MANAGERIAL ECONOMICS CHAPTER 3

Demand Analysis

DEMAND ANALYSIS

OVERVIEW of Chapter 3

- Demand Relationships
- Demand Elasticities
- Income Elasticities
- Cross Elasticities of Demand
- Appendix 3A: Indifference Curves

Health Care & Cigarettes

- Raising cigarette taxes reduces smoking
  - In Canada, $4 for a pack of cigarettes reduced smoking 38% in a decade
- But cigarette taxes also helps fund health care initiatives
  - The issue then, should we find a tax rate that maximizes tax revenues?
  - Or a tax rate that reduces smoking?

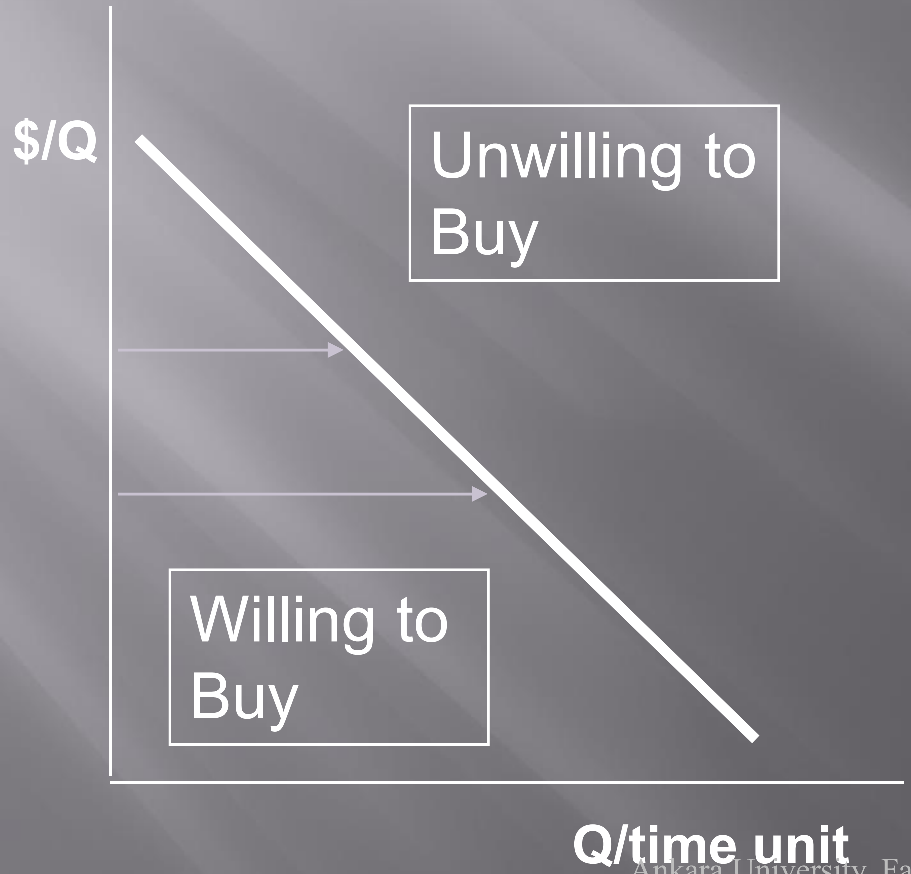
Demand Analysis

- An important contributor to firm risk arises from sudden shifts in demand for the product or service.
- Demand analysis serves two managerial objectives:

  (1) it provides the insights necessary for effective management of demand, and

  (2) it aids in forecasting sales and revenues.

Demand Curves



- **Individual Demand Curve** the greatest quantity of a good demanded at each price the consumers are Willing to Buy, **ceteris paribus**.

