Economics, Law and Ethics

Part IB CST 75%, Part II CST 50%

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with many thanks to Ross Anderson

Overview

- Introduction:
  - Aims and objectives
  - Outline
  - Resources
  - Roadmap
- Classical economics:
  - Prices and markets
  - Basic consumer theory
  - 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: ethics now mandatory for CS and economics for engineers

Aims and Objectives

- Aims: introduce you to basic concepts in economics, law and ethics
- Objectives: at the end, you should have a basic appreciation of economic and legal terminology and arguments; understand some of the applications of economic models to systems engineering and their interest to theoretical computer science; and understand the main constraints that markets, legislation and ethics place on firms dealing in information goods and services

Outline

- Classical economics and consumer theory
- 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

Resources

- Shapiro and Varian “Information Rules”
- Varian “Intermediate Microeconomics”
- Course website, plus as further reading:
  - Adam Smith, “The Wealth of Nations”
  - Richard Thaler, “Misbehaving”
  - JK Galbraith, “A History of Economics”
  - William Poundstone, “Prisoners’ Dilemma”
  - Steven Pinker, “The Better Angels of our Nature”
  - Nuffield Bioethics Council report on biodata

Moodle

- Platform for dialogue with me, and with each other
- Place to ask questions and engage with the material

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 / Keynsian / environmentalist / libertarian approach a problem of interest?
- Write proper essays!

