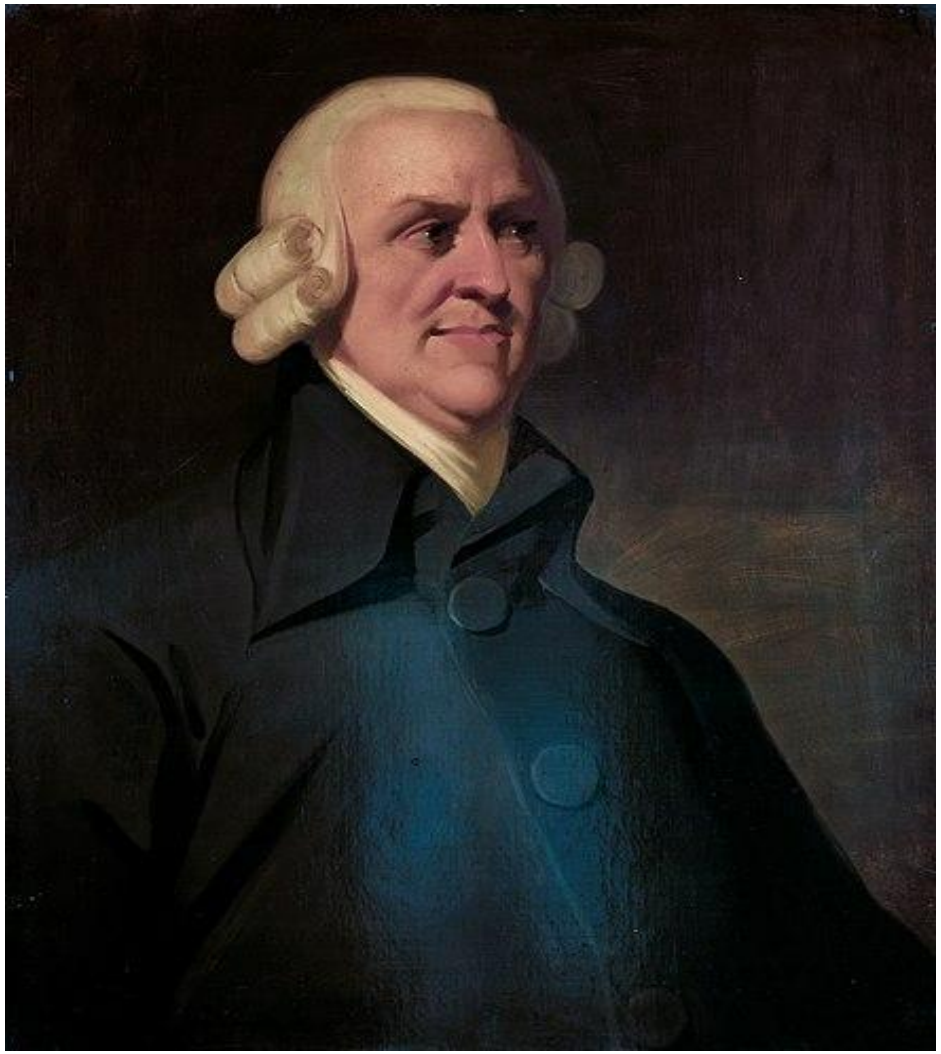
Economic Theory of Choice

Class 4

Early Price Theory and the Marginal Revolution
Chapter 1 (Neuroeconomics – Glimcher)

Where did it all start?



- Adam Smith (1723-1790)
- Wealth of Nations (1776)
- First Theory of Markets
- What creates value of a commodity?

Price Theory (a microeconomic principle)

- Supply-demand determines price
- Exchange-value (price at the market) depends on use-value (to the consumer) and cost of production (for the production)
- Higher use value → higher price
- Higher cost of production → higher price