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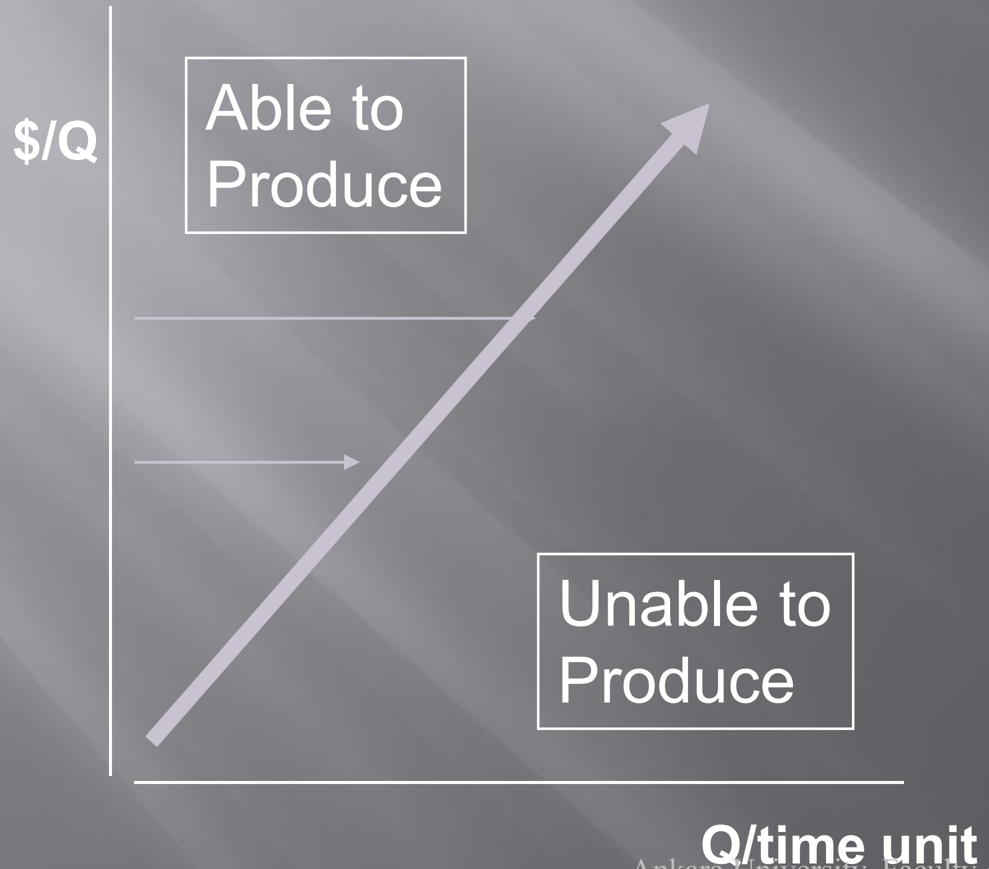
- **The Market Demand Curve** is the horizontal sum of the individual demand curves.

- **The Demand Function** includes all variables that influence the quantity demanded

$$Q = f(P, P^s, P^c, I, W, E)$$

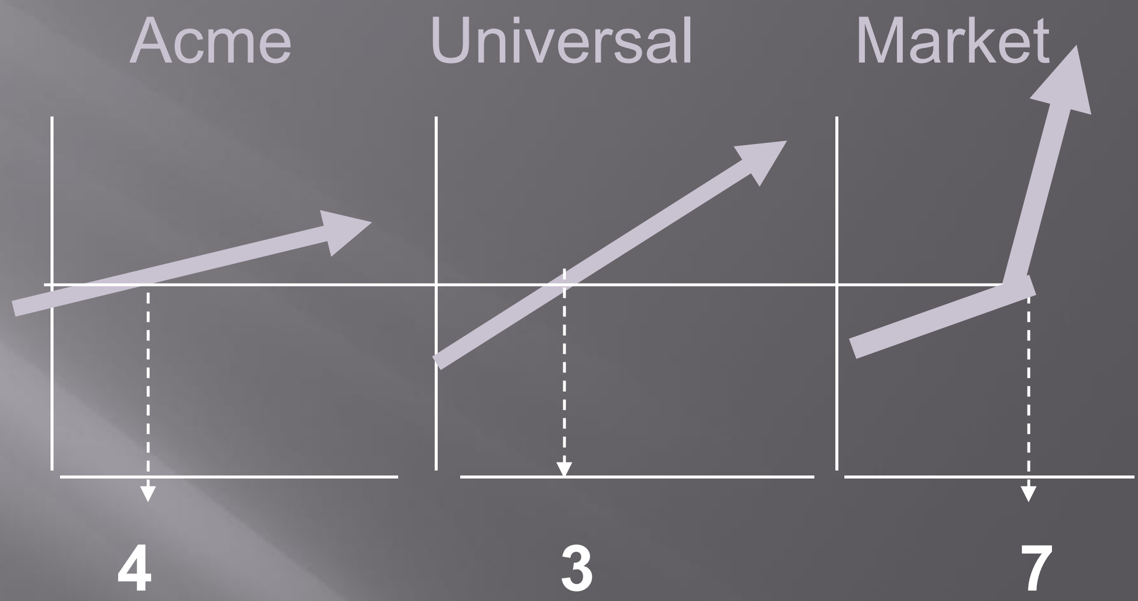
+ + - ? ? +

Supply Curves



- **Firm Supply Curve** - the greatest quantity of a good supplied at each price the firm is profitably able to supply, **ceteris paribus**.

The Market Supply Curve is the horizontal sum of the firm supply curves.

