Revealed Different

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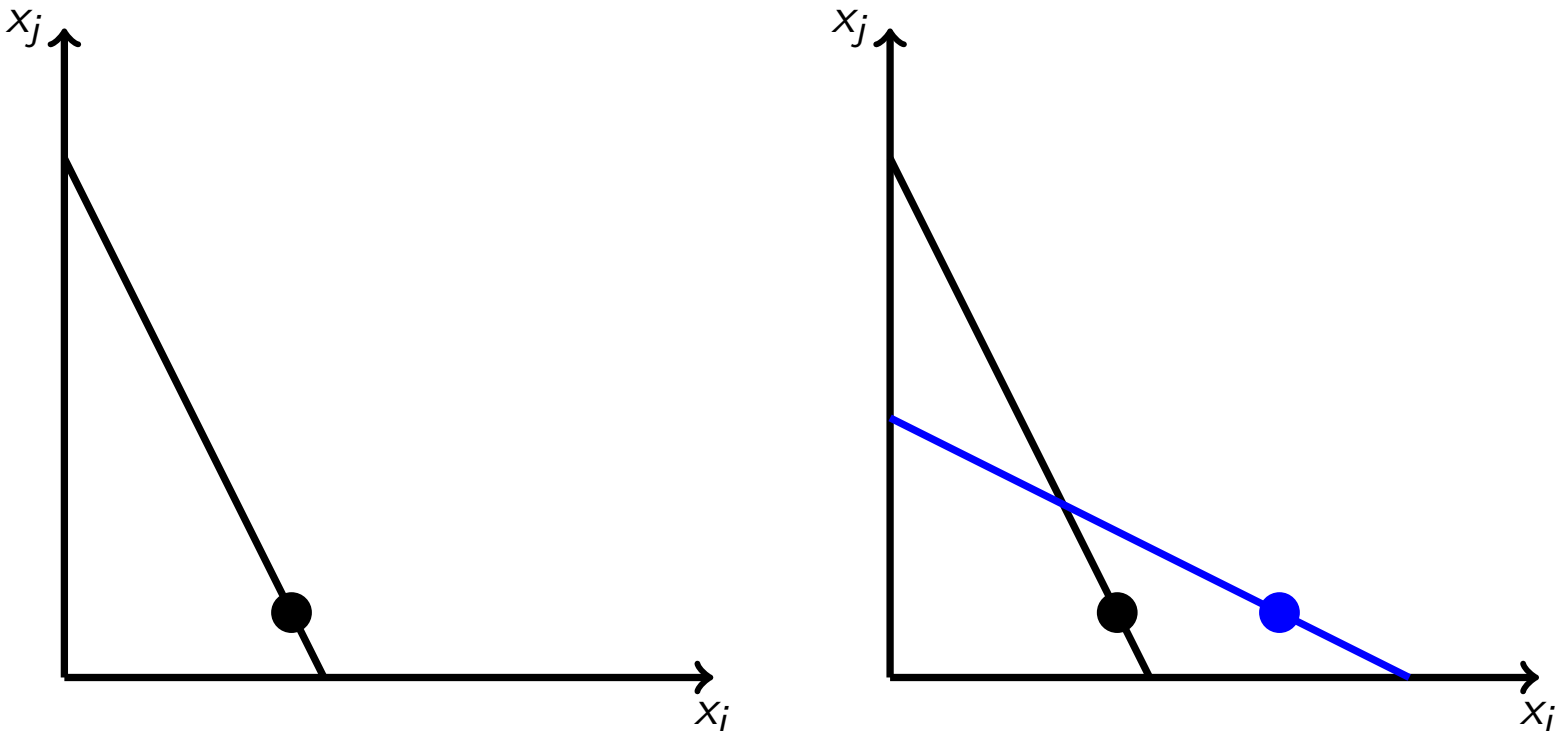
Goal

- *Develop a non-parametric method to test if preferences across individuals are different*
- Determine how heterogeneous preferences are and whose preferences are more heterogeneous
- Investigate how non-parametric assumptions on preferences affect the answers to these questions

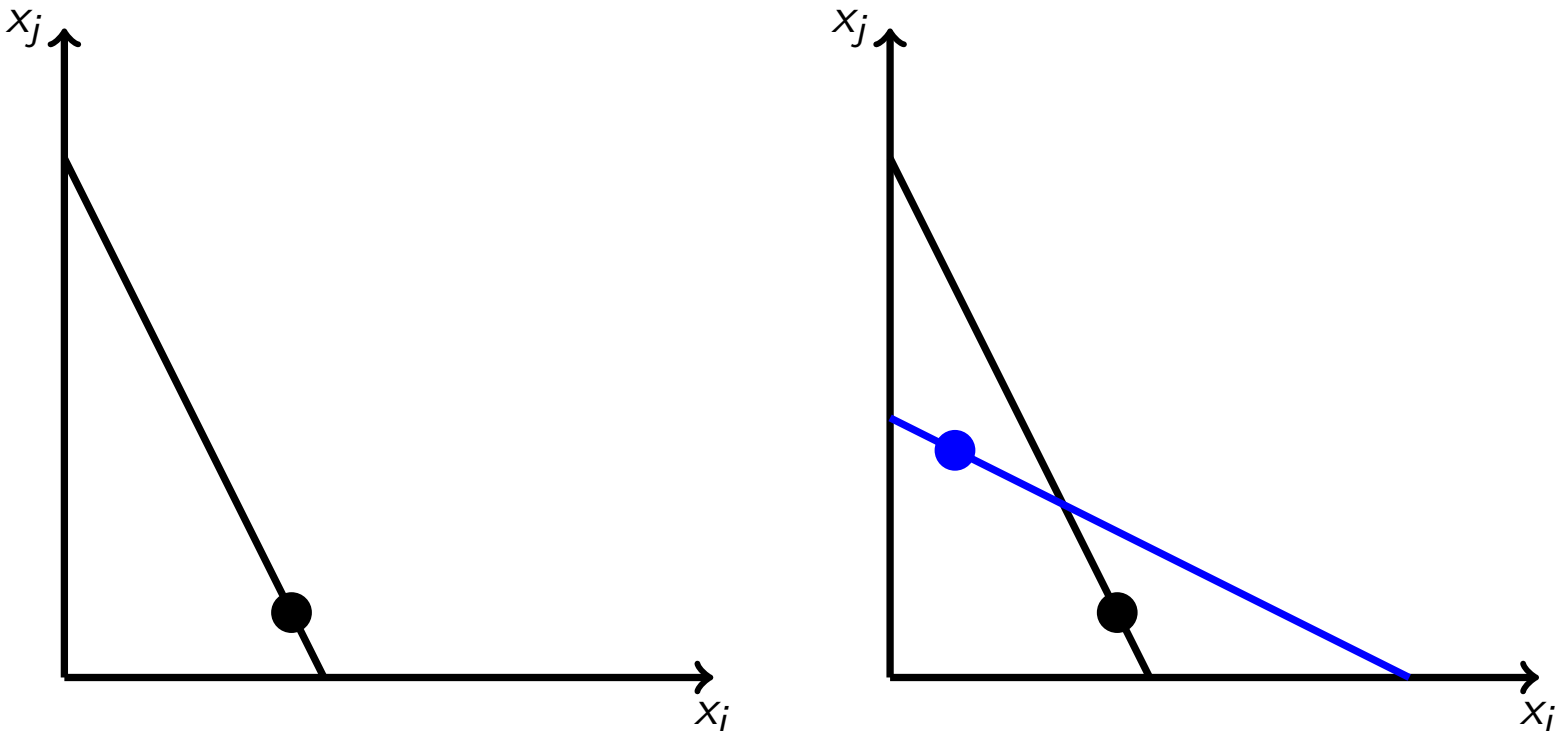
Intuition



If rational agents have same the preferences, the combined decisions of both subjects are still rational

$\Rightarrow$ They are *not Revealed Different*.

