Markets and Information (continued)

CSC200 Lecture 45

Winter 2015

CSC200: Lecture 45

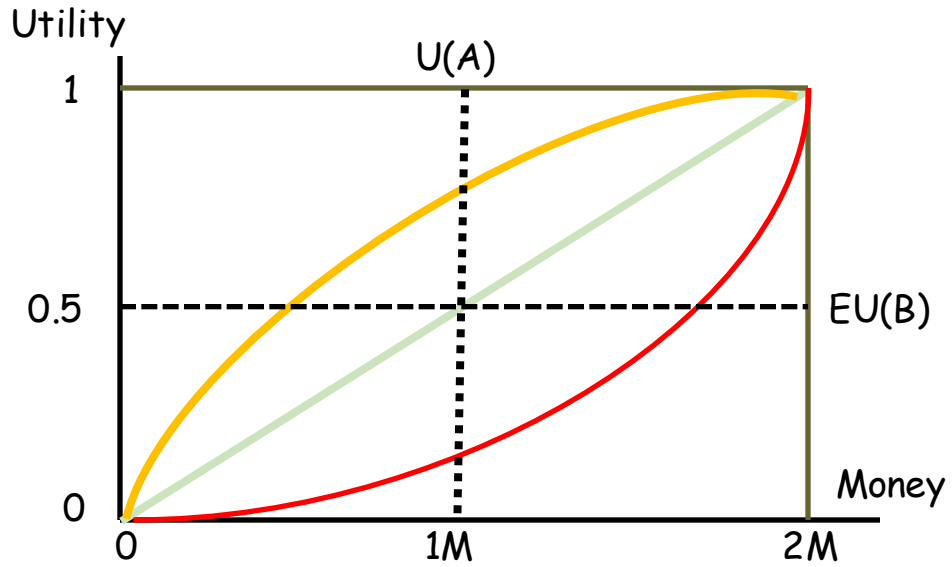
- This week:
  - Finish markets and information (Ch.22 excluding Section 22.10)
- Announcements
  - Check your marks online to make sure they are inserted correctly into the system.
  - Last tutorial this Friday will be devoted to answering questions relating to final exam.
  - I am in my office all day Monday, April 18
  - Scope of final exam: There will be multipart questions on:
    - Game theory (matrix form), stable matchings, matching markets, slot-advertising/VCG/GSP, voting rules, plus some questions on direct benefits, small worlds and Bayes rule
    - And social-affiliation networks: I forgot to mention this previously
- Good way to Review:
  - Look at any assignments and posted solutions

Markets and Information

- Brief recap of last class (see L37 Slides):
  - Markets for exogenous events
    - What is an exogenous event/desirability?
  - Prediction markets
  - Utility for money, risk attitudes, logarithmic utility
  - Optimal betting: betting your beliefs
  - Betting markets, fair odds, state prices (inverse odds)

Review of Risk Attitude (Example)

- What to choose? A: $1M or B: [(.5, $2M), (.5, 0)]
- Risk-averse person with u(w) =
  - A: U(1M) = = **0.707** B: 0.5*U(2M)+0.5*U(0) = 0.5
- Risk-neutral person with u(w) =
  - A: U(1M) = **0.5** B: 0.5*U(2M)+0.5*U(0) = 0.5
- Risk-seeking person with u(w) =
  - A: U(1M) = B: 0.5*U(2M)+0.5*U(0) = **0.5**



Stock Markets

- If we take a “fundamental” perspective on stock trading, investment in a stock can be viewed in a similar way to prediction markets.
- Investment in a stock: paying for future earnings of some company
  - ignore stock trading, ability to sell for a higher price later, time effects, etc.
  - Simple case: imagine two competing companies A, B
  - only one will survive, and provide a payout of $1 per share
  - then we can treat it as a horse race

Stock Markets

- More generally, many factors impact the payout of a stock
  - economic indicators, R&D outcomes, competitors, new entrants…
  - each outcome corresponds to a state, occurs with a certain probability
  - company value (payout) varies with state
- Thus it should be that:
  - probabilities of states (or state prices) determine current value of stock
  - current value of stock should reflect consensus estimate of state prices

Two Companies Example (1)