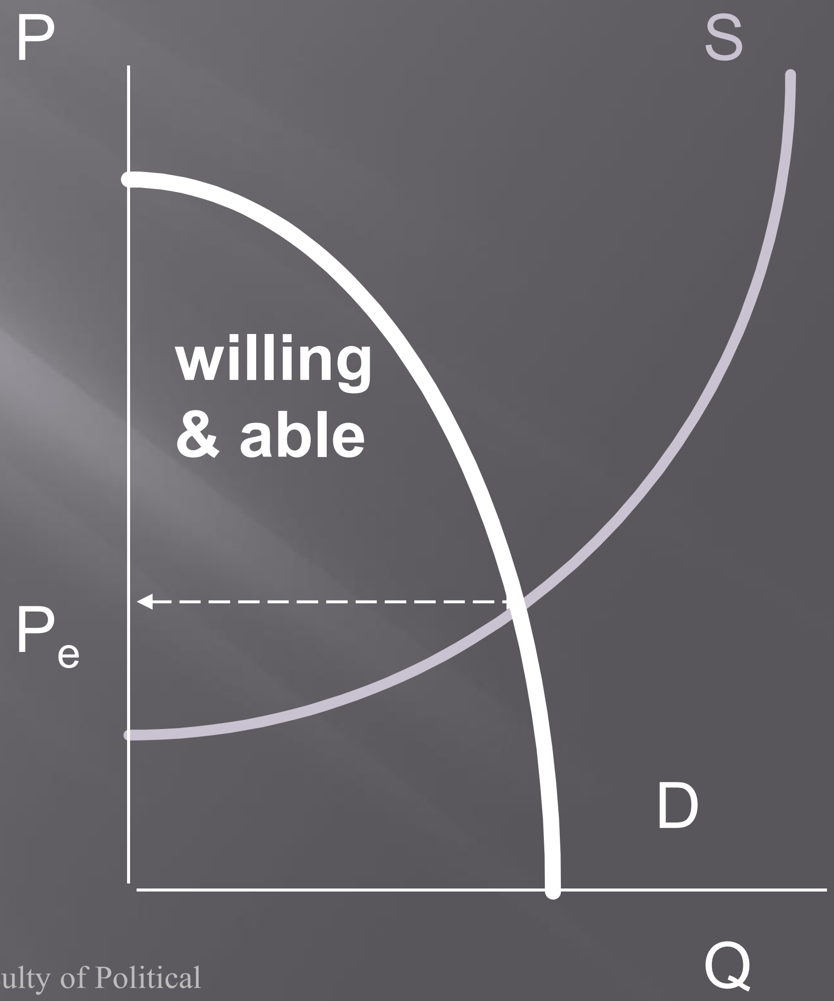


The Supply Function includes all variables that influence the quantity supplied

$$Q = g(\underset{+}{P}, \underset{-}{W}, \underset{-}{R}, \underset{+}{TC})$$

Equilibrium: No Tendency to Change

- Superimpose demand and supply
- If No Excess Demand
- and No Excess Supply
- No tendency to change

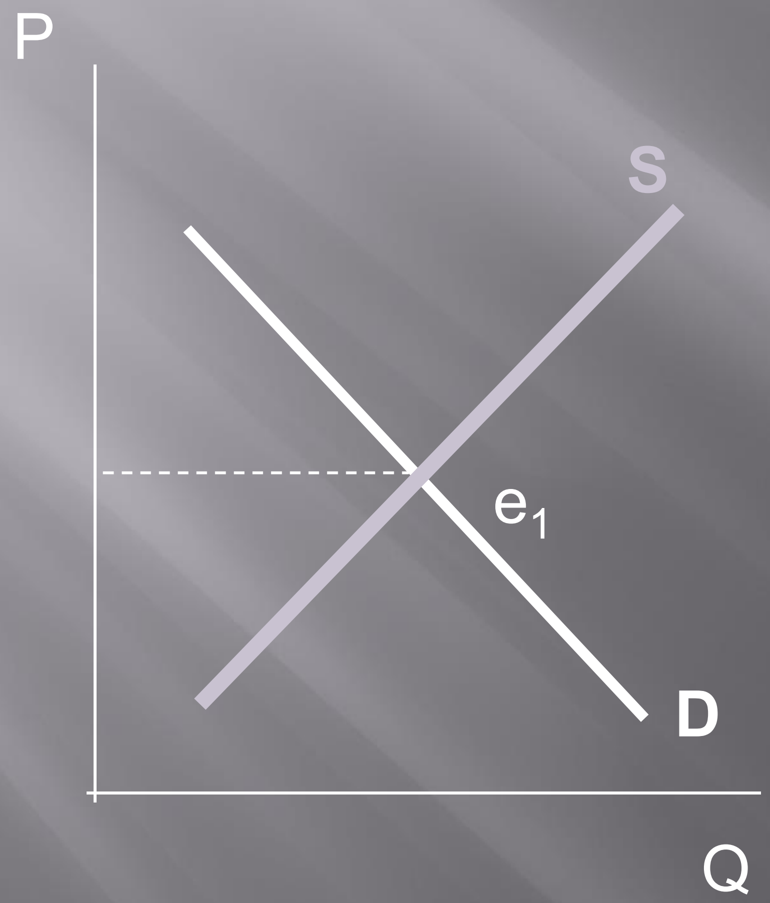


Downward Slope

- Reasons that price and quantity are negatively related include:
  - *income effect*--as the price of a good declines, the consumer can purchase more of all goods since his or her *real income* increased.
  - *substitution effect*--as the price declines, the good becomes relatively cheaper. A *rational consumer* maximizes satisfaction by reorganizing consumption until the marginal utility in each good per dollar is equal:
    - Optimality Condition is $MU_A/P_A = MU_B/P_B = MU_C/P_C = \ldots$

    If **MU per dollar** in A and B differ, the consumer can improve *utility* by purchasing more of the one with higher MU per dollar.