Price Theory

- **Higher use value ➔ higher price**

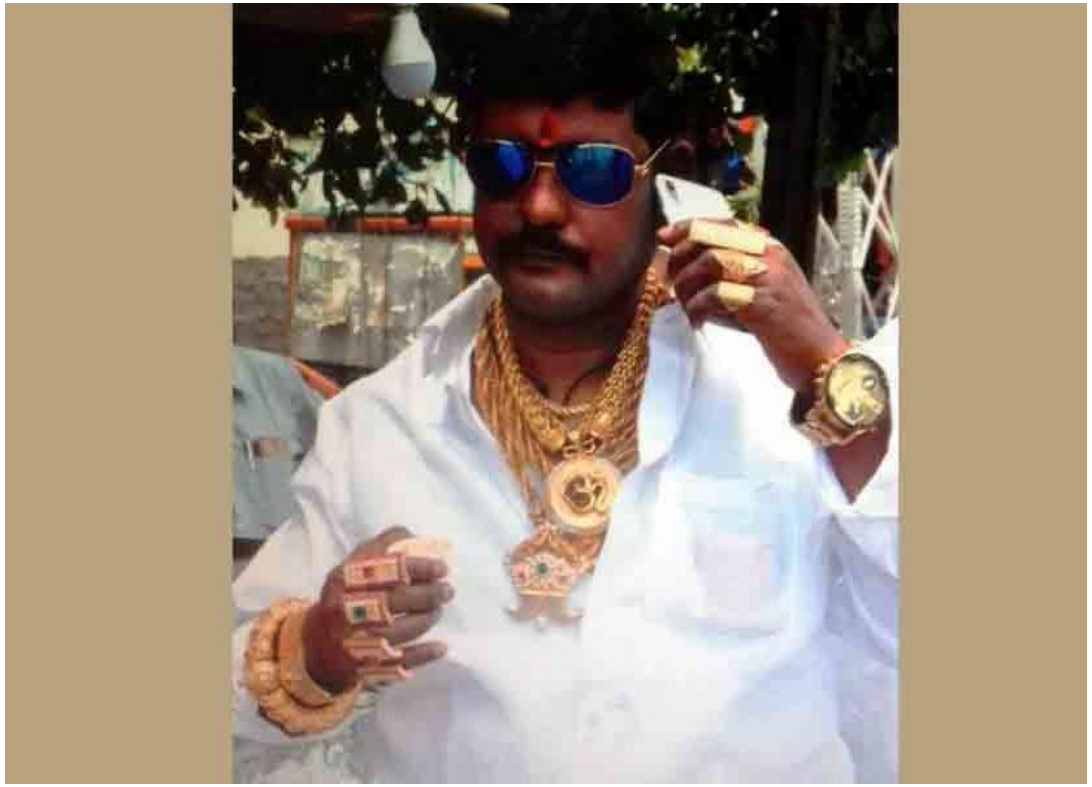
- **Higher cost of production ➔ higher price**

- Per unit vehicle cost production for Tesla is currently $36,000 on an average (profit margin is ~19%)

- Porsche –between $50,000 and $150,000. For every car, the auto manufacturer makes an estimated $17,000. This makes the cost of manufacturing about $ 33,000 to $ 133,000.

- Ferrari – While these sports cars can cost upwards of $200,000 in the market, it has been revealed that the manufacturer makes only about $6,000 per car. This means that the cost of manufacturing could be as high as $195,000.

