ELASTICITY OF DEMAND

Economic intuition is often far off the mark. Probably the best example is what to do when a company is losing money.
- Intuition: raise price, so you will raise sales revenue, eliminating the loss

BUT:
According to the Law of Demand, as the price of a good rises, quantity demanded *falls* (other things equal)

Q: If price rises, what actually happens to total spending (revenue) on a good?
A: This depends on *how much* Q falls

Ex: If a bus company is losing $ on current route, they usually say they must raise price to eliminate the loss, BUT:
$\uparrow$P $\Rightarrow$ **gain** - more $ from all still riding bus
$\downarrow$Q $\Rightarrow$ **loss** - fewer riders, lose their spending

DOES GAIN >LOSS?

Ultimately, the *magnitudes* determine if gain exceeds loss. Theory alone *can't* answer this
$\Rightarrow$ Need an additional concept for this:

Elasticity of demand: indicates how responsive Q^D is to changes in price (other things equal)
- Intuitively, only need to use $\Delta Q/\Delta P$ – the *absolute* changes in Q and P
- But this causes problems when comparing markets of different sizes (ex: small markets in hundreds for Q with large markets of, say, thousands)

Solution: use *relative* changes in P and Q, so that a "large" change doesn't necessarily translate into a large elasticity
$\Rightarrow$ use *percent* changes

Percent change in X = $(\Delta X/X)\cdot 100$, where Δ denotes "the change in."

Elasticity of demand: *tells the percent change in Q for a 1% change in price, other things equal*

$$\frac{\%\Delta Q}{\%\Delta P} = \frac{(\Delta Q/Q)\cdot 100}{(\Delta P/P)\cdot 100} = \frac{\Delta Q/Q}{\Delta P/P} = \eta$$

Since Q and P move opposite directions, demand elasticity is *negative*

Ex: $\eta = -2.5 \Rightarrow$ a 1% rise in price lowers quantity demanded by 2.5% (other things equal)

In evaluating elasticity of demand:

- forget the negative sign (it is understood)
- use as reference point $\eta = 1$ (really –1)

$$If \left|\frac{\%\Delta Q}{\%\Delta P}\right| > 1 \Rightarrow \%\Delta Q > \%\Delta P$$

then Q is very sensitive to price changes, so demand is **elastic**

Q: If demand is elastic, what happens as ↑P?
A: loss of Q > gain from P
⇨ with elastic demand, *total spending falls*

To increase total spending (revenue) with elastic demand, need to ↓P – this is often the opposite of intuition

Q: What makes demand elastic?
A: To have a "large" %ΔQ
(1) Close substitutes exist (it – commodity)
(2) A long time period (or time of year)
(3) This good a large portion of budget
Elastic demand – pertains to "large discount stores" and is rationale behind "loss leaders"
-make less $ per unit, so need *large volume*

If use intuition and raise price to eliminate loss when demand is elastic, total spending (revenue) ***FALLS*** and the loss increases!!
- Why is there a loss? Often, *not enough differentiation* from competition

Loss Leader – sell an elastically demanded good at cost or loss – get people into store and *make money as customers buy complements or other things in store*
Ex: inkjet printers – sell for very little, replacement cartridges/paper very expensive

<u>Other elasticity ranges:</u>
Inelastic Demand:

$$If \left|\frac{\%\Delta Q}{\%\Delta P}\right| < 1 \Rightarrow \%\Delta Q < \%\Delta P$$

⇨ quantity not all that responsive to ΔP

Q: What makes demand inelastic?
(1) No close substitutes exist (*not a commodity*) – differentiation from the competition is recognized by consumers
(2) Shorter time period (or "in season")
(3) This good a small portion of a budget

Only when demand is inelastic does a higher price raise total spending (revenue)

- This is the rationale for milk price supports, and is what intuition presupposes to eliminate losses (thru raising price)

UNIT ELASTIC DEMAND

$$If \left|\frac{\%\Delta Q}{\%\Delta P}\right| = 1 \Rightarrow \%\Delta Q = \%\Delta P$$

- same percent change in P and Q
⇨ gain = loss when ↑P (or ↓P)
⇨ *total spending (revenue) constant*
⇨ *no way to raise revenue by price changes*

CALCULATION OF ELASTICITIES

#1 **Point Elasticity of Demand**

- re-express the elasticity formula as the product of two terms, but incorporate values for a specific point:

$$\eta = \frac{\Delta Q/Q}{\Delta P/P} = \frac{p}{Q} \cdot \left(\frac{\Delta Q}{\Delta P} \right)$$