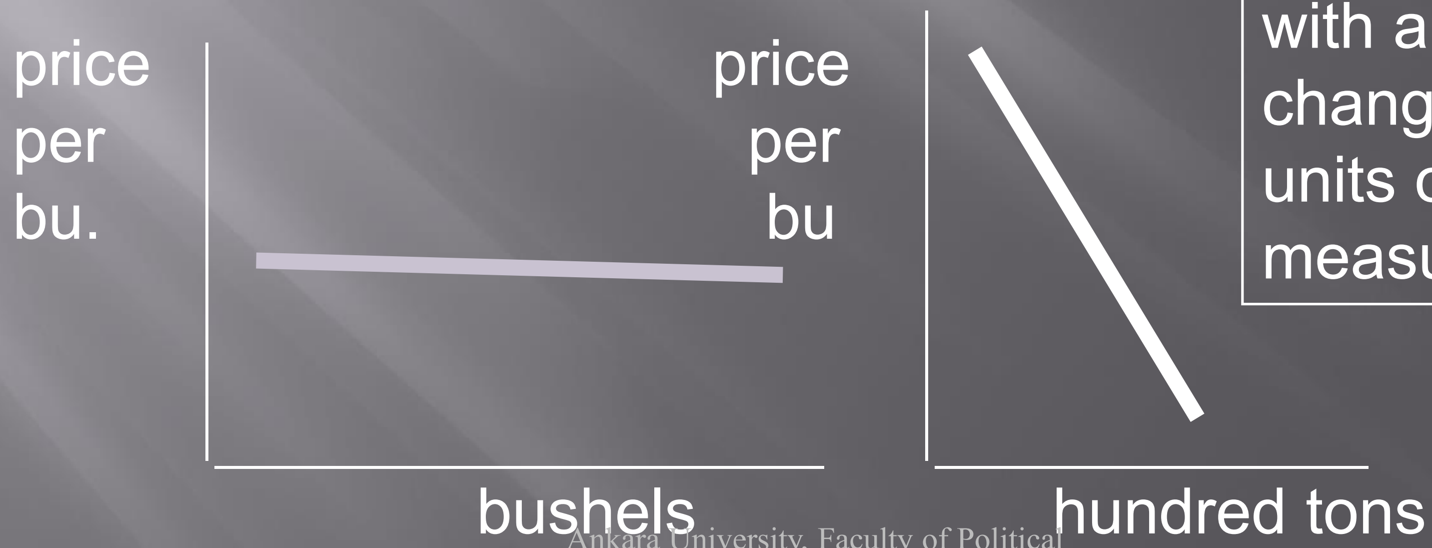
Comparative Statics
and the Supply-Demand Model



- Suppose a shift in **Income**, and the good is a "normal" good
- Does Demand or Supply Shift?
- Suppose wages rose, what then?

Elasticity as Sensitivity

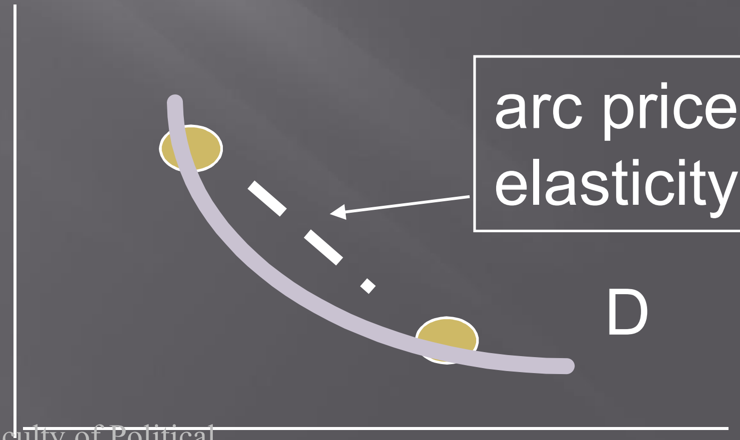
- Elasticity is measure of responsiveness or sensitivity
- Beware of using Slopes



Slopes change with a change in units of measure

Price Elasticity

- E_P = % change in Q / % change in P
- Shortcut notation: $E_P = \%\Delta Q / \%\Delta P$
- A percentage change from 100 to 150
- A percentage change from 150 to 100
- **Arc Price Elasticity** -- averages over the two points



Arc Price Elasticity Example

- Q = 1000 at a price of $10
- Then Q= 1200 when the price was cut to $6
- Find the price elasticity
- Solution: $E_P = \%\Delta Q / \%\Delta P = \dfrac{+200/1100}{-4/8}$

or **-.3636**. The answer is a number. A 1% increase in price reduces quantity by .36 percent.

Point Price Elasticity Example

- Need a demand curve or demand function to find the price elasticity at a point.