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

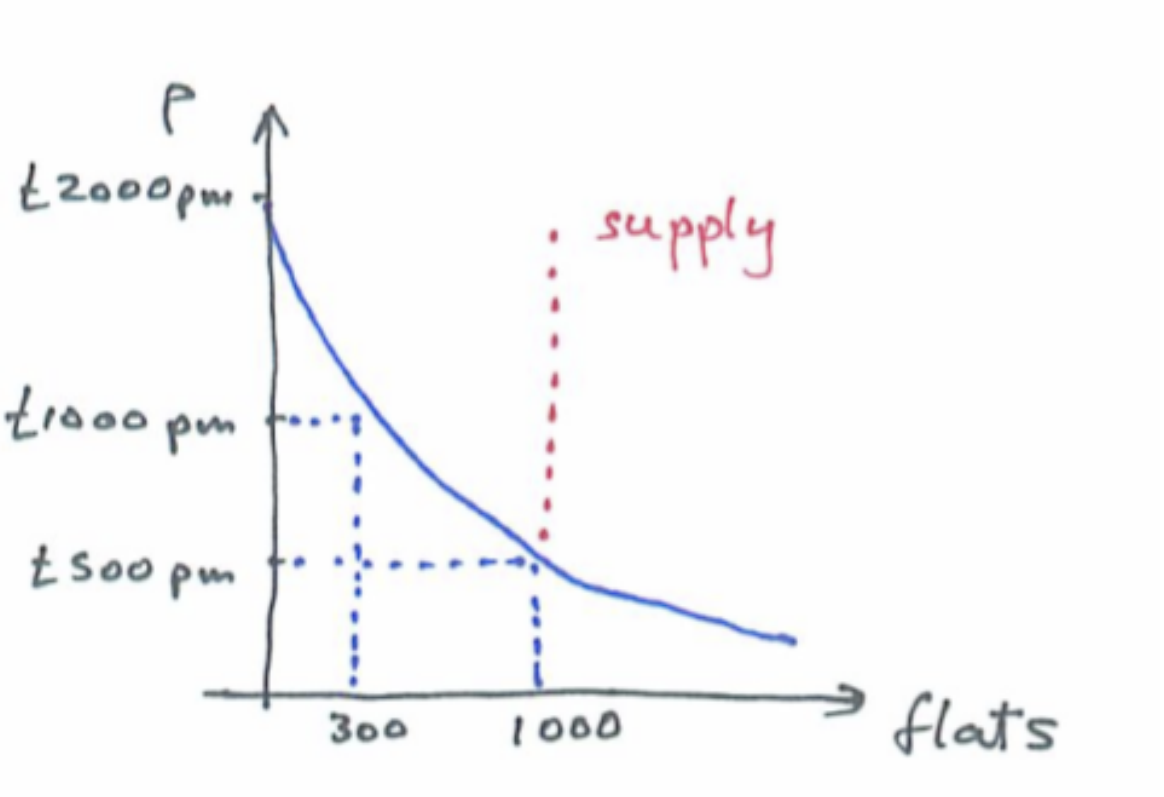
Classical economics

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

Prices and markets

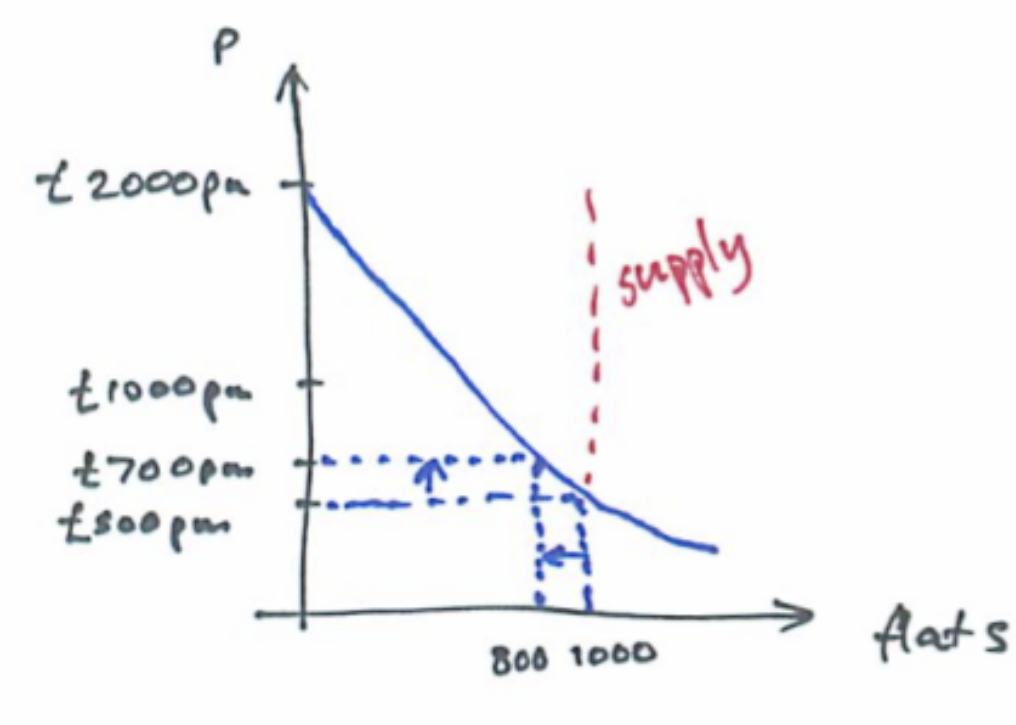
- As an introduction to theories of prices, consumers and markets, consider an idealised market for flats in Cambridge
- Simplify to two types – one-bed flats in town, or house-shares in Cherry Hinton. People who can afford flats will rent them, and those who can't will cycle to distant house-shares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

