Economics 201B

Economic Theory

(Spring 2022)

Ever Since Allais & Ellsberg

(or Ever Since 201A...)

$\Longrightarrow$ The assumption of rational (individual) choice in a model of human behavior is not as restrictive as it sounds...

- It 'simply' requires that each decision maker have consistent preferences over all possible alternatives and that s/he chooses the most preferred alternative from the feasible set.

- Consistency is an empty box and we can fill it as we wish... It does not rule out preference for status or power; nor does it rule out feelings of envy and altruism...

$\Longrightarrow$ Strategic rationality by contrast, is a more restrictive concept.

- Equilibrium assumes that each player chooses a strategy that maximizes her/his payoff taking as given the strategies of her/his opponents.

- In other words, each player chooses a best response to her/his (correct) conjectures about the strategies of the other players.

The fundamental tradeoffs in life

People's attitudes towards risk, time and other people enter every realm of (financial) decision-making:

$$\begin{aligned} \text{risk} &\iff \text{return} \\ \text{today} &\iff \text{tomorrow} \\ \text{self} &\iff \text{others} \end{aligned}$$

Risk, time and social preferences are thus important inputs into any broader measure of welfare and enter virtually every field of economics.

Four types of (fundamental) questions concerning preferences

I Consistency

- Is behavior consistent with a model of utility maximization?

II Structure

- What are the structural properties of the underlying utility function?

III Recoverability

- Can underlying preferences be recovered from observed choices?

IV Linkages

- What are the linkages between preferences in various environments?

The hypotheses (axioms) about (risk) preferences

All theories (EU and non-EU) begin with three assumptions about preferences:

I. Completeness

For any pair of lotteries or gambles (outcomes and probabilities) x and y

$$x \succsim y \text{ or } y \succsim x.$$

The hypotheses about (axioms) about (risk) preferences

All theories (EU and non-EU) begin with three assumptions about preferences:

II. Transitivity

For any three lotteries x, y, z

if $x \succsim y$ and $y \succsim z$ then $x \succsim z$.

The hypotheses about (axioms) about (risk) preferences

All theories (EU and non-EU) begin with three assumptions about preferences:

III. Monotonicity (with respect to first-order stochastic dominance)

For any pair of lotteries x and y with resulting payoff distributions F_x and F_y

$$\text{if } F_x \geq F_y \text{ then } x \succsim y.$$

$\Rightarrow$ The preferences can be represented, or summarized, by a well-behaved (increasing) utility function.

The hunt for a descriptive theory of choice under risk (Starmer, 2000)

The 'standard' model of decisions under risk is based on von Neumann and Morgenstern Expected Utility (EU):

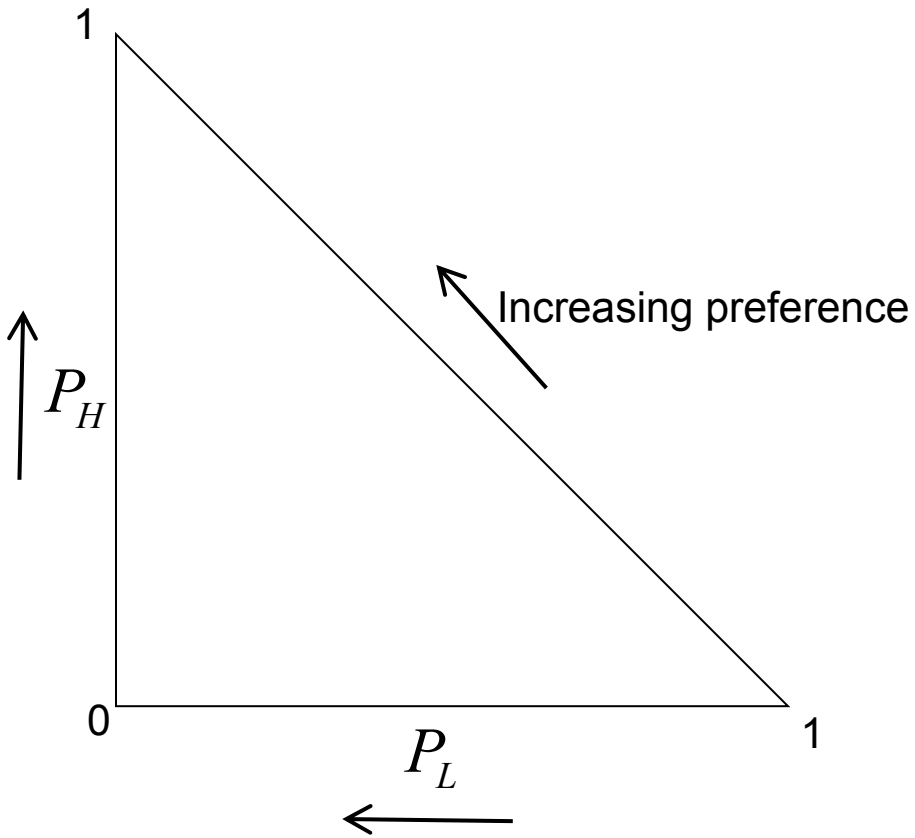
Independence

For any three lotteries x, y, z and $0 < \alpha < 1$

$$\text{if } x \succ y \text{ then } \alpha x + (1-\alpha)z \succ \alpha y + (1-\alpha)z.$$

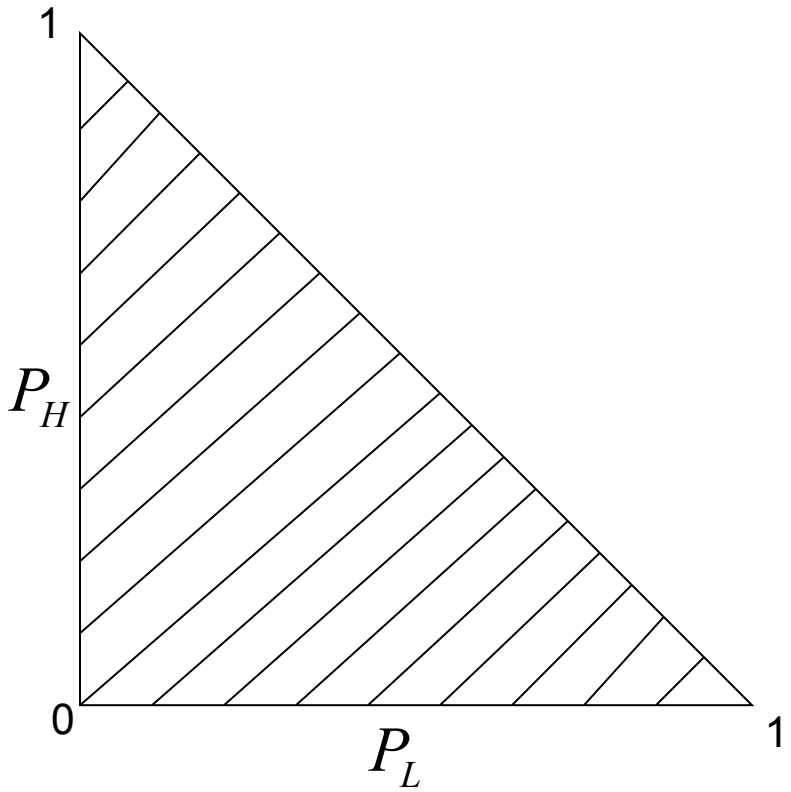
$\Rightarrow$ Empirical violations of independence generated the development of various theoretical alternatives, and the investigation of these theories has led to new empirical regularities, and so on...

The (Marschak-Machina) probability triangle



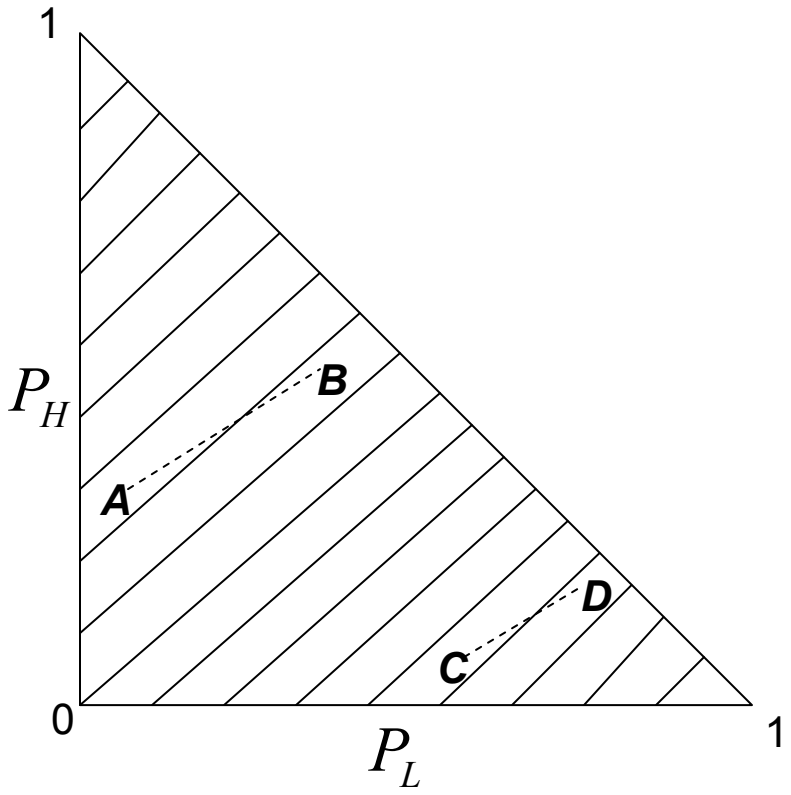
Consider three monetary payouts H, *M*, and *L* where *H>M>L*

An indifference map of a loss-neutral (expected utility) individual



Expected Utility Theory (EUT) requires that indifference lines are parallel

A test of Expected Utility Theory (EUT)



EUT requires that indifference lines are parallel so one must choose either ***A*** and ***C***, or ***B*** and ***D***.

What have we learned from à la Allais experiments (Camerer, 1995)?

- *...EU violations are much smaller (though still statistically significant) when subjects choose between gambles that all lie inside the triangle...*
- *...due to nonlinear weighting of the probabilities near zero (as the rank dependent weighting theories and prospect theory predict)...*
- *...the only theories that can explain the evidence of mixed fanning, violation of betweeness, and approximate EU maximization inside the triangle...*

In a classic sketch from the television show *Monty Python's Flying Circus*, a customer attempts to return a parrot (a "Norwegian Blue") he bought from a pet shop earlier in the day, complaining the parrot was dead when he bought it. The sketch consists of a series of more and more surreal claims by the shopkeeper that the parrot is still alive—that it is merely resting, that it is shagged out after a long squawk, that it prefers resting on its back, and that it is pining for the fjords of Norway. To prove the parrot is dead, the customer takes it out of the cage and starts beating it against the countertop. The shopkeeper repeatedly tries to distract the angry customer from the fact that the parrot is dead by pointing out the parrot's "beautiful plumage." The customer responds that "the plumage don't enter into it," and proceeds to list numerous different ways of saying that the parrot is dead, the most famous of which is the declaration: "This is an ex-parrot."