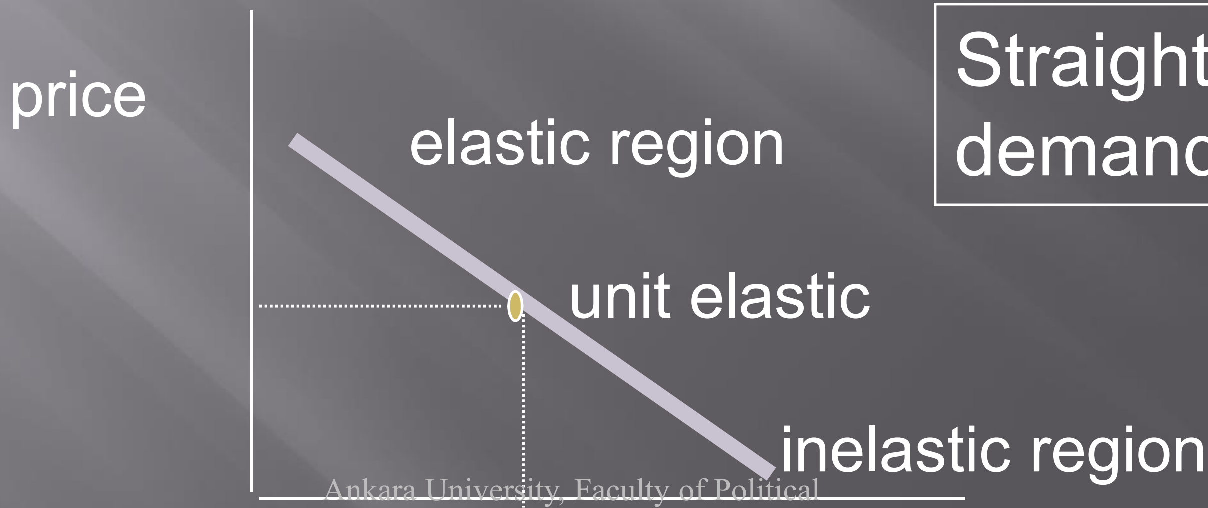
$$E_P = \%\Delta Q / \%\Delta P = (\partial Q/\partial P)(P/Q)$$

If $Q = 500 - 5 \bullet P$, find the point price elasticity at **$P = 30$; $P = 50$; and $P = 80$**

- $E_{Q \bullet P} = (\partial Q/\partial P)(P/Q) = -5(30/350) =$ **$-.43$**
- $E_{Q \bullet P} = (\partial Q/\partial P)(P/Q) = -5(50/250) =$ **-1.0**
- $E_{Q \bullet P} = (\partial Q/\partial P)(P/Q) = -5(80/100) =$ **-4.0**

Price Elasticity (both point price and arc elasticity)

- If $E_P = -1$, unit elastic
- If $E_P > -1$, inelastic, *e.g.*, - 0.43
- If $E_P < -1$, elastic, *e.g.*, -4.0