Intuition



If rational agents have different preferences, the combined decisions of both subjects might not be rational.

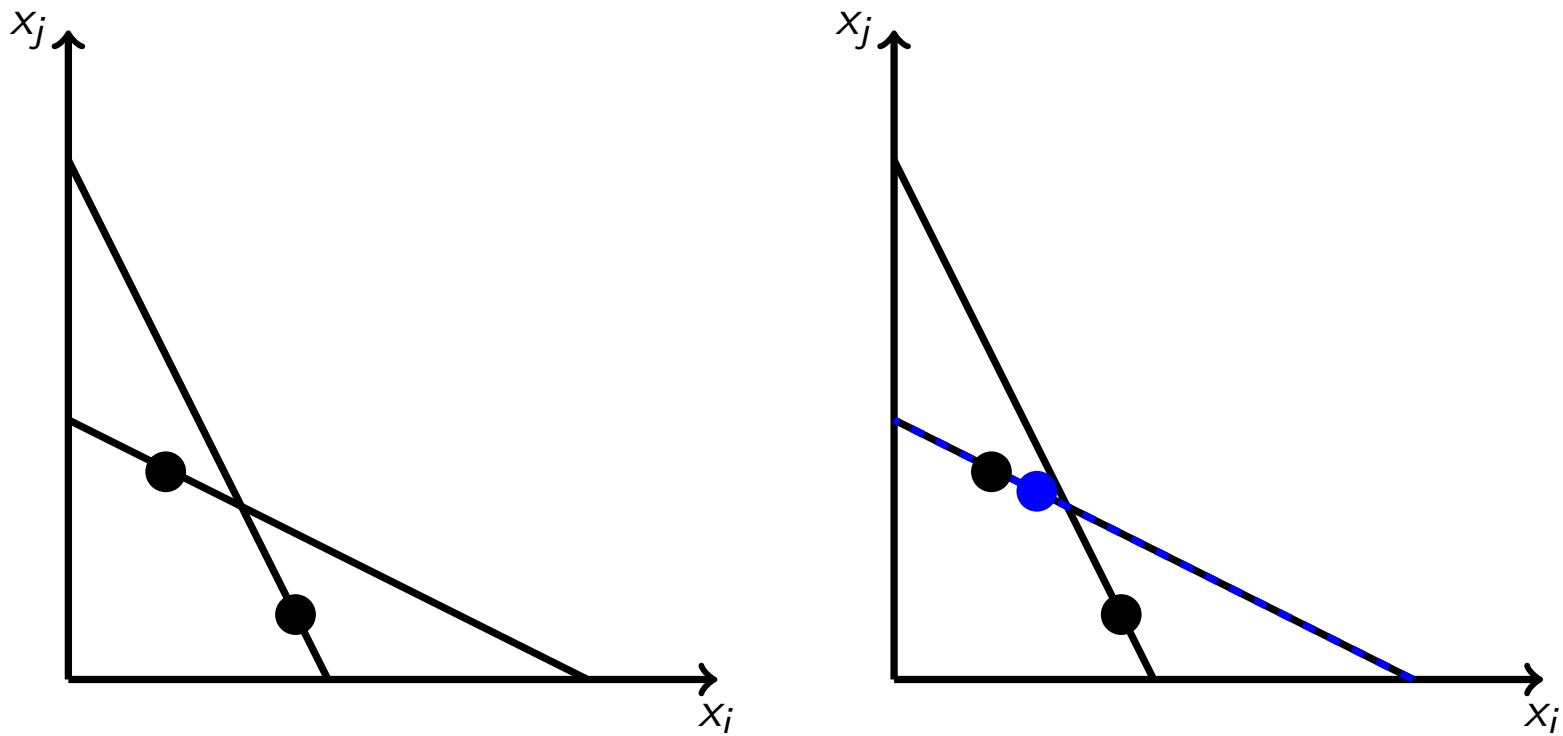
$\Rightarrow$ They are *Revealed Different*.

Challenges

(!) *Most people are not exactly rational* ...

(?) How can we detect differences in preferences among not exactly rational agents?

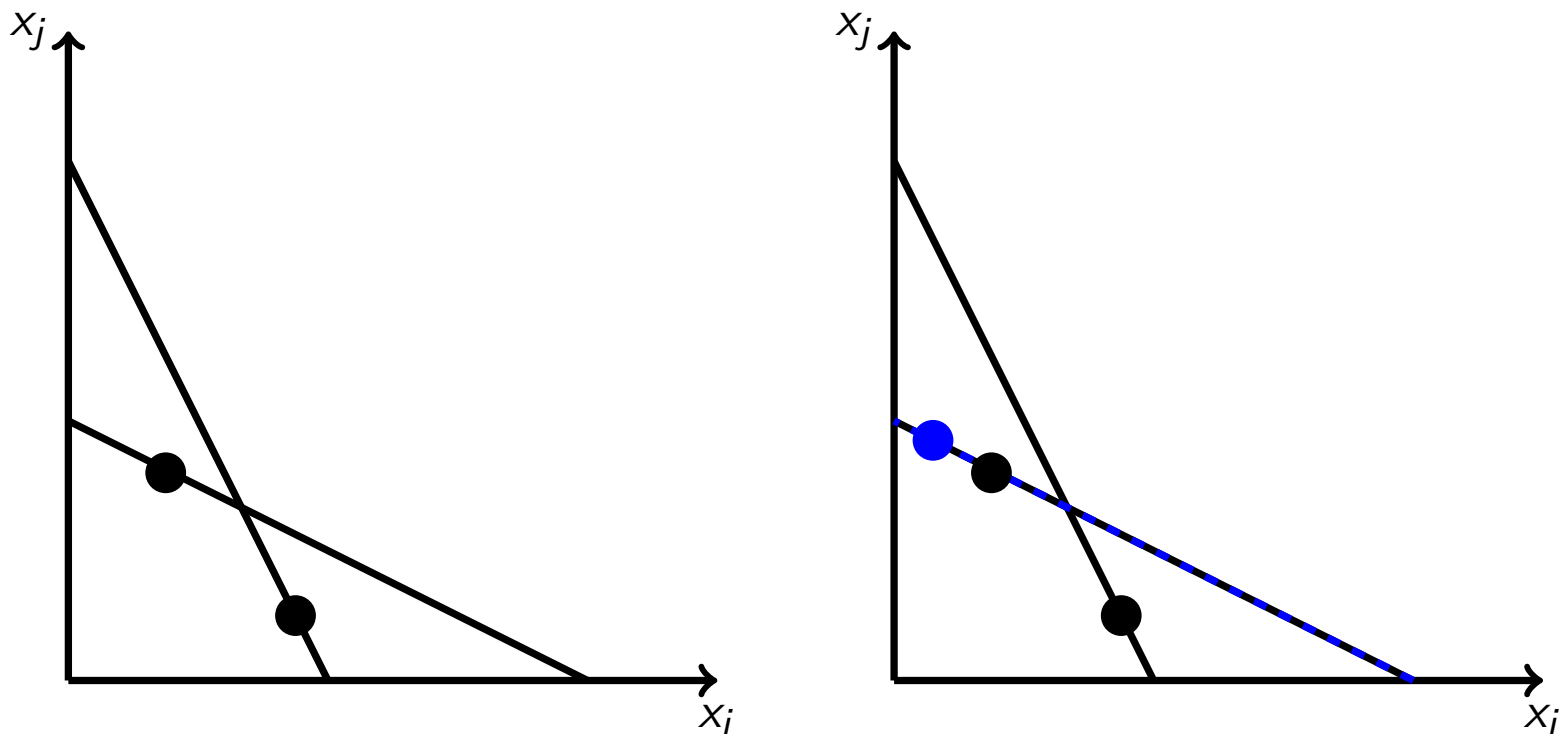
Intuition: Dealing With Irrationality



Not-exactly rational agents have the same preferences and their merged decisions are no less rational

$\Rightarrow$ They are *not Revealed Different*.

