Design I: Inducing Preferences

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Economics 276a,
Lectures 2

Introduction

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This is the problem of **preference inducement** and its solution is a core methodological idea in experimental economics.

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- Induce certain preferences (i.e. over payoff consequences) to cause subjects to reveal by choices the structure of their homegrown preferences.
- **Example:** Dictator game, lottery choice experiment

A lot of non-experimentalists associate experiments entirely with Measurement experiments!

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Continuous Example: The motivation is to test an exotic type of equilibrium (defined by Simon and Stinchombe) and compare it to standard game theoretic predictions under discrete time approximations.

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Real Options Example: I don't have a hypothesis about unusual preferences driving behavior (yet) and am more interested in whether thinking about option values are natural in decision making.

- Again, though, we run experiments to learn...

Induced Preference Theory

Early 60s Vernon Smith begins developing theory of **induced preferences**: a theory of how one causes subjects to internalize some or all of the preferences of an agent in a model.

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Most important part (for our purposes) is description of what must be true of the reward structure for it to effectively induce preferences.

The trick with inducing preferences is to cause subjects to care about outcomes in a way that structurally resembles the agents in the model under study. To do this you need a proper **reward medium**. For example:

- Ex: Candy, Money, Class Points, Effort

Smith argues there are three main sufficient conditions on the reward medium.

IVT 1: Monotonicity

Subjects should always want more of the reward medium (ala money) or always less (ala effort). This rules out candy for anyone over the age of 8.

IVT 2: Dominance

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Suggests rewards be large enough and dependent enough on behavior to overcome alternative homegrown motivations (at least in Convergence experiments, see below).

Also suggests some **methodological considerations** that have become important in experimental economics.

Demand Effects and Tournament Incentives

Demand effects: Subject chooses to do something because they've surmised it is what the experimenter wants them to do.

- Can dominate preferences being induced.
- Causes: too-simple action spaces, poor framing, overtly leading instructions.
- **(Alleged) Example:** Dictator game
- **(Alleged) Example:** Asset bubble experiments (see Crockett and Duffy, 2011 for a corrective)

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Tournament Incentives: Pay subjects according to relative rankings instead of absolute outcomes.

- Some experiments work this way naturally (auctions).
- Otherwise, implementing this is a mistake as it can seriously change behavior.

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- Anytime a design element is elaborate and feels "out of the ordinary" we might worry about demand effects.
- Subjects might think they are expected to respond instantly.
- Why I'm not too worried: the incentives to respond instantly are very strong so I don't think this will have much effect.

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Real Options Example: Subjects are simply choosing a time (or value) at which to invest. The action space is very rich and nothing seems too focal or "called out" by the basic conceit of the experiment.

Competition in the Continuous Example?

Notice that in the **Continuous Example** subjects may be motivated by competition with their counterparts to "win" by exiting first.

Is this "okay"? A few questions to ask:

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Is this "okay"? A few questions to ask:

- Is this true of the real world analogue I want to understand?
- Does it conflict with other forces in the model I want to understand with the experiment?
- Can it be designed around (i.e. is there any way to ask the question without this potential existing)?

Reputations and Anonymity

Humans are social beings and reputations can easily dominate the reward medium if not careful.

Out-of-lab Reputations: Reputations can completely dominate induced preferences if decision makers' true identities are public.

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In-lab Reputations: Even if anonymity is maintained, anonymous ID's can trigger supergame effects when tasks are repeated. If interested in "one-shot" games, reputations can dominate stage game incentives.

- Unless studying supergame/repeated game effects typical to mask even artificial IDs.

Double Blinding

Experimenter Reputations: Even if you make things anonymous subject-to-subject the experimenter usually knows who does what.

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- One of the reasons experimental economists often avoid recruiting out of their own classes.

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Double Blinding: Running experiment procedures that prevent the experimenter from knowing which subject made which decision.

- Pretty complicated to do as it also involves paying subs anonymously.
- Has large effects especially on measured social preferences.
- Critics worry this creates its own demand-like effects.

Double-blind our projects?

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Probably not. Why?

- Decisions in both case seem "morally" neutral.
- Only real scope for experimenter judgement (payoff success) serves only to reinforce the reward medium.

Hypotheticals

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- Generally not accepted in experimental economics.
- Big distinguishing characteristic between experimental economics and a lot of the classical work done in behavioral economics in the 1960s.
- Experimental economics always involve subjects making real economic decisions largely because of dominace: idea is almost anything can easily dominate hypothetical incentives.

