Broadening the Role & Relevance of Economics in Farmed Animal Health Management

Modeling in Animal Health Conference

ModAH

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Nantes

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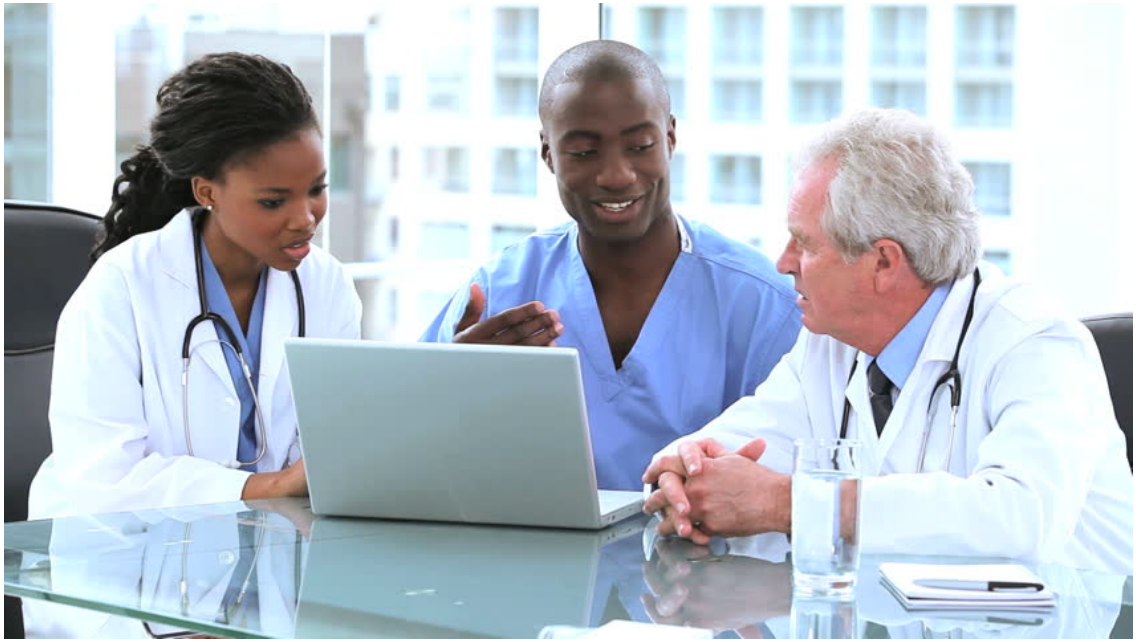
Preamble & Motivation

- Doctor acquaintance once revealed his speciality as 'Internist'
- Half confused it with 'student intern'



- Internist: specialist with broad knowledge of the main body systems, how they integrate, & what can go wrong. Consultant's consultant when puzzled in diagnosis

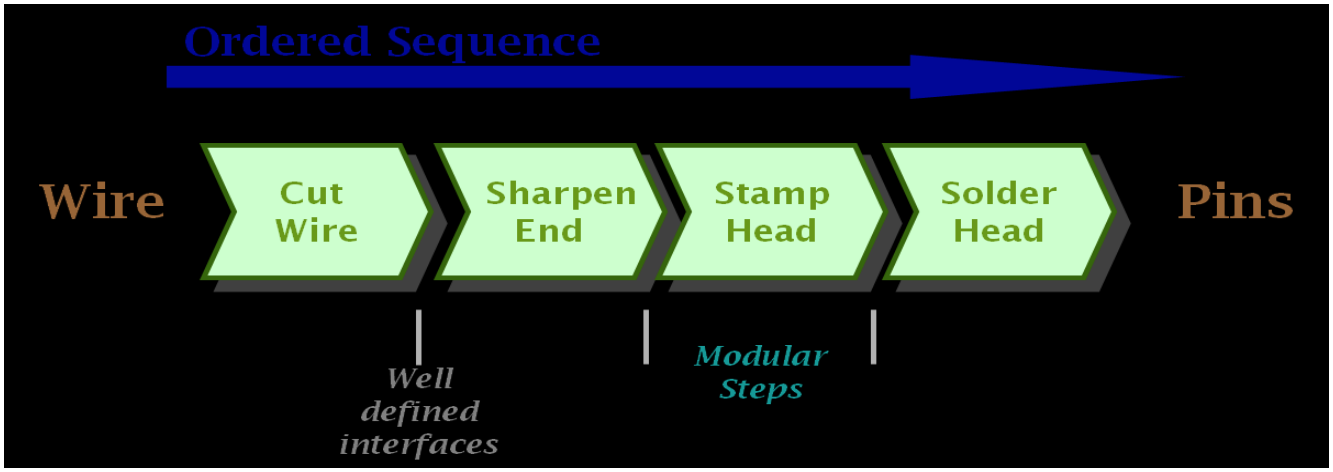
Preamble & Motivation

- ‘Systems analyst’ as opportunity for technical proficiency, ride IT wave and become boss material

- SA specialize in designing, implementing, analyzing information systems with intent to make them more user-friendly

Preamble: Adam Smith (1723-1790)

- Pin factory as depiction of gains from specialization



- ??What is the point of a factory??

- Point: task specialization in a larger endeavor opens up opportunities for cost/quality efficiencies. *Tasks not about info./analysis*
  - But then where might these efficiencies end?