- the p and Q ratio uses starting point values
- the ratio of changes is the same

	p	**Q**	**TR**
A	5	20	100
B	7	10	70

From A to B:

$$\eta = \frac{\Delta Q/Q}{\Delta P/P} = \frac{p_A}{Q_A} \cdot \left(\frac{\Delta Q}{\Delta P} \right)$$

$$\eta = \frac{p_A}{Q_A} \cdot \left(\frac{\Delta Q}{\Delta P} \right) = \frac{5}{20} \cdot \left(\frac{-10}{+2} \right) = -1.25$$

⇨ demand is elastic here, and a 1% rise in price lowers quantity demanded by 1.25%

From B to A:

$$\eta = \frac{\Delta Q/Q}{\Delta P/P} = \frac{p_B}{Q_B} \cdot \left(\frac{\Delta Q}{\Delta P} \right)$$

$$\eta = \frac{p_B}{Q_B} \cdot \left(\frac{\Delta Q}{\Delta P} \right) = \frac{7}{10} \cdot \left(\frac{+10}{-2} \right) = -3.5$$

⇨ demand is elastic here also: a 1% rise in price lowers quantity demanded by 3.5%

Point elasticity gives different values depending on starting point. Sometimes they will indicate opposite elasticity ranges

#2 **Arc Elasticity of Demand**

- to eliminate the effect of starting point in point elasticity, arc elasticity uses *average* price and *average* quantity in the first ratio

$$\eta = \frac{p_{avg}}{Q_{avg}} \cdot \left(\frac{\Delta Q}{\Delta P} \right) = \frac{6}{15} \cdot (-5) = -2.0$$

#3 **Total Revenue Test**

- this uses information on price changes and total revenue changes

	P↑	**P↓**
Elastic	TR↓	TR↑
Inelastic	TR↑	TR↓
Unit Elastic	TR same	TR same

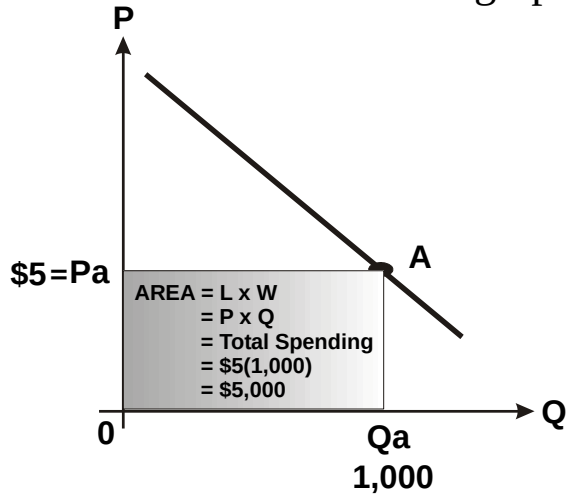
Referring back to the data table:

	p	**Q**	**TR**
A	5	20	100
B	7	10	70

Since TR falls as price rises, demand is elastic, and the total revenue test agrees with the other calculation methods

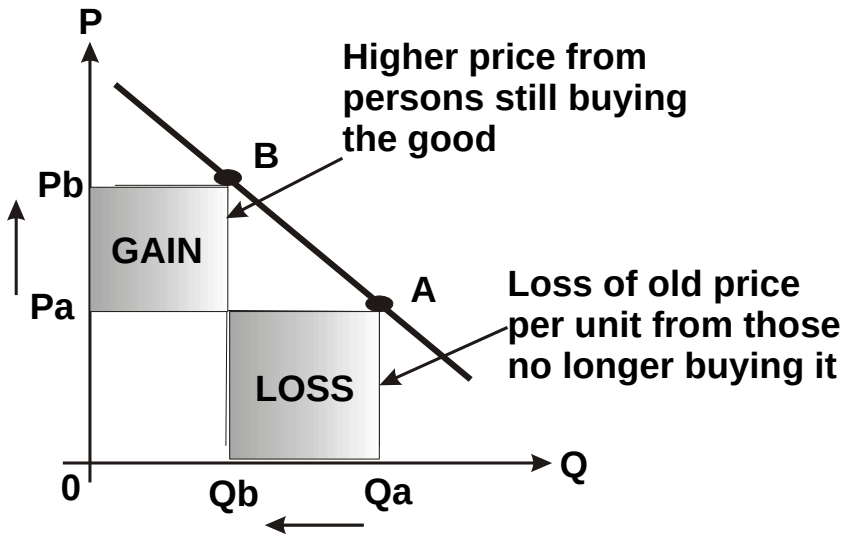
The total revenue test only gives the elasticity range and not elasticity values