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

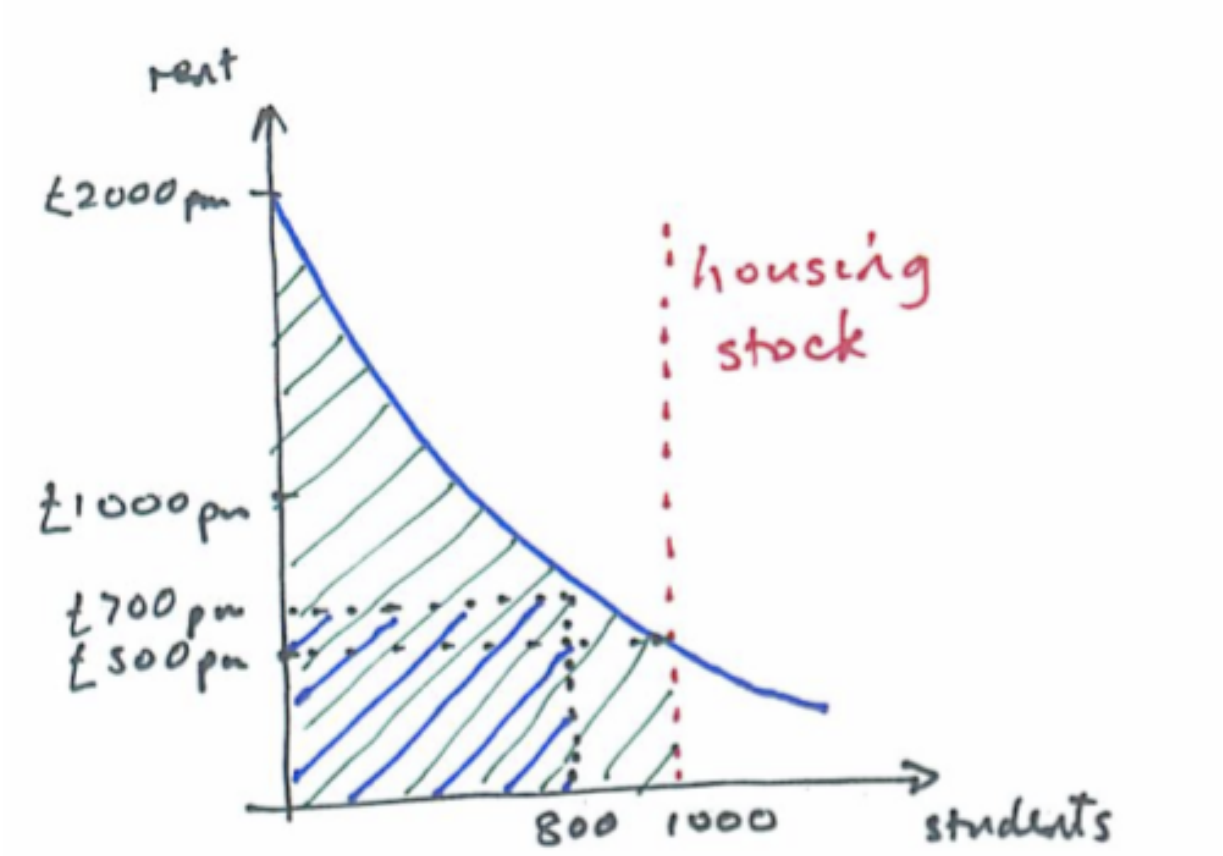


- If the market is rigged, the cartel might restrict supply – 800 flats at £700 pm can earn more than 1000 at £500 pm
- This is inefficient! (there are empty flats which people would pay to rent)
- How can we formalise this?

Efficiency

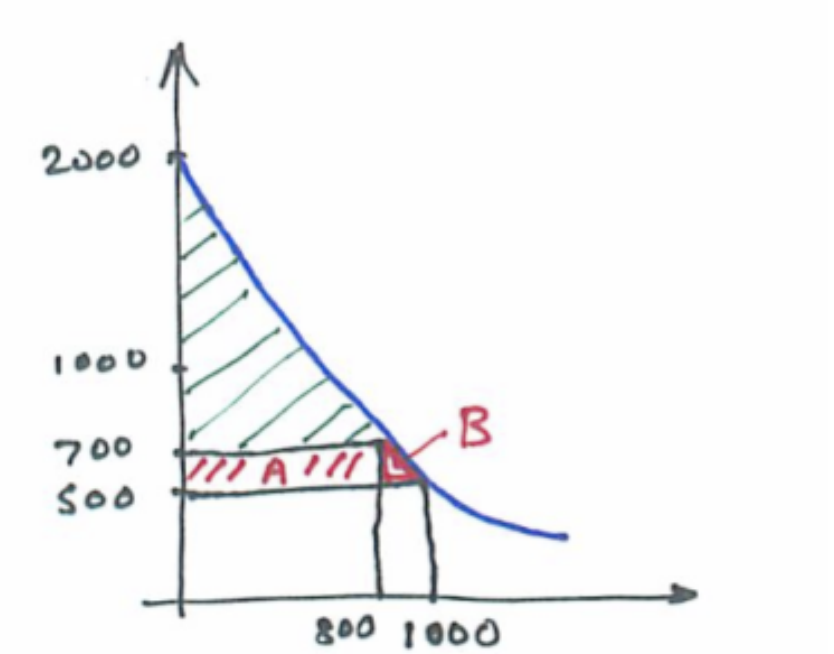
- A monopolist might leave some flats empty despite people being prepared to pay for them
- Definitions
  - A *Pareto improvement* is a way to make some people better off without making anyone worse off
  - A *Pareto efficient allocation* is such that no Pareto improvement is possible
- This is weak: 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 …