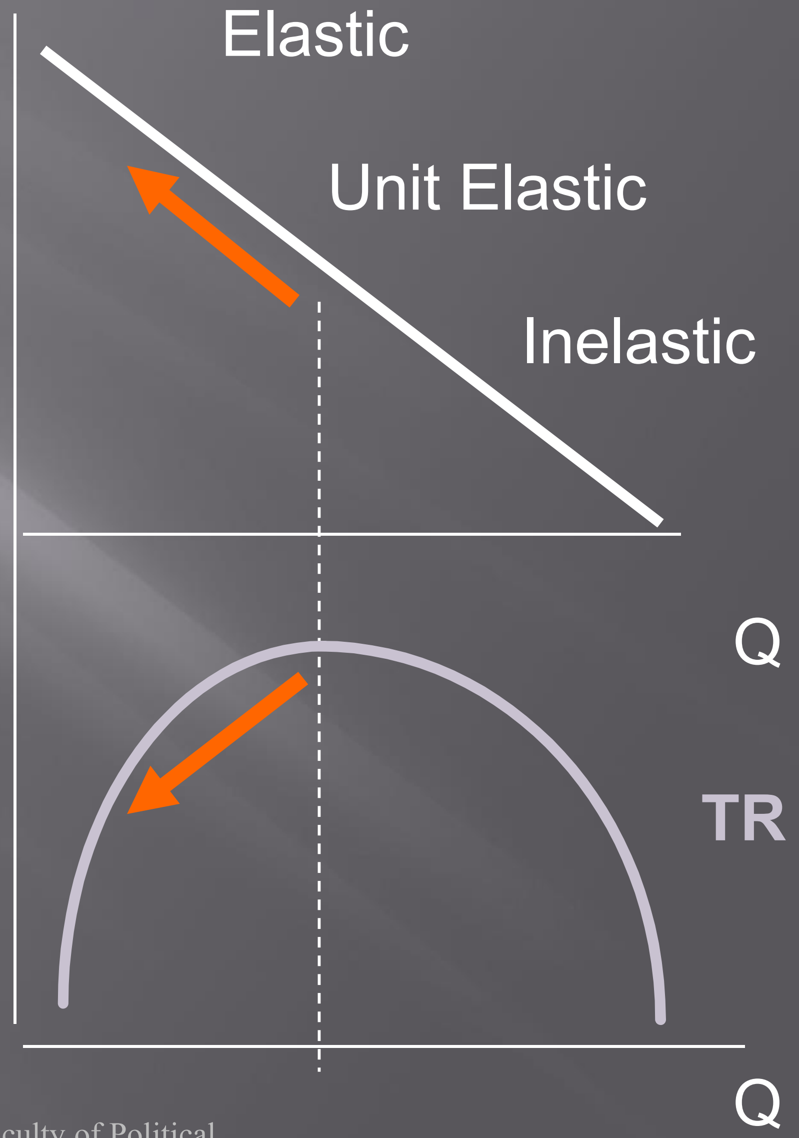
Straight line demand curve

TR and Price Elasticities

- If you raise price, does TR rise?
- Suppose demand is elastic, and raise price. TR = P•Q, so, %ΔTR = %ΔP+ %ΔQ
- If elastic, P↑ , but Q ↓ a lot
- Hence TR FALLS !!!
- Suppose demand is inelastic, and we decide to raise price. What happens to TR and TC and profit?

Another Way to Remember

- Linear demand curve
- TR on other curve
- Look at arrows to see movement in TR



1979 Deregulation of Airfares

- Prices declined
- Passengers increased
- Total Revenue Increased
- What does this imply about the price elasticity of air travel ?

Determinants of the Price Elasticity

- The number of close **substitutes**
  - more substitutes, more elastic
- The **proportion of the budget**
  - larger proportion, more elastic
- The longer the **time period** permitted
  - more time, generally, more elastic
  - consider examples of business travel versus vacation travel for all three above.

Income Elasticity

$$E_I = \%\Delta Q / \%\Delta I = (\partial Q / \partial I)(I / Q)$$

- **arc income elasticity**:
  - suppose dollar quantity of food expenditures of families of **$20,000** is $5,200; and food expenditures rises to $6,760 for families earning **$30,000**.
  - Find the income elasticity of food
  - **%ΔQ/ %ΔI** = (1560/5980)•(10,000/25,000) = **.652**

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Definitions

- If **E** $_I$ is positive, then it is a **normal** or income superior good
  - some goods are **Luxuries**: **E** $_I \geq 1$
  - some goods are **Necessities**: **E** $_I < 1$
- If **E** $_{Q \cdot I}$ is negative, then it's an **inferior** good
- consider:
  - Expenditures on automobiles
  - Expenditures on Chevrolets
  - Expenditures on 1993 Chevy Cavalier

Point Income Elasticity Problem

- Suppose the demand function is:

$$Q = 10 - 2 \bullet P + 3 \bullet I$$

- find the income and price elasticities at a price of P = 2, and income I = 10
- So: Q = 10 -2(2) + 3(10) = 36
- $E_I = (\partial Q/\partial I)(I/Q) = 3(10/36) = .833$
- $E_P = (\partial Q/\partial P)(P/Q) = -2(2/36) = -.111$
- Characterize this demand curve !

Cross Price Elasticities

$E_X = \%\Delta Q_x / \%\Delta P_y = (\partial Q_x / \partial P_y)(P_y / Q_x)$

- **Substitutes** have positive cross price elasticities: Butter & Margarine
- **Complements** have negative cross price elasticities: VCR machines and the rental price of tapes
- When the cross price elasticity is zero or insignificant, the products are **not related**

HOMEWORK PROBLEM:

Find the point price elasticity, the point income elasticity, and the point cross-price elasticity at P=10, I=20, and P^s=9, if the demand function were estimated to be:

$$Q_d = 90 - 8 \cdot P + 2 \cdot I + 2 \cdot P_s.$$

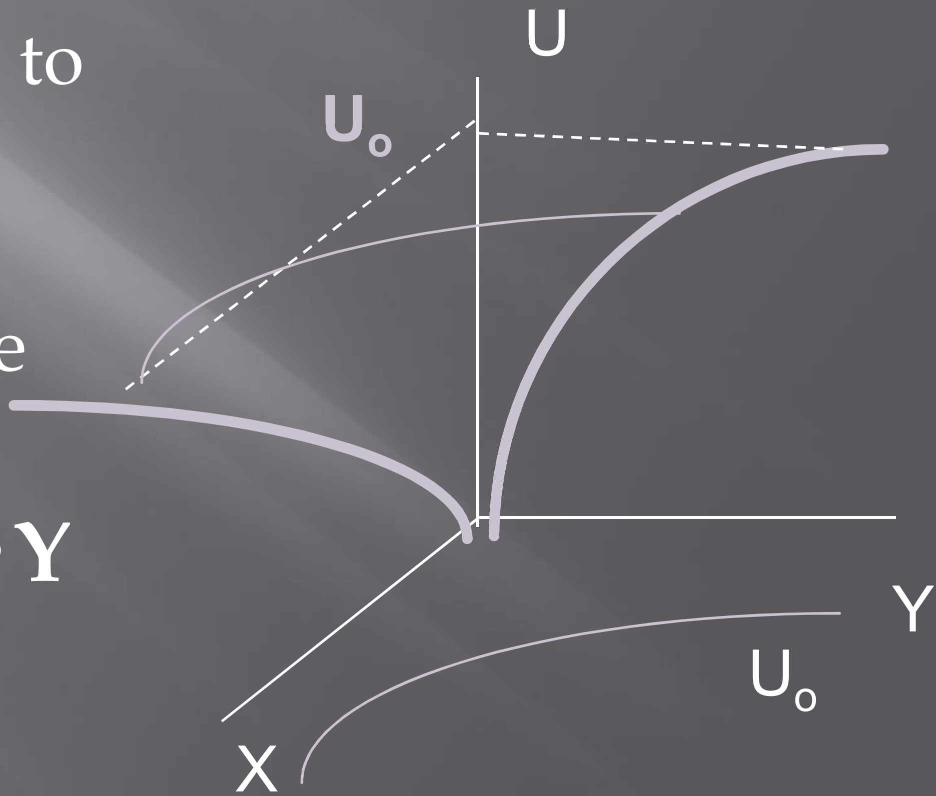
Is the demand for this product elastic or inelastic? Is it a luxury or a necessity? Does this product have a close substitute or complement? Find the point elasticities of demand.