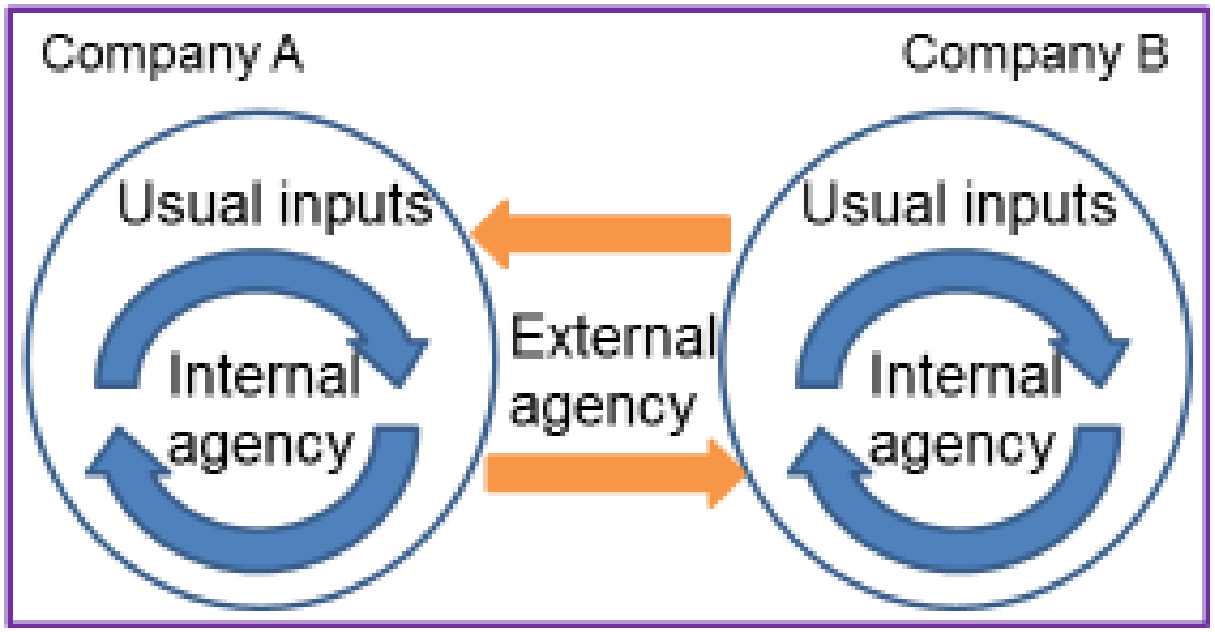
Preamble: & Ronald Coase (1910-2013)

- Like Smith, Coase was inspired by factory tour case studies, in this case 1931-1932 US Midwest

- ??What is the point of a firm??

- In picture, should there be a coal mining Co., a power production Co., & a distribution Co. or just one firm?

& RC



His answer: there are technological costs and also costs of agency/ transactions sort. **Is about info./analysis**

Agency costs: using managers as agents to run business; they have own goals. Or buying from outside; you have to communicate needs, give up trade secrets, make investments another firm might use as hostage while bargaining, etc. Or letting go workers, etc.

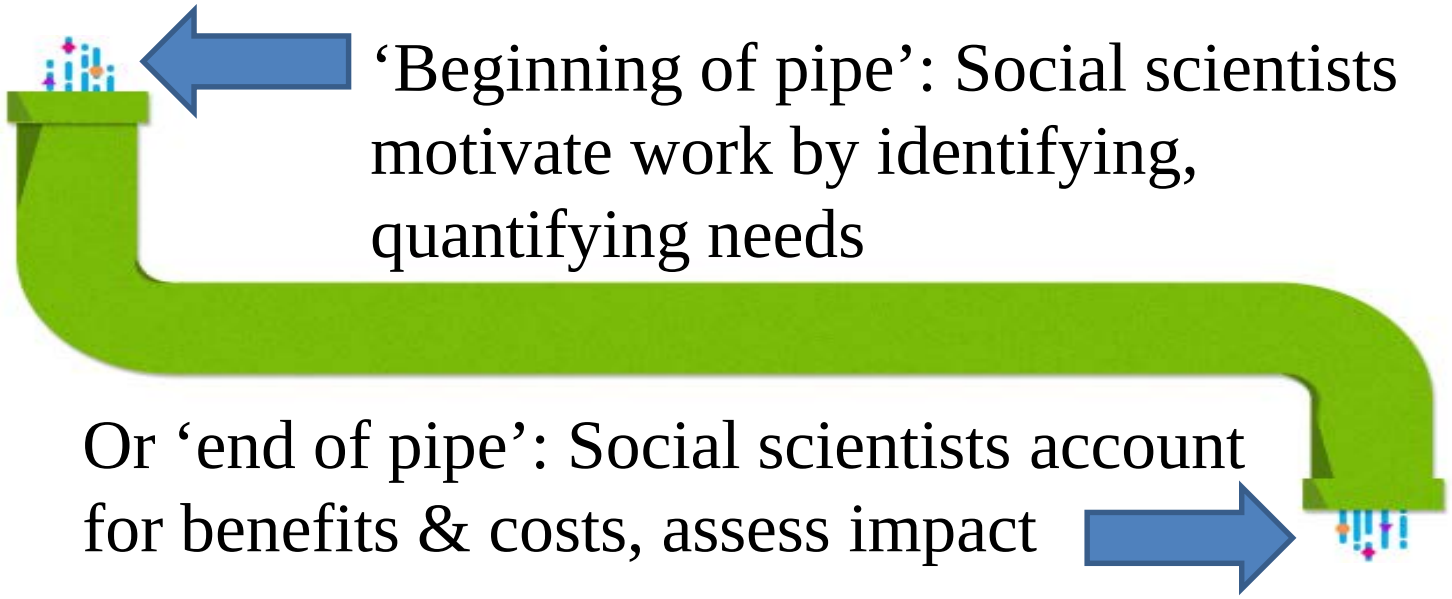
Figure applies to interdisciplinary academic teams too, lots of agency costs so a) potential joint product should be high,
b) internist/SA needed to integrate? Epidemiologist, social scientist?

