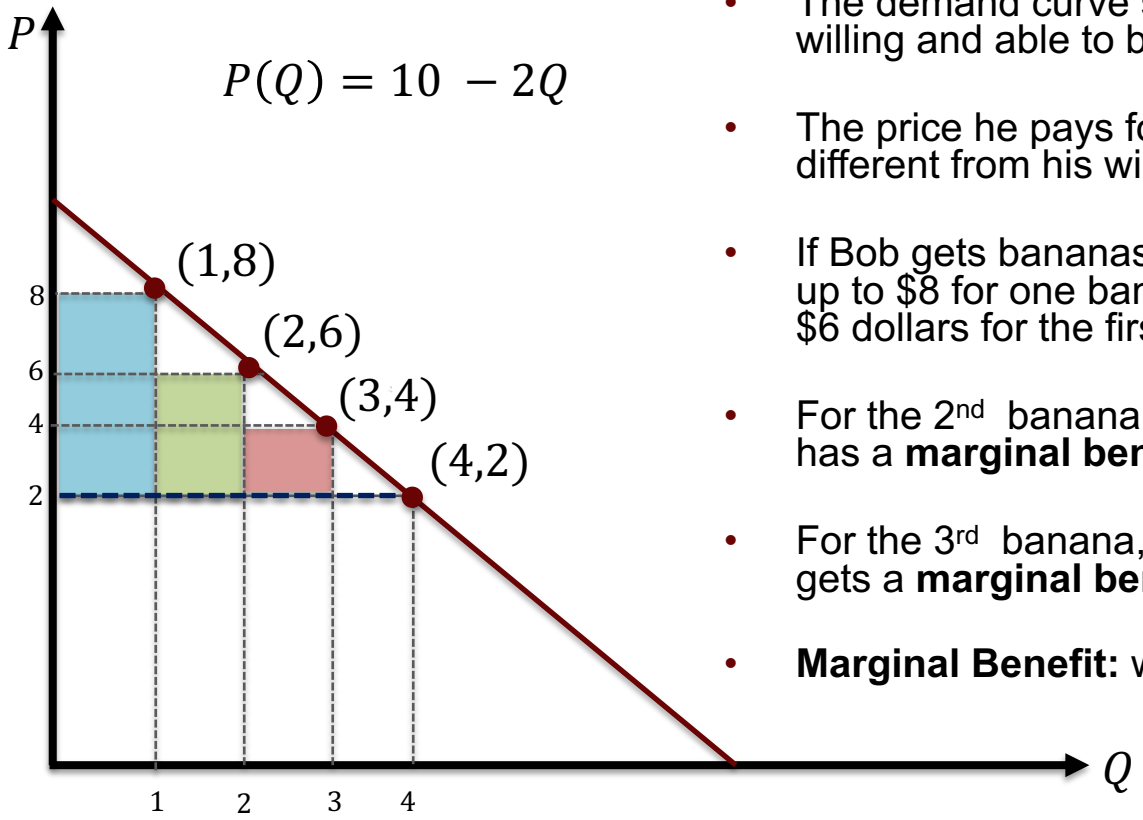
$$Q(P) = 10 - 3P$$

- Write its inverse demand function and plot its graph. Identify the intercepts in both axis and the slope.