Intuition: Dealing With Irrationality



Not-exactly rational agents don't have the same preferences and their combined decisions are less rational

$\Rightarrow$ They are *Revealed Different*.

What do we want?

Weitzman (1992)

Existence of a distance function is all that is needed to characterize diversity (i.e. to classify species and value their diversity)

- $d(i,j)$ is a distance function
  - $d(i,i) = 0$
  - $d(i,j) \geq 0;\ \forall x, y$ (Non-negative)
  - $d(i,j) = d(j,i)$ (Symmetric)

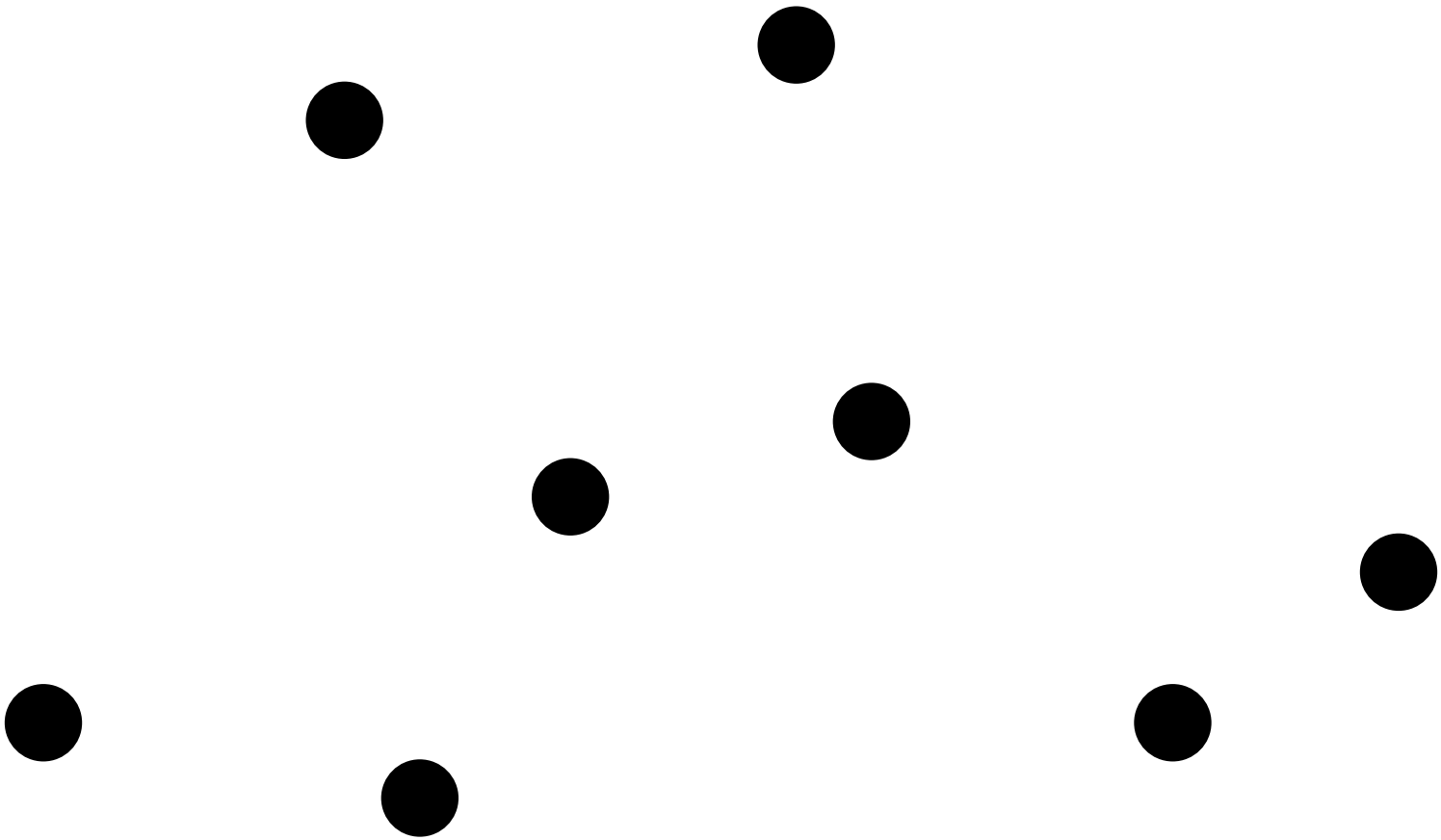
Being Different

$$RD(x,y) = \begin{cases} 1, \ \textit{if} \ \ \rho(x \cup y) > \max\{\rho(x); \rho(y)\} \\ 0, \ \textit{otherwise} \end{cases}$$

where $\rho(\cdot) =$ distance from rationality

Characterizing heterogeneity

Dots for people, arrows for *revealed different*



Characterizing heterogeneity

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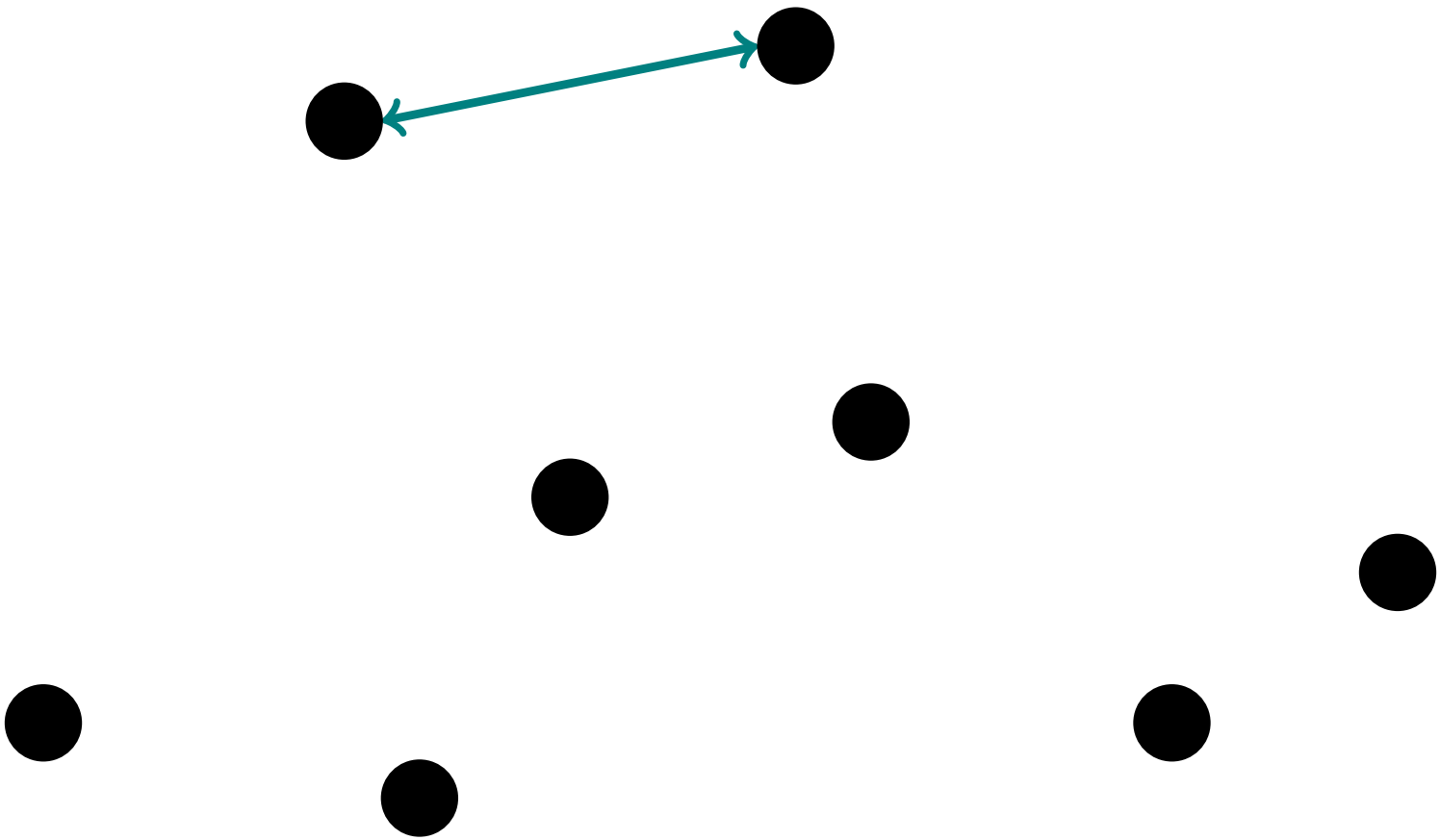