Total revenue can be shown on a graph:



For any point on a demand curve, the area delineated by the P-Q combination gives total revenue or total spending

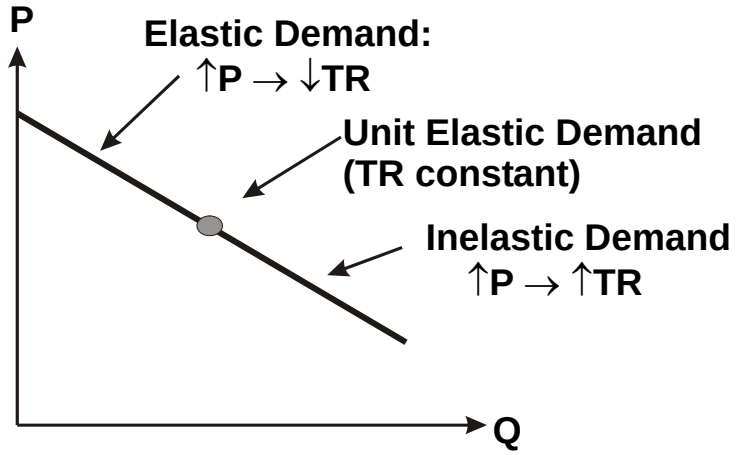
Elasticity of demand thus evaluates the *relative* sizes (areas) of loss and gain when price and quantity are changed



- related to the changing total revenue is:

<u>Marginal Revenue</u> (MR) – the change in total revenue that results from selling one more unit
To ↑Q, must ↓P. If the gain > loss, MR >0
Q: When is MR >0?
A: If demand is elastic (see TR test)

ELASTICITY VARIES ALONG A LINEAR DEMAND CURVE

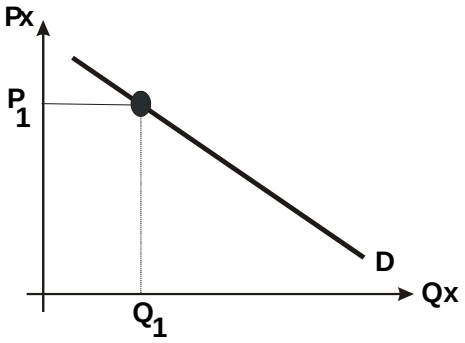


Application: Conservation
Let price to rise enough so that consumption moves into the *elastic* range of demand. Then, as price rises further, total revenue falls, and less is spent on this good

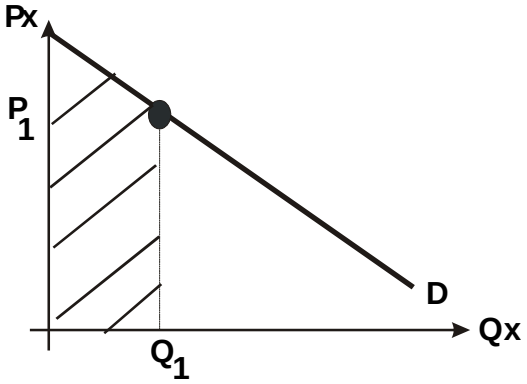
APPLICATION: WHY ARE THERE SO MANY DIFFERENT INSURANCE RATES?

We saw that the price-quantity combination gives an area in the demand curve that is total revenue

- But, with a single price, consumers pay *less* than the total value they place on this good



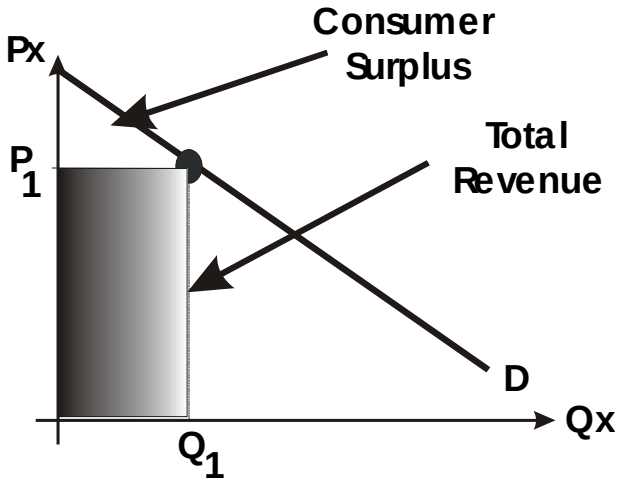
The valuation consumers place on quantity Q_1 is P_1. This is the maximum price they would be willing to pay for Q1, which is its **demand price**.