$$P(Q) = \frac{10}{3} - \frac{1}{3}Q$$

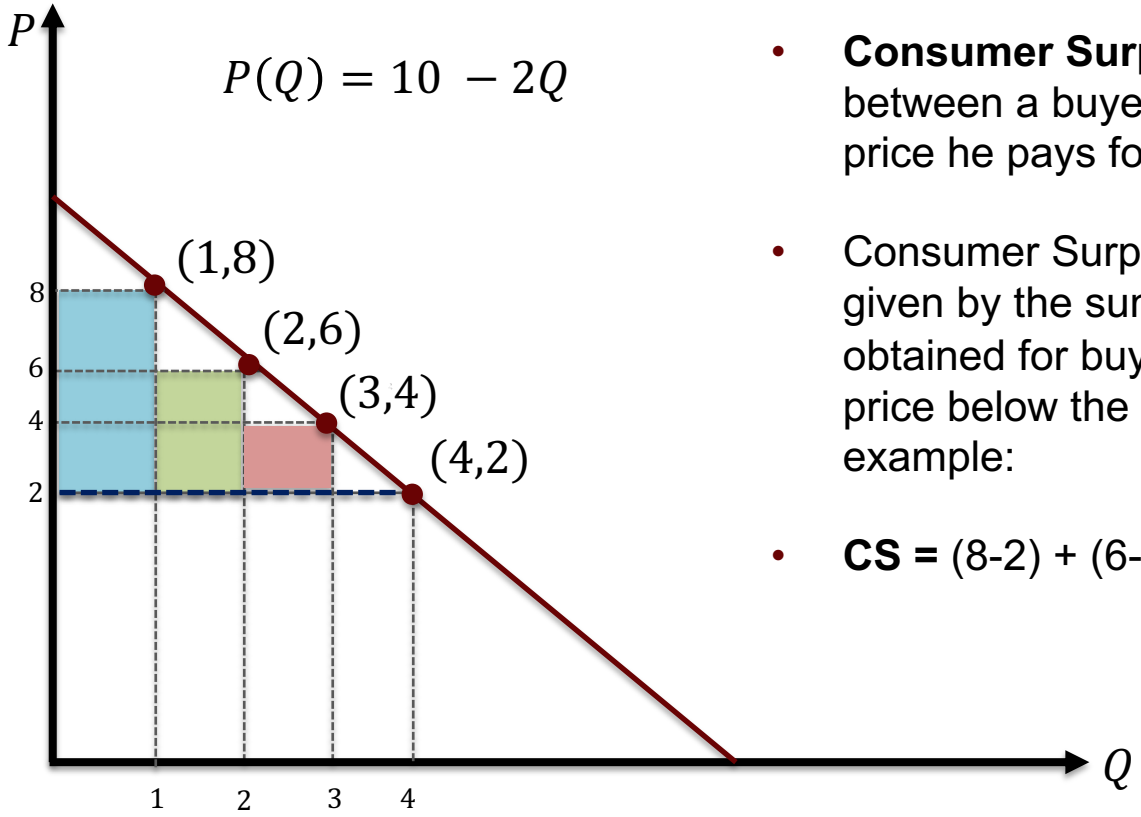


Willingness to Buy



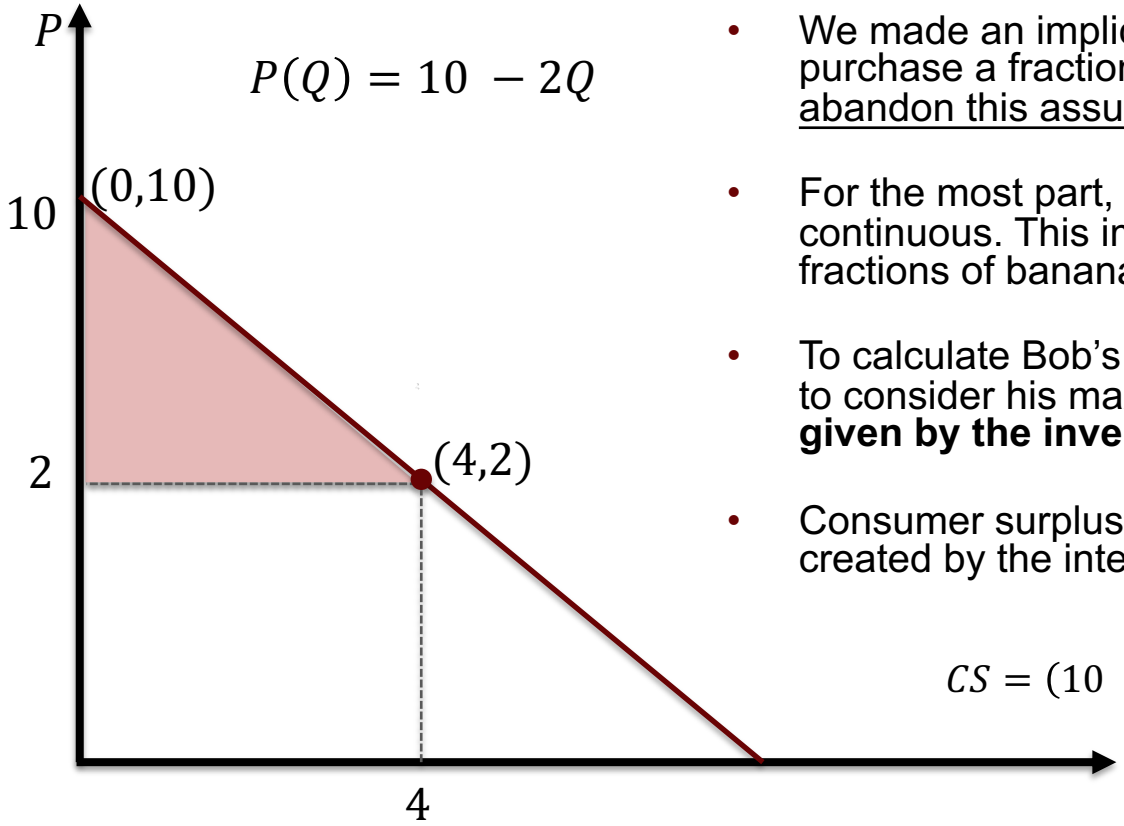
- The demand curve shows all the points at which Bob is willing and able to buy.
- The price he pays for one unit, however, might be different from his willingness to buy such unit.
- If Bob gets bananas at $2 each, but he is willing to pay up to $8 for one banana, he has a **marginal benefit** of $6 dollars for the first banana.
- For the 2nd banana, he is willing to pay up to $6, so he has a **marginal benefit** of $4 for the 2nd unit.
- For the 3rd banana, he is willing to pay up to $4, so he gets a **marginal benefit** of $2 for that third unit.
- **Marginal Benefit:** willingness to pay.

Consumer Surplus: Intuition



- **Consumer Surplus (CS):** the difference between a buyer's willingness to pay and the price he pays for a good.
- Consumer Surplus of buying 4 bananas is given by the sum of the marginal benefits obtained for buy each additional banana at price below the willingness to pay. In our example:
- **CS =** (8-2) + (6-2) + (4-2) + (2-2) = 12