- Suppose just two states s_1 and s_2 (represent relative success of A, B)
- Company A pays out \$2 in s_1; \$1 in s_2 ; B pays out \$1in s_1; \$2 in s_2
- Suppose consensus estimates: $Pr(s_1) = = 0.75$ and $Pr(s_2) = = 0.25$
- First: state prices should determine value of each stock

Odds, state price of s_1

$$o_1 = {}^{1}/_{0.75} = {}^{4}/_{3}$$

$$\rho_1 = {}^{1}/_{o_1} = {}^{3}/_{4}$$

Odds, state price of s_2

$$o_2 = {}^{1}/_{0.25} = 4$$

$$\rho_2 = {}^{1}/_{o_2} = {}^{1}/_{4}$$

Value of stock A: $v_A = 2\rho_1 + 1\rho_2 = 2({}^{3}/_{4}) + 1({}^{1}/_{4}) = {}^{7}/_{4}$

Value of stock B: $v_B = 1\rho_1 + 2\rho_2 = 1({}^{3}/_{4}) + 2({}^{1}/_{4}) = {}^{5}/_{4}$

Two Companies Example (2)

- Value of stock (assuming known value of payout at each state) can determine the state prices (odds of each state)
  - In this way, we can view the price of a stock as a prediction of future outcomes.
  - More generally, they place constraints on odds of each state:

Value of stock A: $v_A = 2\rho_1 + 1\rho_2 = {}^{7}/_{4}$

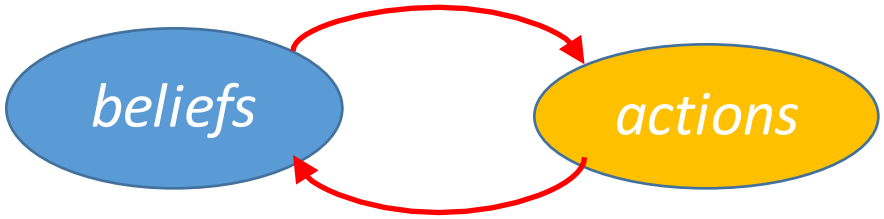
Value of stock B: $v_B = 1\rho_1 + 2\rho_2 = {}^{5}/_{4}$

Solution to linear system gives state prices:

$$\rho_1 = \frac{2v_A - v_b}{3} = \frac{3}{4} \qquad \rho_2 = \frac{2v_B - v_A}{3} = \frac{1}{4}$$

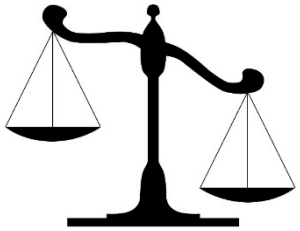
Markets with Endogenous Events

- We've seen that markets can aggregate opinions, predictions, beliefs of participants with respect to some exogenous event.
- But what if the functioning of the market impacts the event itself? i.e., what if events are endogenous?
  - In this case, people's expectations or beliefs about market actions influence the market actions themselves, which can in turn influence beliefs, which…
  - This is a form of *self-fulfilling expectations equilibrium*



Asymmetric Information

- *Asymmetric information:* one side of market has better information about the goods or services offered



- Markets with asymmetric information:
  - Used car market (sellers know more than buyers)
  - e-bay or Amazon (sellers know more than buyers)
  - Health insurance (buyers know more than sellers)
  - Stock Market (either side can have valuable info. on the future value of stock unknown to other)
- It can lead to total market failure.
- Let's start with a simple, but classic example.

The Market for Lemons

- Consider market for used cars (Akerlof 1970)
  - Two types of cars: *good, bad*
  - Sellers *know* the type of the car they sell
  - Buyers *do not know* the type of the car they buy
  - Good cars worth more than bad
  - Cars are worth more to buyers than sellers
  - Everyone knows fraction of good *(g)* vs. bad *(1-g)* cars for used cars

Car Type	*Good*	*Bad*
Value to Seller ($,000)	*10*	*4*
Value to Buyer ($, 000)	*12*	*6*
Relative Fraction	*g*	*1-g*