Characterizing heterogeneity

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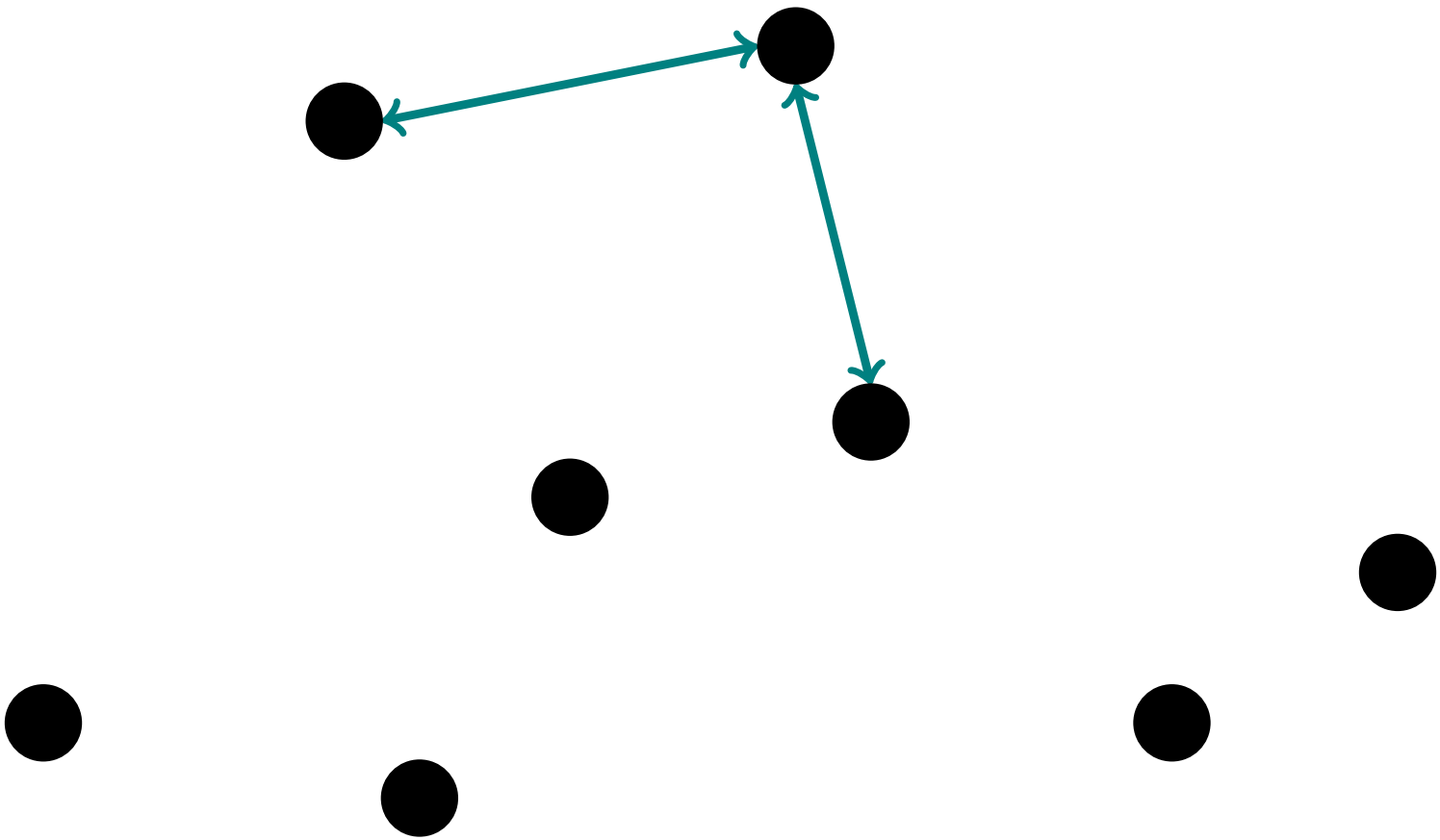

Characterizing heterogeneity

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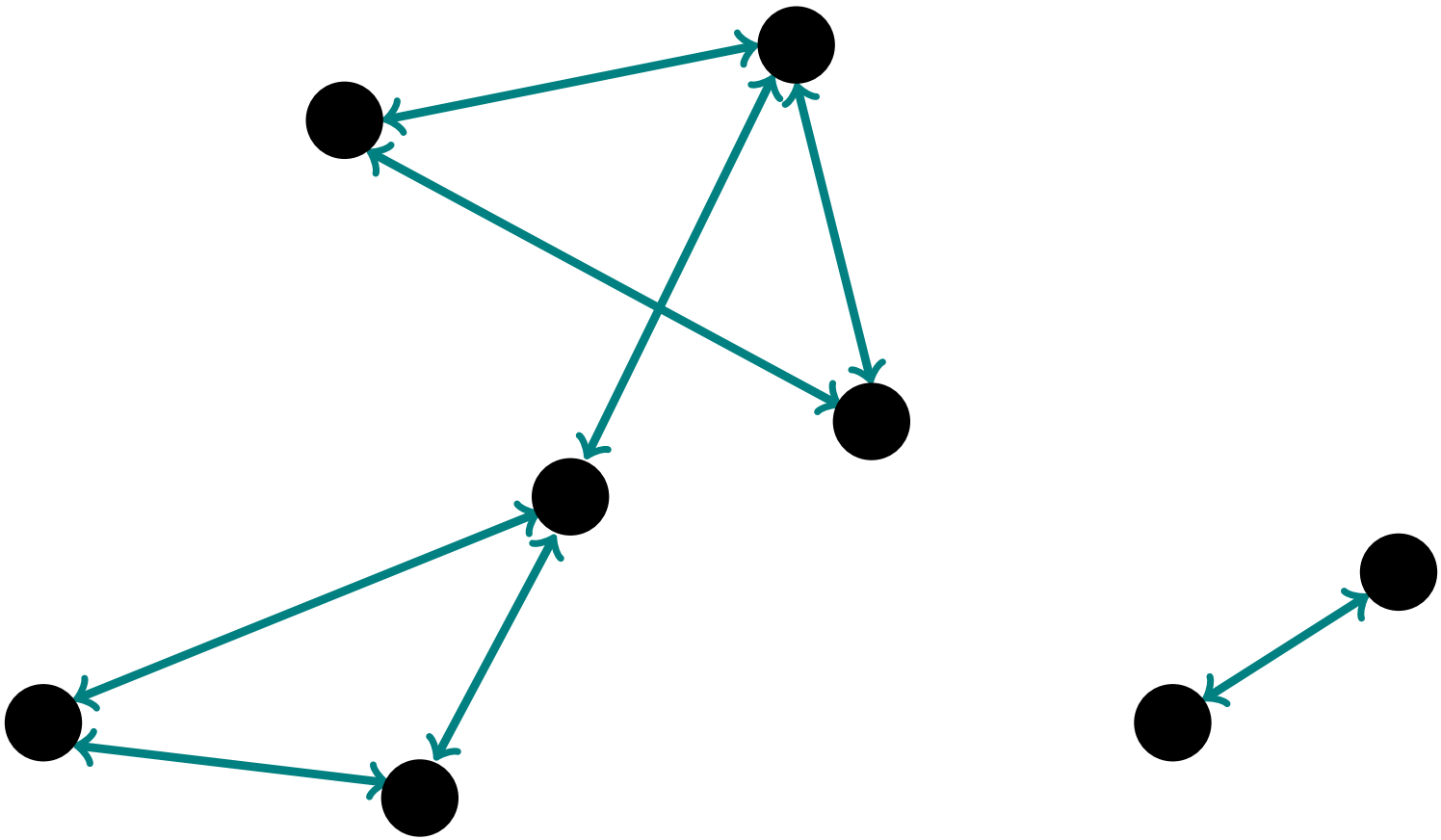