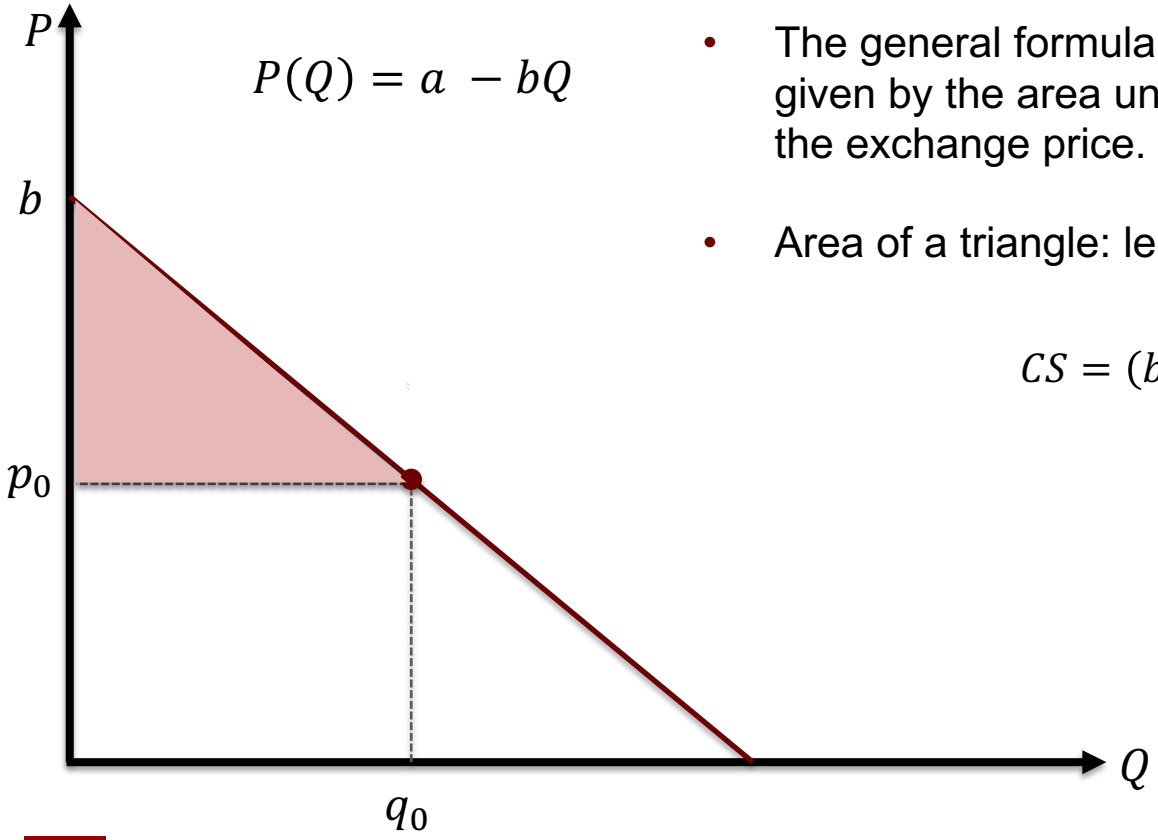
Consumer Surplus: Exact Measure



- We made an implicit assumption before: Bob cannot purchase a fraction of the banana. In general, we will abandon this assumption.
- For the most part, we will assume that demand is continuous. This implies that Bob can purchase small fractions of bananas.
- To calculate Bob's exact consumer surplus we need to consider his maximum willingness to pay, **which is given by the inverse demand's intercept!**
- Consumer surplus is given by the area of the triangle created by the intercept and the amount consumed.

$$CS = (10 - 2) \times 4 \times \frac{1}{2} = 8 \times 2 = 16$$

Consumer Surplus: Exact Measure



- The general formula of the Consumer Surplus is given by the area under the demand curve, above the exchange price.
- Area of a triangle: length times width divided by 2.

$$CS = (b - p_0) \times q_0 \times \frac{1}{2}$$

Individual Demand vs Market Demand

So far, we have only studied Bob's demand curve for bananas. But there are other consumers that like bananas too. To study the complete market, we need to sum everyone's demand. For simplicity suppose there are only two individuals in our economy: **Bob and Sandy**.

- The market demand curve is the **horizontal sum of individual demands**.
- Like in the individual case, it represents the **market's willingness to pay**.
- If the two individuals have different preferences/tastes, then their demand curve's slopes (elasticity) might differ, and the market demand curve might have some kinks.
- Still, it will satisfy the Law of Demand.

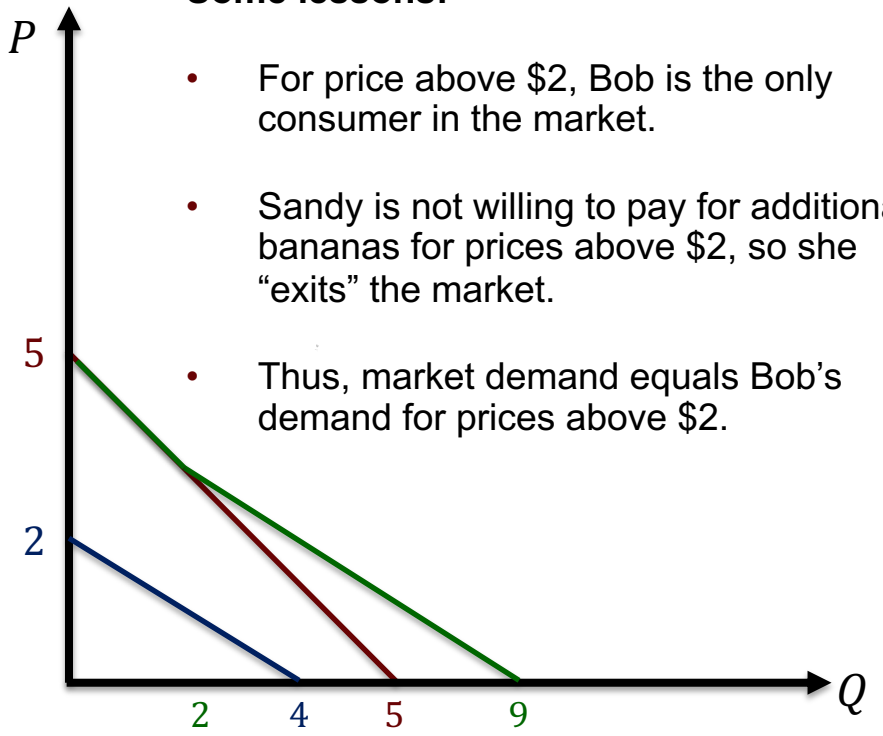
Individual Demand vs Market Demand

Example: Market demand for bananas.

$Q_B(P) = 5 - P$ $\quad$ $Q_S(P) = 4 - 2P$

WTP/Quantity Demanded by:

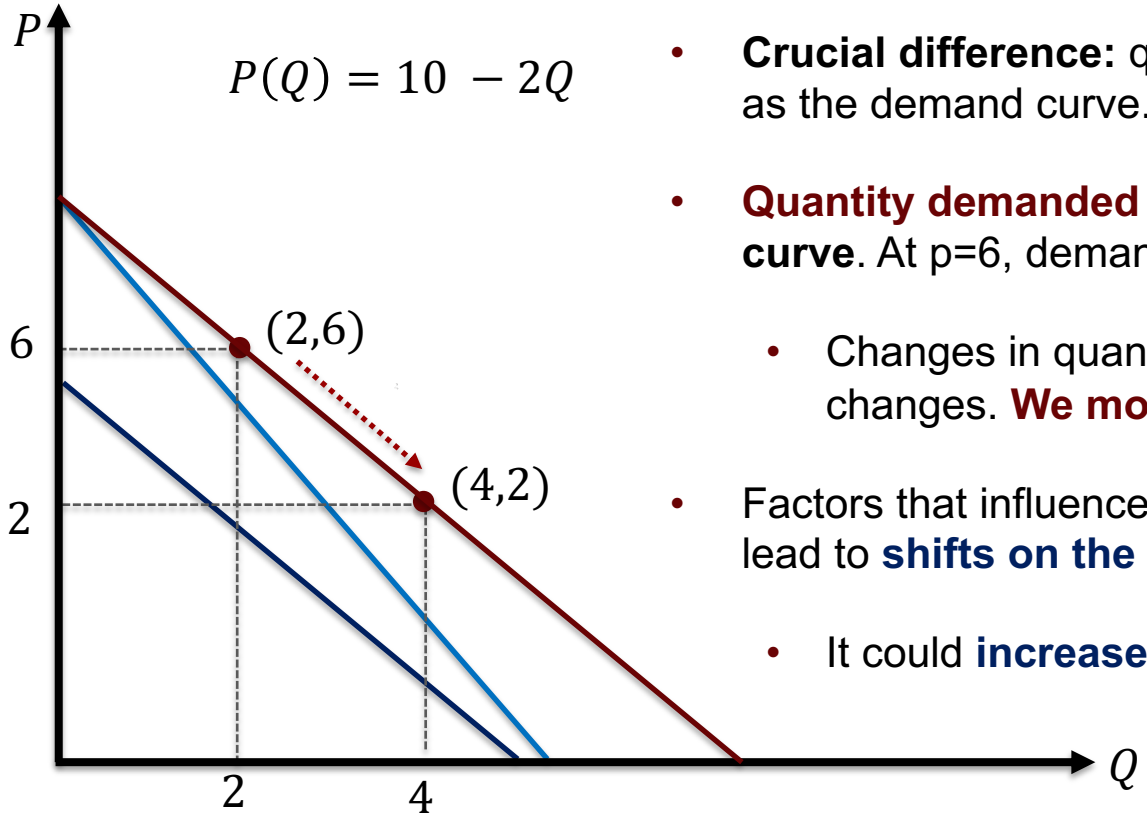
Price	Bob	Sandy	Market
0	5	4	9
1	4	2	6
2	3	0	3
3	2	-	2
4	1	-	1
5	0	-	0



Some lessons:

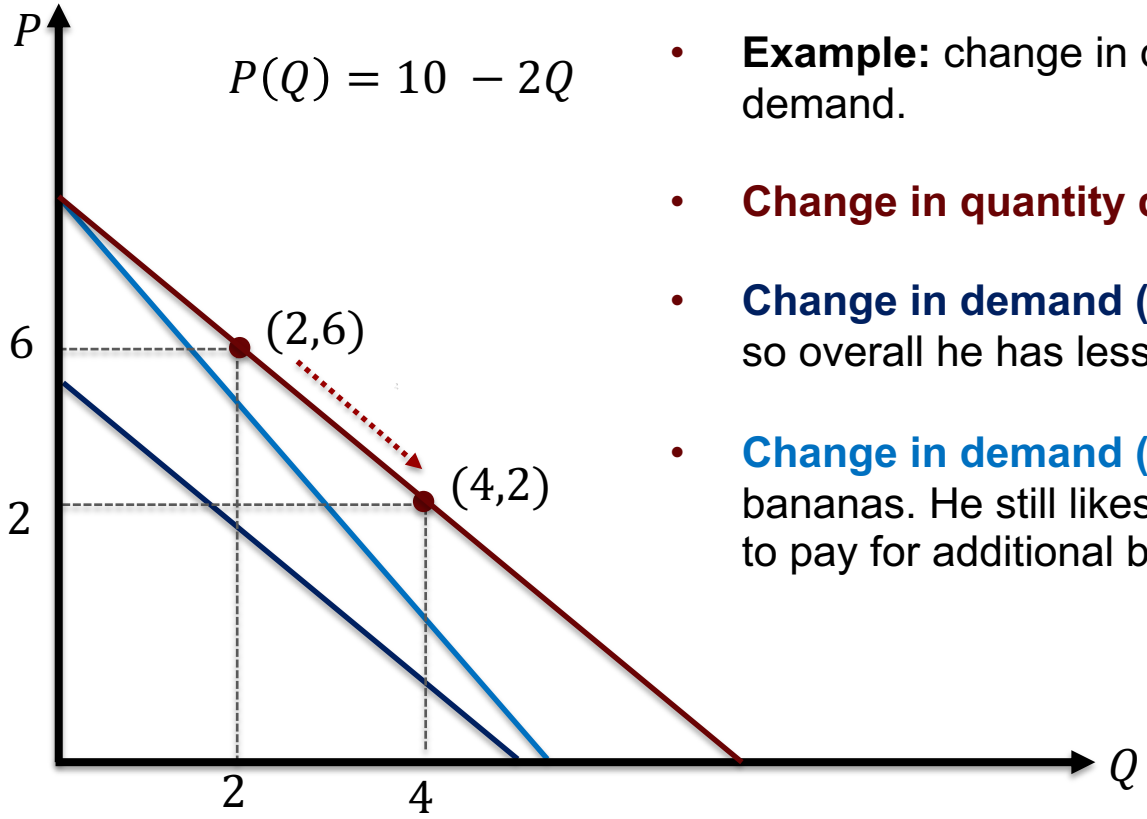
- For price above $2, Bob is the only consumer in the market.
- Sandy is not willing to pay for additional bananas for prices above $2, so she "exits" the market.
- Thus, market demand equals Bob's demand for prices above $2.