Symmetric Information

- Suppose *buyers also knew* if car is good or bad
- Transactions would be clear:
  - good cars would sell for anywhere between $10-12K
  - bad cars would sell for anywhere between $4-6K
  - actual prices would be determined by buyer:seller ratio
    - assuming more buyers than sellers, prices push to upper end

Car Type	*Good*	*Bad*
Value to Seller ($,000)	*10*	*4*
Value to Buyer ($,000)	*12*	*6*
Relative Fraction	*g*	*1-g*

Asymmetric Information

- Now return to "sellers know, buyers don't" scenario
- Let's assume for now that *all cars (good or bad) are up for sale*
- What is value of purchasing a car to a buyer B?
  - With probability *g,* B gets a good car, with probability *1-g* a bad car
  - Expected value of car to buyer is $12g + 6(1-g) = 6 + 6g$
  - Buyers require car prices to be $p^* \leq 6 + 6g$
- Would any transactions occur?
  - Depends on price p^* of used cars on the market
  - Good sellers require a price $p^* \geq 10$ (and bad sellers will charge same!)
  - So feasible price (for selling all cars) exists if $6 + 6g \geq 10$; i.e., $g \geq 2/3$
- What would happen if $g < 2/3$?
  - Buyers maximum price is less than 10
  - So no good sellers would sell
  - Only bad cars would hit the market!

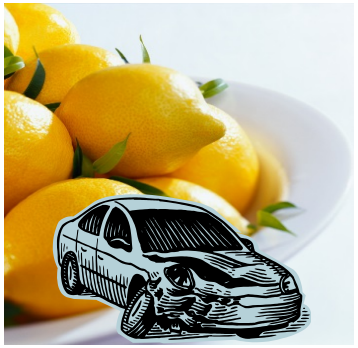
Car Type	*Good*	*Bad*
Value to Seller	*10*	*4*
Value to Buyer	*12*	*6*
Relative Fraction	*g*	*1-g*

Self-fulfilling expectations equilibria

- B knows g but not necessarily all g good cars are on market.
- So B needs to have belief on which portion of good cars are for sale
- Suppose he believes *h ≤ g of cars are good and* for sale.
- B will pay *p* ≥ 10* only if *h=g (i.e., all good cars for sale) and 2/3 ≤ g.*
- But if h < g, Then B's willingness to pay is < *10*
- But at that price no good sellers will sell, thus leaving the market.
- We have two *self-fulfilling expectations equilibria* (if *g ≥ 2/3)*
  - Both h=0 and h=g are sustainable (no other equilibrium points)
- If *g < 2/3* then only equilibrium is h=0
- *Market failure for good cars (h=0):*
  - occurs when *g < 2/3* but can also occur when *g ≥ 2/3*
  - due solely to the asymmetry in information between buyer and seller

Multiple Levels of Quality

- Generally, cars come in variable qualities, but impact is same
- Consider a simple three-quality extension
  - good cars, bad cars, and "lemons" (worthless), say, in equal proportions
  - again, sellers know quality, buyers do not
- Let's see what happens…



Car Type	*Good*	*Bad*	*Lemon*
Value to Seller ($,000)	*10*	*4*	*0*
Value to Buyer ($, 000)	*12*	*6*	*0*
Relative Fraction	*1/3*	*1/3*	*1/3*

Lemons can "Infect the Market"

- If buyers believes all cars are on the market:
  - expected value to buyers is (12+6+0)/3 = 6: max. price buyers will pay
  - less than price 10 required by good sellers, so…
  - *no good cars will be on the market:* not an equilibrium
  - note: this price would support bad sellers; except…
- If buyers believe only bad cars and lemons are on the market:
  - expected value to buyers is (6+0)/2 = 3: max. price buyers will pay
  - less than price 4 required by bad sellers, so…
  - *no bad cars will be on the market:* not an equilibrium
- Only equilibrium is for lemons to be sold: *complete market failure*

Car Type	*Good*	*Bad*	*Lemon*
Value to Seller	*10*	*4*	*0*
Value to Buyer	*12*	*6*	*0*
Relative Fraction	*1/3*	*1/3*	*1/3*