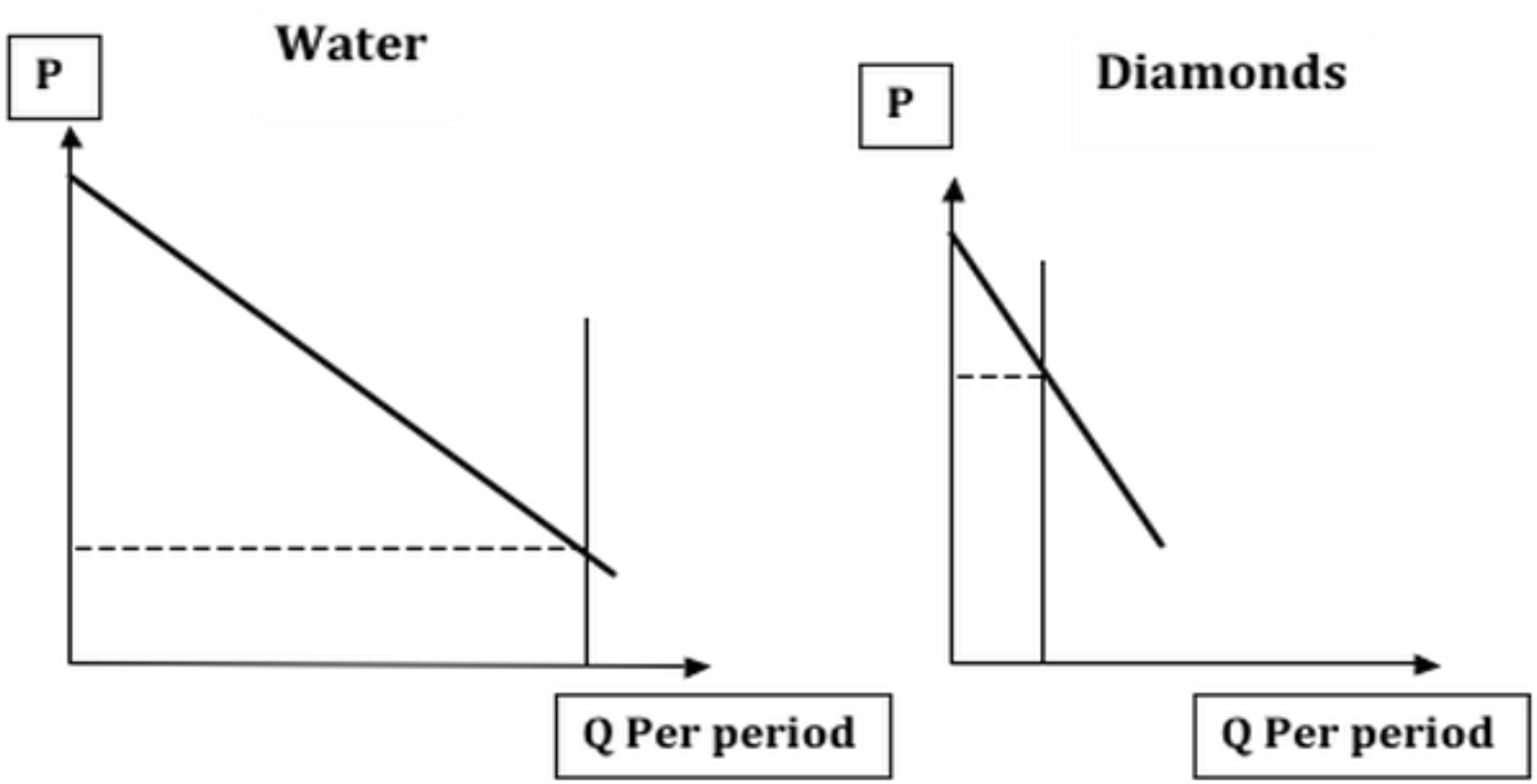
- **High value to life vs. high value in terms of money**