Change in Demand vs Change in Quantity Demanded



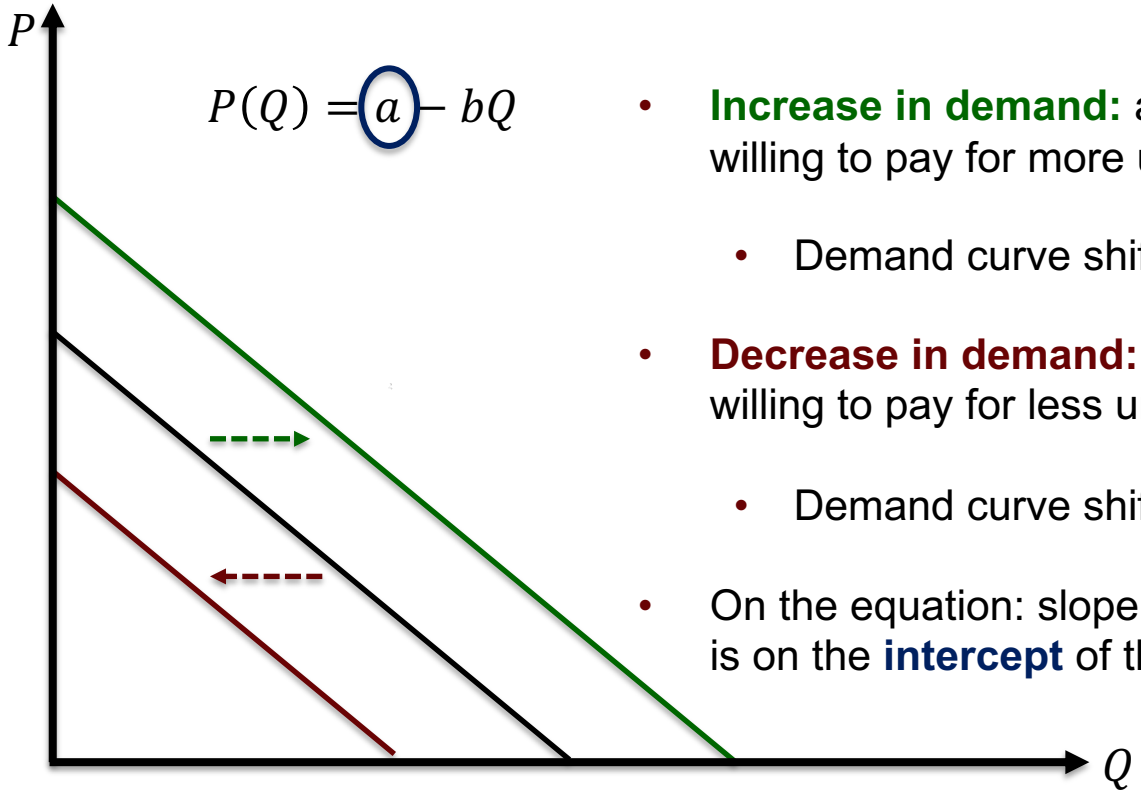
- **Crucial difference:** quantity demanded is not the same as the demand curve.
- **Quantity demanded** refers to points **on the demand curve**. At p=6, demand for bananas equals q = 2.
  - Changes in quantity demanded occur upon price changes. **We move along the curve**.
- Factors that influence individual's willingness to pay lead to **shifts on the demand curve.**
  - It could **increase/decrease** or **pivot**.

Change in Demand vs Change in Quantity Demanded



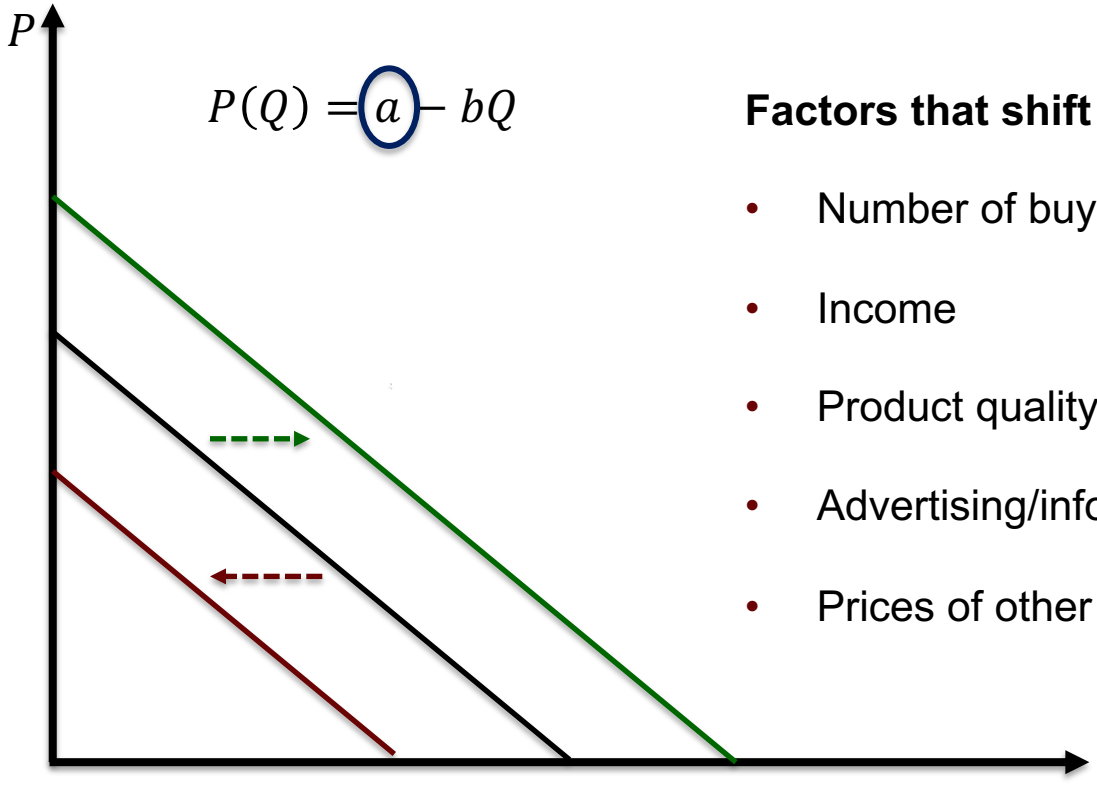
- **Example:** change in quantity demanded vs change in demand.
- **Change in quantity demanded:** price of bananas fall.
- **Change in demand (shift):** Bob's income decreased, so overall he has less money to spend.
- **Change in demand (pivot):** Bob became allergic to bananas. He still likes them a lot, but now is less willing to pay for additional bananas.

Shifts in Demand



- **Increase in demand:** at all prices, consumers are willing to pay for more units.
  - Demand curve shifts to the **right**.
- **Decrease in demand:** at all prices, consumers are willing to pay for less units.
  - Demand curve shifts to the **left**.
- On the equation: slope remains the same, the change is on the **intercept** of the inverse demand function.