A comprehensive nonparametric test

Test complete representations of preferences rather than focusing on individual axiom(s) (comprehensive) and make no auxiliary functional form assumptions (nonparametric):

- utility maximization (rationalizability)
- stochastically monotone utility maximization (FOSD-rationalizability)
- expected utility maximization (EU-rationalizability)

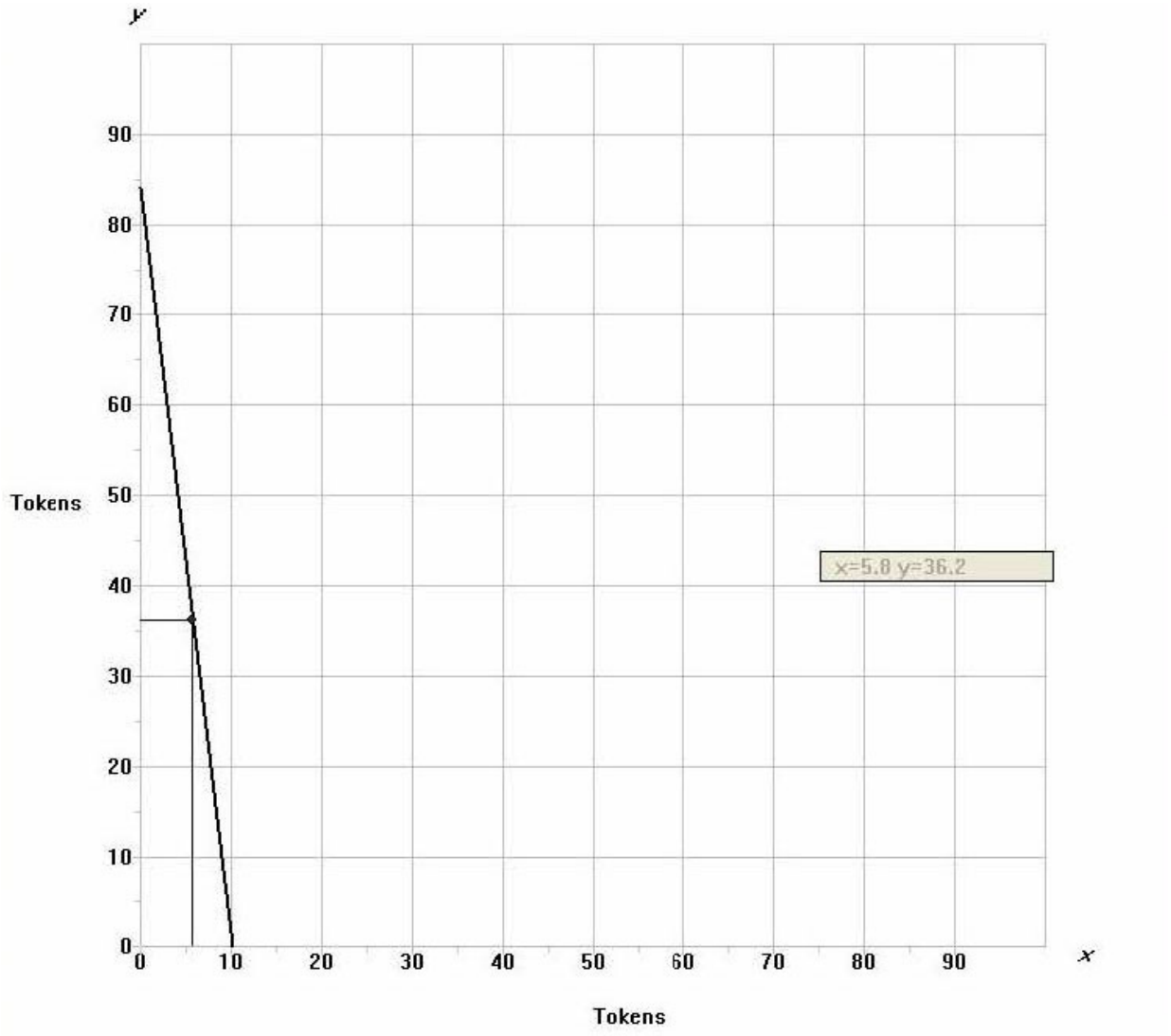
A not-so-new experimental design

An experimental design that has a couple of innovations:

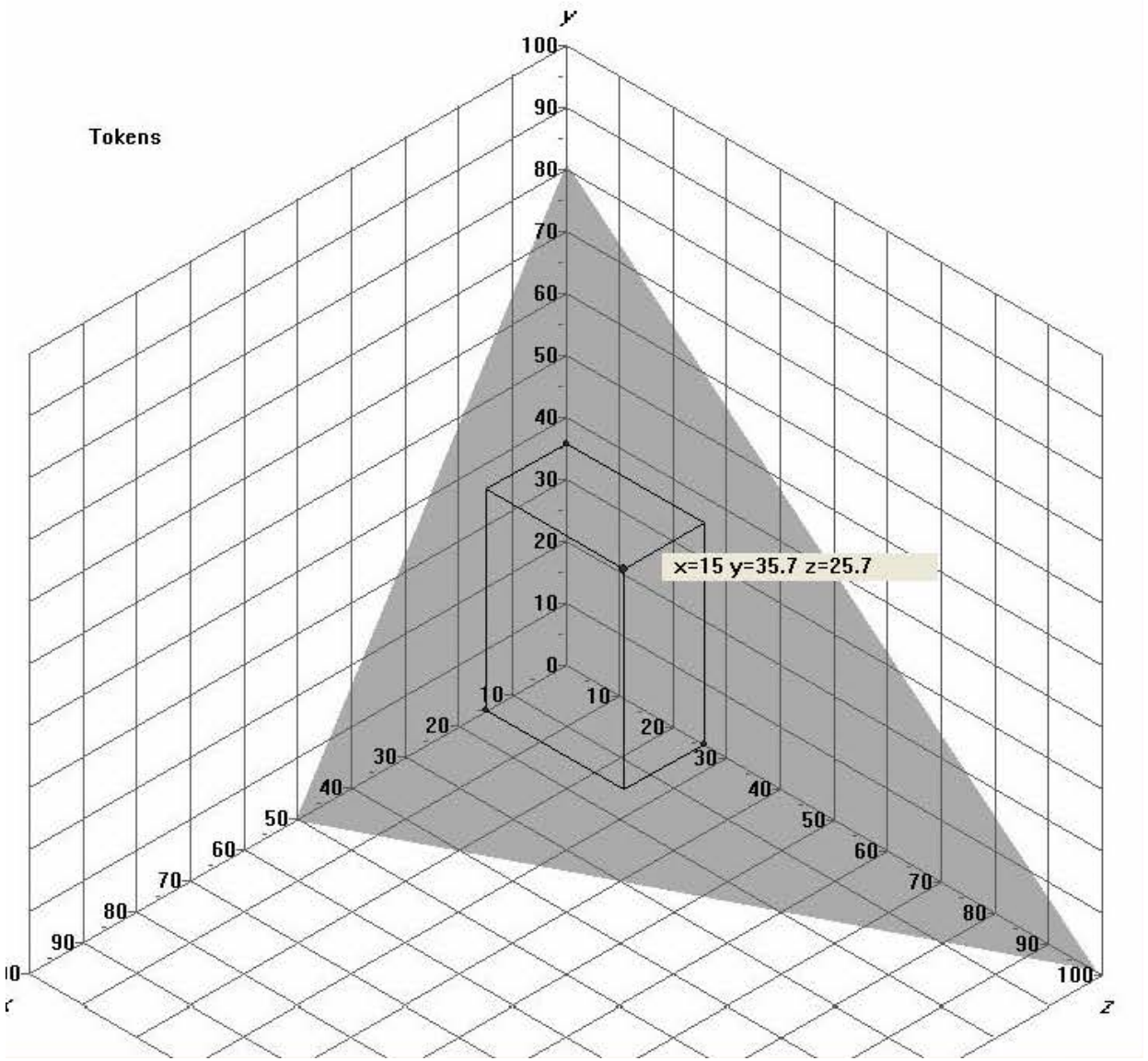
- A selection of a bundle of contingent commodities from a budget set (a portfolio choice problem).
- A large menu of decision problems that are representative, in the statistical sense and in the economic sense.
- A graphical experimental interface that allows for the collection of a rich individual-level data set.

$\Rightarrow$ Build on Nishimura, Ok and Quah (2017), and Polisson, Quah and Renou (2020) and (1) allow subjects to make choices over three-dimensional budget sets, and (2) study choice under ambiguity.