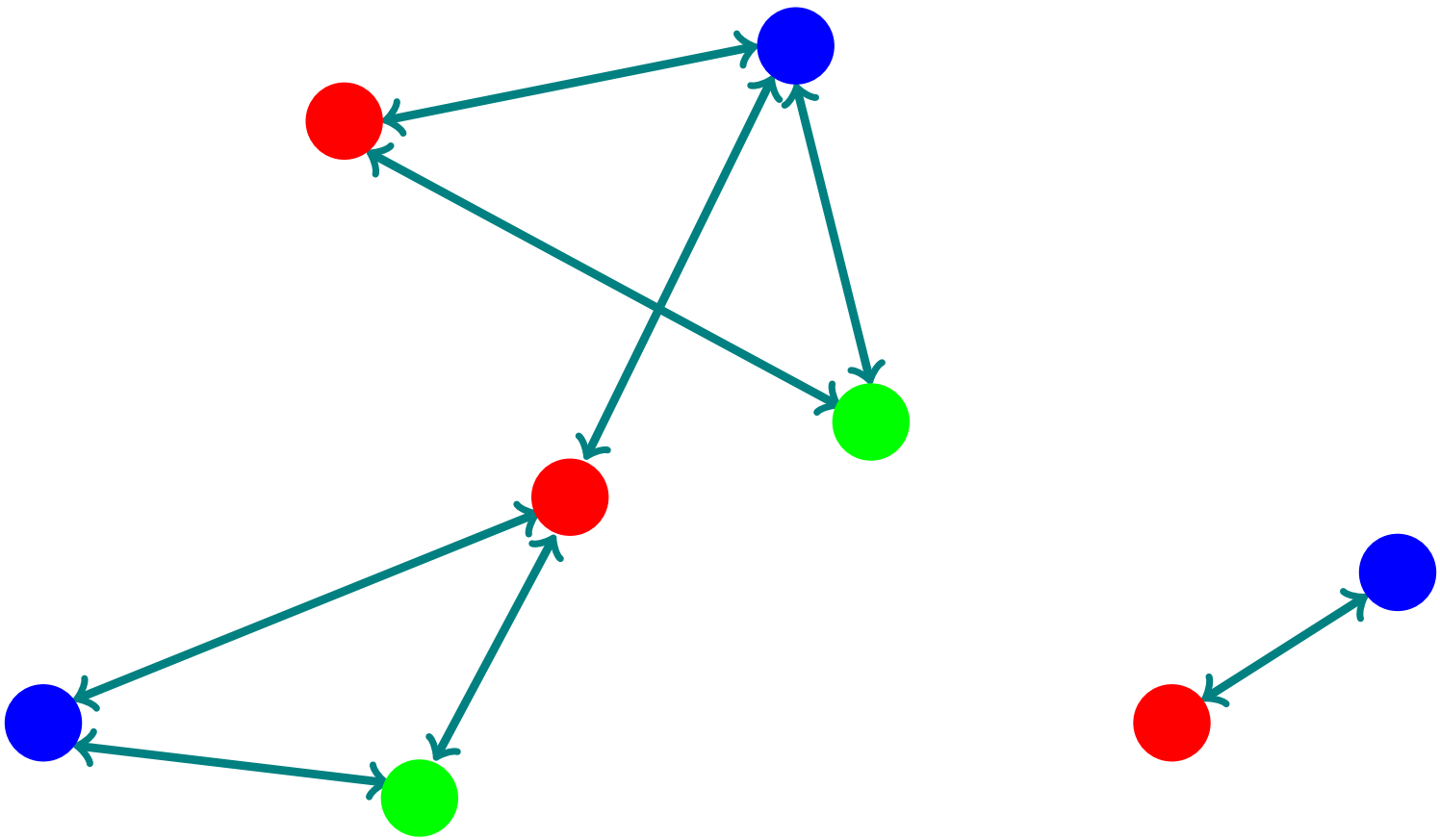
Characterizing heterogeneity

- How many types does the Revealed Different relation contain?

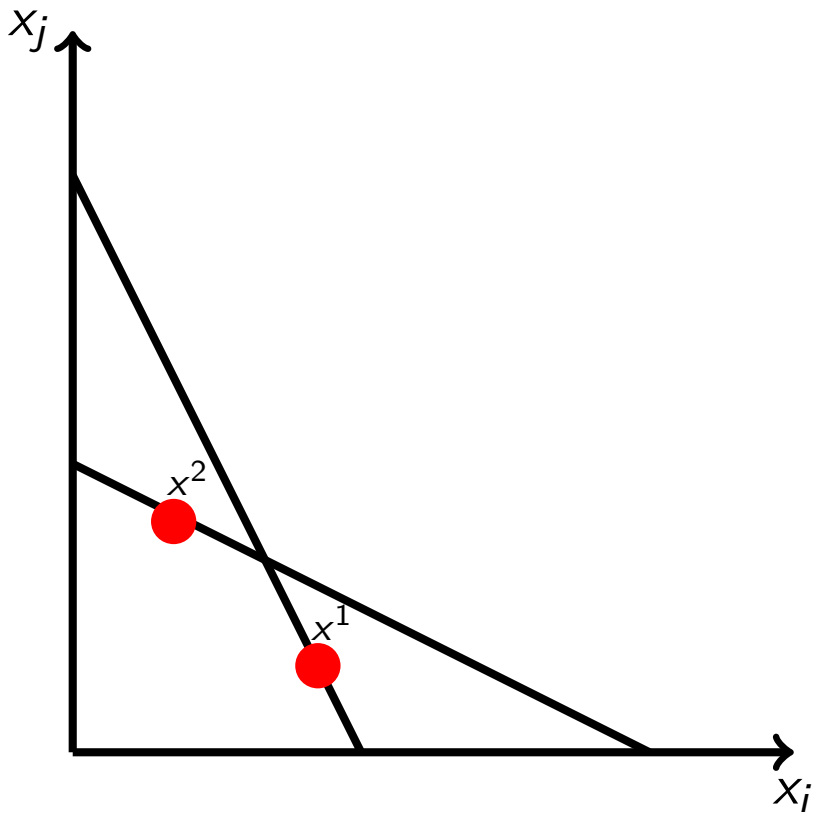
- We group people such that:
  $\Rightarrow$ No two agents in a group is different from each other
  $\Rightarrow$ The amount of types is minimal

Coloring Graph (3 types: red, blue and green)