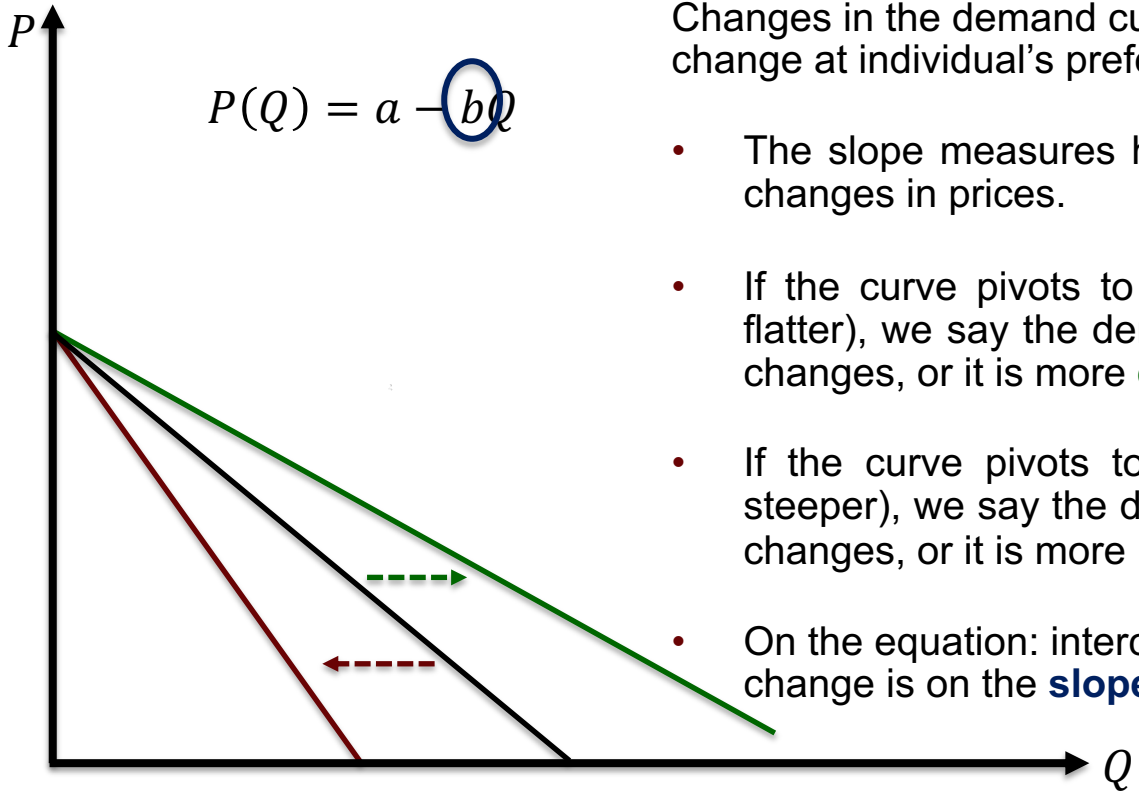
Shifts in Demand



Factors that shift the demand curve:

- Number of buyers/population.
- Income
- Product quality.
- Advertising/information.
- Prices of other goods.

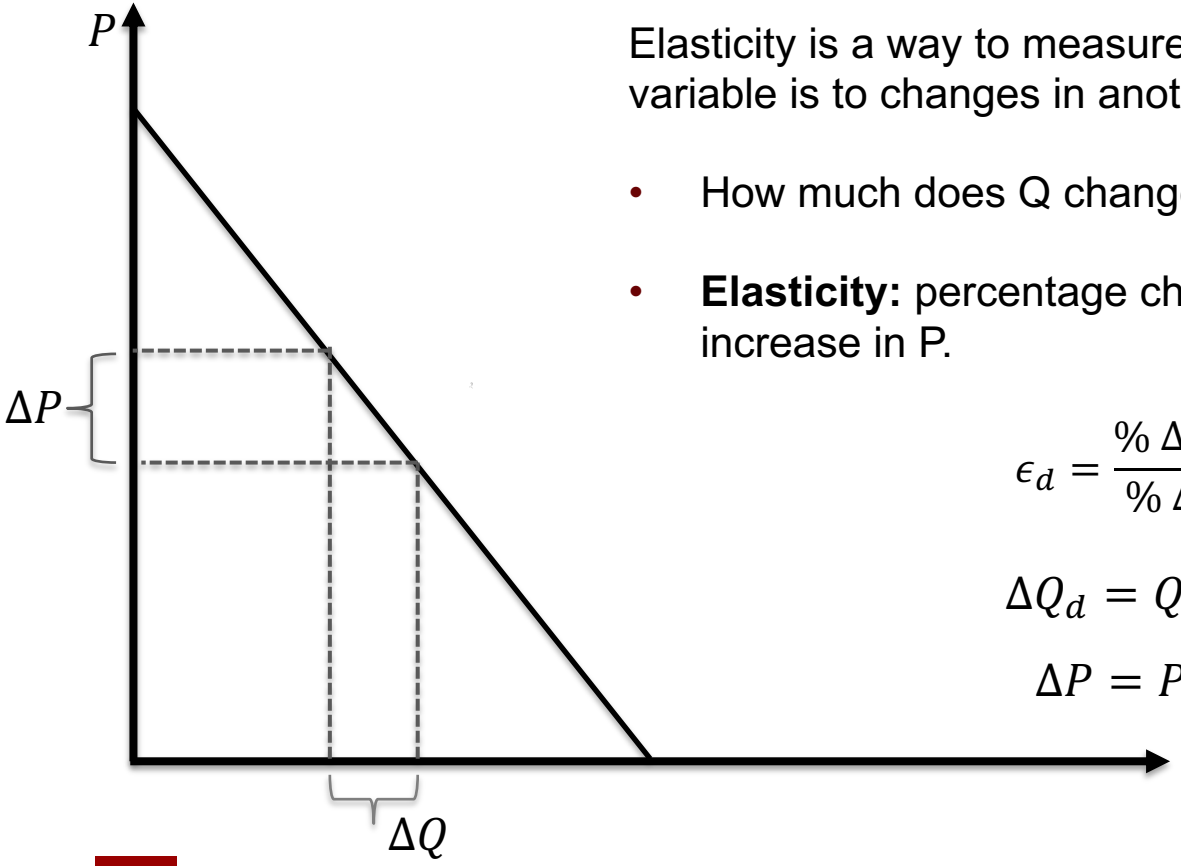
Shifts in Demand: Slope and Elasticity



Changes in the demand curve's slope occur when there is a change at individual's preferences.