& what of ModAH?

- This business is not easy;
  - training, instincts are for garnering disciplinary prowess
  - as it should be; to share depth of specialization you first need to have it, something administrators tend to forget
  - but habits die hard, incentives can be skewed, there uncertainty about product and teammate contributions
- Real business has advantages when encouraging interdisciplinarity
  - $ rewards and redundancy
  - reputation tied to product development. Not so much knowledge or methods that can be tied to a person's name

View 1 (pipe) of social science in modeling health of farmed animals

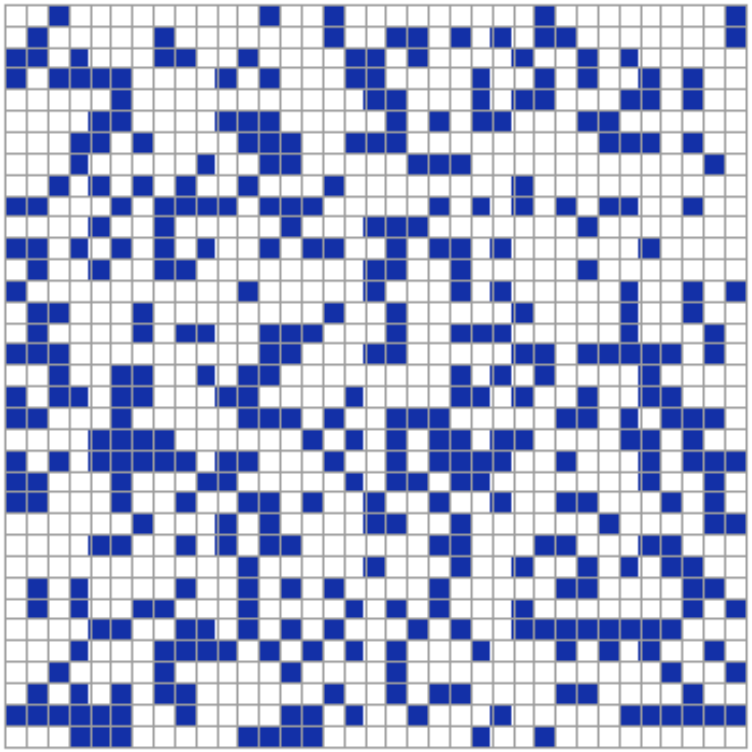
- Impacts of hard science on animal farming have been huge; DNA, nutrition sci., drugs, mechanization, ...
- But animals are farmed by humans, typically to provide a living, and are consumed by humans



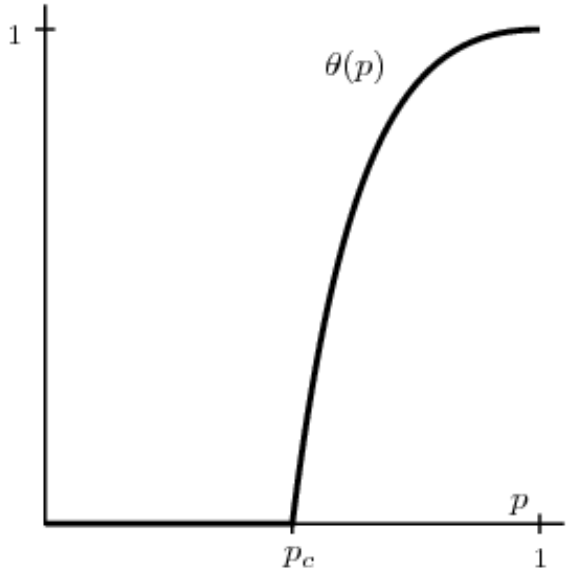
View 2: Percolating in coupled human-tech systems