Dots for people, arrows for *revealed different*

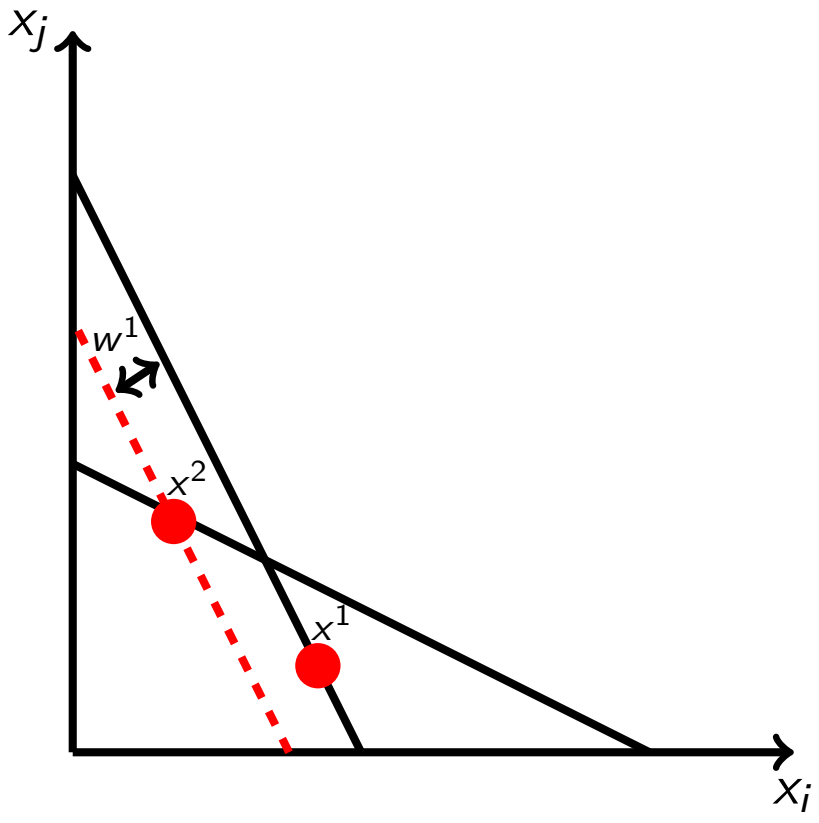


Critical Cost Efficiency Index (Afriat, 1973)



Moving x^1 budget

Critical Cost Efficiency Index (Afriat, 1973)



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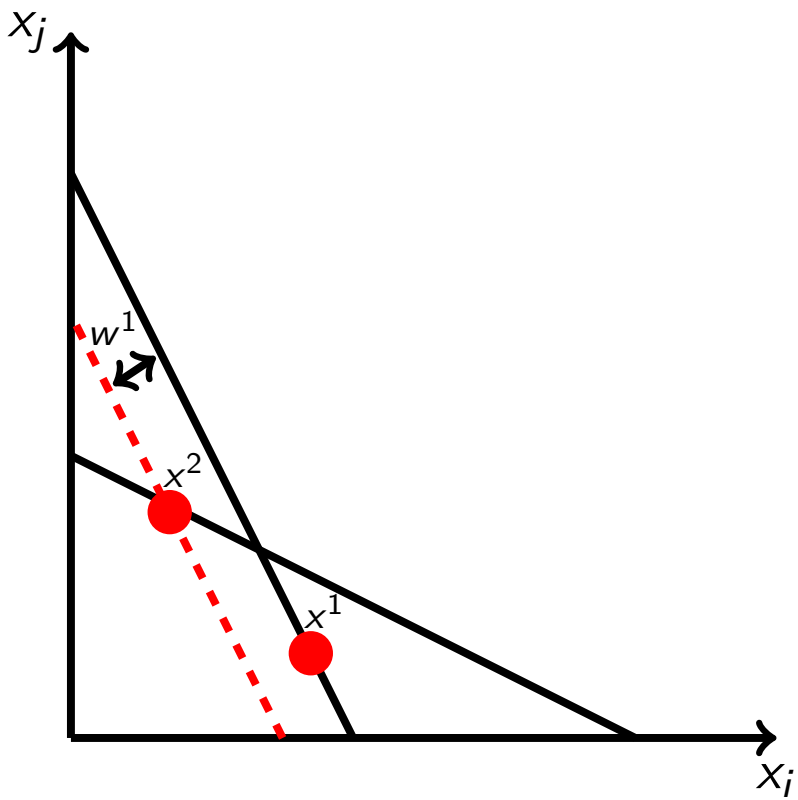

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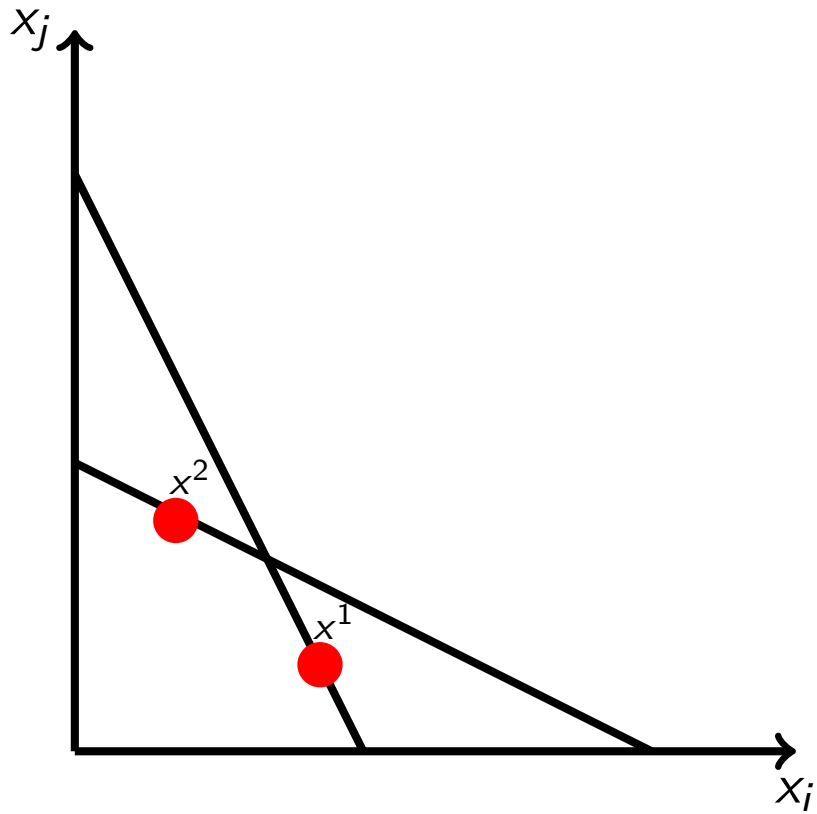
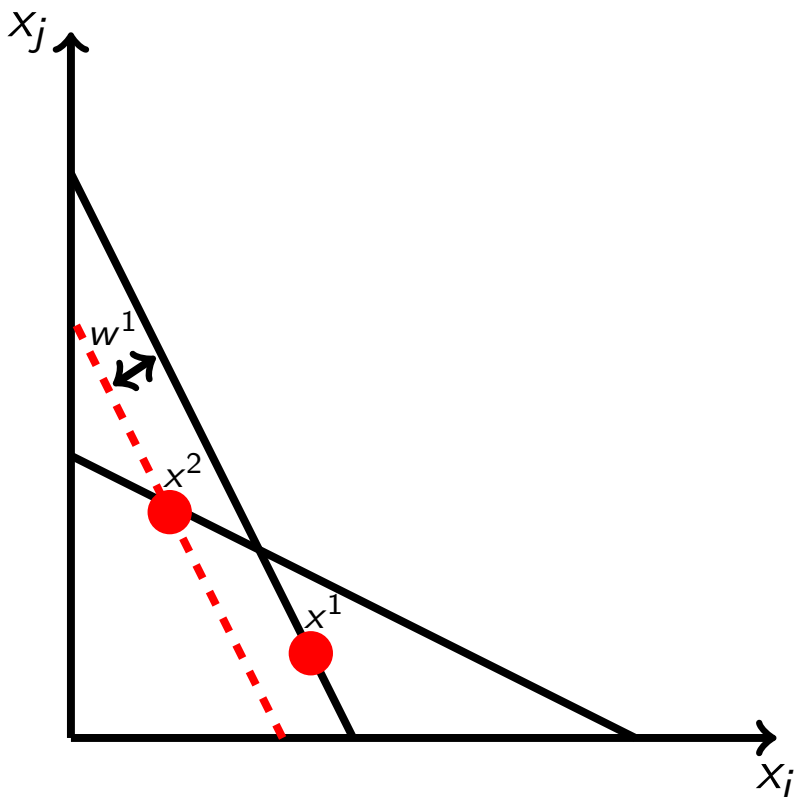
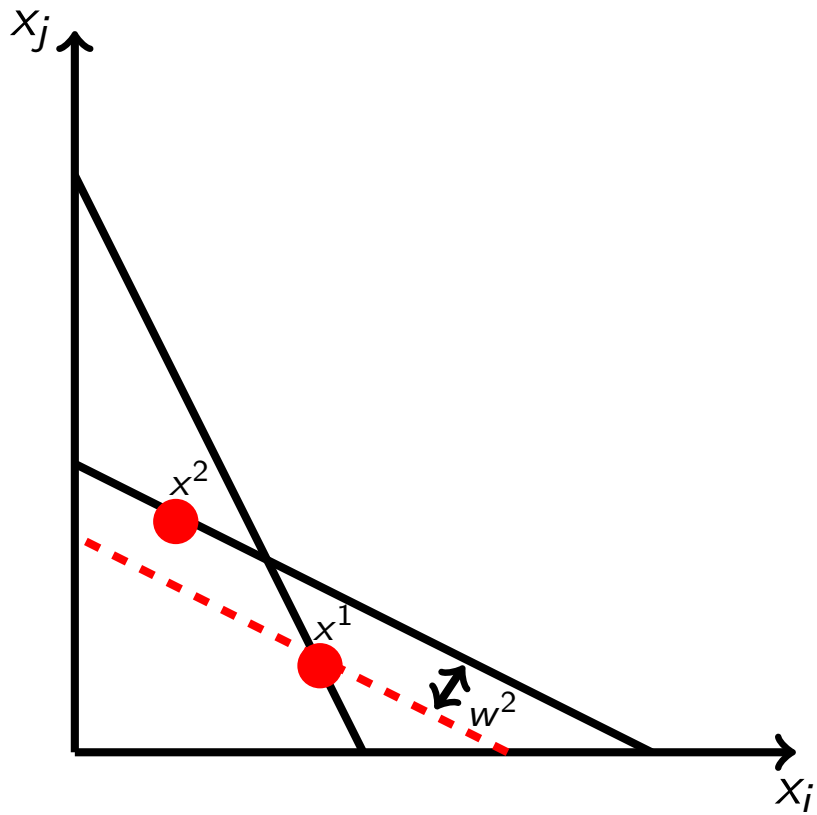