Indifference Curve Analysis
Appendix 3A

- Consumers attempt to max happiness, or utility: U(X, Y)
- Subject to an income constraint:

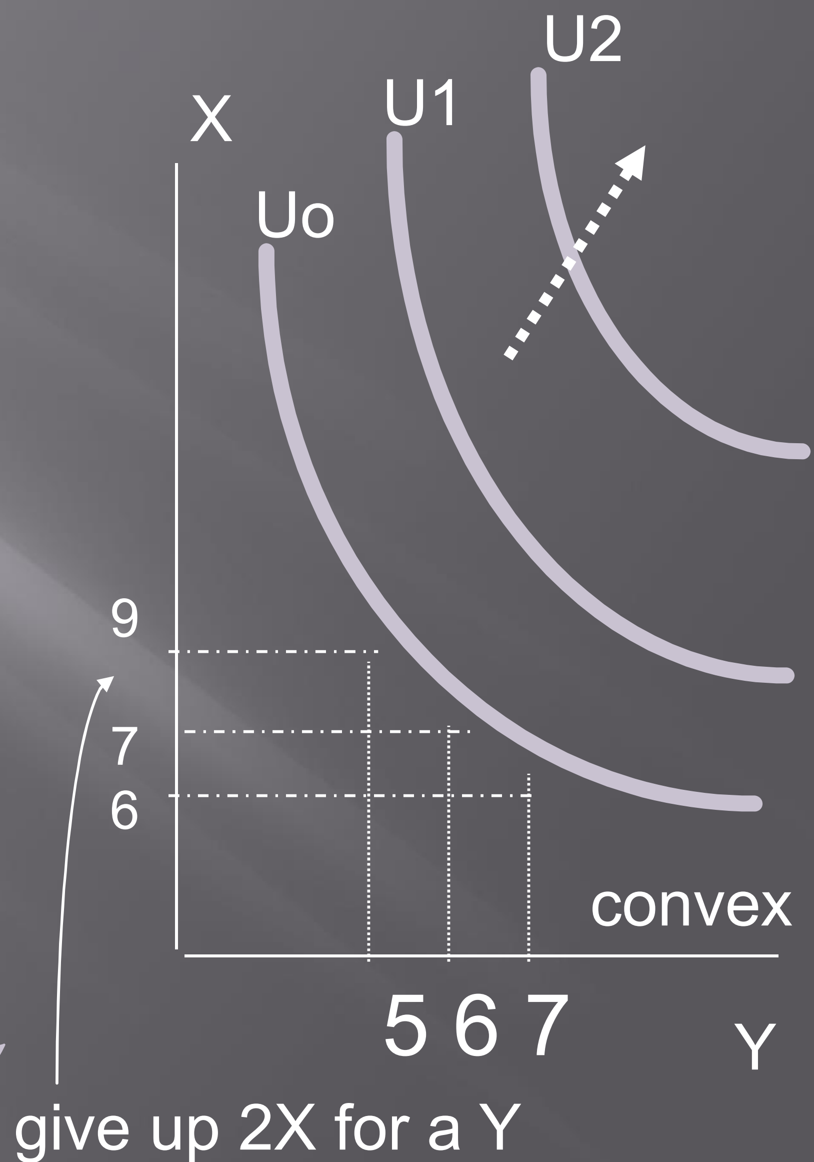
$$I = Px \cdot X + Py \cdot Y$$

- Graph in 3-dimensions

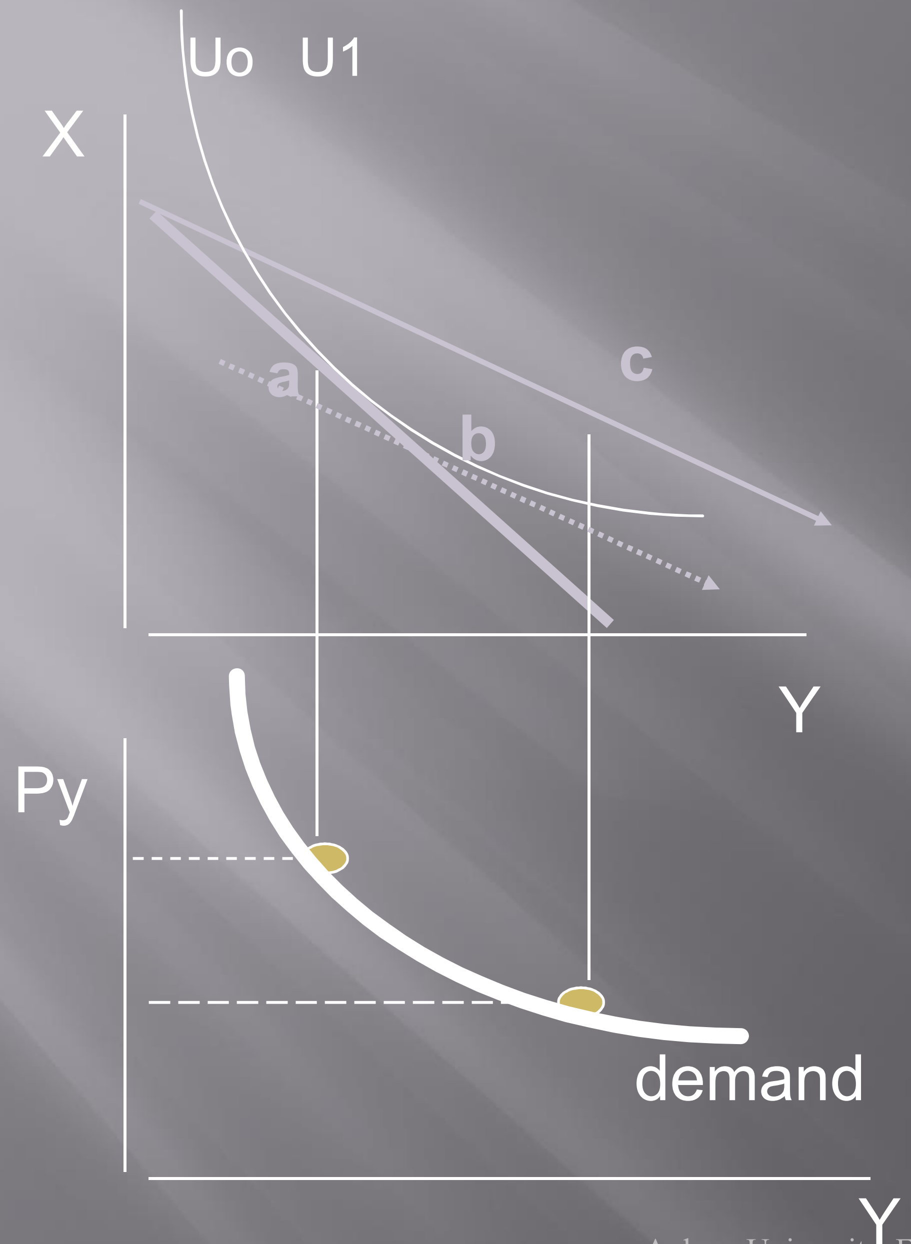


Consumer Choice - assume consumers can rank preferences, that more is better than less (nonsatiation), that preferences are transitive, and that individuals have diminishing marginal rates of substitution.

Then indifference curves slope down, never intersect, and are convex to the origin.



Indifference Curves



- We can "derive" a demand curve graphically from maximization of utility subject to a budget constraint. As price falls, we tend to buy more due to (i) the **Income Effect** and (ii) the **Substitution Effect.**

Consumer Choice & Lagrangians

- The consumer choice problem can be made into a Lagrangian
- Max $L = U(X, Y) - \lambda \{\mathbf{P_x \bullet X + P_y \bullet Y - I}\}$

i) $\partial L / \partial X = \partial U / \partial X - \lambda P_x = 0$ $\quad MU_x = P_x$