Blue medium: Technical or social impediments to be removed by team members

Human energy, $



Knowledge



Increasing returns to scale.
Everyone needed in team

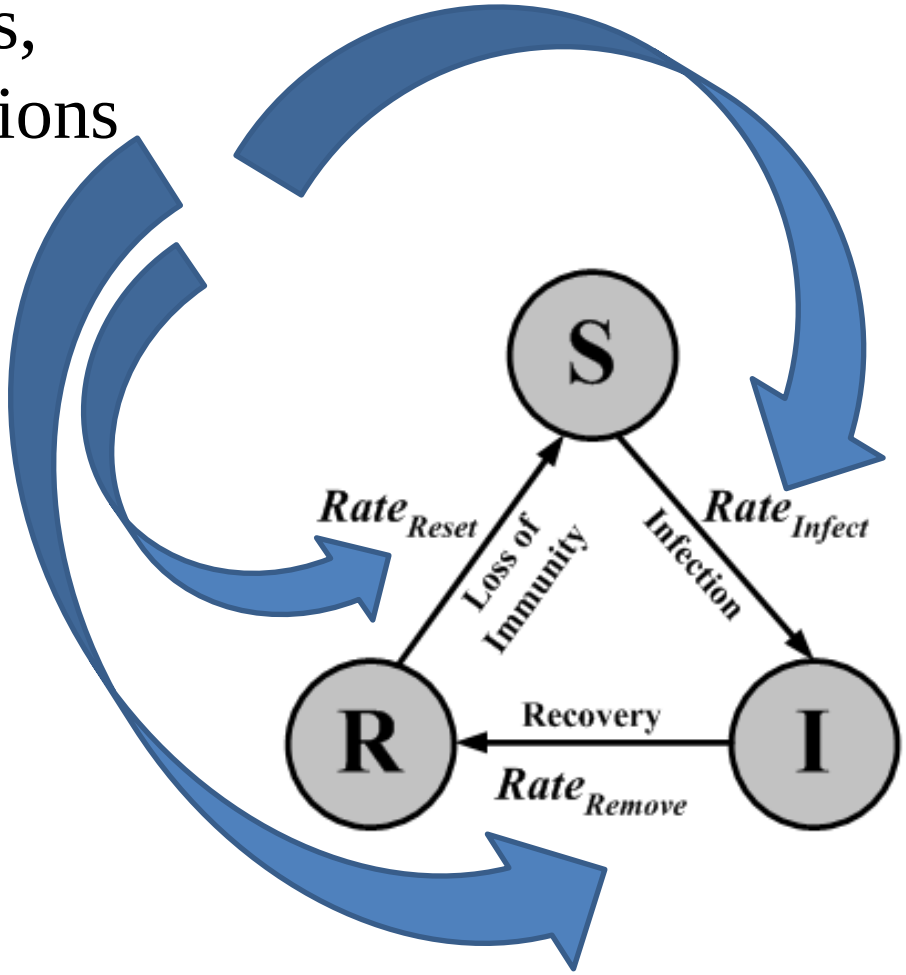
Economists, either end of pipe typically deductive analysis

- Measuring productivity differentials
- Welfare analyses
- Trade and price impacts
- Regional analysis, incl. other sectors
- Demand for disease free meat/livestock
- Characterizing incentives
- Identifying external effects
- Program evaluation

All worthy activities, but what of interdisciplinary outputs?

Economists, deductive analysis & what is in middle?

Biosecurity actions & incentives,
Policies,
Institutions



C.-Y. Huang, C.-T. Sun, H.-C. Lin (2005) "Influence of Local Information on Social Simulations in Small-World Network Models" *J. Artificial Societies & Social Simulation* 8(4)

Other view of social scientists and what's in the middle?

- Economists and other social scientists are not really in trenches in the above
- Technologies come in packets, as in helping to manage Johne's Disease
- Three key components of U.S. bovine JD program: *a*) education, *b*) management, *c*) herd testing & classification. Tech. & human parts aren't separate
- Ask
  - are b) and c) technically feasible?
  - are a)-c) consistent with enough parties economic incentives?
  - do a)-c) accord with moral & other social constraints?

A sampler: Barnes et al.

- For disease reporting there is *habituation effect* (complacency over time) + unclear awareness of purpose
- For reporting, Elbers et al. interviewed Dutch pig farmers. Reasons for not reporting include
  - Don’t know signs
  - Guilt, shame and fear of prejudice
  - Haven’t bought into control measures in place in general and for reporting farms
  - Opaque reporting procedures
  - Distrust in gov’t bodies, neighbours, etc.

Behavioral economics

- **Neoclassical economics** has emphasized optimal behavior by a rational person, *homo economicus*
- Deductive reasoning, going from a general framework emphasizing rational, optimizing decision-makers with clear objectives
- Social welfare may or may not be consistent with these objectives
- Implications drawn for specific settings
- BE, for now, has moved from deduction by questioning 'rationality' and presumed objectives in a variety of ways, often drawing on psychology

Thinking Fast

- Kahneman ‘Thinking, Fast & Slow” sees two selves; one lazy, effort-conservating, associative, emotional, heuristic; the other calculating when aroused
- In animal health events, there are cognitive issues
  - can be rare with poorly understood causes
  - interconnected with behavior of others
  - may falls into box the ‘heuristic self’ deals with
- Availability bias: ascribe likelihood to recent events we can think of
- We anchor
- We sort out a simplistic narrative for cause and effect, just so that we can function in business