Moving x^2 budget

Critical Cost Efficiency Index (Afriat, 1973)



Moving x^1 budget



Moving x^2 budget

Being Different + CCEI

Why does it work?

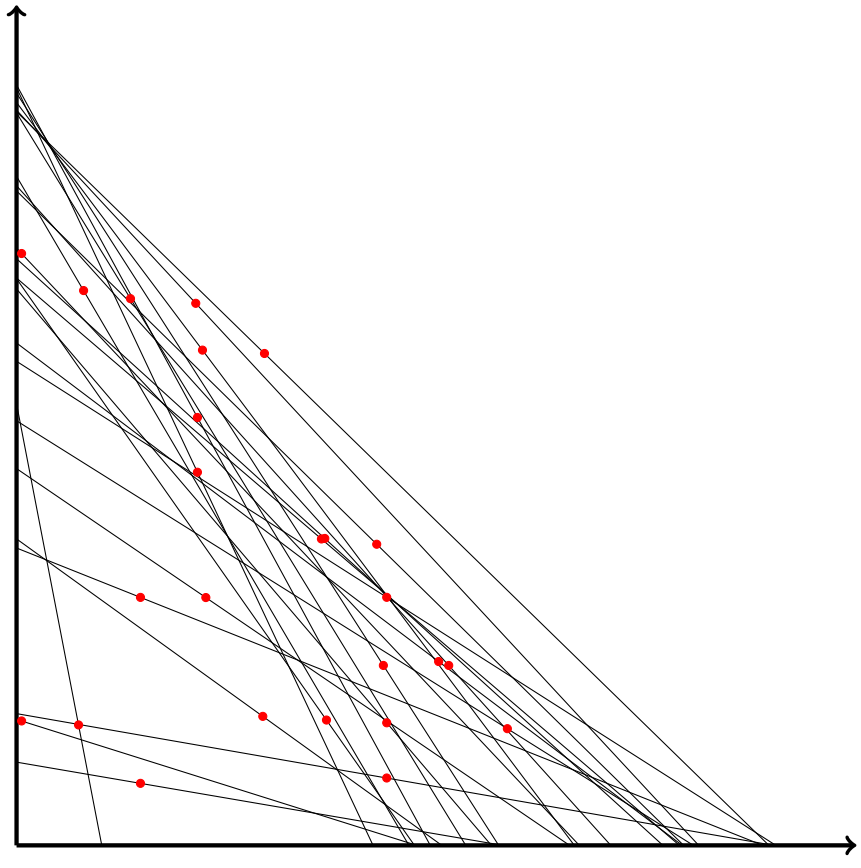
$$RD(x,y) = \begin{cases} 1, & \textit{if } \; CCEI(x \cup y) < \min\{CCEI(x); CCEI(y)\} \\ 0, & \textit{otherwise} \end{cases}$$

Data

Choi et al (2014).

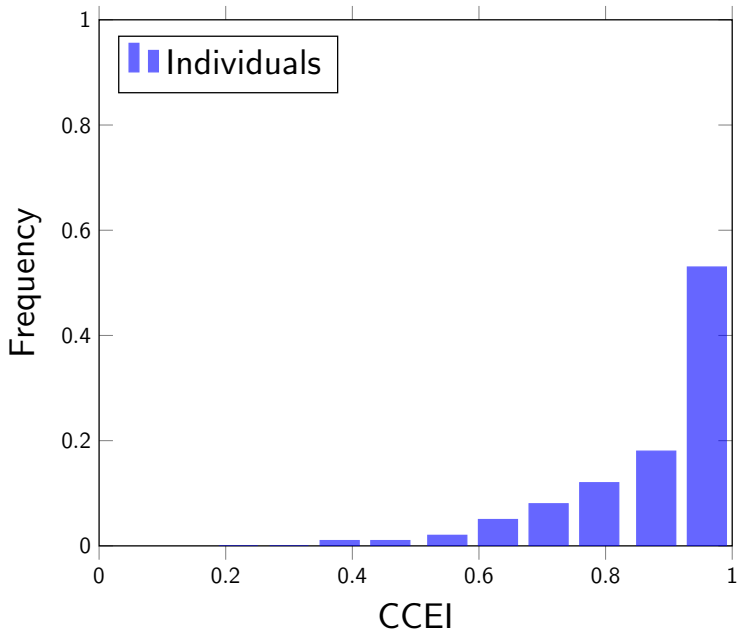
- Participants are a representative sample of the Dutch adult population.
- Each participant faced 25 budgets with two risky assets that obtain with equal probability.
- The cost of each asset were assigned randomly.