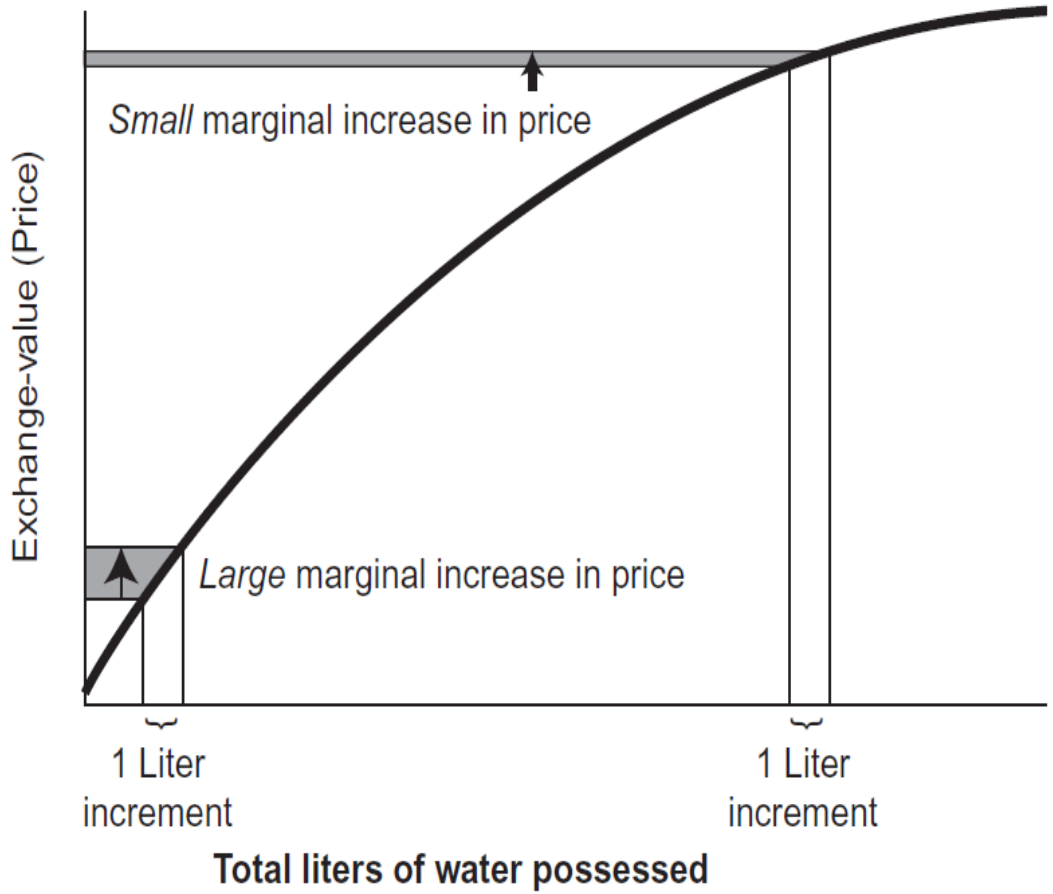
Ricardo’s Solution

- David Ricardo (1772-1823)
- Labor theory of value
- Diamond expensive : it’s difficult to cut and polish diamonds
- What if I take an ordinary rock and do the same?
- Would it be as costly as diamonds?

Diamond- Water paradox



Marginal Revolution



Represents the price theoretic notion of diminishing marginal value

- Middle-late nineteenth century
- Exchange value depends on the existing quantity
- Not the average, but the marginal increase determines value
- But why?
- Value depends on the level of satisfaction (utility) obtained

Theory of Rational Choice

1. Decision-makers maximize utility/satisfaction by choosing action
2. Decision-makers obtain utility by owning or consuming goods
3. The amount of utility they experienced per unit of most goods was a function “diminishing at the margin.”

First Neuroeconomists?

- Measuring utility in utils
- Needed tools to infer value from physical signals, through a “hedonimeter”
- Notable economists: Ramsey, Edgeworth, Fisher
- Keynes: theory of animal spirit – how emotion can drive decision-making in uncertain environment and volatile times!.

Early Decision Theory and Utility Maximization

A parallel development!

- Blaise Pascal (1623-1662)
- Exploring how people gamble
- Should I buy a lottery ticket that yields a 50% chance of winning $200 at a price of $45
- His answer: expected value
- Expected value of lottery:

  .5*200=100
- Definitely buy the ticket

Logic of insurance

- Suppose the chance of house being destroyed by lightning is 0.0001, but if it is destroyed, you lose $300,000.
- The expected value of your house is therefore 0.9999 x 300,000 = $299,970.
- The expected loss of your house is just $30.
- An insurance company may be willing to insure against the loss of your 300,000 house for $100 a year.
- According to the expected value, should you insure the house?

Source: economics of DM.

Bernoulli's Lottery (modified from St. Petersburg Paradox)

- Tossing a coin infinitely many times
- If "T" comes in first draw get $2
- If "T" comes in second draw get $4
- If "T" comes in n^{th} draw get $\$2^n$
- How much will you pay for the lottery?