2D experimental interface

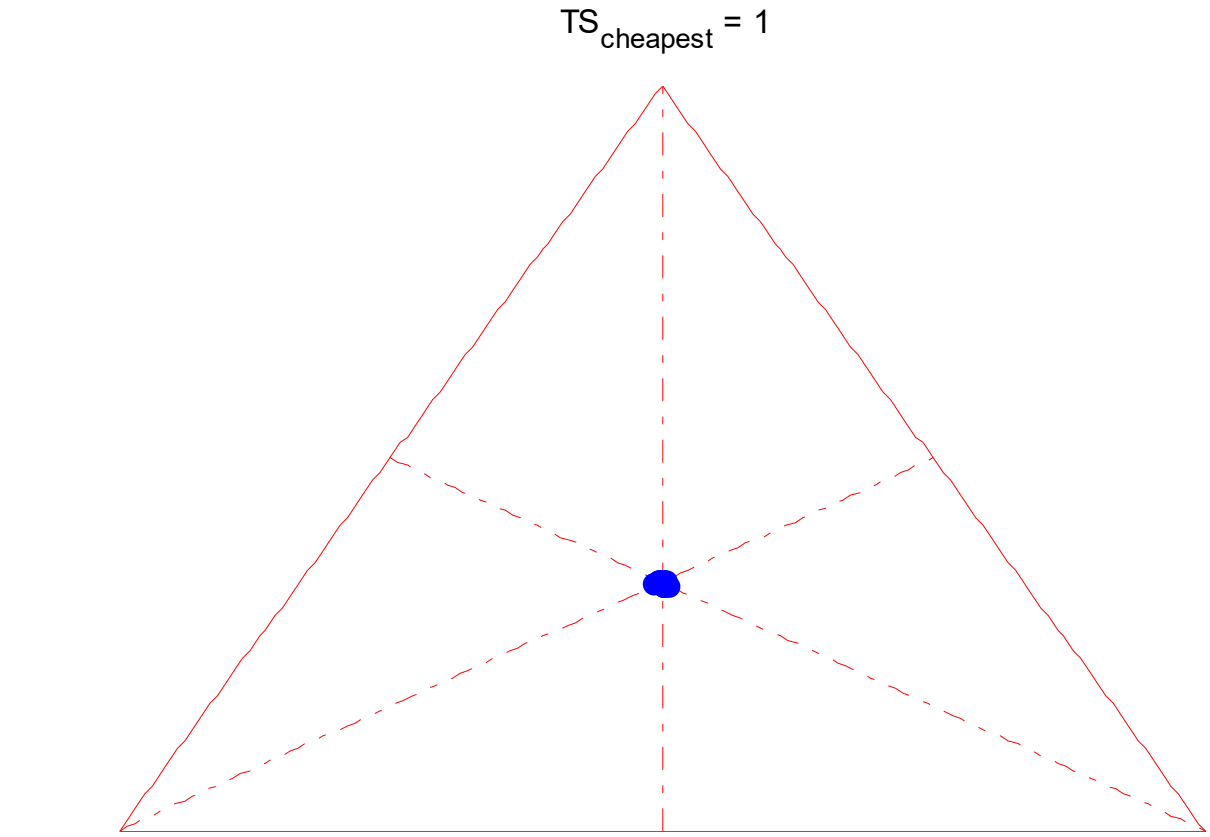


3D experimental interface

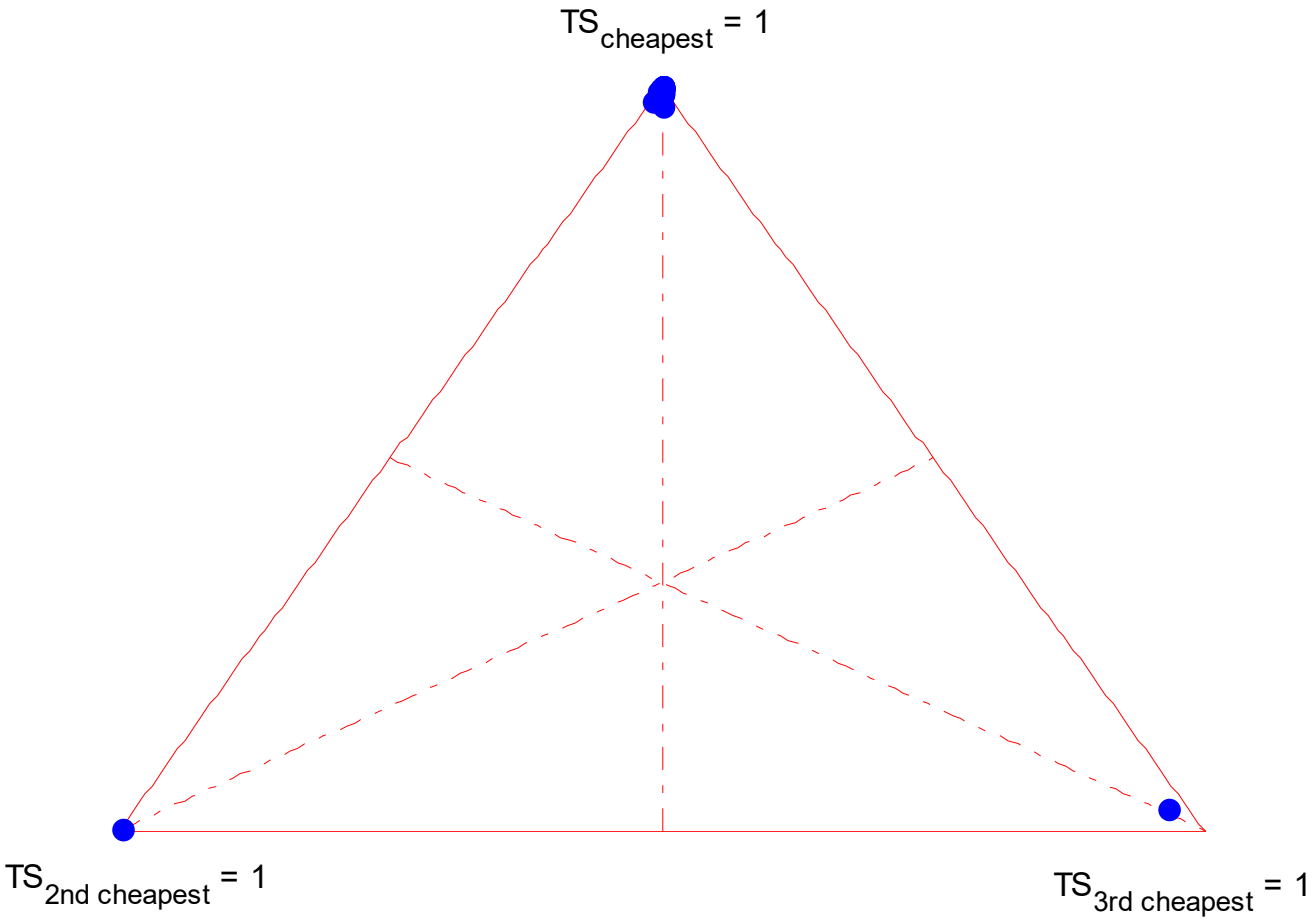


Individual behaviors

Token Shares for Subject ID 35



Token Shares for Subject ID 13



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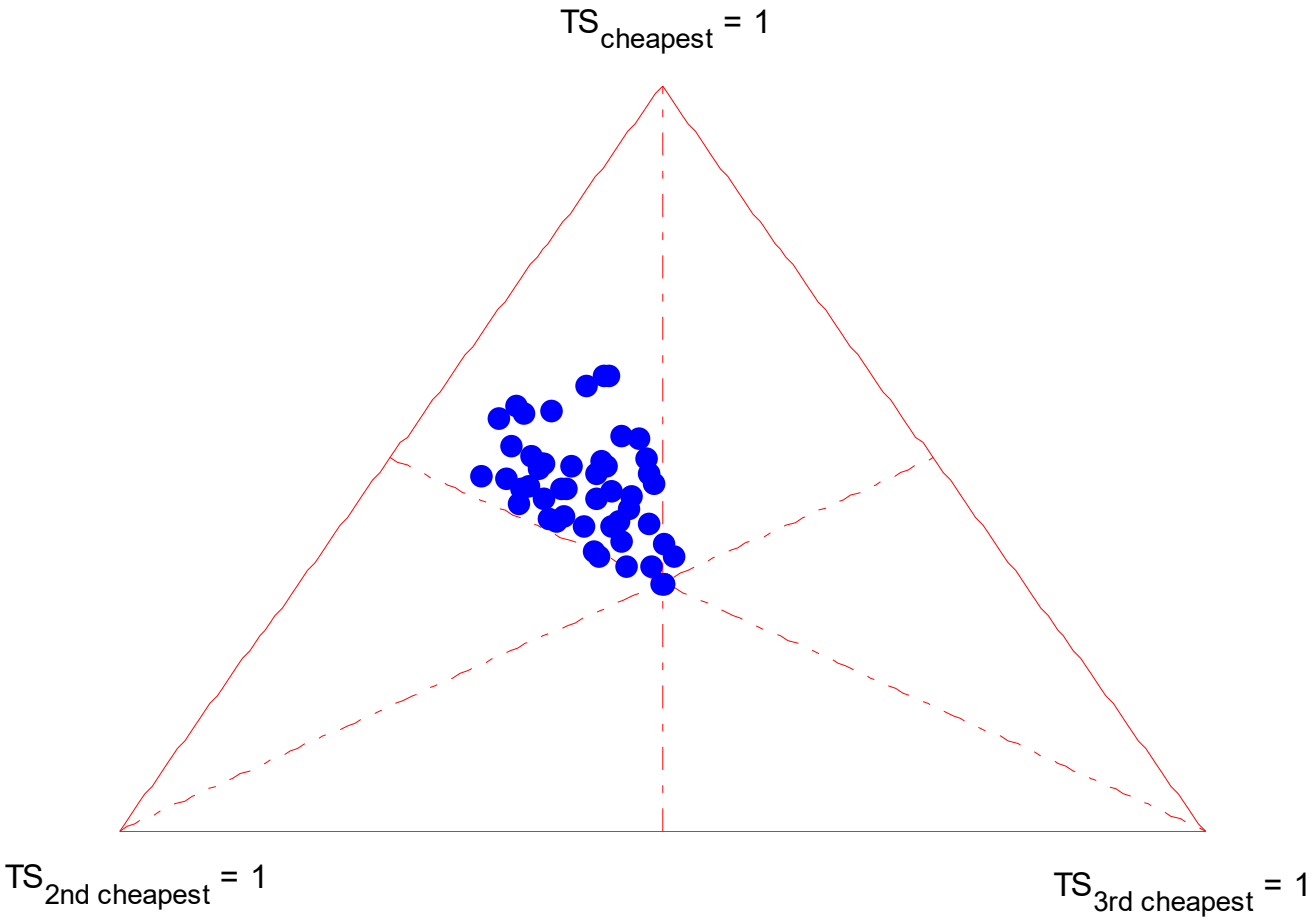

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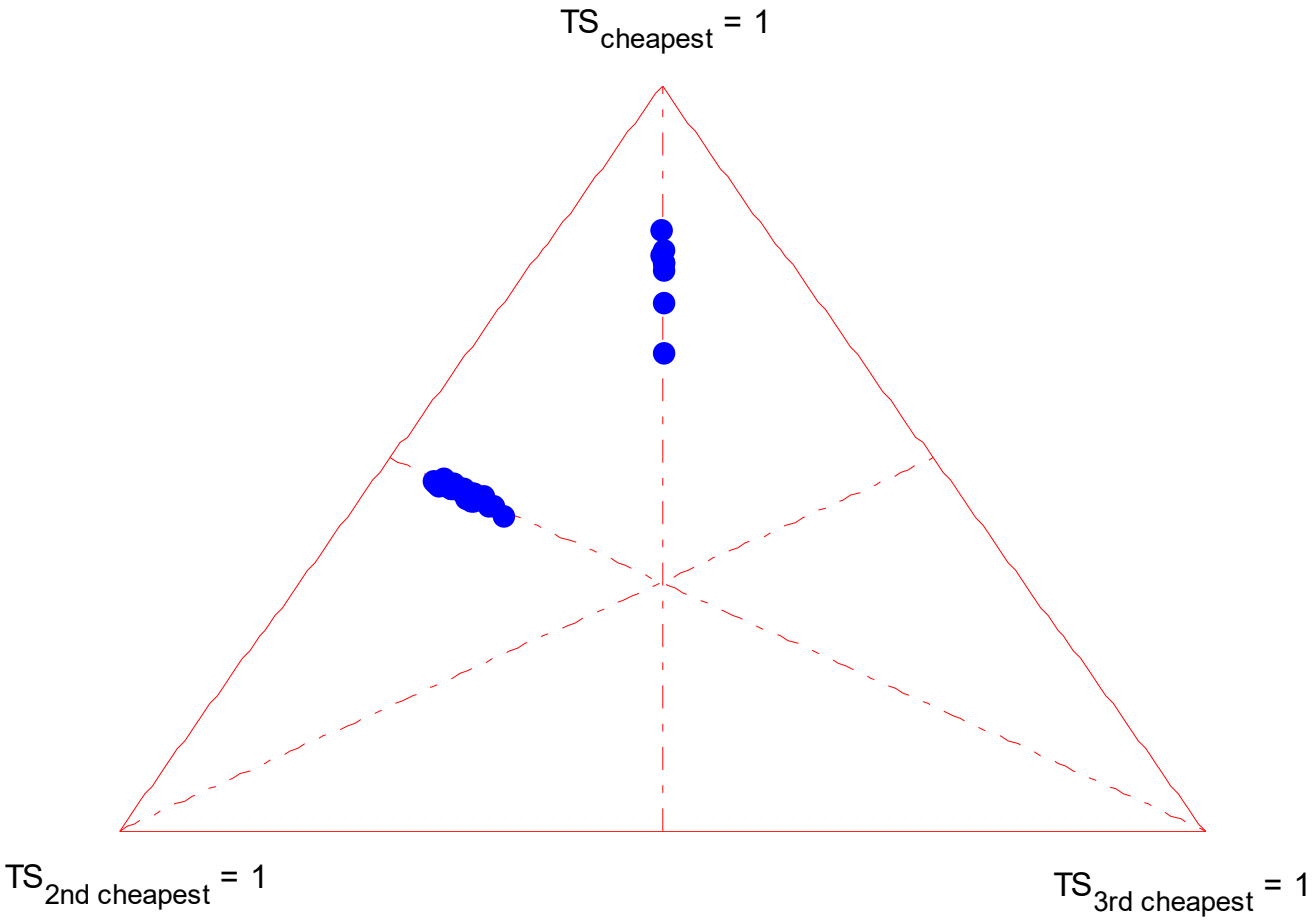