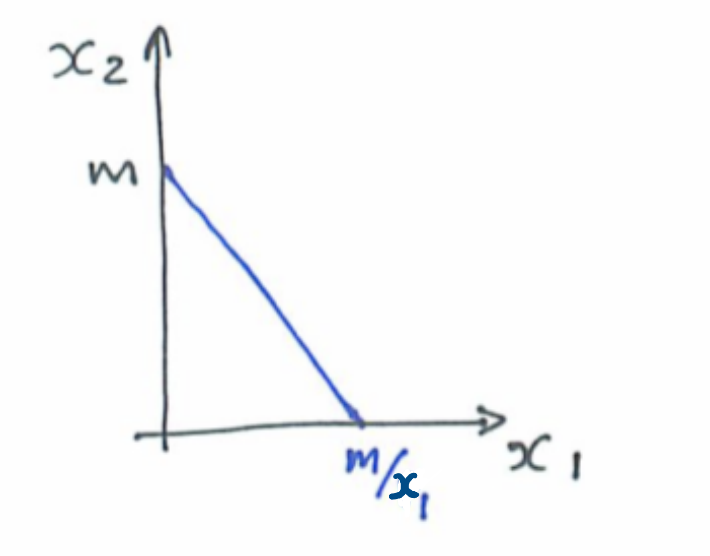
Consumer surplus



- 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!

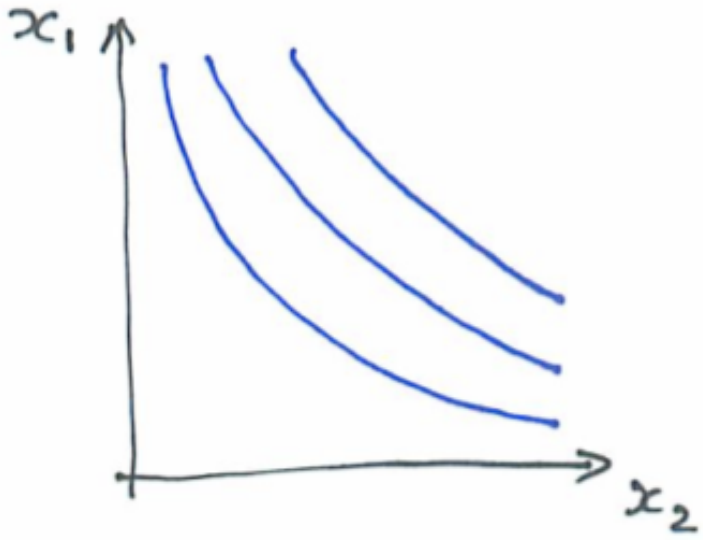
Basic consumer theory

- Examines mechanisms of choice
- Consumers choose 'best' bundle of goods they can afford
- Most of the time, two goods are enough – say books versus everything else
- Assuming a budget constraint m, $p_1x_1 + p_2x_2 \leq m$
- This gives a line on which choices must lie



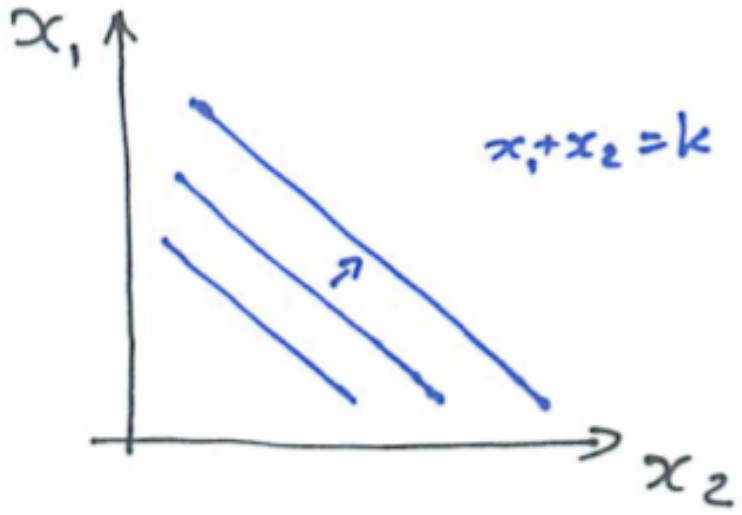
Preferences

- We draw 'indifference curves' or 'isoquants' joining mutually indifferent points – that is, where the consumer prefers bundle (x_1, x_2) equally to (y_1, y_2)
- We assume they're well behaved – the curves don't cross. I.e. if (x_1, x_2) is preferred when (y_1, y_2) is affordable, then when (y_1, y_2) is preferred, (x_1, x_2) is not affordable (the 'weak axiom of revealed preference')



