Lecture 1: Classical economics

Alice Hutchings, Richard Clayton

with many thanks to Ross Anderson
Overview

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Classical economics
Prices and markets
Supply and demand
Efficiency, welfare and justice
Why do you think Economics, Law, and Ethics is important to you, as a computer scientist?
Why teach this course?

- Systems: economics used in protocol design, congestion control, mechanisms like blockchain...
- Theory: the combinatorial auction is now seen as the archetypal complexity-theory problem
- Professional: over half of you will become entrepreneurs or go into consultancy, management
- Law: what can make you liable online?
- Ethics: how can you navigate the many grey areas?
- Course accreditation: requirement for CS
Aims and Objectives

**Aims**: introduce you to basic concepts in economics, law and ethics

**Objectives**: On completion of this course, students should be able to:

- Reflect on and discuss professional, economic, social, environmental, moral and ethical issues relating to computer science
- Define and explain economic and legal terminology and arguments
- Apply the philosophies and theories covered to computer science problems and scenarios
- Reflect on the main constraints that markets, legislation and ethics place on firms dealing in information goods and services
Outline

• Classical economics
• How information markets are different
• Market failures and behavioural economics
• Auction theory and game theory
• Principles of law
• Law and the Internet (Richard Clayton)
• Ethics
• Contemporary ethical issues
Assessment

Summative assessment
Two examination questions in Paper 7
Essay style
https://www.cl.cam.ac.uk/teaching/exams/pastpapers/t-EconomicsLawandEthics.html

Formative assessment
Supervisions
Interacting with your peers
Resources

• Shapiro and Varian “Information Rules”
• Hare “Technology is not neutral”
• Optional further reading:
  – Links to various articles on the course materials site
  – Varian “Intermediate Microeconomics”
  – Adam Smith, “The Wealth of Nations”
  – Richard Thaler, “Misbehaving”
  – William Poundstone, “Prisoners’ Dilemma”
  – Steven Pinker, “The Better Angels of our Nature”
  – Nuffield Bioethics Council report on biodata
Studying a humanities subject

It’s not like learning to prove theorems or program in Java, which gives a testable skill.

Wide reading is important – ideas become clearer when approached from several perspectives.

College libraries are a good place to start.

Dig into some subproblem that interests you.

Work out different viewpoints: how would a socialist / Keynesian / environmentalist / libertarian approach a problem of interest?
Roadmap

• Economics as a subject is traditionally made up of macroeconomics, microeconomics and specialised topics

• ‘Macro’ is about the performance and structure of the global economy or a nation or region. It’s about models of employment, inflation, growth, investment, trade, savings, credit, tax, GNP…

• We will touch on this only occasionally
Roadmap (2)

• Microeconomics or ‘micro’ is about how individuals and firms react to incentives, how market mechanisms establish prices, and the circumstances in which markets can fail

• Many topics of interest to computer scientists & engineers include game theory, the economics of information, the economics of dependability, and behavioural economics (economics + psychology)

• Our tools range from mathematical models to empirical social science
Classical economics

- Interlocking models of consumption, production, labour, finance, etc., in a world of free competition
Prices and markets

<table>
<thead>
<tr>
<th>Consider</th>
<th>As an introduction to theories of prices, consumers and markets, consider an idealised market for flats in Cambridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplify</td>
<td>Simplify to two types – one-bed flats in town, or house-shares in Cherry Hinton. People who can afford flats will rent them, and those who can’t will cycle to distant house-shares instead</td>
</tr>
<tr>
<td>Assume</td>
<td>Assume that there are 1000 flats to rent, and that people vary in their ability / willingness to pay</td>
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</tbody>
</table>
Accommodation market

• So there might be 1 person prepared to pay £2000, 300 prepared to pay £1000, 1000 prepared to pay £500…
• With 1000 flats to let, the market equilibrium price \( p^* \) is where the supply and demand curves cross, i.e. £500
Monopoly

- One seller or producer of a particular good or service, dominating and controlling the entire supply
- Significant market power and control over pricing
- Price maker, has the power to set prices
• If the market is rigged, the cartel might restrict supply – 800 flats at £700 pm can earn more than 1000 at £500 pm
• This is inefficient! (there are empty flats which people would pay to rent)
• How can we formalise this?
Efficiency

• A monopolist might leave some flats empty despite people being prepared to pay for them
• Definitions
  – A *Pareto improvement* is a way to make some people better off without making anyone worse off
  – A *Pareto efficient allocation* is such that no Pareto improvement is possible
• This is weak: pure monarchy and pure communism are both Pareto efficient!
• Anyway, is there any way for the monopolist to find a Pareto efficient allocation?
Discriminating monopolist

• If you know what everyone can pay, charge them just that!
• This arrangement is Pareto efficient!
• The monopolist captures all the consumer surplus …
Consumer surplus

- Consumer surplus is the total amount people saved on their reservation price
- Ordinary monopoly: green area left to consumers
- The monopolist diminished surplus by A and B
- The discriminating monopolist gets the lot!
The marginalist revolution

Until 1871, no-one had a good theory of supply and demand. Why are essentials like water cheap, while diamonds are expensive?