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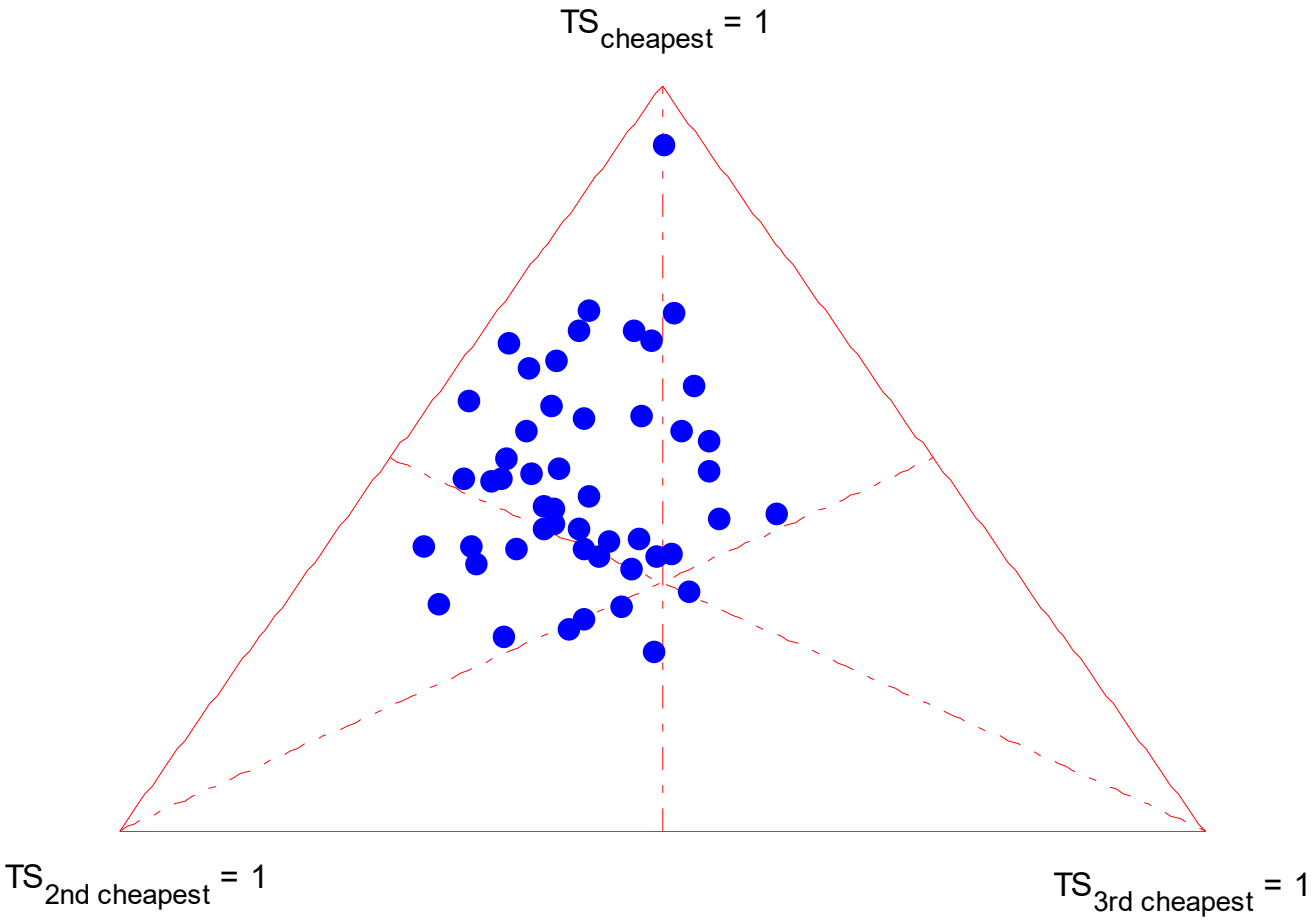
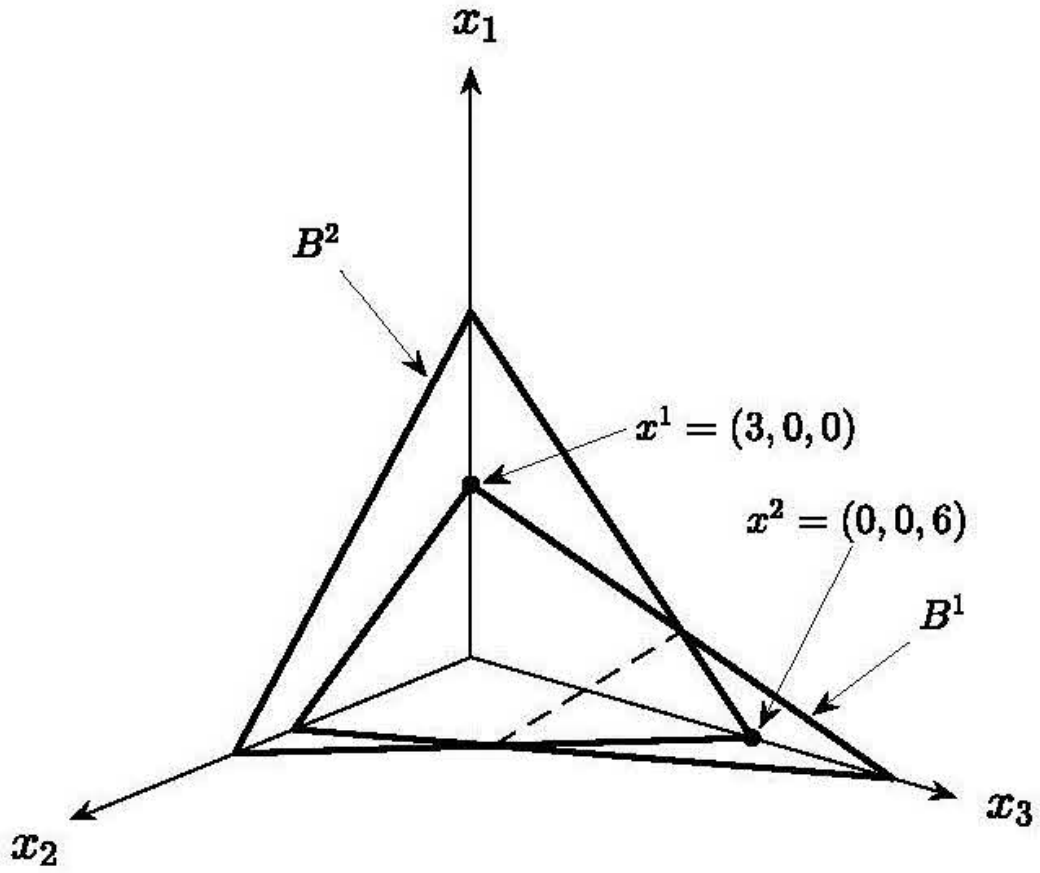
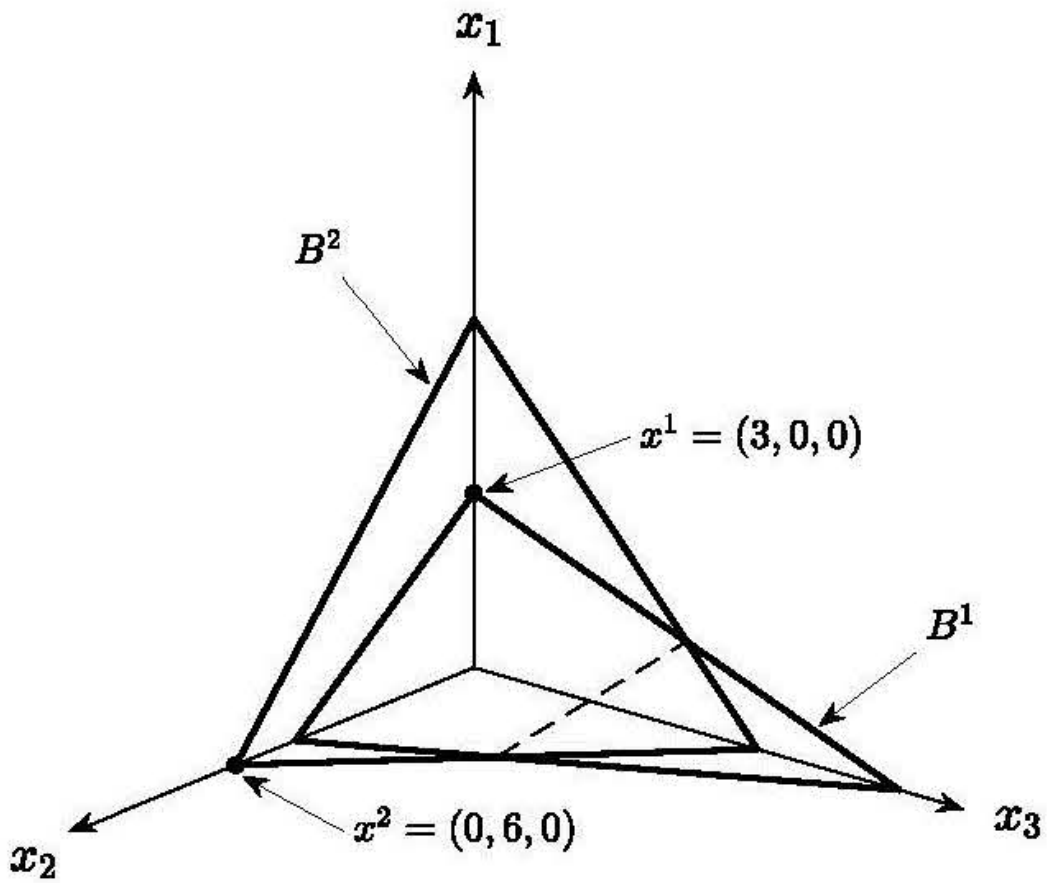


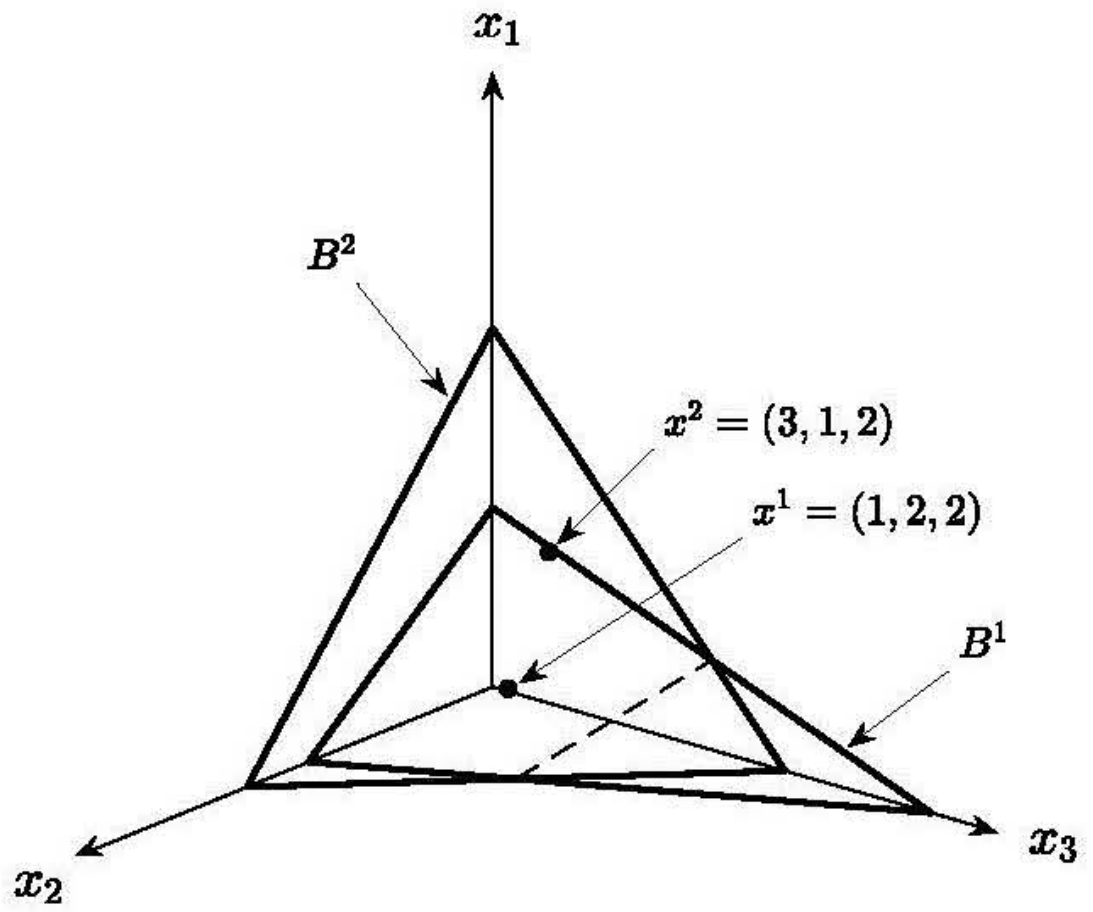
Fails GARP



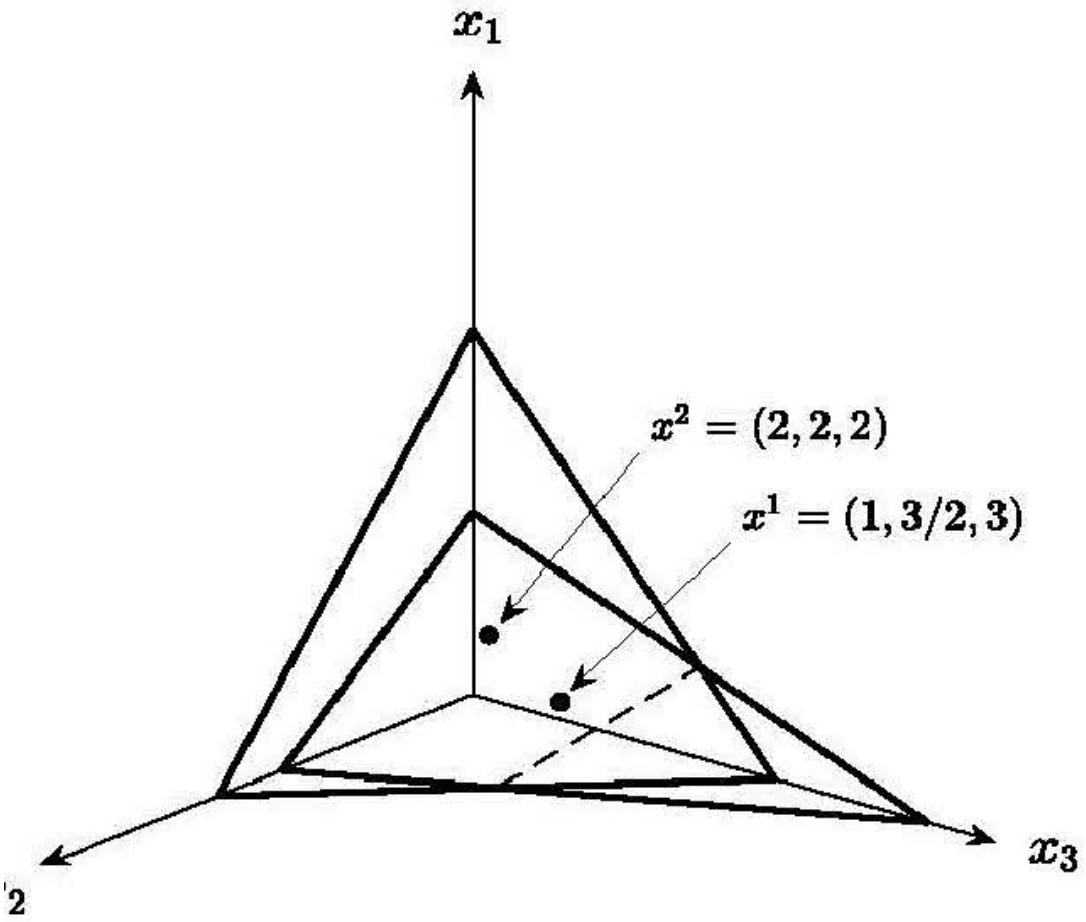
Passes GARP but fails FOSD



Passes GARP and FOSD but fails EUT



Passes EUT



Rationalizability

Let $\left\{(\mathbf{p}^i, \mathbf{x}^i)\right\}_{i=1}^{50}$ be the data generated by some individual's choices: $\mathbf{p}^i$ is the i-th observation of the price vector and $\mathbf{x}^i$ is the associated allocation.