One Man's Dominance is Another Man's Abstract

In **Convergence Experiments**, the point is to induce preferences in order to examine reasoning, learning or adaptation.

- Unobserved heterogeneity in homegrown preferences makes data noisier.
- Uncontrolled preferences can also lead to confounding dis-analogies to the problem being modeled.

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In **Measurement Experiments**, most preferences are induced to allow a specifically examined homegrown preference to (potentially) dominate induced preferences.

- **Example:** Subjects choose between lotteries in an experiment on risk preferences to allow risk preferences to potentially dominate expected payoffs.
- Even in these dominance by other factors not under study need to be carefully avoided.

Either way, deeply considering potential channels of dominance underlying your design is central to an experimental economics project.

The Harrison Critique

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- Decisions in models/experiments can be conceived in either **action space** or **payoff space** and
- huge deviations in action space can sometimes be tiny in payoff space.
- Overbidding in, say, first price auctions ala Cox et al (1982 and followups) might be due to best response functions having a **flat maximum**.

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Interesting philosophical methodological points raised in the argument

- Friedman (1992) pointed out that in order for payoff flatness to induce bias, the flatness must be **asymmetric** around best response (not true of first price auctions).
- Cox et al. (1992) pointed out attention to payoff steepness imposes cardinal utility on laboratory experiments and note that steepness is in the eye of the beholder.

Current Best Practice

The stylized fact from the literature (as Cox et al. (1992) acknowledge) going back to Siegel (1961) is that payoff flatness (and more generally, low powered incentives to optimize) induce noisier behavior.

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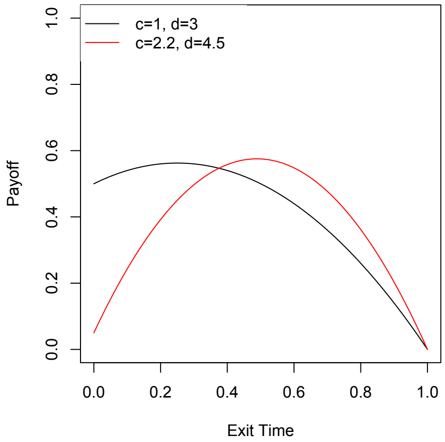
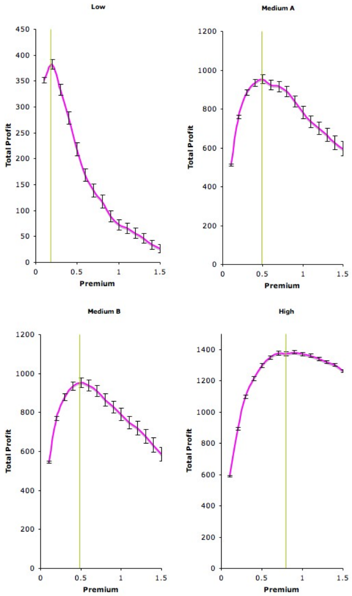
Best practice is to carefully :

1. Look at the payoff hills around the optimum or at equilibrium best response when testing a model in the lab.
2. Look for parameterizations that induce relatively steep payoff functions or consider paying subjects based on a steepening transformation of the payoff function.
3. If payoff functions are asymmetrically flat make sure this is attended to in building hypotheses for the experiment as it suggests a potential boundedly rational source of bias.

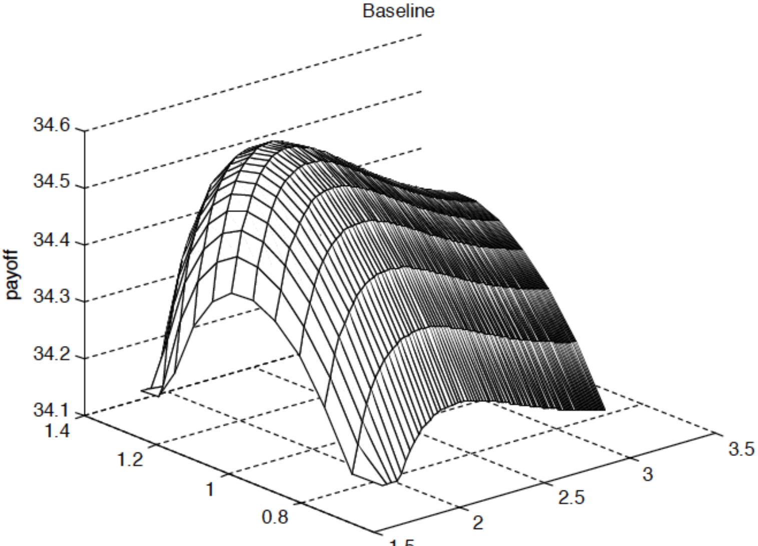
Continuous Example Payoff Hills



Real Options Example Payoff Hills



3d Payoff Hill



IVT 3: Salience

The connection between actions and payoffs should be clear to subjects.