Solution: the value of the last and least wanted addition to your consumption of a good sets its value to you (Karl Menger, Stanley Jevons, 1871)

Shifted thinking from costs of production to demand, and led to ‘classical synthesis’ of Marshall and others – interlocking models of consumption, production, labour, finance etc in a world of free competition
Utility

- Utility: Preferences, or how much consumers value a good or service
- Marginal Utility: The additional satisfaction or value that an individual derives from consuming an additional unit of good or service
- Law of Diminishing Marginal Utility: As an individual consumes more of a particular good, the additional satisfaction from each successive unit tends to decrease
Supply and demand

- Suppose a local coal market in 1840 had three typical suppliers / customers

<table>
<thead>
<tr>
<th>Suppliers (price)</th>
<th>Customers (price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea coal gathering (8s)</td>
<td>Blacksmiths (15s)</td>
</tr>
<tr>
<td>Small deep mine (5s)</td>
<td>Households (8s)</td>
</tr>
<tr>
<td>Open-cast mine (2s)</td>
<td>Export (3s)</td>
</tr>
</tbody>
</table>

- The market price determines who produces and who consumes
- It’s determined by the marginal transaction
- It fluctuates with demand (weather) and can evolve in the long term with tech, investment…
• Assuming functions well-behaved, we can get a consumer’s demand from their utility or vice versa
• Market demand is the sum of demand over consumers
• In general, a price change will have a substitution effect (if beer goes up, drink more wine) and an income effect (if rent goes up, you’re poorer), but at the level of this course, we can ignore this…
Supply

- Firms typically have fixed costs and variable costs, so the average cost of goods initially falls with output.
- The variable costs typically rise at some point (overtime etc) and eventually rise sharply due to capacity constraints.
- Thus the supply curve typically takes the above convex shape, at least in the short run (static analysis).
Cost evolution

- In the long run, firms can fix capacity constraints by building more factories.
- This gives nearly constant fixed costs and thus constant returns to scale as the firm / industry expands.
Firm supply

- In a competitive market, firms are price takers
- The demand curve faced by each firm is in black – at any price above p*, demand is zero, while at any price below p*, the firm would face all the demand
- The firm’s profit is maximised when it sets output so that its marginal cost equals the price p*
Putting it all together

- In the classical synthesis, prices are set where supply and demand curves intersect in competitive markets.
- Key: $p^*$ will be the marginal cost of the marginal supplier.
- Similar models apply in markets for labour etc.
- Intrinsic advantages of non-marginal suppliers (e.g. easily mined coal, good farmland) get built into rental values.
- By 100 years ago, people thought they understood the ‘invisible hand’ and just had to guard against monopoly.
Equilibrium (1)

- Studying supply and demand for one good is ‘partial equilibrium analysis’. ‘General equilibrium analysis’ adds in labour, capital etc.
- First theorem of welfare economics: market equilibrium is Pareto optimal.
- Second theorem: any Pareto optimal allocation can be achieved by market forces provided preferences are convex.
Equilibrium (2)

- Arrow and DeBreu, 1948. Technical conditions include rational actors, property rights, complete information, no transaction costs … (assumptions often broken in practice)
Efficiency, welfare and justice (1)

• Efficiency does not imply justice! Giving the king all the money is Pareto efficient
• Different theories of justice are consistent with different welfare functions
  – $W = \sum U_i$ is classical utilitarian welfare
  – $W = \min U_i$ is Rawlsian welfare – that of the most miserable citizen
Efficiency, welfare and justice (2)

- Pigou: diminishing marginal utility of money means that transferring £1 from a rich man to a poor one will generally increase welfare
- But no perfect way to aggregate personal choices into social welfare that’s consistent with democracy!
Transaction costs

• Trades are not free! Time & effort; commissions; search; bargaining; policing and enforcement
• Ronald Coase (1937): why do some sectors have large companies, and others small ones? External transaction costs higher than internal ones
• Jensen-Mockling (1976): agency costs within firms also matter hugely
• Oliver Williamson (1980s-90s): incomplete contracts: frequency, specificity, uncertainty, limited rationality, opportunistic behavior
• So should tech make firms smaller on average?