The Generalized Axiom of Revealed Preference (GARP)

If $\mathbf{x}^i$ is indirectly revealed preferred to $\mathbf{x}^j$, denoted $\mathbf{x}^i R \mathbf{x}^j$, then $\mathbf{x}^j$ is not *strictly* directly revealed preferred to $\mathbf{x}^i$, denoted $\mathbf{x}^i R^D \mathbf{x}^j$.

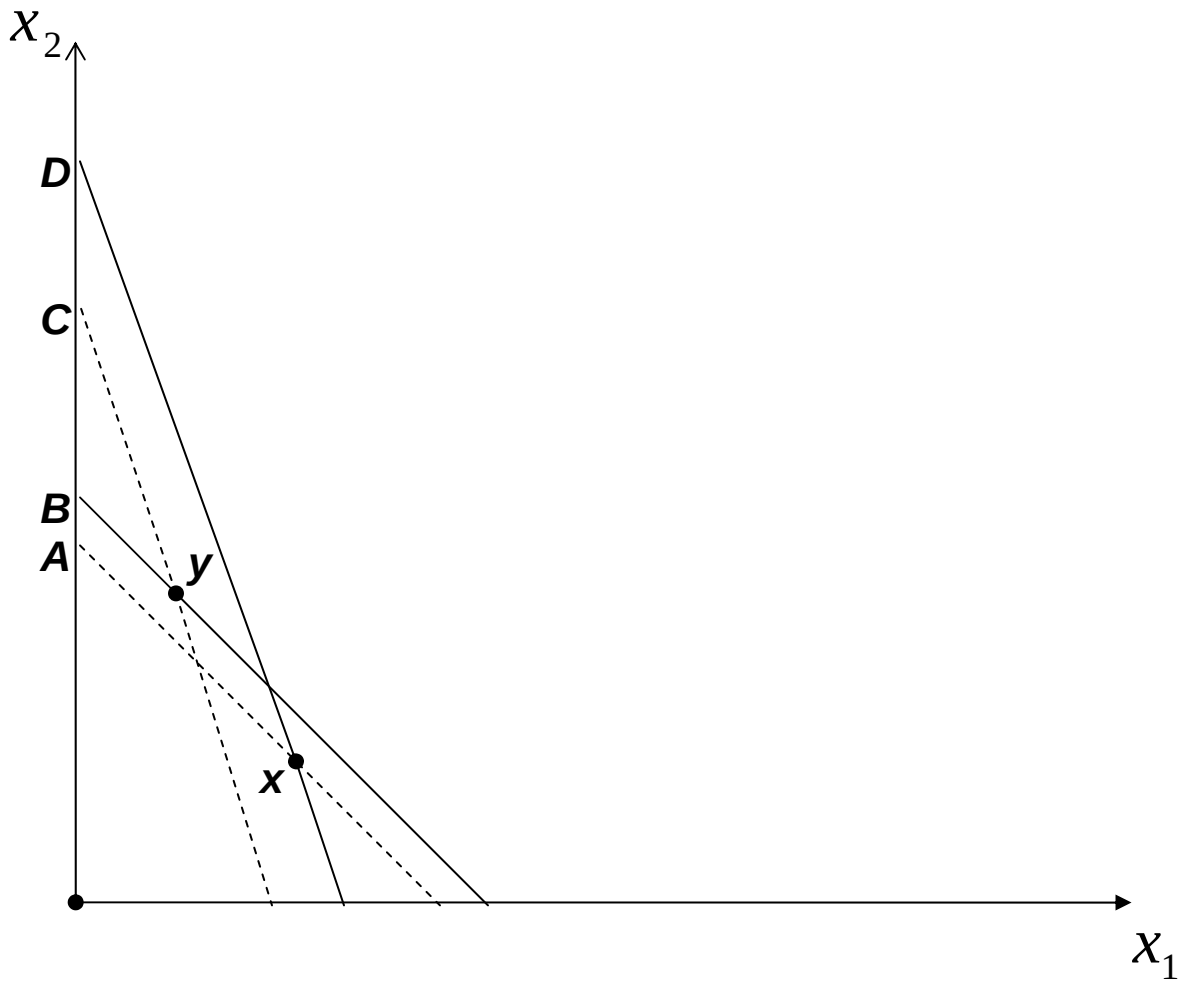
Consistency with GARP thus implies consistent preferences, but any consistent preference ordering over lotteries is admissible.

The CCEI measures the fraction by which each budget constraint must be shifted in order to remove all violations of GARP:

> For any number $0 \leq e \leq 1$, define the direct revealed preference relation $R^D(e)$ as
>
> $$x^i R^D(e) x^j \text{ if } ep^i \cdot x^i \geq p^i \cdot x^j,$$
>
> and define $R(e)$ to be the transitive closure of $R^D(e)$. The CCEI e^* is the largest value of e such that the relation $R(e)$ satisfies GARP.

The CCEI is between 0 and 1 – indices closer to 1 mean the data are closer to perfect consistency with utility maximization.

The construction of the CCEI for a simple violation of GARP



The agent is ‘wasting' as much as *A/B<C/D* of his income by making inefficient choices.

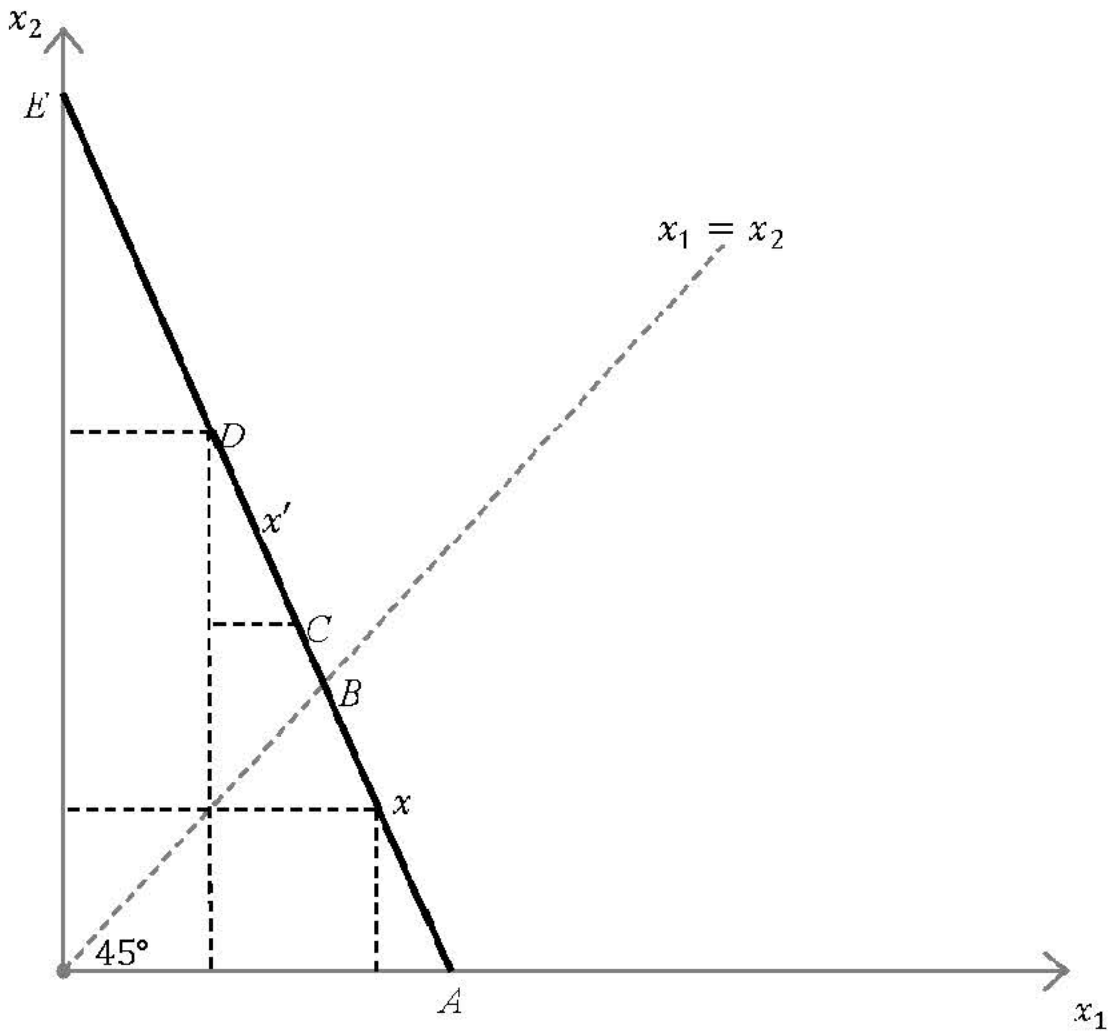
FOSD-rationalizability

- Choices can be consistent with GARP and yet fail to be reconciled with any utility function that is normatively appealing given the decision problem at hand.

- The experiment is *symmetric* (each state had an equal probability), choice behavior should respond symmetrically to *permutations* in prices.

- Compute the CCEI obtained by augmenting the set of revealed preference comparisons at each observation.

A violation of FOSD-rationalizability



EU-rationalizability

(The GRID method of Polisson, Quah and Renou, 2020)

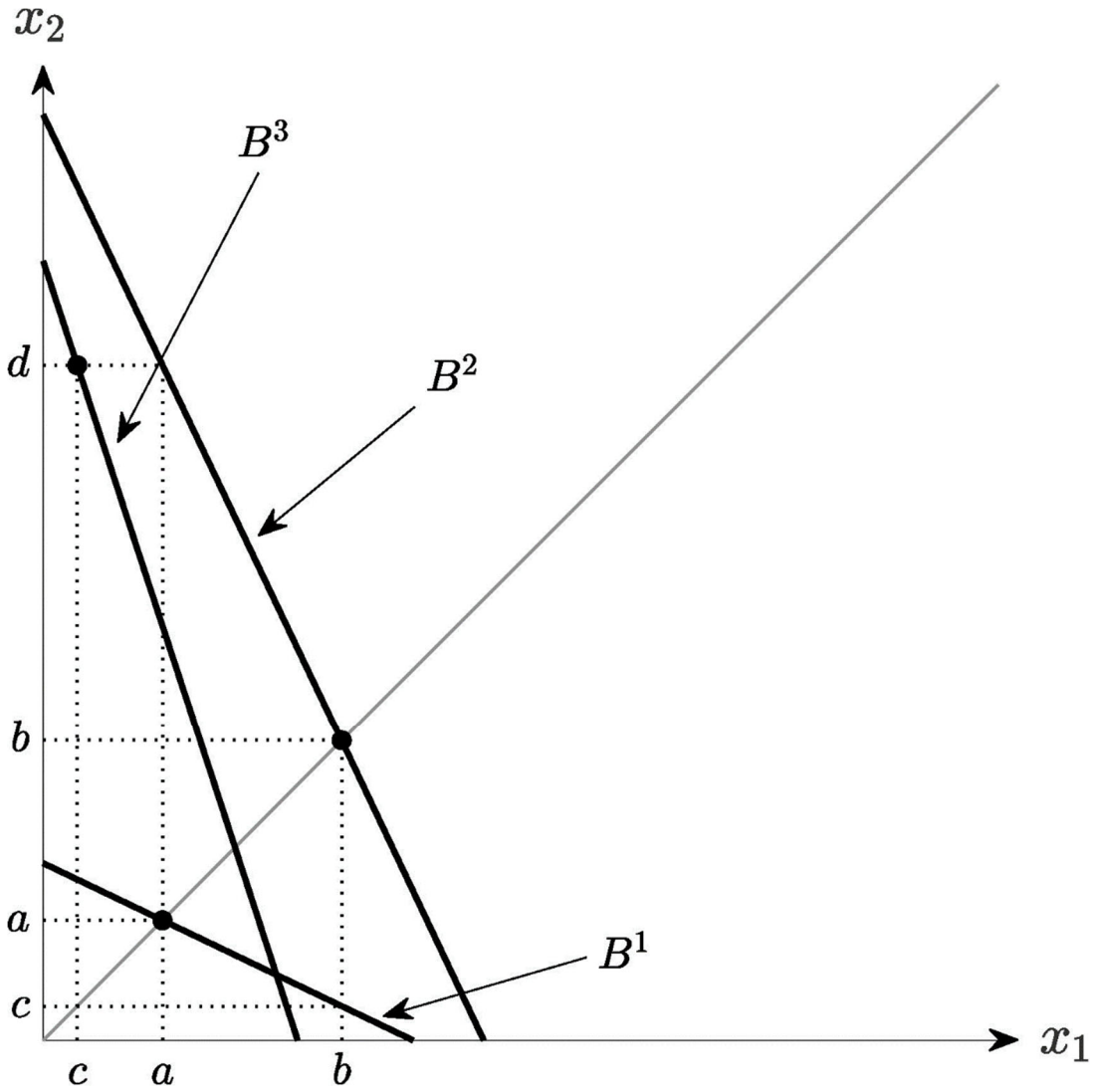
An example of a preference ordering that is FOSD-rationalizable but not EU-rationalizable, is rank-dependent utility function (Quiggin, 1993):

$$U(\mathbf{x}) = \omega_L u(\mathsf{min}\{\mathbf{x}\}) + \omega_M u(\mathsf{med}\{\mathbf{x}\}) + \omega_H u(\mathsf{max}\{\mathbf{x}\})$$

When weights $w_H < w_M < w_L$, the indifference curves have "kinks" where $x_s = x_{s'}$

$\Longrightarrow$ Allocations that satisfy $x_s = x_{s'}$ will be chosen for a non-negligible set of price vectors, which is not consistent with EU.