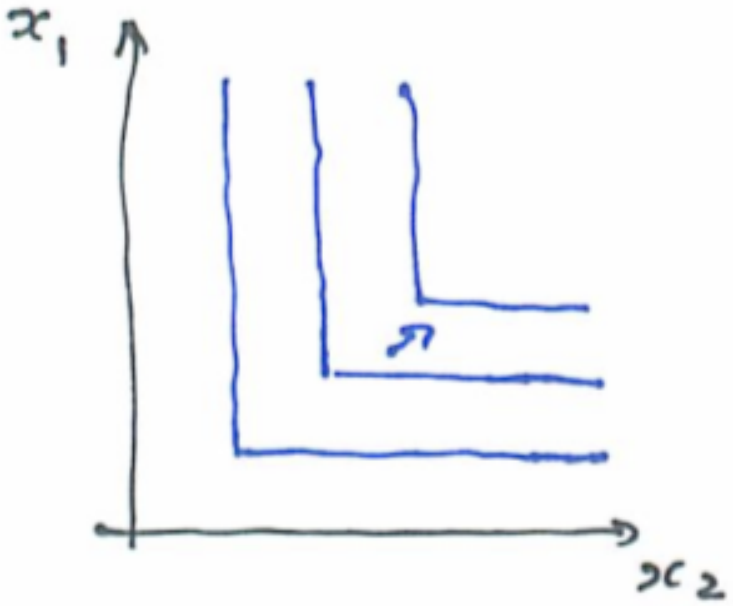
Perfect Substitutes

- Sometimes I just don't care at all whether I have good 1 or good 2
- E.g.: Tesco's sugar or Sainsbury's sugar
- Such goods are called perfect substitutes



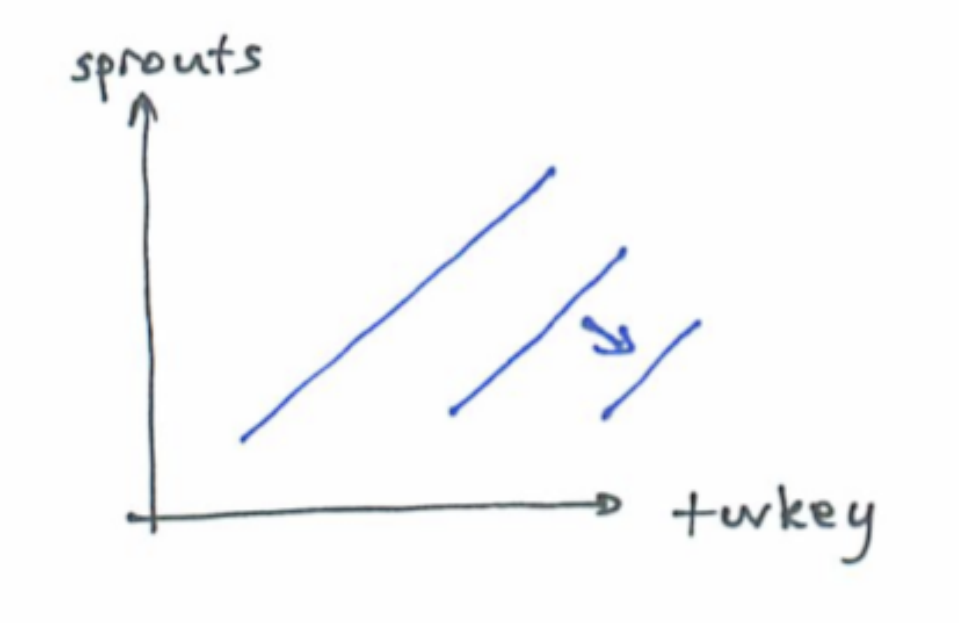
Perfect Complements

- Sometimes I want exactly the same quantity of good 1 and good 2
- E.g. left shoes and right shoes
- Such goods are called perfect complements