From Expected value to Expected Utility

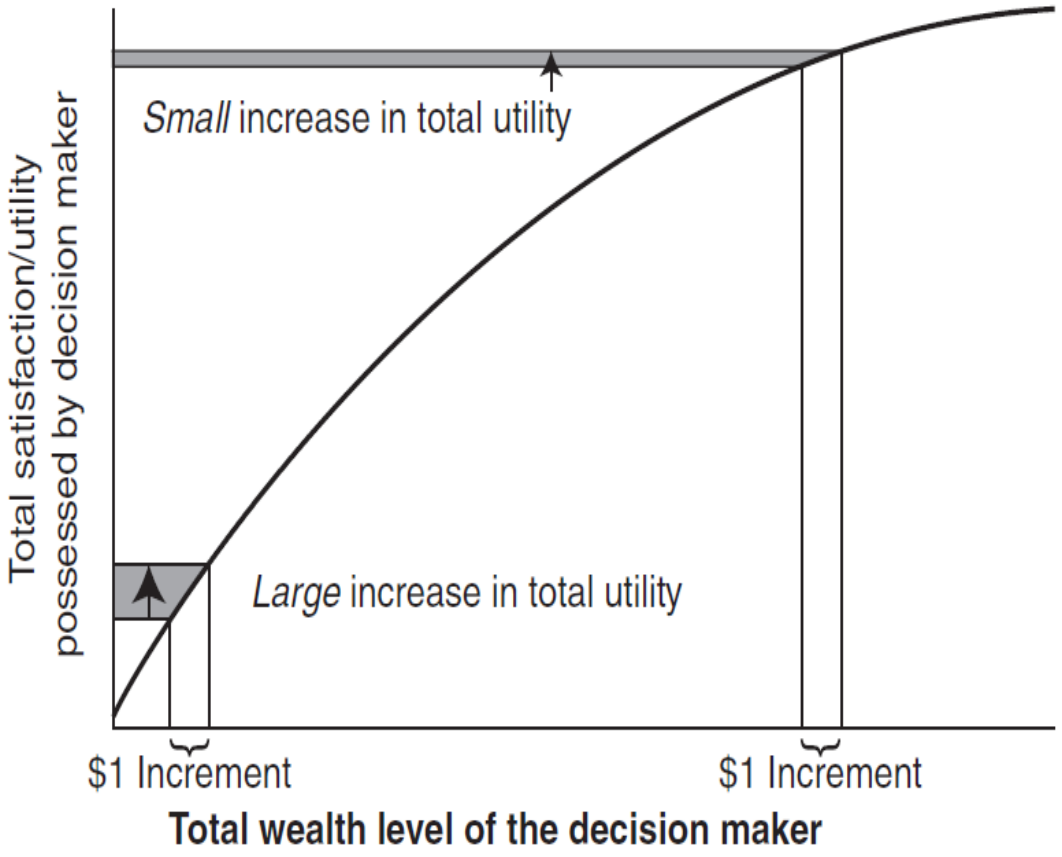
- Daniel Bernoulli (1700-1782)
- Most people pay less than $10 for Bernoulli's lottery (I should pay an infinite amount of money to play this game)
- As the expected value is infinity!
- Bernoulli's solution use expected utility
- Utility: logarithmic function of value

St Petersburg Paradox

- Consider a poor man who obtains a lottery ticket that offers a 50% chance of winning $20,000. A wealthy woman offers to buy that ticket for $7000. Should the poor man accept the offer? – as per Pascal's theory?

- According to our expected value method, the poor man should refuse the rich person's offer!

Expected Utility

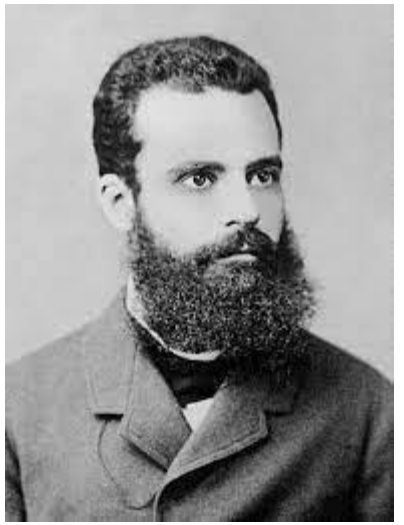


Presents a decision theoretic notion of diminishing marginal utility.

- As wealth increases additional utility falls
- Expected value can go to infinity but expected utility does not
- Logarithmic function are commonly observed in many decision-making context

THE ORDINAL REVOLUTION AND THE LOGIC OF CHOICE

- Taking their lead from these insights, the major economists of the nineteenth century began to focus their energies on understanding how use-value, costs-of production and exchange-value were related to the utilities experienced by decision makers.
- But of these theories were brought to a crashing halt at the end of the nineteenth century by the next revolution in the economic theory of choice, the Ordinal Revolution initiated by **Vilfredo Pareto (1906).**