- The slope measures how responsive are individuals to changes in prices.
- If the curve pivots to the **right** (i.e. the line becomes flatter), we say the demand is more responsive to price changes, or it is more **elastic**.
- If the curve pivots to the **left** (i.e. the line becomes steeper), we say the demand is less responsive to price changes, or it is more **inelastic**.
- On the equation: intercept remains the same, the change is on the **slope** of the inverse demand function.

Price Elasticity of Demand



Elasticity is a way to measure how sensitive or responsive one variable is to changes in another variable.

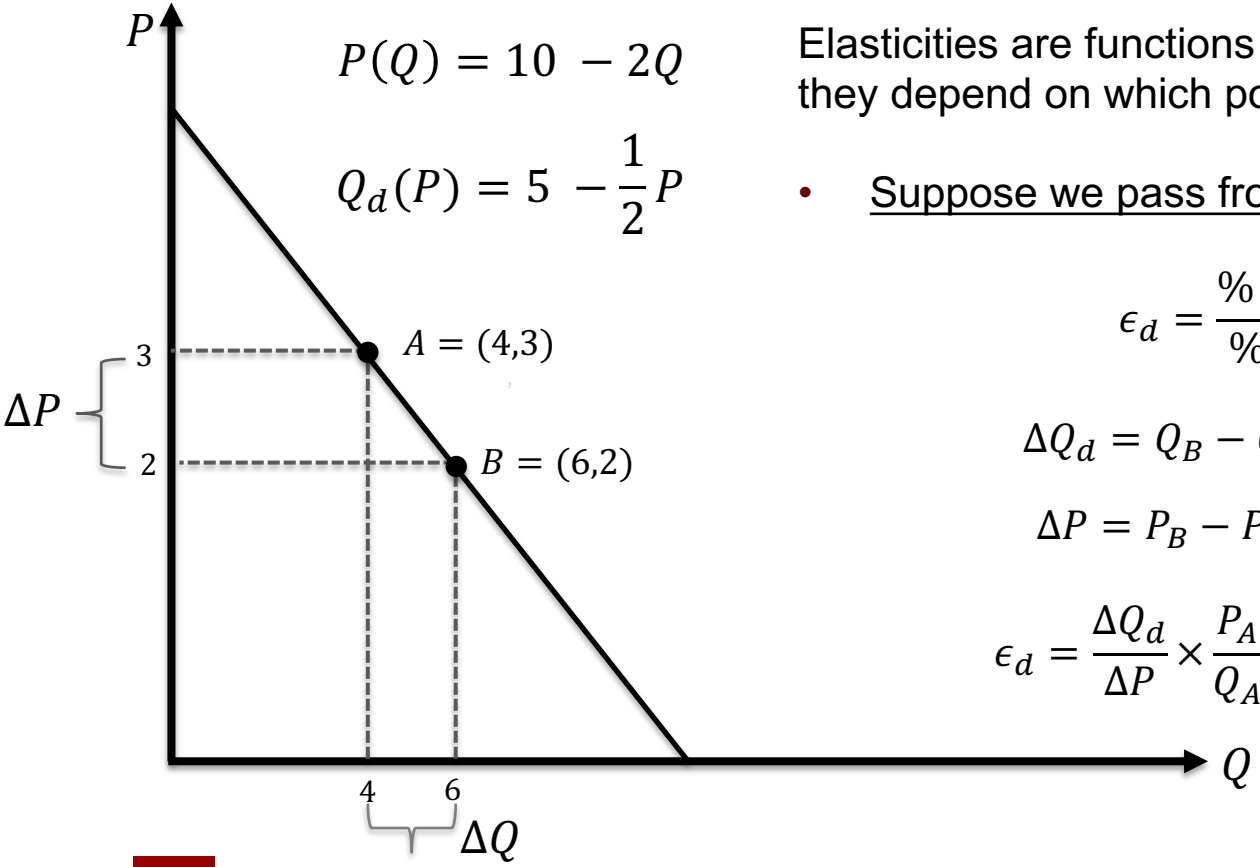
- How much does Q changes, when P changes ?
- **Elasticity:** percentage change in Q upon a one percentage increase in P.

$$\epsilon_d = \frac{\%\,\Delta Q_d}{\%\,\Delta P} = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q}$$

$$\Delta Q_d = Q_{after} - Q_{before}$$

$$\Delta P = P_{after} - P_{before}$$

Price Elasticity of Demand: Example



Elasticities are functions of P and Q. In other words, they depend on which points they are calculated.

- Suppose we pass from point A to B.

$$\epsilon_d = \frac{\%\,\Delta Q_d}{\%\,\Delta P} = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q}$$