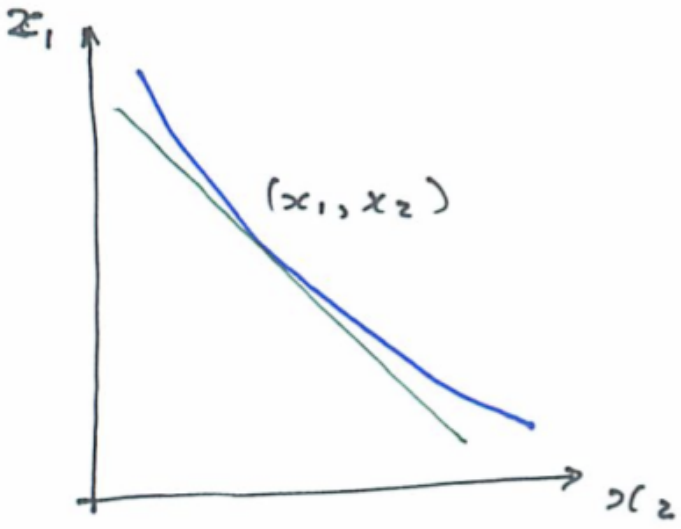
Bads

- There are some goods I'd rather avoid!
- But sometimes I have to consume some of a bad in order to enjoy some of a good



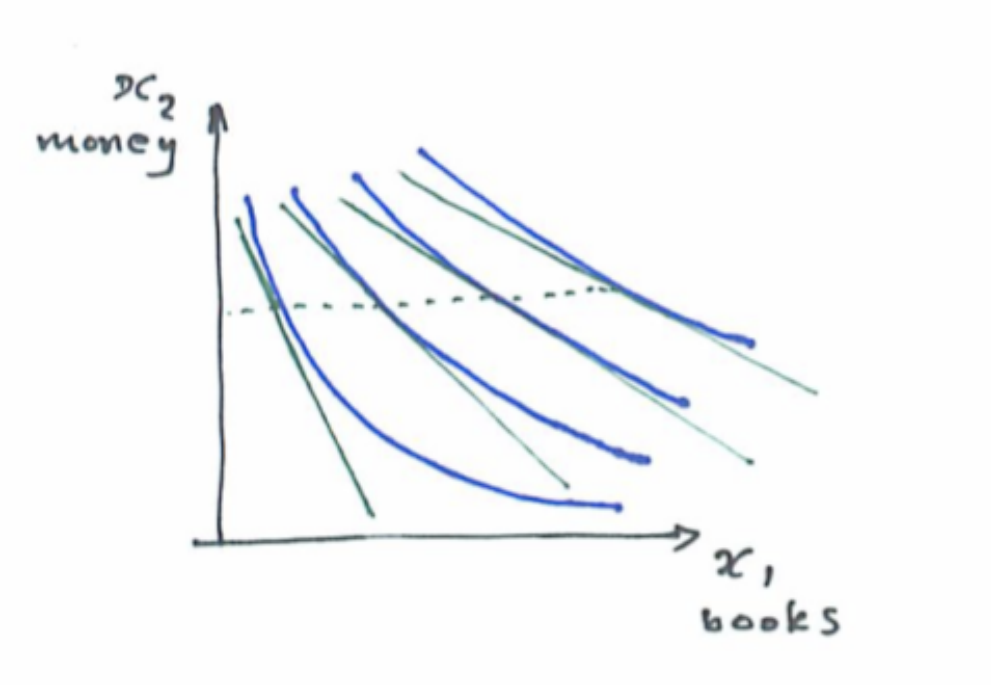
Marginal rate of substitution

- The tangent to an isoquant gives the marginal rate of substitution (MRS)
- This is the exchange rate at which the consumer will trade the two: MRS = $\Delta x_1/\Delta x_2$
- Convex curves: you're more likely to trade the good if you have more of it



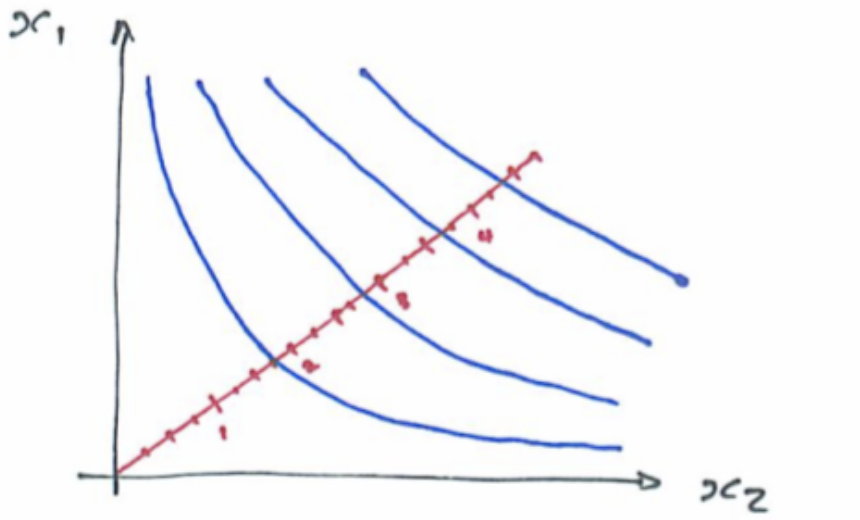
Diminishing MRS

- The more you have of x_1 relative to x_2, the more likely you are to trade x_1 for x_2, in the strictly convex case
- i.e. you become less willing to pay for 'one more'