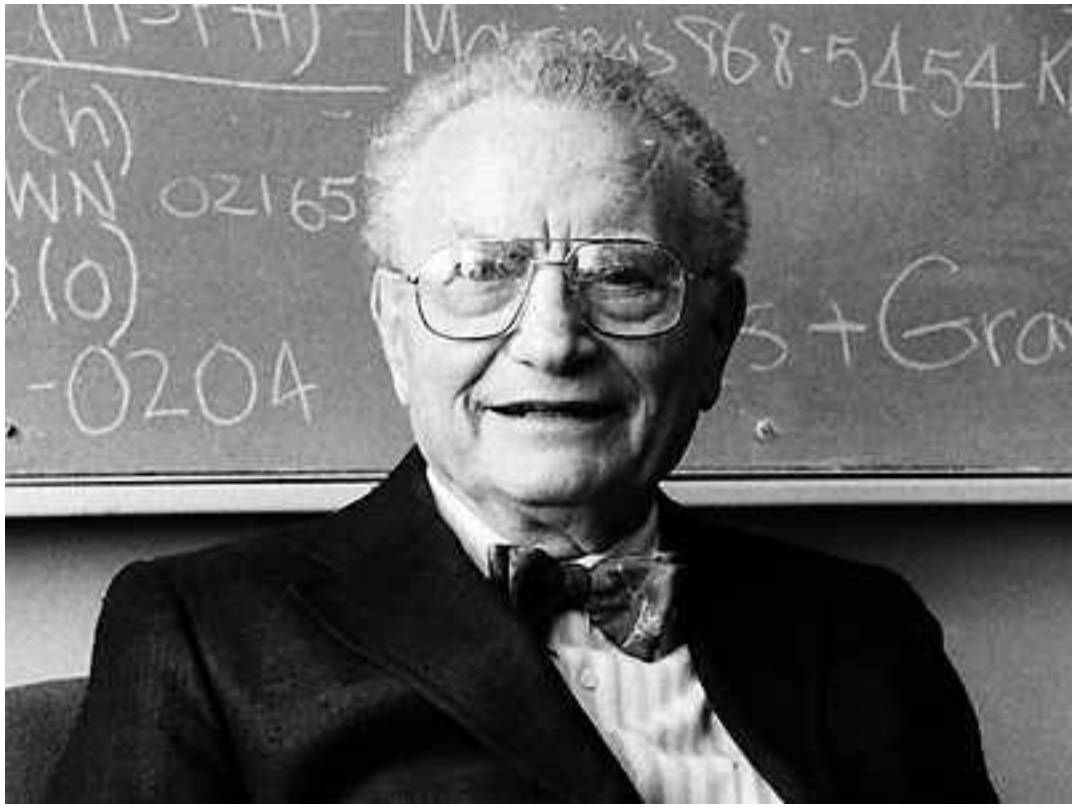
Ordinal Revolution

- Vilfredo Pareto (1848-1923)
- Utility numbers are not important
- Only the ranking matters
- Apple = 12 utils, Orange = 5 utils same as Apple = 15 utils, Orange = 8 (while giving numerical value makes no sense!). These are systems of numbers referred to as cardinal.
- Theory of ordinal ranking

Why Ordinal Ranking?

- Economists can’t measure utility
- Precise functional form does not matter
- But we can measure prices and choices
- Ordinal theory based on choice data

Samuelson’s Critique



- Paul Samuelson (1915-2009)
- Ordinal preferences are still not measurable
- Only measurable quantities: price and choice
- Need a theory based on observed choices

Idea of Revealed Preference

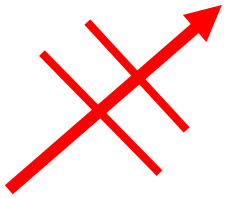
- Ordinal preference theory started with a ranking of preference
- Apples > Oranges;
- Oranges > Grapes and
- Apples> Grapes

- Revealed preference theory started with choices
  - Price of apple = 10, price of orange = 8
  - 1 apple and no oranges are bought
  - Apple $\succ$ Oranges

- Reveal Preference from choices

Apples > oranges

Apples = Rs 180/kg
Oranges = Rs 60/kg



Consistency Axioms

Maximize some utility function –Samuelson test of Utility Maximization

Revision

- Utility is the measure of value an individual gets from some good or service.
- For example, a student of CS might get more utility from a course in programming than in behv. economics, as programming not only keeps them focused but also improves job prospects.

