Can you design a market?

Three students, three schools, one seat each, no prices. First come, first served leaves a pair who would both rather switch. Gale and Shapley's rule, deferred acceptance, leaves nobody wishing to switch, and it now matches new doctors, high-school students and kidney donors. The course closes with its eleven ideas.

1 A market without prices

the second question

- Lessons 1-10 ⇒ buyers who know what they want (1-4) · sellers who know costs (5) · a price not simply taken (6-7) · honest information (8) · stops where nobody gains without a loss (9) · unless someone else pays (10)
- Second question ⇒ no price wanted (school places, first jobs for doctors, kidneys) ⇒ still a **good match**?
- **Matching** = pairing two sides by their lists, best first, **no price**
- **Repugnant** trades = so distasteful they are banned (Alvin Roth, US economist, **2007**) ⇒ paying for a kidney banned in most countries · for a price: more donors, lives saved · against: the poor pushed to sell, the rich skip the queue ⇒ **no verdict**

2 Blocking pair

first come, first served

Students	`Nadia: Harbor › Hill › Lagoon · Omar: Harbor › Lagoon › Hill · Lia: Hill › Harbor › Lagoon`
Schools	`Harbor: Omar › Nadia › Lia · Hill: Nadia › Lia › Omar · Lagoon: Nadia › Omar › Lia`

- First come ⇒ Nadia → Harbor · Omar → Lagoon · Lia → Hill ⇒ Omar ranks Harbor above Lagoon **and** Harbor ranks Omar above Nadia
- **Blocking pair** = a student and a school who would **both** rather be together than with what they got ⇒ the match falls apart
- **Stable matching** = **no** blocking pair · ≠ everyone's first choice
- Practice · doctors Ravi, Sofia, Tom · hospitals Bay, Cliff, Fern ⇒ first come: Tom → Cliff (his last) ⇒ **Tom + Bay** block · 1 pair is enough

3 Deferred acceptance

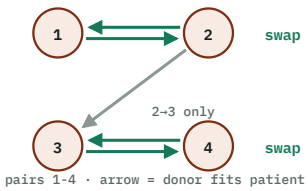
Gale and Shapley, 1962

- **1.** each asks the top choice not yet tried ⇒ **2.** each school **holds** its best asker, turns the rest away ⇒ **3.** the turned away ask again ⇒ until nobody is turned away · holds final only at the end = **deferred**
- Lesson ⇒ Harbor holds Omar, drops Nadia · Hill holds Nadia, drops Lia · Lia → Harbor no → Lagoon ⇒ **Harbor–Omar · Hill–Nadia · Lagoon–Lia** · stable · Lia gets her last
- David **Gale** and Lloyd **Shapley**, Americans, paper on college admissions, **1962**
- Asking side ⇒ **truth is best**, no gain from lying (US mathematicians Dubins and Freedman 1981; Roth 1982) · holding side can sometimes gain · no stable rule honest for both
- Practice ⇒ **the side that asks gets its best stable match** · doctors ask: ranks `1 + 2 + 2 = 5` · hospitals ask: `3 + 3 + 3 = 9`

4 Designed markets

Nobel 2012 · 2020

- **New doctors** (US) ⇒ central match since early **1950s** · Roth **1984**: its rule = deferred acceptance · since **1998** the doctors ask
- **High schools** ⇒ New York City **2003-04**, 90,000+ students a year · Boston a little later
- **Kidney exchange** = patient + donor who does not fit ⇒ two pairs **swap** donors · Roth and colleagues **2004**, New England · practice: 0 alone ⇒ `1↔2, 3↔4` ⇒ **4** kidneys · only 2 pairs ⇒ 0
- Shapley and Roth ⇒ Nobel **2012** "theory of stable allocations and the practice of market design"
- **Auction** = designed, **with** prices · US radio licenses **1994** · Paul Milgrom and Robert Wilson, US economists ⇒ Nobel **2020** (Games 7)



5 What a market needs

idea 11 of 11

- Roth ⇒ **thick** (enough people on both sides) · **uncongested** (time to compare offers) · **safe** (no gain from lying)
- Prices ⇒ strawberries, a used scooter · matching ⇒ school places, doctors' jobs, kidney exchange · auction ⇒ radio frequencies, ad slots
- **Eleven ideas behind the curves** · `1 · A demand curve is a chain of best bundles` `2 · A price change is two effects: substitution and income` `3 · Selling what you own is the same choice` `4 · Risk has a price: the risk premium` `5 · Cost curves come from the cheapest mix of inputs` `6 · A seller with many prices takes the buyers' surplus` `7 · Rivals answer each other's quantities: more firms, lower price` `8 · When one side knows more, the market shrinks` `9 · Trade stops where nobody can gain without a loss` `10 · A public good needs everyone's benefit added; a river needs an owner or a rule` `11 · Some markets are designed, not left alone` · at university: market design

Watch out: stable ≠ everyone gets a first choice · stable = **no blocking pair** · a switch needs **both** sides to gain · market design ≠ no prices (auctions)