Utility

- Often indifference curves can be parametrised
- Marginal utility $MU_1 = dU/dx_1$
- Then $MRS = -MU_1/MU_2$
- Utility functions can be useful for describing consumer choices
- They can often be inferred from shopping behaviour, and answer questions about the value of better / faster / …



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

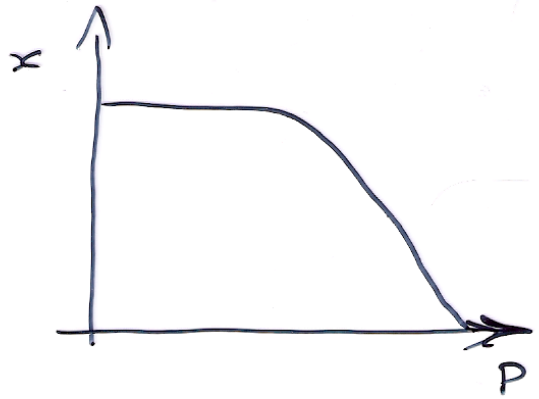
Concrete example

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

Sea coal gathering 8s	Blacksmiths 15s
Small deep mine 5s	Households 8s
Open-cast mine 2s	Export 3s

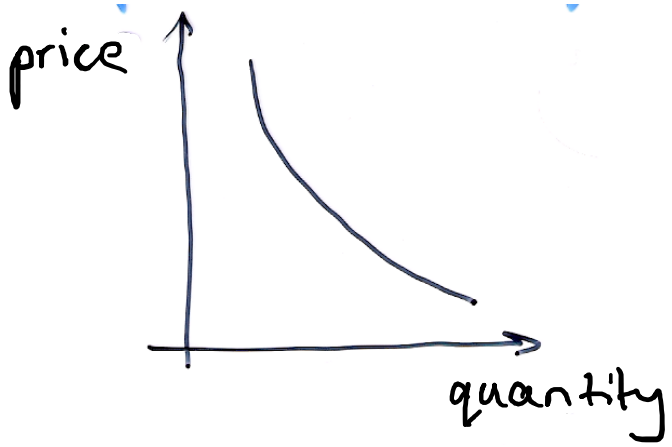
- The market price determines who produces and who consumes
- It's determined by the marginal transaction
- It fluctuates with demand (weather) and can evolve in the long term with tech, investment…

Demand



- 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)
- At the level of this course, we can ignore this…

Elasticity

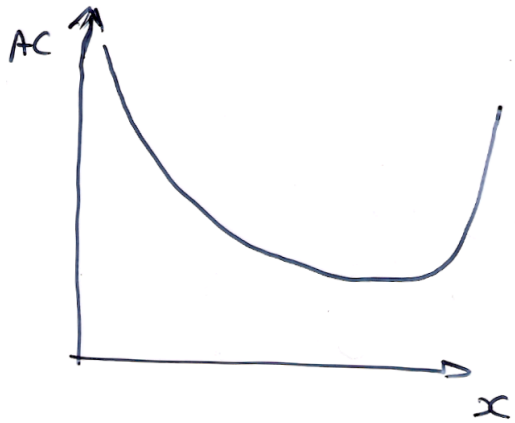


- Given a market demand curve, elasticity measures the effect on demand of a small change in price
- Formally, $\varepsilon(p) = (\Delta q/q)/(\Delta p/p) = p\Delta q/q\Delta p$
- Elasticity = 1 means there are likely to be substitutes
- Revenue $R = pq$, so