Example for expected utility

- **Expected Utility Theorem**
- Suppose you're deciding whether to bring an umbrella with you today. You might do a calculation of the expected utility of bringing it versus the expected utility of leaving it at home.

Options: bring it or do not.

What are the scenarios and the corresponding probability?

Bring it: you lose it (20% chance), you carry it around unnecessarily (50% chance), or you use it to keep you dry (30% chance)

Not bring it: you lose it (0% chance), you never need it (62.5% chance), or you need it (37.5% chance).

What is the ‘subjective’ variable here?

Example for expected utility

- Bring an umbrella:
- Eu[u(x)]=p1u(x1)+p2u(x2)+p3u(x3)=20%×u(losing your umbrella)+50%×u(carry umbrella around unnecessarily)+30%×u(umbrella keeps you dry).
- Don’t bring an umbrella:
- En[u(x)]=p1u(x1)+p2u(x2)+p3u(x3)=0%×u(losing your umbrella)+62.5%×u(umbrella never needed)+37.5%×u(you get wet).

Example for expected utility

- If you don’t like to get wet > carry an umbrella around:

- $Eu[u(x)]=20\%\times(-2)+50\%\times(-1)+30\%\times(10)=2.1$ utils

Versus

- $En[u(x)]=0\%\times(2)+62.5\%\times(1)+37.5\%\times(-10)=-3.125$ utils.

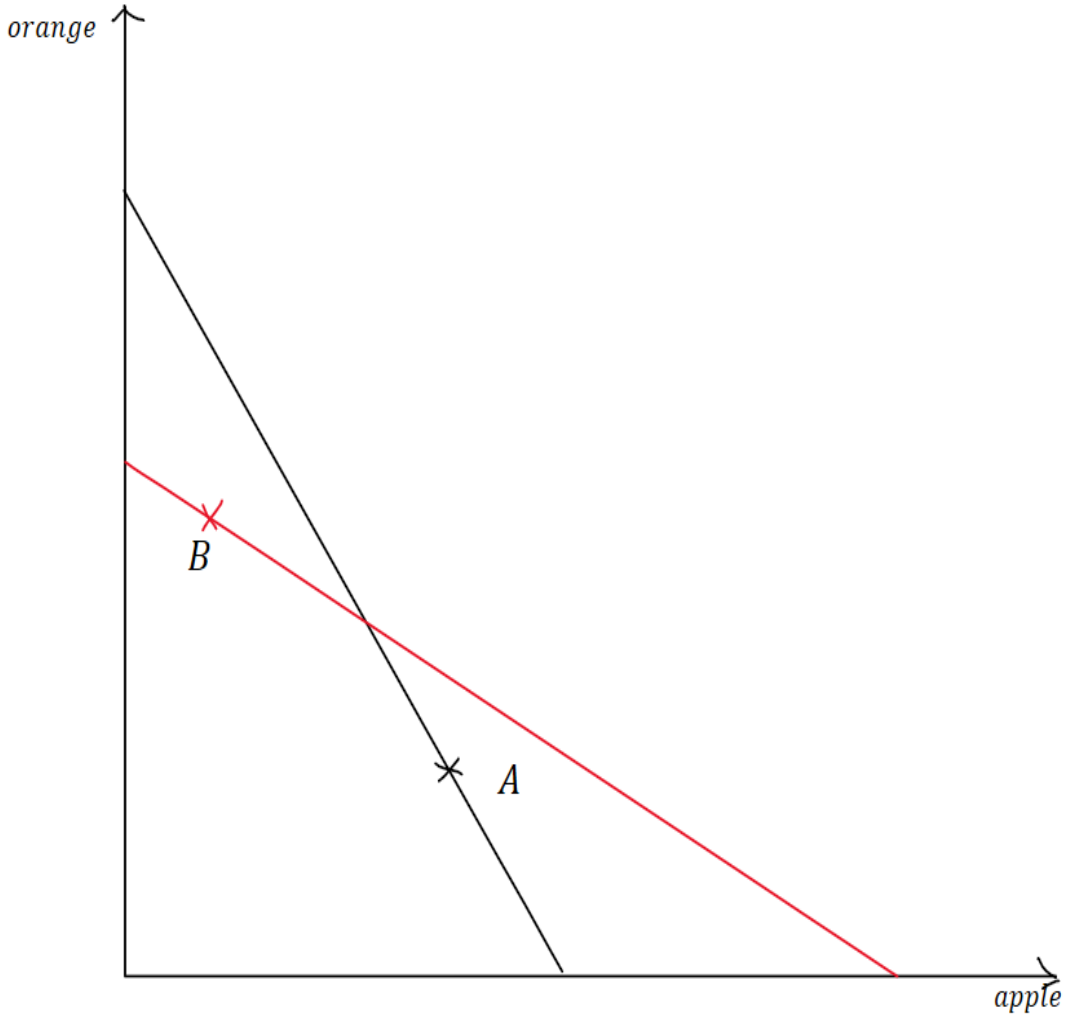
Move from pure choice to mathematical models