- This connection is taken for granted in most models.
- Burden on us to make the experiment fit the premises of the model.
- Experiments are **not** preference function math tests.
- Again, a few important methodological implications.

Salience and Comprehension

Clear instructions

- Instructions designed to maximize subject comprehension without introducing dominance problems (more on this later).

Repetition of task

- Subjects often learn by doing at beginning of complex experiments.
- Very common to use repetition of task and focus on later behavior once subjects have a feeling for problem (see Friedman (1998) for a very informative/entertaining discussion).

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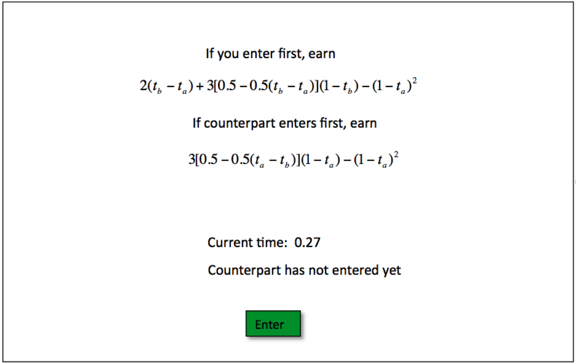
Visualization

- Well laid out and visually rich interfaces can speed the learning curve (more on this later)

Continuous Bad Visualization



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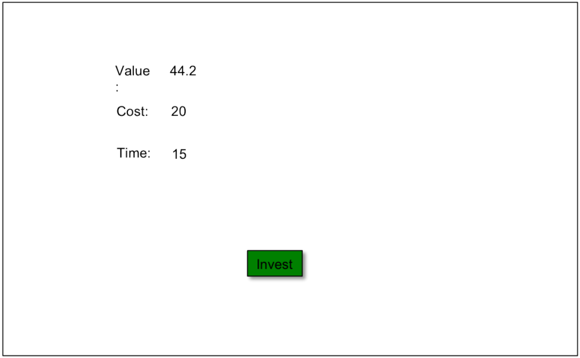

Salience and Credibility

Non Deception

- Strong norms against deception for salience reasons.
- Don't want subjects wondering what's **really** going on.
- Reputation effects for further experiments.
- Some labs have boilerplate instructions language noting difference between psych and econ experiments to control cross-lab reputation effects on a campus.

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Credible randomization

- Many experiments have stochastic components/moves by nature.
- Complex problems require resolution by computers, but otherwise strong norms to use public, objective randomization devices.

Randomization in Our Examples

No randomization in the **Continuous Example**.

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Lots in the **Real Options Example**.

- As we'll see, lots of tiny shocks generate a brownian motion.
- Thousands, too many to handle with coin flips!

Risk Preferences

Most economic theory involving uncertainty uses risk neutrality as the default source of predictions.

- Should these be our hypotheses in experiments?
- Deviations from these theories can sometimes be rationalized as rational behavior by risk averse subjects.
- Makes it hard to form or test a hypothesis!

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- Makes it hard to form or test a hypothesis!

Risk aversion ala EU can rationalize a lot of deviations from predictions

- Some reviewers/critics will use this to argue experimental results deviating from prediction do not actually reject a piece of theory.
- Some argue opposite when they see risk neutral outcomes in experiments!
- Potentially dangerous and unpredictable source of wiggle room – in my experience referees often don't think too hard before raising this objection.

Can we actually go a step further and induce risk preferences?

Lottery Payments

Yes (at least under EU) and Roth and Malouf (1979) show how:

- Just pay in lottery tickets for a prize instead of currency.
- Suppose utility outcome after resolution is $x \in [a, b]$. Instead of receiving x, subjects receive a x/b probability of earning a lump some of π.
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Is this necessary?

- Stakes are very small in experiments; utility functions should be locally pretty linear anyway (see Rabin, 2000).
- If EU is right and subjects act risk averse in experiments, they would be nearly infinitely risk averse in the field.
- The "this is perfectly rational neoclassical behavior" is not a good response to systematic deviations observed in lab.

Early risk behavior is often conservatism due to confusion that fades with experience (see List (2003, 2004) for interesting field examples).

Risk in Real Options Example

No risk in Continuous Example (unless subjects end up mixing) but major in Project #2.