A simple violation of EU-rationalizability



EU requires that

$$\begin{aligned} U(a,a) &= 2u(a) \geq u(b) + u(c) \\ U(b,b) &= 2u(b) \geq u(a) + u(d) \end{aligned}$$

b/c $(a,a)R^D(b,c)$ and $(b,b)R^D(a,d)$.

But rearranging yields

$$u(a) + u(b) \geq u(c) + u(d)$$

which contradicts that $(c,d)R^D(a,b)$.

– e^* – maximizing any utility function (GARP).

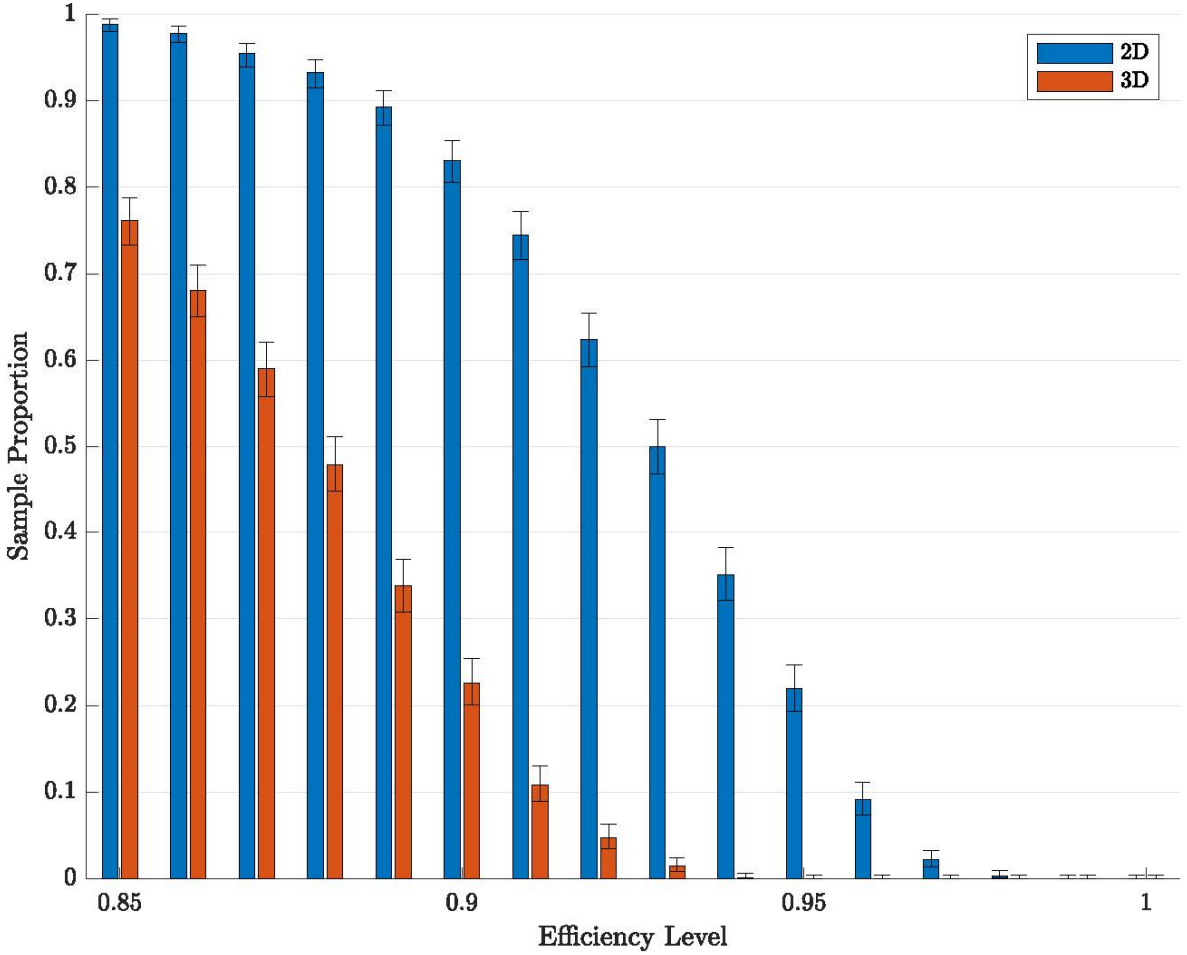
– $e^{**} \leq e^*$ – maximizing a monotonic utility function (GARP+FOSD).

– $e^{***} \leq e^{**}$ – maximizing an expected utility function (GARP+FOSD+EU).

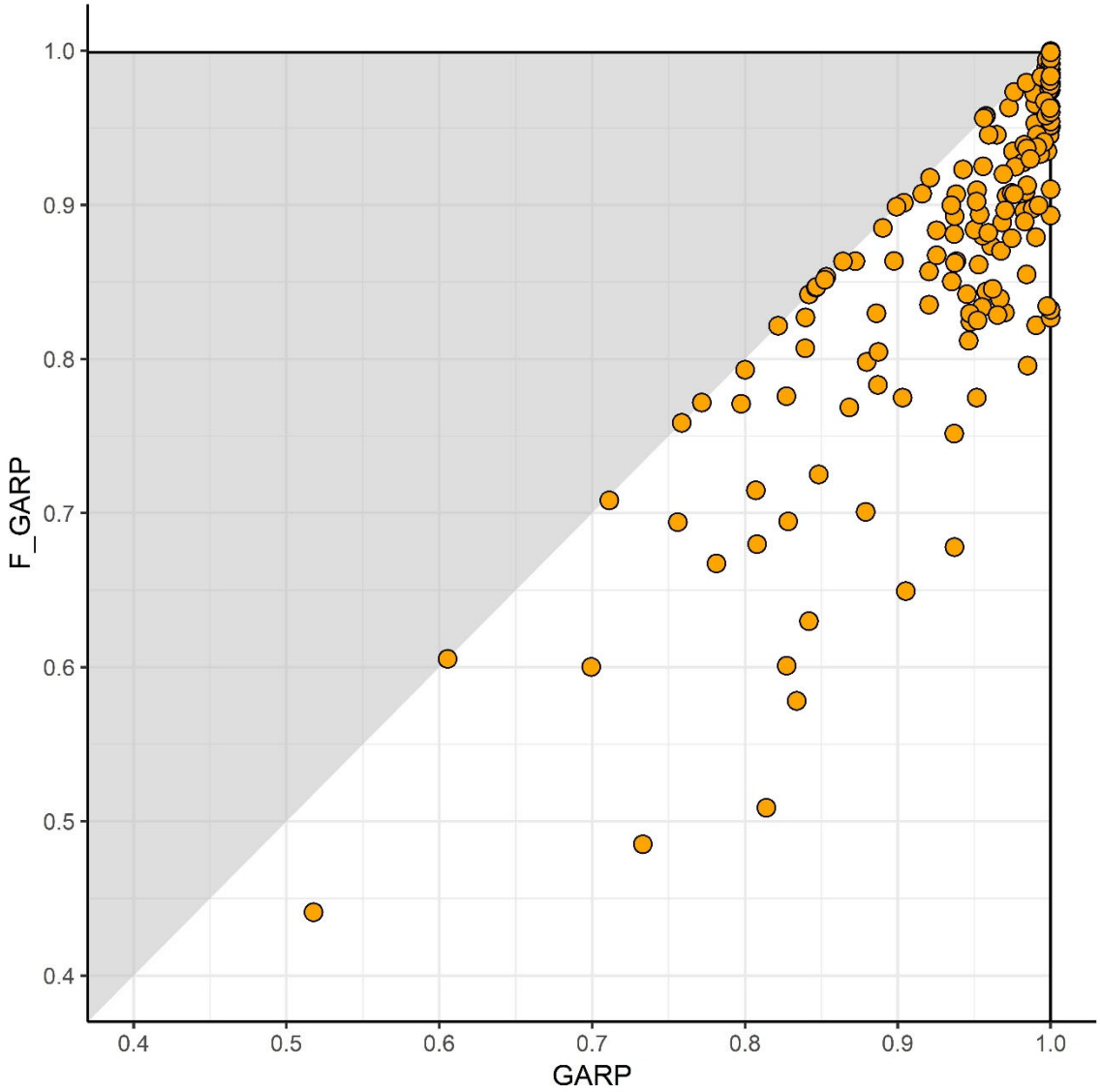
$\Rightarrow$ For all non-EU theories, which number well into double figures (Starmer, 2000), including stochastic reference dependence (Kőszegi and Rabin, 2006 & 2007):

$$e^{***} < e^{**} = e^* = 1.$$

Power analysis
(randomly uniform datasets that are that are FOSD-rationalizable exactly)