Themes and behavioral economics

A. Dealing with losses and low probability events

B. Knowledge processing

   – our brains are remarkable,

   – but not necessarily geared for rational thought

C. Antibiotics and inductive analysis

D. Biosecurity and inductive analysis

E. Disease commons, vaccination and public good

F. Other theories, team activities

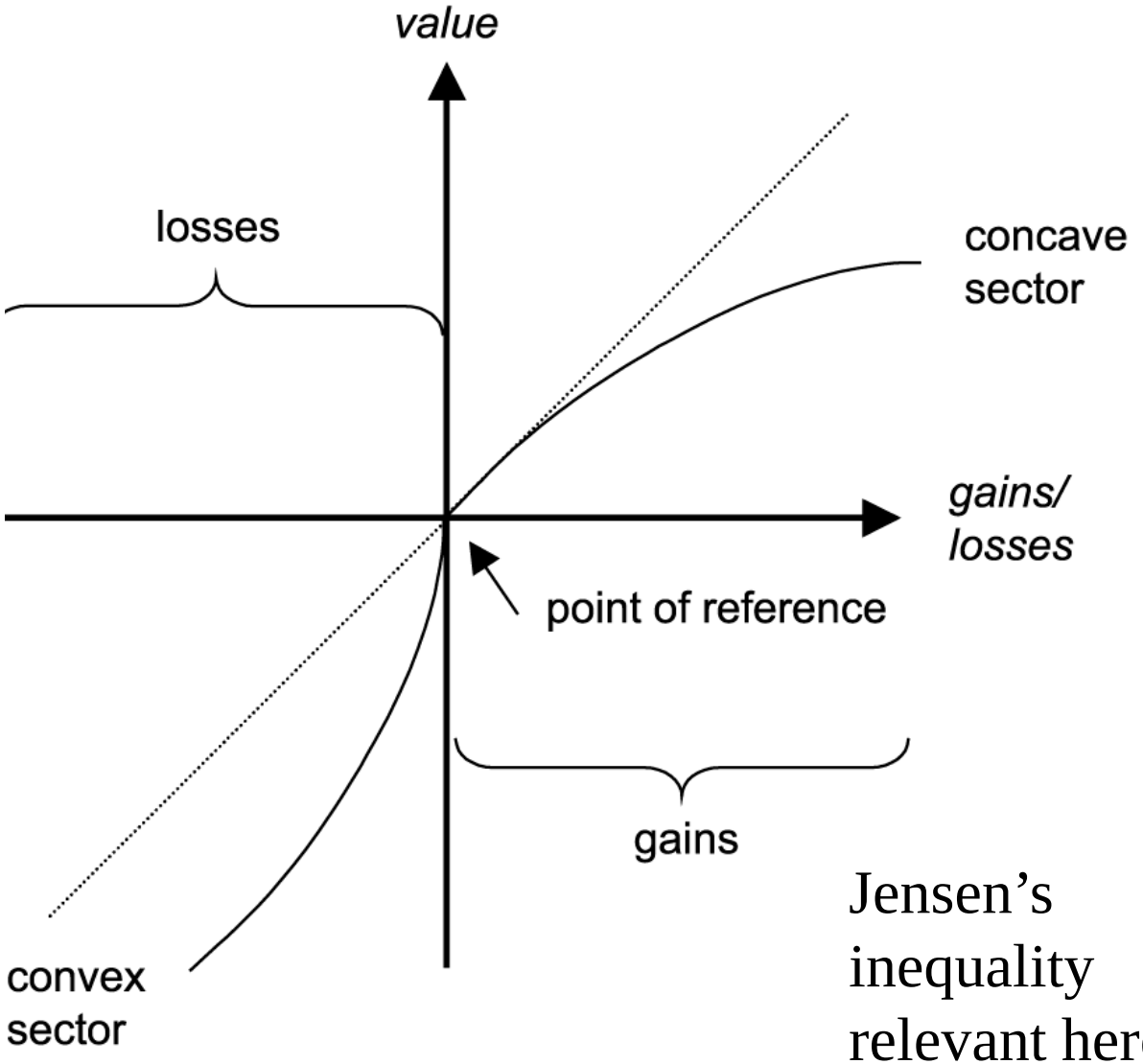
A. Prospect Theory

Cumulative PT asserts that individuals

- like risk over losses and are averse to it over gains
- place too much/little weight on low/high prob. events

- This leads to the fourfold pattern: people are risk
  - seeking when faced with low-prob. gains,
  - averse when faced with high-prob. gains,
  - averse when faced with low-prob. losses,
  - seeking risk when faced with high-prob. losses