  $\Delta R/\Delta p = q + p\ \Delta q/\Delta p$

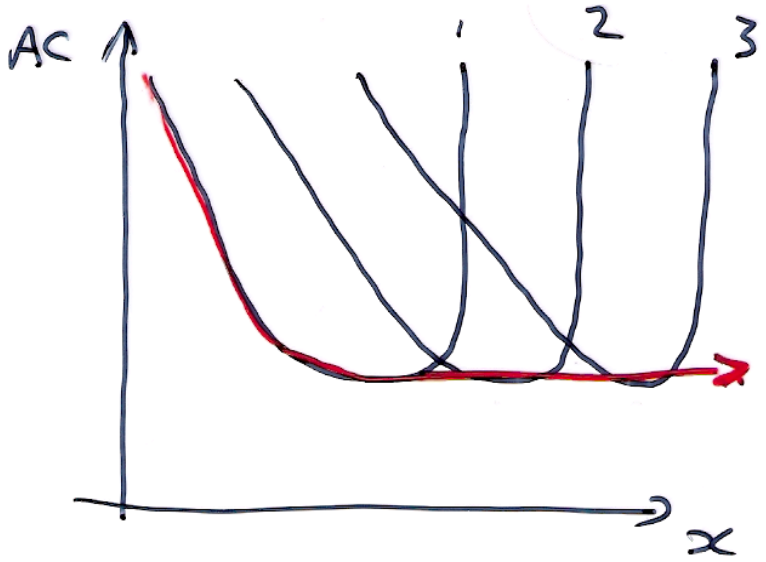
  $= q\ (1 + \varepsilon(p)\ ) = q\ (1 - |\varepsilon(p)|\ )$
- Key fact: price increases boost revenue iff $|\varepsilon(p)| < 1$

Supply



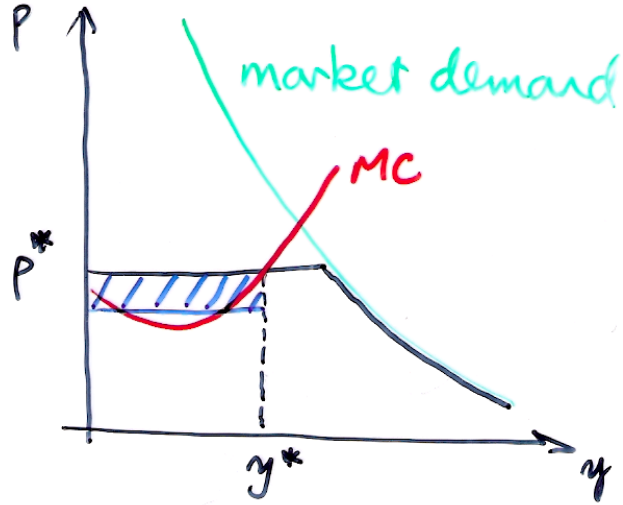
- Firms typically have fixed costs and variable costs, so the average cost of goods initially falls with output
- The variable costs typically rise at some point (overtime etc) and eventually rise sharply due to capacity constraints
- Thus the supply curve typically takes the above convex shape, at least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

Cost evolution



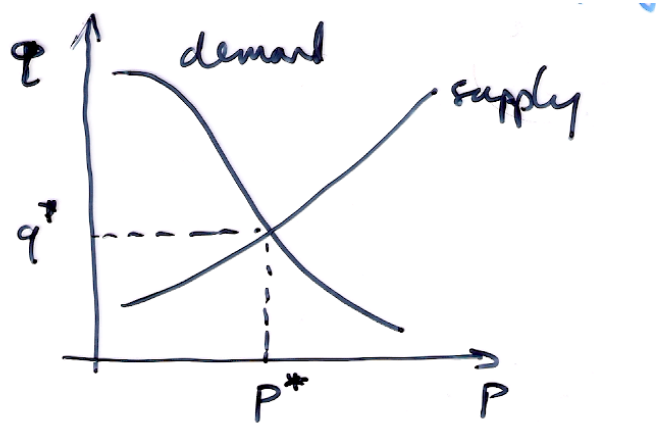
- In the long run, firms can fix capacity constraints by building more factories
- This gives nearly constant fixed costs and thus constant returns to scale as the firm / industry expands

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

- 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
- Arrow and DeBreu, 1948. Technical conditions include rational actors, property rights, complete information, no transaction costs … (more later)

Efficiency, welfare and justice

- 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
- Pigou: diminishing marginal utility of money means that transferring £1 from a rich man to a poor one will generally increase welfare
- But – there's a methodological problem!

Efficiency, welfare and justice (2)

- Composing utilities into welfare is hard!

	A	B	C
First	X	Y	Z
Second	Y	Z	X
Third	Z	X	Y

- Arrow's impossibility theorem says there is 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?