Ever since Allais...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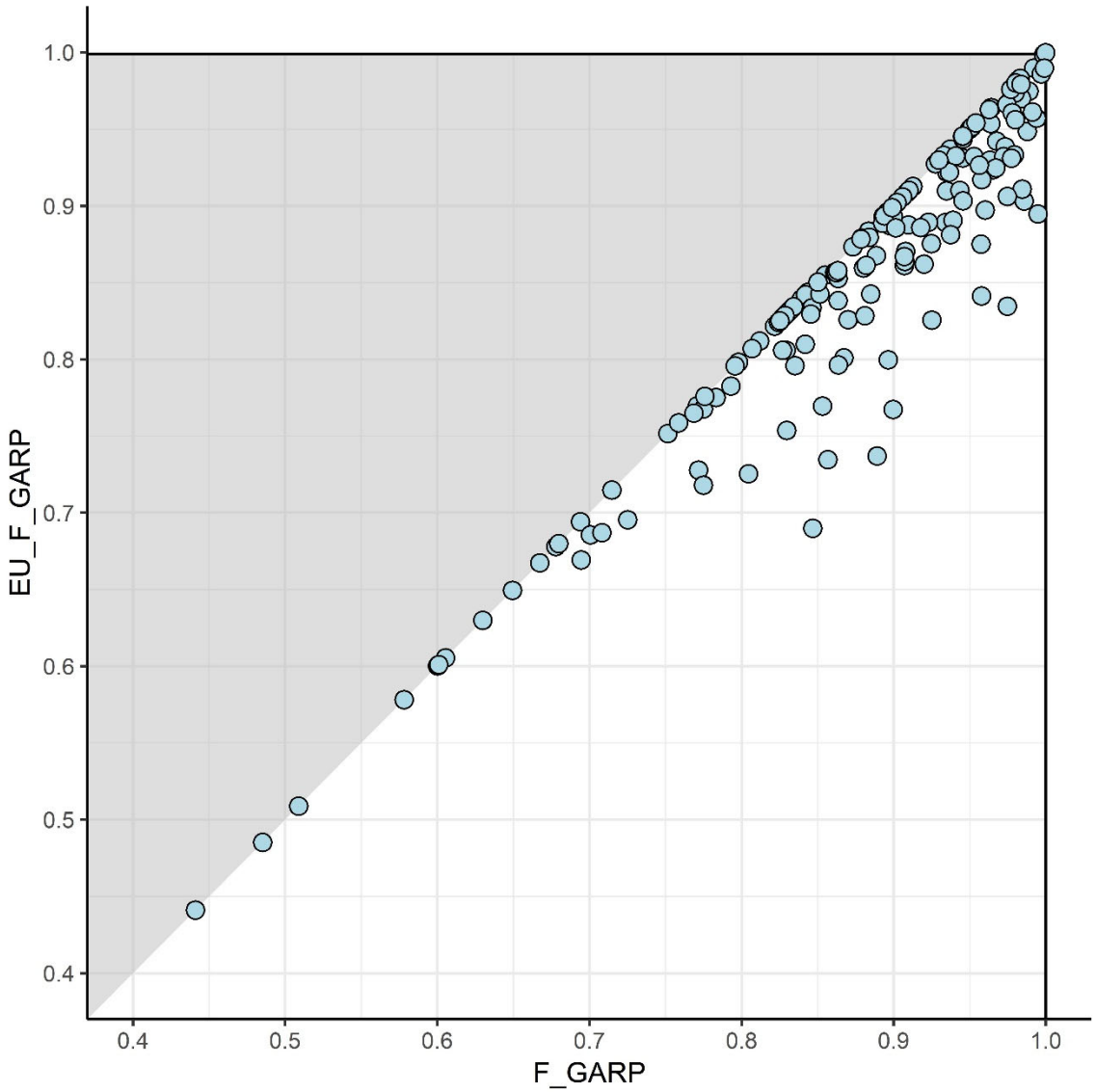
GARP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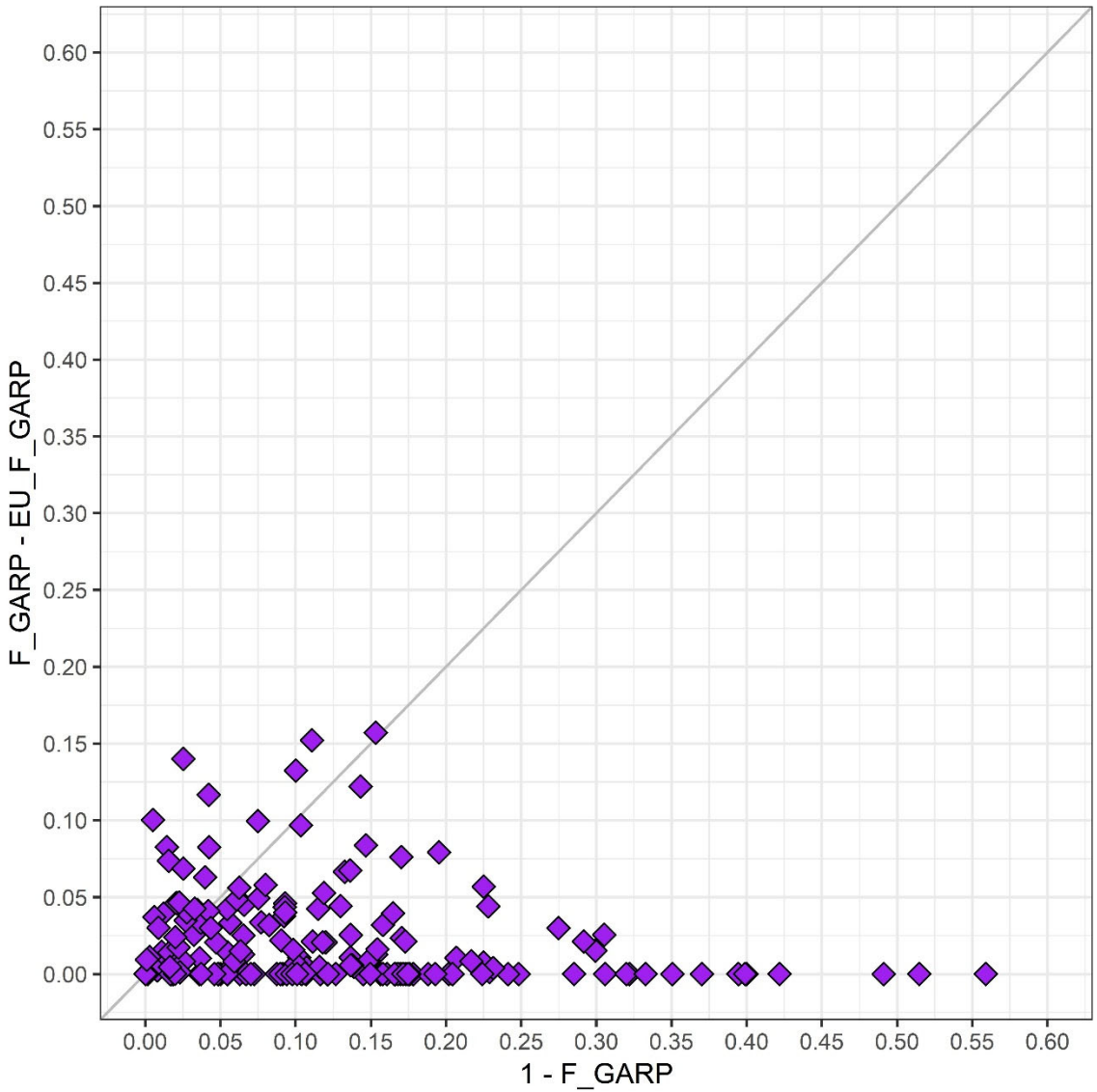
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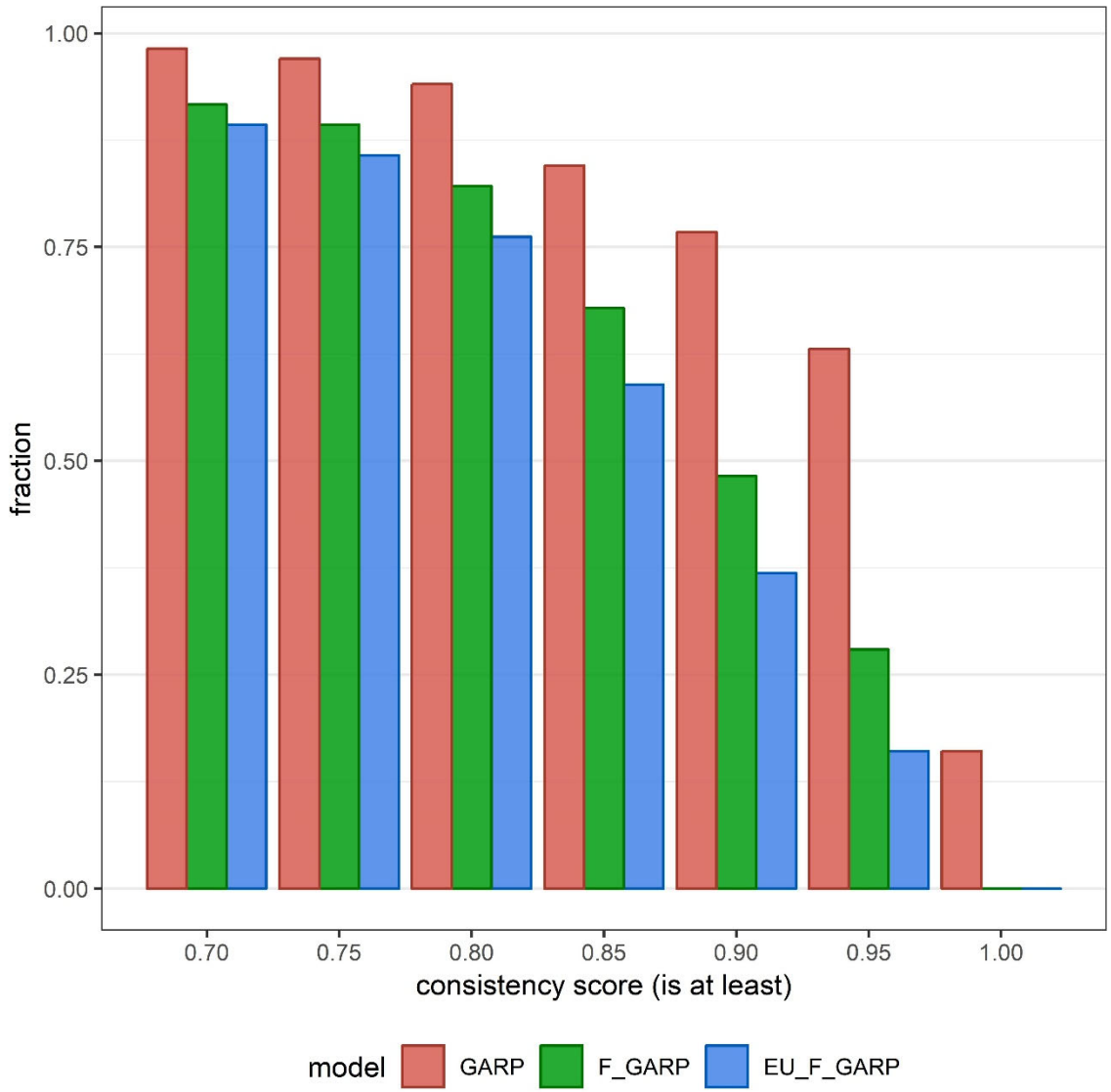
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GARP
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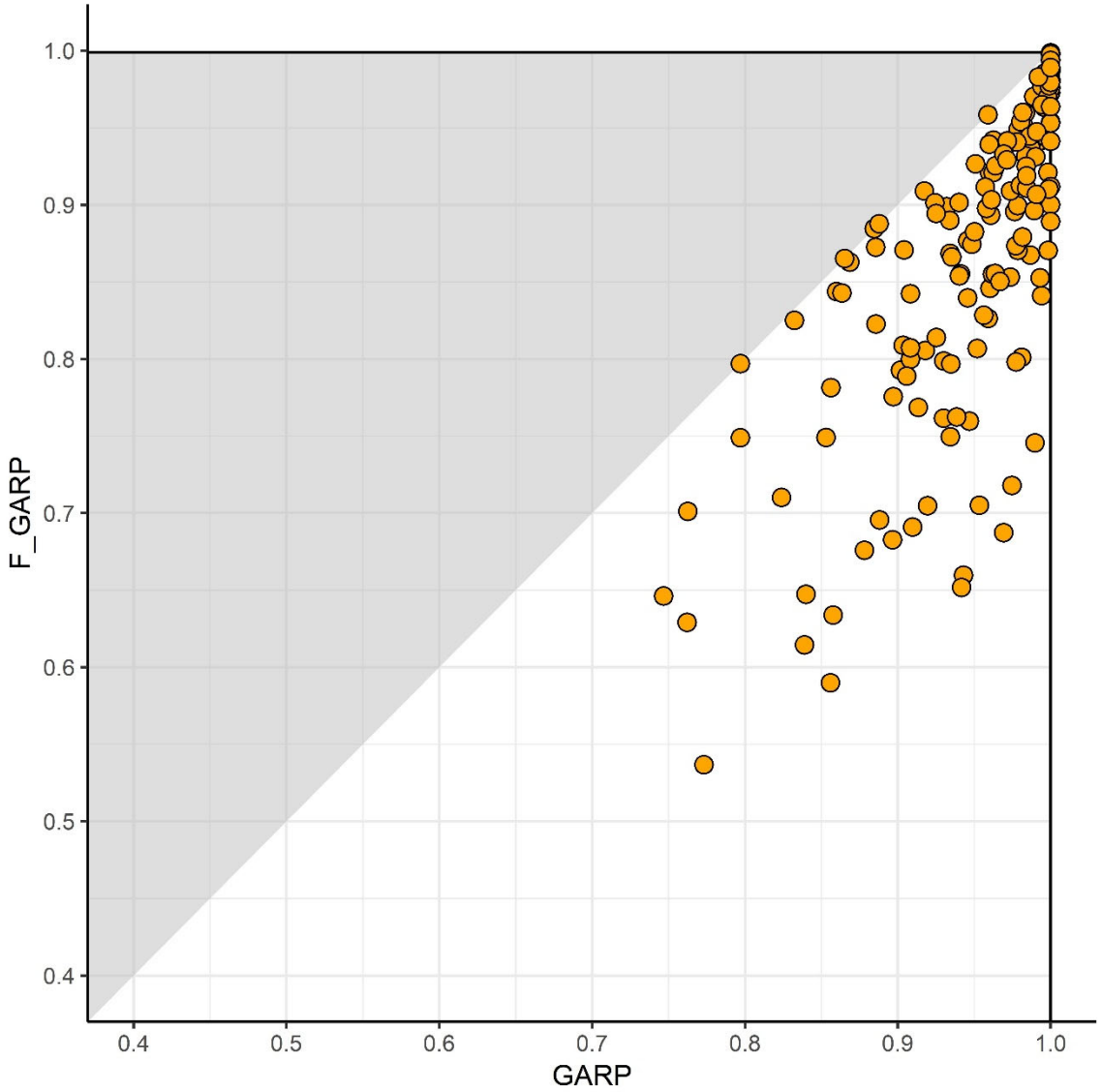
EU_F_GARP