Signaling Quality

- Information asymmetry can powerfully affect the operation of a market.
- How to mitigate the effect of information asymmetry?
  - signaling quality might help.
- If seller can signal some reliable indicator of quality, it can improve the prospects of good cars
  - E.g., some dealers guarantee that a used car is a “certified used car”: checked for certain problems/defects and repaired if needed.
  - Some dealers provide short-term warranties in used cars

Labor markets

- Labor markets
  - Workers offering services of various qualities to employers
  - Workers have better idea of their skills than employers
  - Interviews help, but only partially (just like car inspection)
  - Skill-full workers can always be self-employed.
  - Information asymmetry can drive good workers out of market.
- Signaling Quality:
  - E.g., investment in education as signaling
  - Your CS degree: indication of productivity/intelligence even if you work in another area

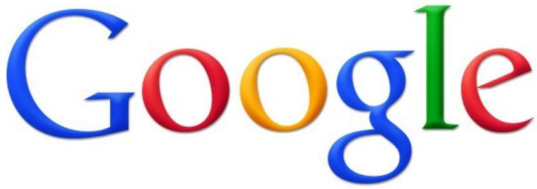
Health Insurance Market

- Insurance markets: very asymmetric information
  - Buyers of insurance: more info about their health than Insurance comp.
  - Expected payout per policy is avg. of payout to people in poor health and people in good health
- Thus people in good health *pay more than their expected return*
  - If pool of insured has many poor-health folks, may drive out some healthy people
  - So policy costs to go up, which drives out more healthy people, …
  - Soon: only people with very poor health participate
  - Insurance company charges full expected cost
  - Phenomenon known as *adverse selection.*
- How can this be mitigated in practice?

Other Issues

- Relation to crowdsourcing: think about it…
- Relation to online selling (e.g., E-Bay)
  - Reputation mechanisms
  - False-names/identities may circumvent

- Relate to ad auctions
  - Why is it in Google's interests to prevent spammers (irrelevant ad posters) from posting ads that induce a lot of clicks (hence revenue for Google)?



Wrapping up: The Big Picture

- What have we covered and how does it all fit together?
- **Types of Networks**
  - Social Networks: people interacting in various relationships
  - Affiliation Networks: people interacting with institutions
  - Physical Networks: traffic networks, internet, etc.
  - Economic Networks: trading networks, marriage markets, kidney exchange, …
  - …
- **How Networks Shape Information Flow and Behavior**
  - closure properties: how relationships spread
  - information diffusion: how information spreads
  - technology diffusion: how behaviors spread
  - epidemics: how diseases spread
  - …

The Big Picture Continued

- **Explaining Interactions at the Micro-level**
  - Game theory: how people choose behaviors: incentives, equilibria
  - Probabilistic reasoning: how evidence (personal as well as behavior of others) shapes one's beliefs
- **How Micro-interactions Manifest at Macro-level**
  - information cascades
  - positive externalities/network effects (tipping points)
  - technology diffusion *(*one of only a few with network playing a role)*
  - power laws
  - small worlds/search *(*one of only a few with network playing a role)*
  - epidemics *(*one of only a few with network playing a role)*
  - prediction markets and market failures
  - voting (both info and preference aggregation)

Discuss: There are Lots (!) of Gaps

- The influence of networks on micro-formation of beliefs and preferences, macro-level behavior is still poorly understood
  - how do social networks influence people preferences, voting behavior, economic interactions, beliefs/biases?
  - lots of current research going on: but in its infancy…
- The influence of micro-level preferences, beliefs, existing relationships on the formation of networks also poorly understood
  - how do existing relationships, beliefs, preferences all come together to influence to formation and dissolution of network ties?
  - lots of partial models, abstract mathematical models, but…
- ***Beyond*** "understanding": How do we design, shape, exploit networks to help people become better informed, form desired relationships, make better decisions, of help shape their behavior?

How can we make the course better?

- Topics
  - What would you like to see more/less of?
  - What was missing that should have been here?
- Style, emphasis:
  - Mathematical modeling/analysis
  - Algorithms, programming, computation
  - Interdisciplinary: not enough? Too much?
  - Rigor and formality…
- Background Needed
- Materials, text, slides, assignments, tests…
- CS vs. non-CS students: how do we attract more of each?

- Next year: half course focued more on economic models, game theory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