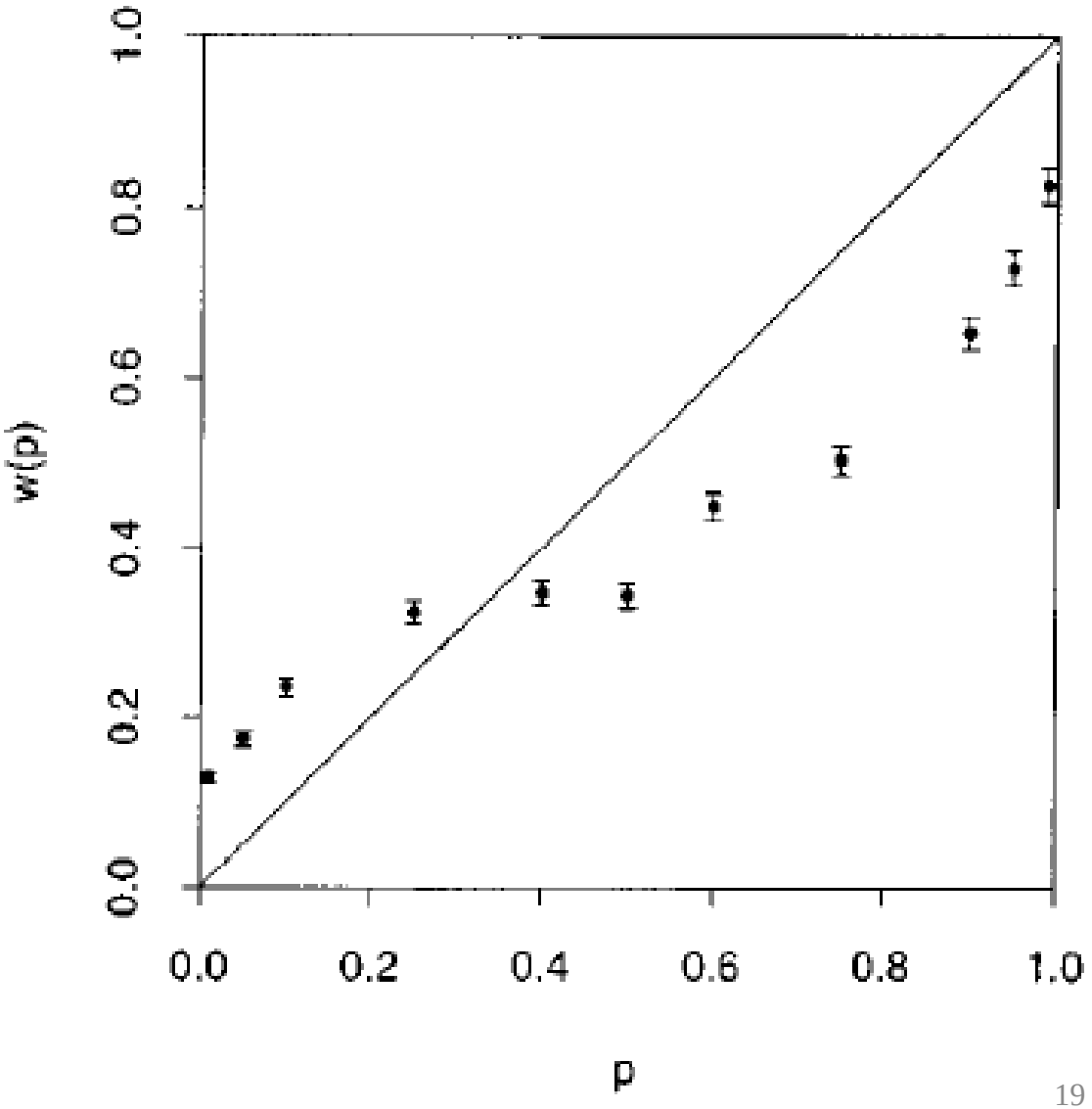
A. PT gains and losses



Jensen's inequality relevant here

A. PT weighting function

From lab experiments in Gonzalez & Wu (1999). 15 graduates facing a money lottery



A. PT & Four-fold, adapted from John Byrne, Skeptical Medicine

	Outcome	
Prob.	Big gain (concave)	Big loss (convex)
High (under-weighted)	*Risk averse* Late- or non-adopter of practice, despite strong evidence on benefit	Seek risk Don't report reportable disease. Unconventional defense strategies. Unresponsive to authorities
Low (over-weighted)	Seek risk On-farm experiments/ tinkering. Quack practices	*Risk averse* Insure. Use likely uninformative diagnostic tests

B. Knowledge processing, Bayes' Rule, Inverted Prob.

$$\Pr(\text{Disease}\,|\,\text{Symptom}) = \frac{\Pr(\text{Symptom}\,|\,\text{Disease})\Pr(\text{Disease})}{\Pr(\text{Symptom})}$$

- Let $\Pr(\text{Disease}) = 1/1,000$

  $\Pr(\text{Symptom}\,|\,\text{Disease}) = 900/1,000$

  $\Pr(\text{Symptom}) = 50/1,000$

- Then what is $\Pr(\text{Disease}\,|\,\text{Symptom})$?

$$\Pr(\text{Disease}\,|\,\text{Symptom}) = \frac{0.9 \times 0.001}{0.05} = 0.018 \approx 2\%$$

- As with population at large, medical professionals have a very poor record in making this computation

B. Bounded rationality

- Idea that cognitive resources are finite too. People have limited capacity and time to process information
- Particularly relevant for
  - small firms, such as farms and veterinary practices
  - tough problems such as uncommon events or events not occurring in controlled environments
  - events involving interactions, as in whether the farmer down the road is biosecuring
- Emphasis shifts from optimization to heuristic rules that are consistent with peer norms and appear to hold up in practice
- Let's face it, is even how public health regulators operate

C. Antibiotics

- How antibiotics are used in animal agriculture
  - cure
  - prevention, including subclinical
  - growth promotion
- Use varies by species, but I'll focus on dairying to illustrate joint roles for hard and soft sciences
- Cows ruminate so use is not through feed/water but administered for prevention (dry cow therapy) or cure, typically for mastitis
- Who administers? Primary operator, other family, employee, vet?

C. Antibiotics & inductive analysis

- Erskine et al. (several papers) have used focus groups of different agents in the antimicrobial decision making process to ask how decisions are made http://qualitymilkalliance.com/2015/02/13/video-project-update-for-years-one-and-two/
- One feature is that workers are typically Hispanic with limited English language skills and limited science education
- Farmers/Owners often assert that they have protocols and provided training to employees
- Employees often assert a) no training either occurred or registered with them, and b) their knowledge came informally from peers or by figuring out themselves
- Erskine et al. seek to develop a role for modifying farm management culture, as well as technology, diagnostics, etc.

D. Biosecurity & inductive analysis

- Enticott, geographer, has looked at disconnect between declared biosecurity practices when administering TB tests and actual practice. Video evidence and analysis. Discrepancy may be for good reasons; insufficient time or bovine handler safety
- Economics, Sociology, Epidemiology, Public Health, Administration Science? Does it matter? Skills required, keen observation, control, measurement, inference, are good science but not particular to any one field
- That line of work is as relevant to, say study of food safety on slaughter line, or processes in retail food preparation

E. Disease commons & vaccination

- Public good: one person's use does not reduce value to others, and people cannot be excluded from use
- Economic commons: an asset is available for common use. It tends to be under-protected and over-used (free riding)
- Control of infectious disease is public good. Access to disease-free production environment can be a commons
- Benefits accrue regardless of taking action, but costs can be avoided
- Deduced net result: few will do it, unless compelled
- Reality: voluntary vaccination if 'managed' well