Ever since Ellsberg...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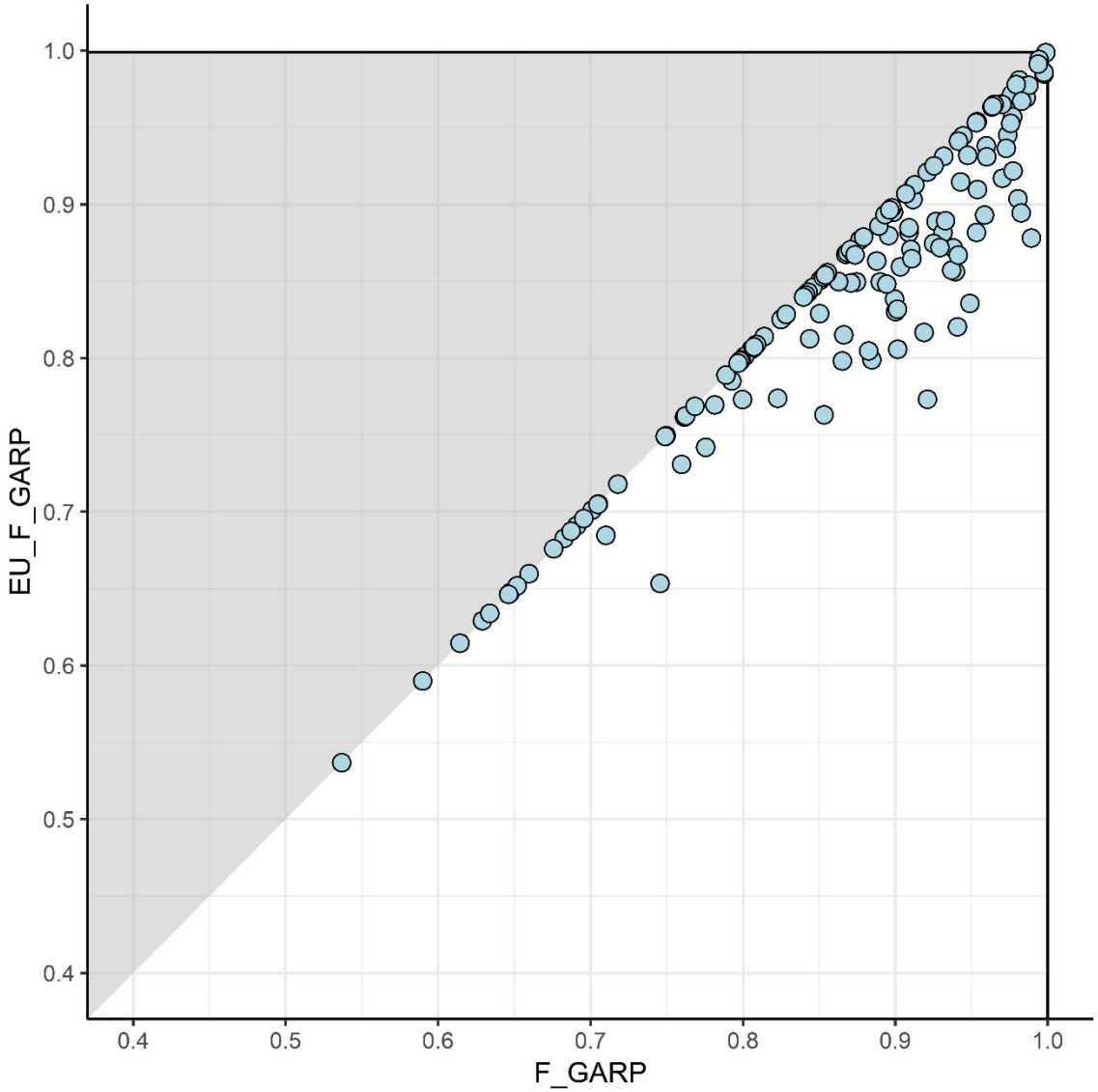
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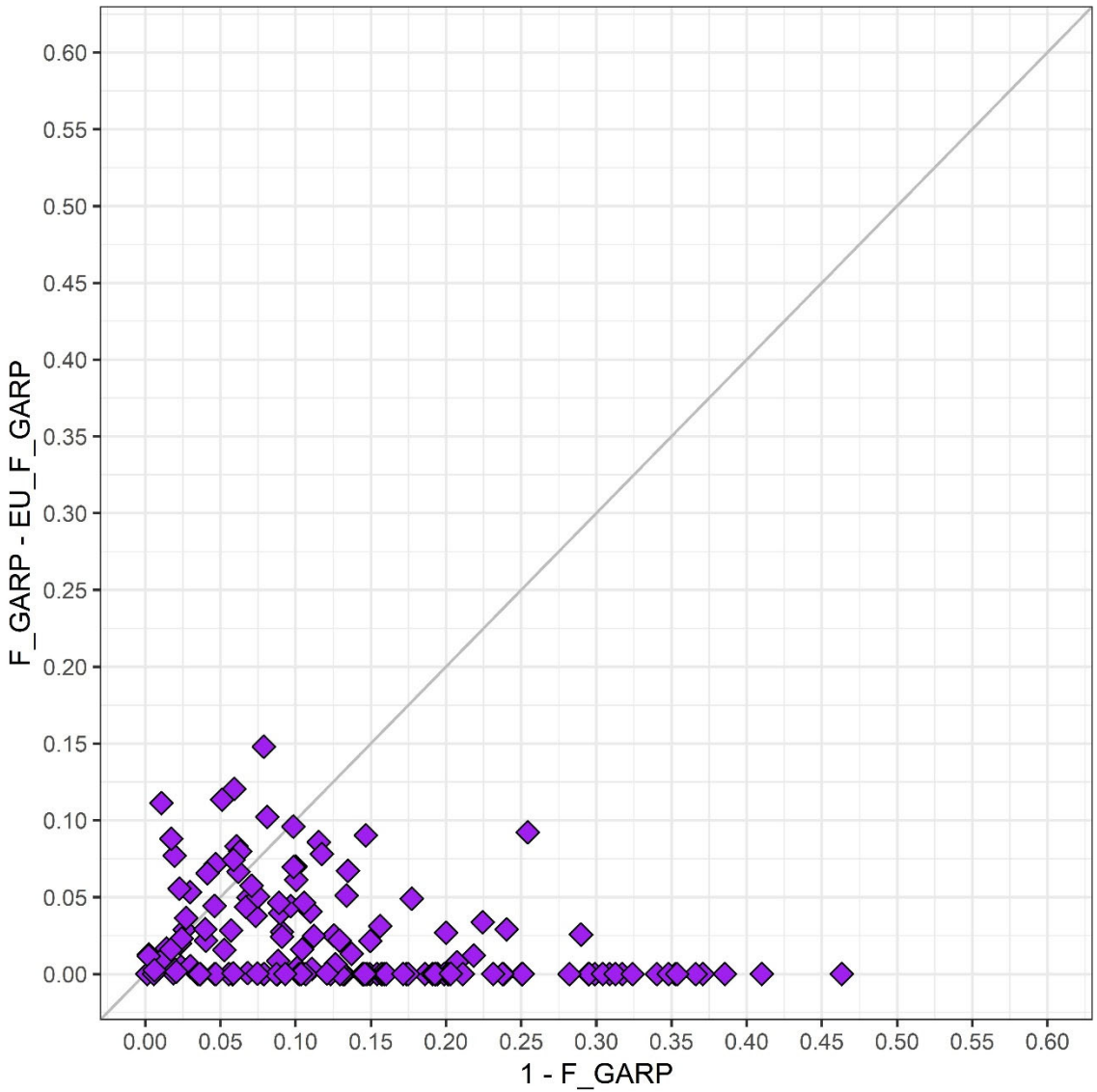
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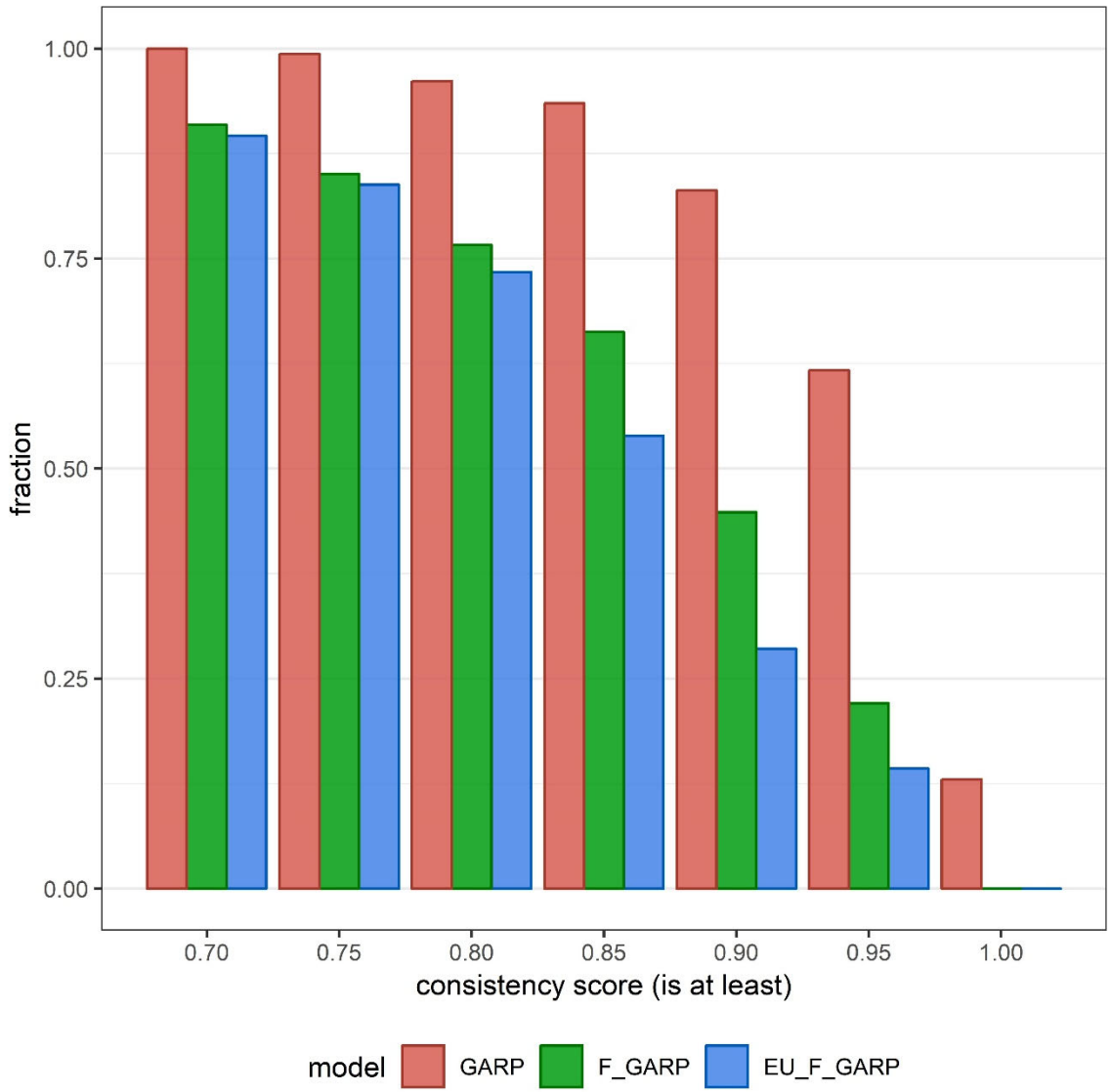
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consistency score (is at least)
model
GARP
F_GARP
EU_F_GARP

Takeaways

1. Violations of independence need not be the most important factors when it comes to failures of EU under risk (and ambiguity).

2. Instead, the failures appear to be more basic – conditional on obeying GARP and FOSD, the majority of subjects also obey EU.

$\Rightarrow$ Light paternalism – even light paternalistic policies should only be put into play when welfare judgments tend to be relatively straight-forward (Loewenstein and Haisley, 2008).