- Suppose one gets data that shows 100kgs of tomatoes were purchased in a certain locality – can we say that this population preference is tomatoes and they assign a higher utility to it?
- That is, preferences and utility functions have no independent existence from choices

- *but in this assumption what is the data analyser missing?*

pause

WARP (Weak Axiom of Revealed Preference) – the bottle & pebles play



- When A was chosen B was strictly inside the black set
- $A \succ B$
- But when B was chosen A was strictly inside the red set
- $B \succ A$
- WARP implies both can't true together

Why WARP?

- If WARP holds true then the choice can be presented by a utility function
- Actually there are infinitely many utility functions
- Functional form is irrelevant
- Do not need a theory of satisfaction

Is WARP enough?

- What if..
  - A is chosen when B is available but C is not available
  - B is chosen when C is available but A is not available
  - C is chosen when A is available but B is not available
- Forms a cycle of preferences
- Does not violate WARP

Money pump

- S prefers
  - Vanilla $\succ$ Chocolate
  - Chocolate $\succ$ Strawberry
  - Strawberry $\succ$ Vanilla
- If S has Vanilla, offer her Strawberry for 1 rupee
- If S has Strawberry, offer Chocolate for 1 rupee
- If S has Chocolate, offer her Vanilla for 1 rupee
- We created a money pump out of S!

GARP (Generalized Axiom of Revealed Preference)

- Excludes cycles
- If $A \succcurlyeq B$ and $B \succcurlyeq C$ then $A \succcurlyeq C$
- Rational theory of choice $\equiv$ no money pump

Problems with Axiomatic Approach

- Since Pareto Economics taken axiomatic approach
- We do not need to know how people choose something but what they chose
- No need to rely on psychological models
- Many relevant behavior remains unexplained
- Serious implications for policy making

From Micro to Macro

- Arrow-Debrue Model
- Model of markets with individual preferences
- General Equilibrium: explains all transactions in an economy

Lucas Critique

- If policy makers do not understand preference then policies can fire back
- Macro welcomed *micro foundation*
- Most recent macro models are based on GE framework
- Recent developments include stochasticity and heterogeneity

Expected Utility

- Stochasticity is crucial for many markets
- Von- Neuman and Morgenstern: brought EU back
- More general utility function capturing risk attitude
- Independence: axiom when an irrelevant alternative is added to all options, choices do not change
- Without independence EU fails

Allais Paradox

Experiment 1				Experiment 2			
Gamble 1A		Gamble 1B		Gamble 2A		Gamble 2B	
Winnings	Chance	Winnings	Chance	Winnings	Chance	Winnings	Chance
$1 million	100%	$1 million	89%	Nothing	89%	Nothing	90%
		Nothing	1%	$1 million	11%		
		$5 million	10%			$5 million	10%

- Most people choose Gamble 1A and 2B
- Violates Independence

Enter Behavioral Economics

- First generation of BE: criticism of EU
- Kahneman and Tversky
- Multiple experiments show independence fails
- Especially problematic
  - when probability are very small or very large
  - Zero is involved
  - Loss is involved

Recent models of Decision-making

- Agents face various cognitive and other psychological constraints
- Preferences are not always *rational*
- Choice reversal are common empirical phenomenon
- Many choices are too complex
- People often do not understand implications of complex choices
- Theory of *constrained* rationality of choice