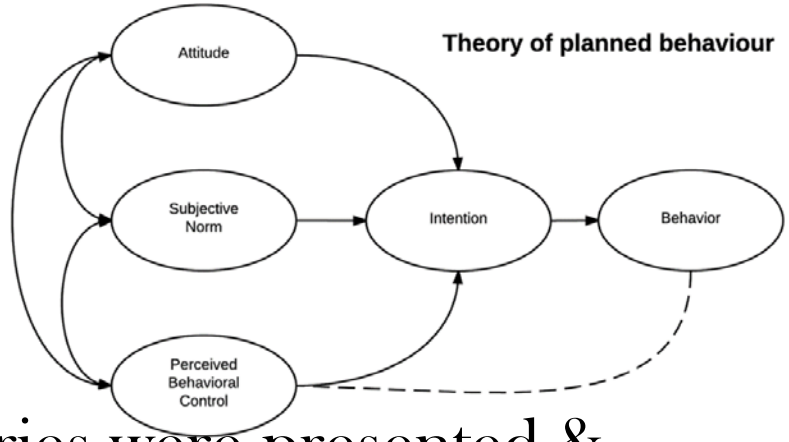
Characterizing markets

	Excludable	Hard to exclude	Non-excludable
Rival	**Private goods** food, clothing, home, haircut, parking spot	**Common-pool resource** fish stocks, pasture, water, timber,	**Open access pools** Open seas fish stocks, water
Between	Tennis/golf club, pte parks, cinema	neighbourhood commons	Roads, info. incl. price & weather
Non-rival	**Club good** satellite tv, copyrighted materials	software, pop songs, police security	**Public good** free-to-air television, air, national defense, lighthouses

Categories, with eye toward infectious disease

	Excludable	Hard to exclude	Non-excludable
Rival	**Private goods** veterinary care, biosecurity inputs	**Common-pool resource** livestock marts, access to commonage & mkting systems	**Open access pools**
Between	low disease genetics(?)		Sanitation in public infrastructure
Non-rival	**Club good** low disease genetics(?), health certs	region's reputation on disease control	**Public good** border protection, disease mgt programs

F. Enter other theories



- In Aviemore, March, several theories were presented & applied to the animal health setting
  - reasoned action, planned behavior, self determination theory, theory of change, Burton and "behavioral approach"
- These get at important things. Economics may display arrogance, aggressive expansion. But its framework is laid out in its entirety, with quantified inputs and outputs
- "*Economists are often in error, but seldom in doubt, whereas economists believe anthropologists spend too much time in the field without testable hypotheses.*" Bardhan & Ray

F. Other theories

- Are there places where these ideas are put in more economic terms?
- Please don't get me wrong, what I'm asking is for reach-out on both sides to communicate
- Kahneman & Tversky, psychologists of prospect theory fame, woke economics to other views on decision-making
- What they did was reach out far enough that economists could cop it
- Where I'm going here; economists are needed in animal health economics but tools need to broaden & become a little more inductive. We need to listen more to others in a team

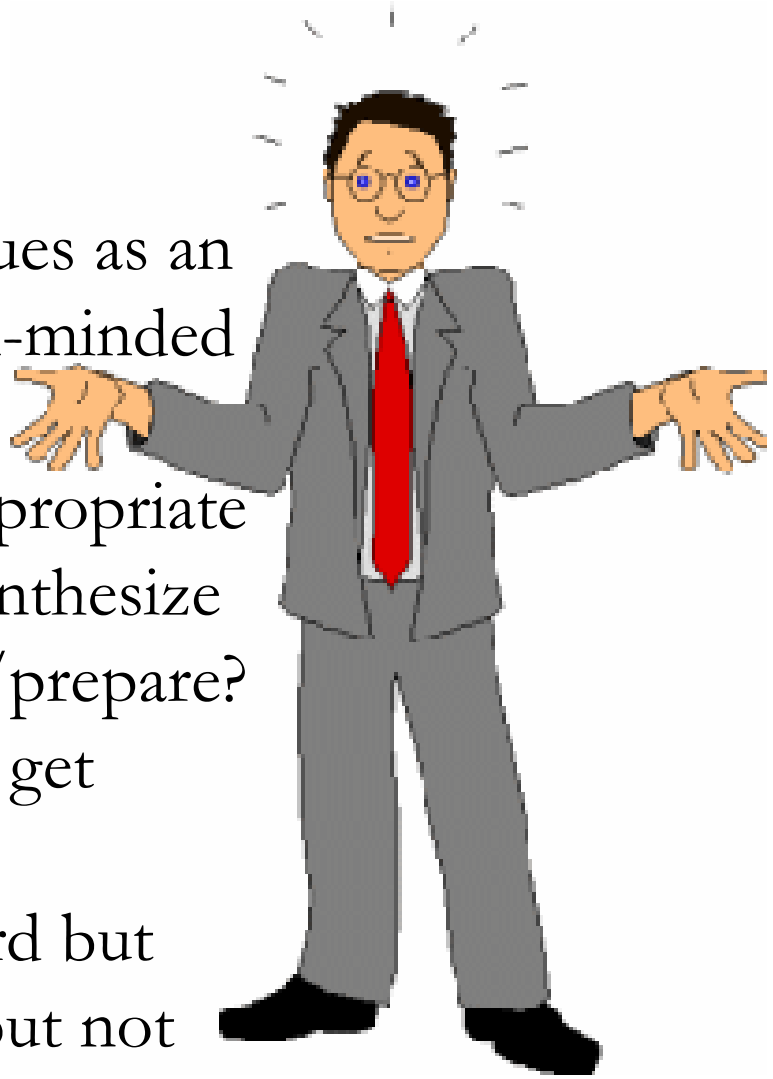
Ostrom model for interdisciplinarity, animal health, social science