The total valuation of Q_1 units is the highlighted area

Note that: (1) Demand price falls as consumption (Q) rises; and (2) By paying P_1 for all Q_1 units, consumers pay less than the total value they place on the Q_1 units

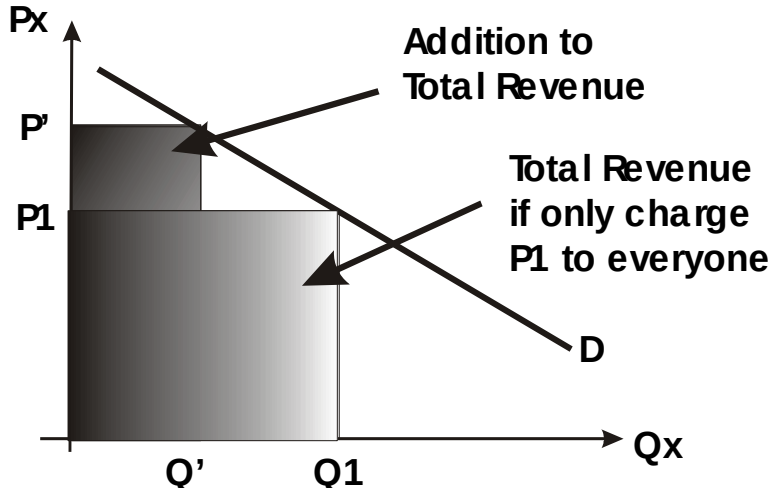
Consumer Surplus: The difference between what consumers pay and how much they value the goods consumed



So, paying a uniform (single) price creates consumer surplus. Guess who would like to get a "piece of that action?" Firms.

Q: Why might a firm charge a price above P_1 (call it P') for the first Q' units and P_1 for the remainder of Q_1? What's in it for them?

A: More total revenue – firms capture part of consumer surplus



P' might be the insurance rate for teenagers and P_1 the rate for everyone else

- The added revenue compensates the insurance company for the greater expected cost of accidents from teenagers

The greater is the number of different prices charged, the more will firms be able to capture consumer surplus

Q: If your company wishes to charge different prices to different customers (or groups of customers), how should they decide who pays the higher prices?

A: Since charging a higher price lowers quantity demanded (sales), consider how lost sales balance against the added revenue from those still buying

- USE ELASTICITY OF DEMAND

Higher Price – to inelastic demand customers
Lower Price – to elastic demand customers

- Explain why this works

OTHER ELASTICITIES

Income Elasticity of Demand

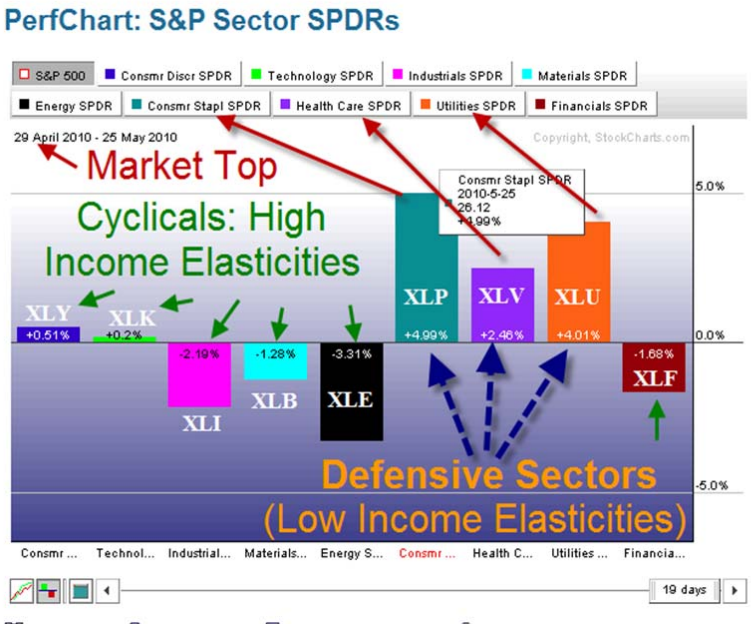
- indicates the sensitivity of quantity demanded to changes in income (i.e., the state of the economy)
- can be positive (normal good) or negative (inferior good)
- reflects magnitude of demand curve *shift*
- uses terminology for elasticity "ranges"

$$IE = \frac{\%\Delta Q}{\%\Delta I} = \frac{I}{Q} \cdot \left(\frac{\Delta Q}{\Delta I} \right)$$