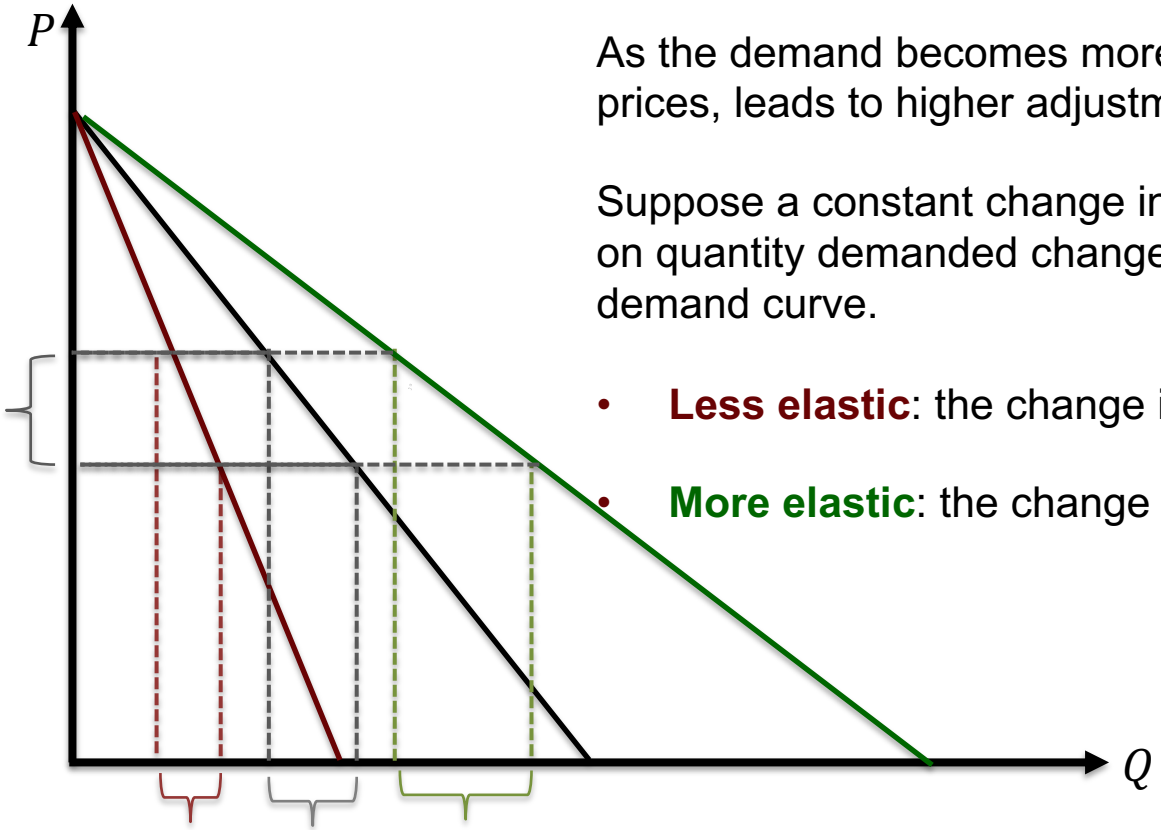
$$\Delta Q_d = Q_B - Q_A = 6 - 4 = 2$$

$$\Delta P = P_B - P_A = 2 - 3 = -1$$

$$\epsilon_d = \frac{\Delta Q_d}{\Delta P} \times \frac{P_A}{Q_A} = -\frac{2}{1} \times \frac{3}{4} = -\frac{3}{2} = -1.5$$

Cool feature
Unit-free comparison

Price Elasticity of Demand and Pivoting the Curve

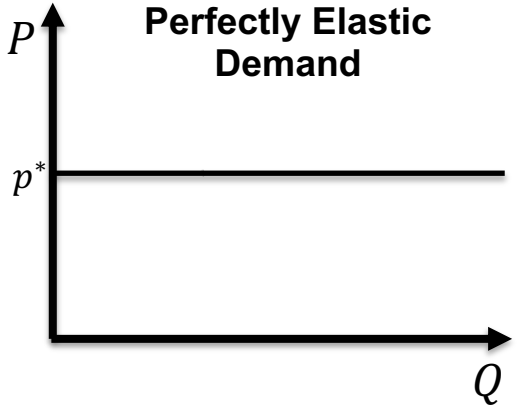


As the demand becomes more elastic, the same change on prices, leads to higher adjustments in the quantity demanded.

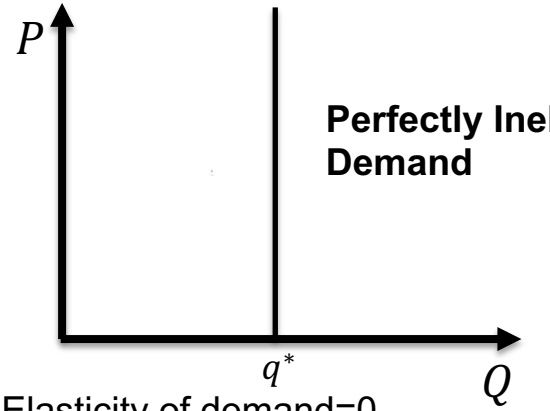
Suppose a constant change in prices. Let's see how the effect on quantity demanded changes across the elasticity of the demand curve.

- **Less elastic**: the change in q is **smaller**.
- **More elastic**: the change in q is **larger**.

Elasticity of Demand: Extreme Cases



- Elasticity of demand=-∞
- Consumers are full responsive to price changes.
- If price rises by any amount, quantity demanded falls to zero. If price falls by any amount, quantity demanded increases without limit.
- Examples: luxury goods.



- Elasticity of demand=0
- Consumers do not respond to price changes
- Quantity demanded is the same at all prices.
- Examples: necessities (e.g. healthcare, water, electricity), sin goods (addictions).

Elasticity of Demand: Some Determinants

Elasticity of demand reflects consumer's responsiveness to price changes. Which factors could influence consumer behavior for this matter?

- Goods on other markets: number of substitutes available in the market. More options imply more elastic demand (i.e. it is easier to change your behavior).
- The opposite is true as well: less options made demand more inelastic (e.g. basic human needs).

Elasticity of Demand: Short vs Long Run

Elasticity of demand reflects consumer's responsiveness to price changes. This also varies across time, and depends on the type of good.

- **In the short run, demand is often less elastic (more inelastic):** price changes are hard to anticipate. Takes time to adjust your consumption behavior.
- Depends on the type of goods: clean water vs iPhones.
- For most goods, **demand is more elastic in the long run**: consumers have more time to adapt consumption behavior; firms have time to develop more products.

Homework: Food for thought.

- What is the relation between the slope of the inverse demand function and the elasticity of demand?

$$P(Q) = a - bQ$$

$$\epsilon_d = \frac{\%\,\Delta Q_d}{\%\,\Delta P} = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q}$$

- Can you write the formula of the elasticity of demand as a function of the slope?

$$\epsilon_d = f(b)??$$

For next class:

- **Next Episode:** the Supply Curve.
- **Readings:** Mankiw Chapters 4 and 5.

SPEA-V-202

Contemporary Economic Issues in Public Affairs

Demand Curve

Luis Navarro

INDIANA UNIVERSITY BLOOMINGTON

Demand as Function

- **General Case:** suppose Bob's demand function is given by the following expression. a, b are different from zero.

$$Q(P) = a - bP$$

- From the Law of Demand we know that b always goes along a negative sign.

- Then, the inverse demand function $P(Q)$ is given by:

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