1. Brownian risk
2. Expiration risk (see below)

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1. Brownian risk
2. Expiration risk (see below)

We did not pay in lotteries and we had to put up a spirited, multi-round defense for this decision.

Solution: We showed even deviations from the data are not consistent with risk aversion. To be continued...

Induced Time Preferences

Lots of economic models are **infinite horizon** with **time discounting**.

- Need to control discount rates to have clear theoretical predictions.
- A precise theory test of an infinite horizon game can't be accomplished in even very long finite games (though the two are closer than theory suggests, see Selten and Stoecker 1986).

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Need two things to bring these items into the lab

- A "shadow of the future" that does not diminish with time.
- A method for causing subs to put less weight on future decisions than present ones.

A few ways the literature has tried to deal with this.

Shrinking Pie Method

The seemingly most direct way is to actually reduce the earnings potential by the discount factor in each period.

Problems:

Shrinking Pie Method

The seemingly most direct way is to actually reduce the earnings potential by the discount factor in each period.

Problems:

- Causes subjects' incentives to optimize to drop over time, potentially violating dominance in a non-stationary way.
- Lacks a natural ending rule (experiments can't literally go on infinitely).
- Eventually the potential period earnings drops below a penny, meaning the game is effectively finite time.

Expiration Hazard

Converting discount rate into a per-period probability of experiment terminating provides the exact same incentives (see Roth and Murnighan, 1978).

- Creates a natural ending rule for the experiment.
- Distribution is memoryless; shadow of the future is stationary.
- Incentives are unchanged period to period.

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There are advocates of both methods but my impression is that the expiration hazard method has become the industry standard. There is also evidence that the two methods yield similar results.

Time Preferences in Real Options Example

Real Options Example is infinite horizon and we went with random expiration on project 2.

Got a lot of pushback from a (non-experimentalist) referee over risk preferences over infinite horizons.

A few notes

- In the end we showed that our results are not consistent with risk aversion over random expiration risks.
- Decision lead to some censoring problems; solving this lead to some tricky statistical analysis (more on this later).

Bibliography I

- Cox, J. C., Roberson, B. and Smith, V. L., (1982) "Theory and Behavior of Single Object Auctions," in Vernon L. Smith, ed., Research in Experimental Economics, Greenwich: JAI Press.
- Cox, J.C., Smith, V.L and Walker, J.M. (1992) "Theory and misbehavior of first-price auctions: Comment" American Economic Review, 82(5): 1392-1412.
- Crockett, S. and Duffy, J. (2014) "A Dynamic General Equilibrium Approach to Asset Pricing Experiments." Working Paper.
- Friedman, D. (1992) "Theory and misbehavior of first-price auctions: Comment" American Economic Review, 82(5): 1374-1378.
- Friedman, D. (1998) "Monty Hall's Three Doors: Construction and Deconstruction of a Choice Anomaly," American Economic Review, 88(4): 933-946.
- Harrison, G. (1989) "Theory and misbehavior of first-price auctions," American Economic Review, 79(4): 749-762.
- Kagel, J. H. and Roth, A.E. (1992) "Theory and misbehavior of first-price auctions: Comment" American Economic Review, 82(5): 82(5): 1379-1391.
- List, J. (2003) "Does Market Experience Eliminate Market Anomalies?" Quarterly Journal of Economics, 118(1): 41-71.
- List, J. (2004) "Neoclassical theory versus prospect theory: evidence from the marketplace," Econometrica, 72(2): 615-625.

Bibliography II

- Rabin, M. (2000) "Risk aversion and expected-utility theory: a calibration theorem," 60(5): 1281-1292.
- Roth A., and Murnighan, J. K. (1978) "Equilibrium Behavior and Repeated Play of the Prisoners Dilemma." Journal of Mathematical Psychology, 17(2): 189- 197.
- Roth, A.E. and M. Malouf (1979) "Game theoretic models and the role of information in bargaining," Psychological Review 86: 574-594.
- Selten, R. and R. Stoecker (1986): "End behavior in sequences of finite prisoner's dilemma supergames: a learning theory approach," Journal of Economic Behavior and Organization, 7: 47-70.
- Siegel, S. (1961) "Decision Making and Learning Under Varying Conditions of Reinforcement," Annals of the New York Academy of Sciences, 89: 766-783.
- Smith, V. (1976) "Experimental Economics: Induced Value Theory," American Economic Review, May.
- Smith, V. (1982). "Microeconomic Systems as and Experimental Science," American Economic Review, 56:2, pp. 95-108.