ii) $\partial L / \partial Y = \partial U / \partial Y - \lambda P_y = 0$ $\quad MU_y = Py$

iii) $\mathbf{P_x \bullet X + P_y \bullet Y - I} = 0$

- Equations i) and ii) are re-arranged on the right-hand-side after the bracket to show that the ratio of MU's equals the ratio of prices. This is the **equi-marginal principle** for optimal consumption

Optimal Consumption Point

- Rearranging we get the Decision Rule:
- $MU_x / P_x = MU_y / P_y = MU_z / P_z$

"the marginal utility per dollar in each use is equal"

- Lambda is the marginal utility of money

Suppose $MU_1 = 20$, and $MU_2 = 50$
and $P_1 = 5$, and $P_2 = 25$
are you maximizing utility?

Problem

- Max L = $2X + 2Y - .5X^2 + XY - .6Y^2$ - λ {48 - 4X - 6Y }

1. L_x: $2 - X + Y = 4\lambda$
2. L_y: $2 + X - 1.2Y = 6\lambda$
3. L_λ: $48 - 4X - 6Y = 0$

X = 1.08•Y + .4

(1) and (2) yields: $X = 1.08 \bullet Y + .4$

(3) can be reduced to $X = 12 - 1.5Y$

Together we get: $X = 5.256$, $Y = 4.496$

Substitute X and Y into (1) we find $\lambda = .31$