- On how commons problems are addressed in practice, she looked at common pool resources
- Standard theory: under *Laissez Faire*, resource will be overused. Regulation has been viewed as necessary, including restricting access assigning property rights
- Ostrom pointed out that in many cases locals sorted the problem out, at least to some degree
- She saw several criteria for success, incl. clearly defined property & effective, if costly, means to exclude, good monitoring, collective choice arrangements, means of conflict resolution
- 'Markets' for infectious disease only partly CPR form

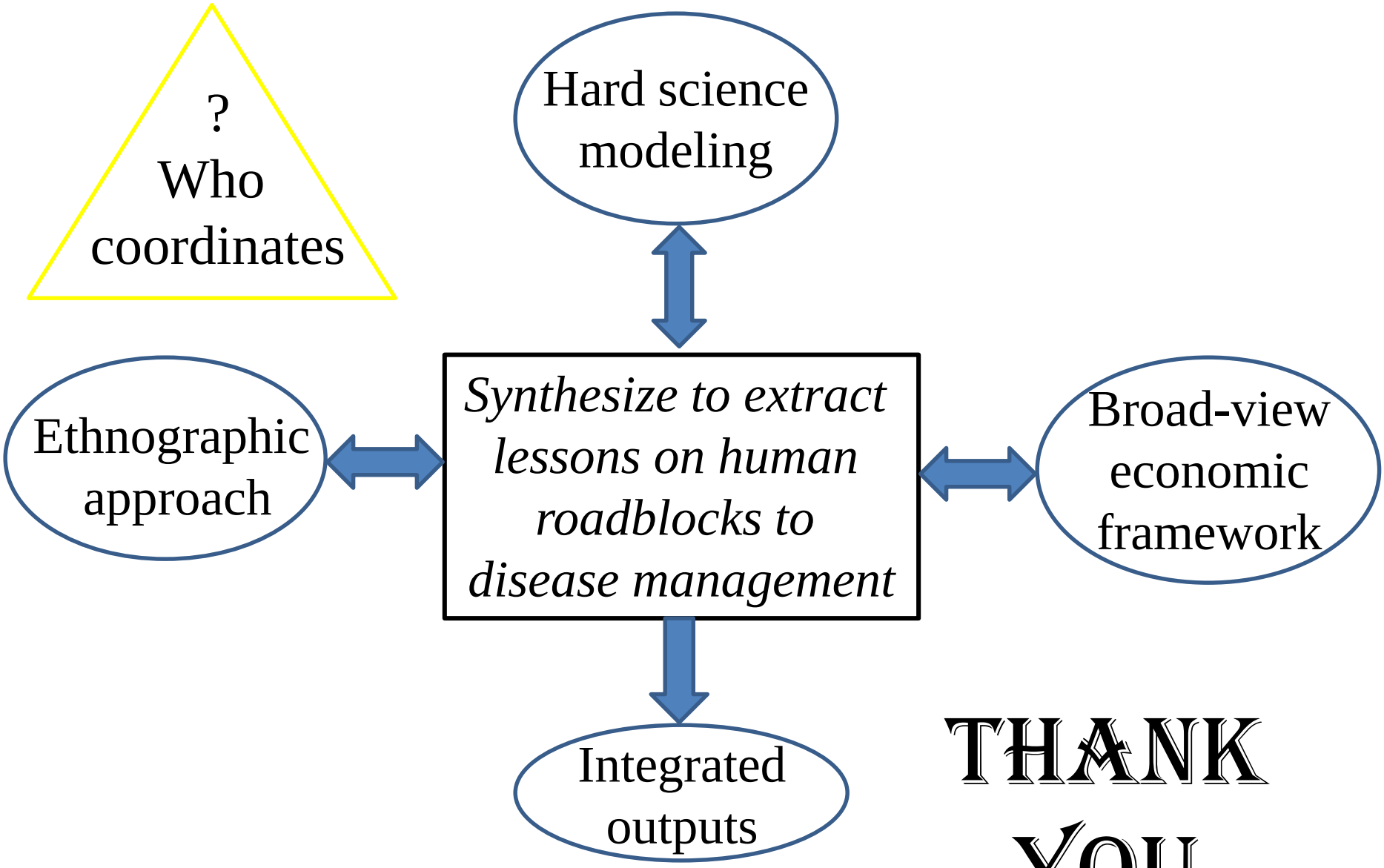
Ostrom model

- She bought into idea of incentives & optimization, as in monitoring, access denial, low cost resolution mechanisms, game theory etc.
- But, as with Smith/Coase took an inductive approach, using case studies to flesh out her ideas
- Ostrom's law: "A resource arrangement that works in practice can work in theory" Fennell (2011)
- Annoyed everyone. Economist dislike case studies, etc. Other social scientist critiqued way she framed the problem as 'economic' and not one of culture, philosophical mindset …

Two questions



- Are there ways to define the issues as an economist would but be more open-minded about collecting evidence?
- Back to internist/SA, who is appropriate to integrate, identify deficiencies, synthesize outputs, and whether/how to train/prepare?
- Otherwise, I'm not sure how to get beyond the pipeline approach
- People in area are looking toward but then past each other, seeing needs but not really linking up


?
Who coordinates
Hard science modeling
Ethnographic approach
Synthesize to extract lessons on human roadblocks to disease management
Broad-view economic framework
Integrated outputs

THANK YOU

References

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