If IE > 1 for a normal good, demand is *income elastic:* **%ΔQ > %ΔI.** The demand for this good fluctuates more than overall economic activity, and it is **CYCLICAL**. Ex: durable goods

- If IE < 1, demand is *income inelastic*, and the demand for this good fluctuates by less than does overall economic activity. It is *not* cyclical (ex: necessities)
- If IE = 1, demand is unit income elastic

Since income elasticity determines the magnitude of demand shifts, the greater is income elasticity, the more likely is it for substantial price fluctuations (draw this)



(note: Above, % designate how far above or below the S&P's performance each sector was over this period)

Following a short-term market top (4/20/2010), as worries about possible economic slowdown emerged, defensive sectors (**XLP**,**XLV**,**XLU**), those with low income elasticities, outperformed the overall stock market (a ***defensive sector rotation***).
- Cyclical sectors (**XLY,XLK,XLI,XLB,XLE,XLF**), those with high income elasticities, underperformed the market
- Interest rates also fell over this period (explain why)

Cross (Price) Elasticity of Demand

- indicates the sensitivity of the demand for one good (X) to changes in the price of *another* good (Y)
- can be positive, negative, or zero

$$CE = \frac{\%\Delta Q_x}{\%\Delta P_y} = \frac{P_y}{Q_x} \cdot \left(\frac{\Delta Q_x}{\Delta P_y} \right)$$

If CE > 0, then X and Y are *substitutes* (i.e., as Py↑⇒ Qy↓ => Qx↑. Since Qx and Qy move in opposite directions ⇒ substitutes)
- If CE < 0, then X and Y are complements
- If CE = 0, X and Y are independent

Cross elasticity of demand has been used in antitrust cases. If CE is large and positive, it implies that X and Y are strong substitutes and thus part of the same market – competitive. Merger is then not allowed.

Elasticity also pertains to supply:

ELASTICITY OF SUPPLY: *tells the percent change in Q^S for a 1% change in price (other things equal)*

$$\frac{(\Delta Q^S/Q^S)\cdot 100}{(\Delta P/P)\cdot 100} = \frac{\Delta Q^S/Q^S}{\Delta P/P} = \eta^S$$

- Based on the Law of Supply this is positive (i.e., as P↑ get Q^S↑)
- The longer the time period, the more elastic is supply (since then capital as well as labor can vary, giving a larger increase in Q^S than in the short-term)

PRACTICE QUESTIONS

Block's sells 500 bottles of perfume a month when the price is $7. A huge increase in resource costs causes price to rise to $9 and Block's only manages to sell 460 bottles of perfume. The arc elasticity of demand is:
A) 0.33 and elastic. B) 3.3 and elastic. C) 0.33 and inelastic. D) 3.3 and inelastic.

Suppose you are given the following data on demand for a product. The point elasticity of demand when price decreases from $9 to $7 is:

Price	Quantity demanded
$10	30
9	40
8	50
7	60
6	70

A) 0.63. B) 1.16. C) 1.60. D) 2.25.

When the price of candy bars increased from $.45 to $.55 the quantity demanded changed from 21,000 per day to 19,000 per day. In this range the point elasticity of demand for candy bars is approximately:
A) 1. B) 2. C) 0.2. D) 0.4.

When the demand for a good is price-elastic at a given output level, then:

A) total revenue is negative.
B) total revenue for the good will increase if its price decreases.
C) an increase in price will lead to an increase in total revenue for firms selling the good.
D) a large change in price will result in a relatively small change in the quantity demanded.

Which is *not* characteristic of a product with relatively inelastic demand?

A) The good is regarded by consumers as a necessity.
B) There are many good substitutes for the good .
C) Buyers spend a small percentage of their total income on the product.
D) Consumers have had only a short time period to adjust to changes in price.

As price increases along a downward sloping linear demand curve:

A) price elasticity of demand increases .
B) price elasticity of demand decreases.
C) price elasticity of demand does not change.
D) the behavior of price elasticity of demand cannot be determined.