Data

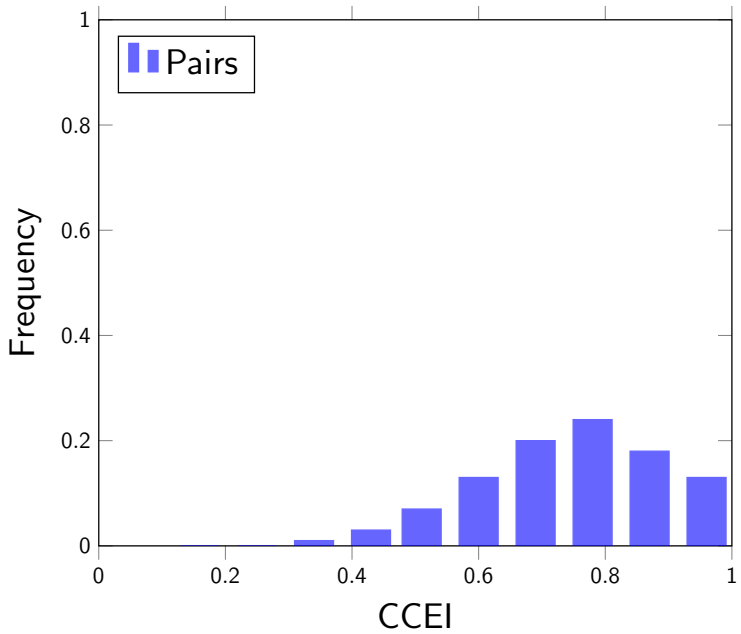


25 Decisions Made by Subject

Descriptive: CCEI distributions



CCEI of Individuals



CCEI of Pairs

Coloring Real Graph

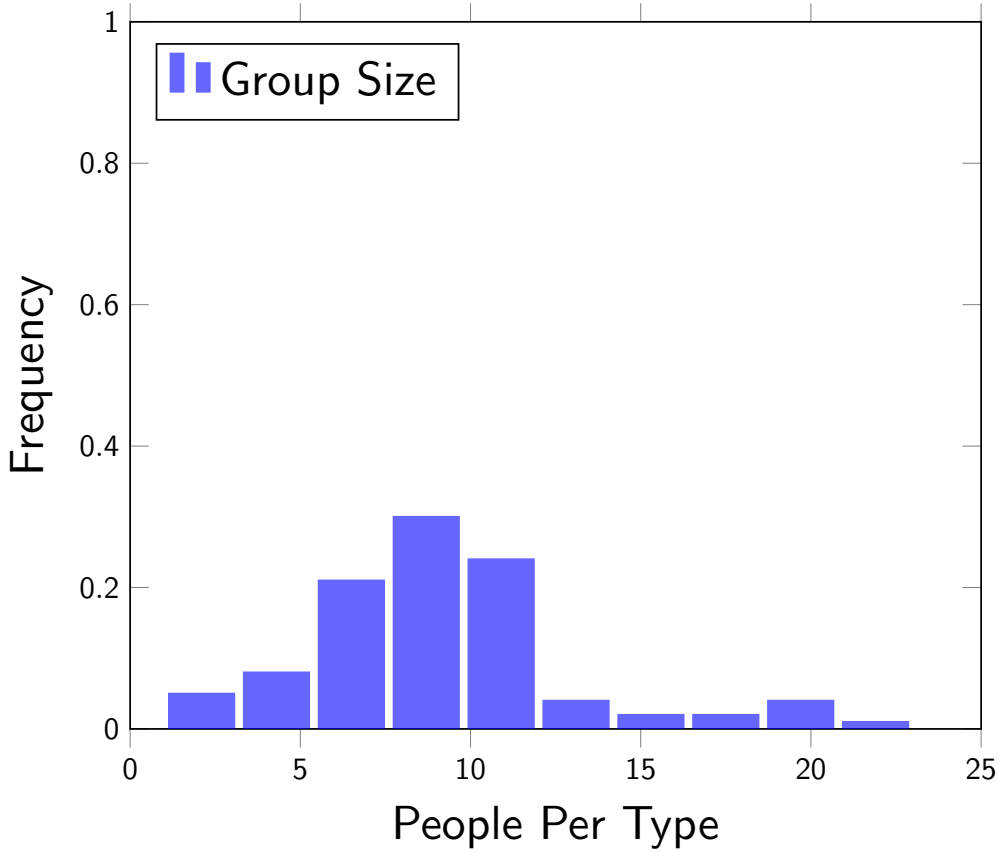


Figure: Distribution of Type Sizes

Males vs Females: GARP + measurement error

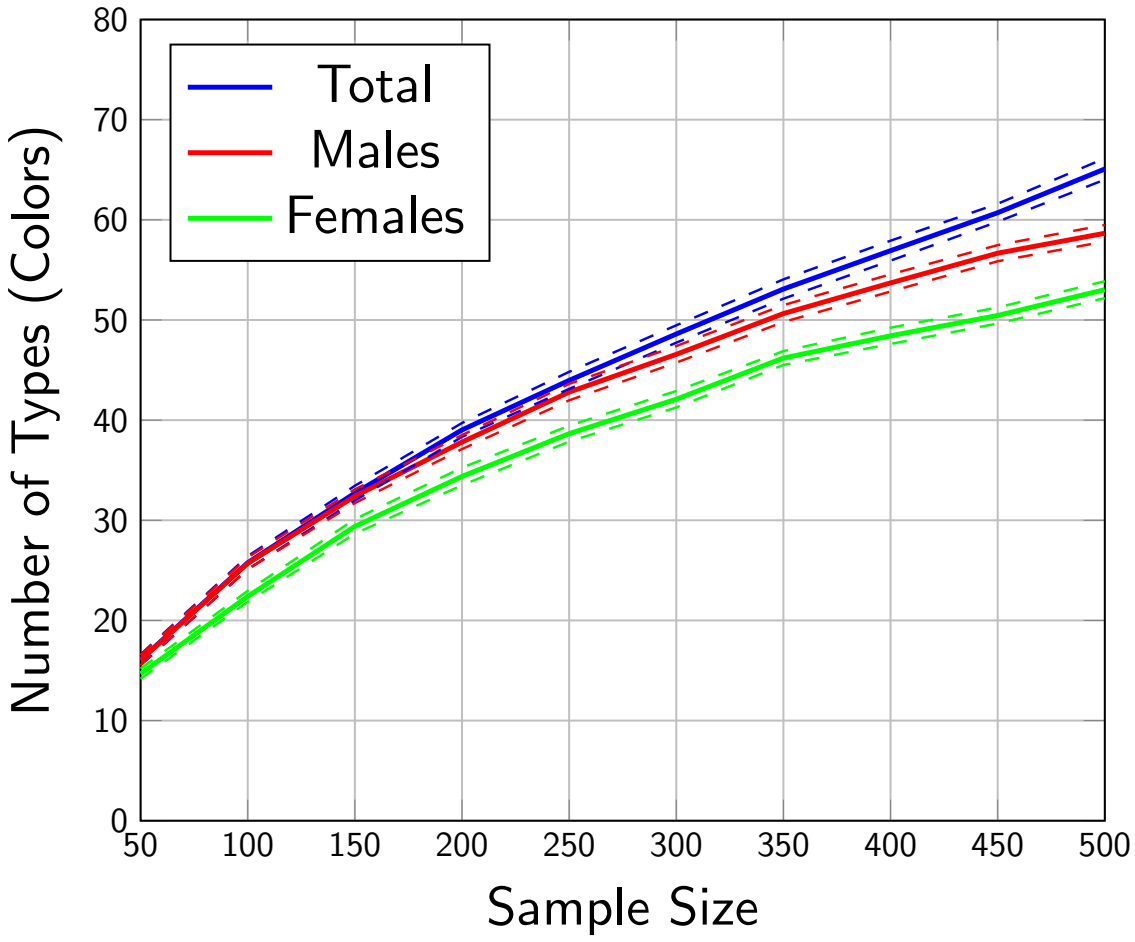


Figure: Number of Types (with respect to GARP)

Additional Assumptions: GARP vs FGARP

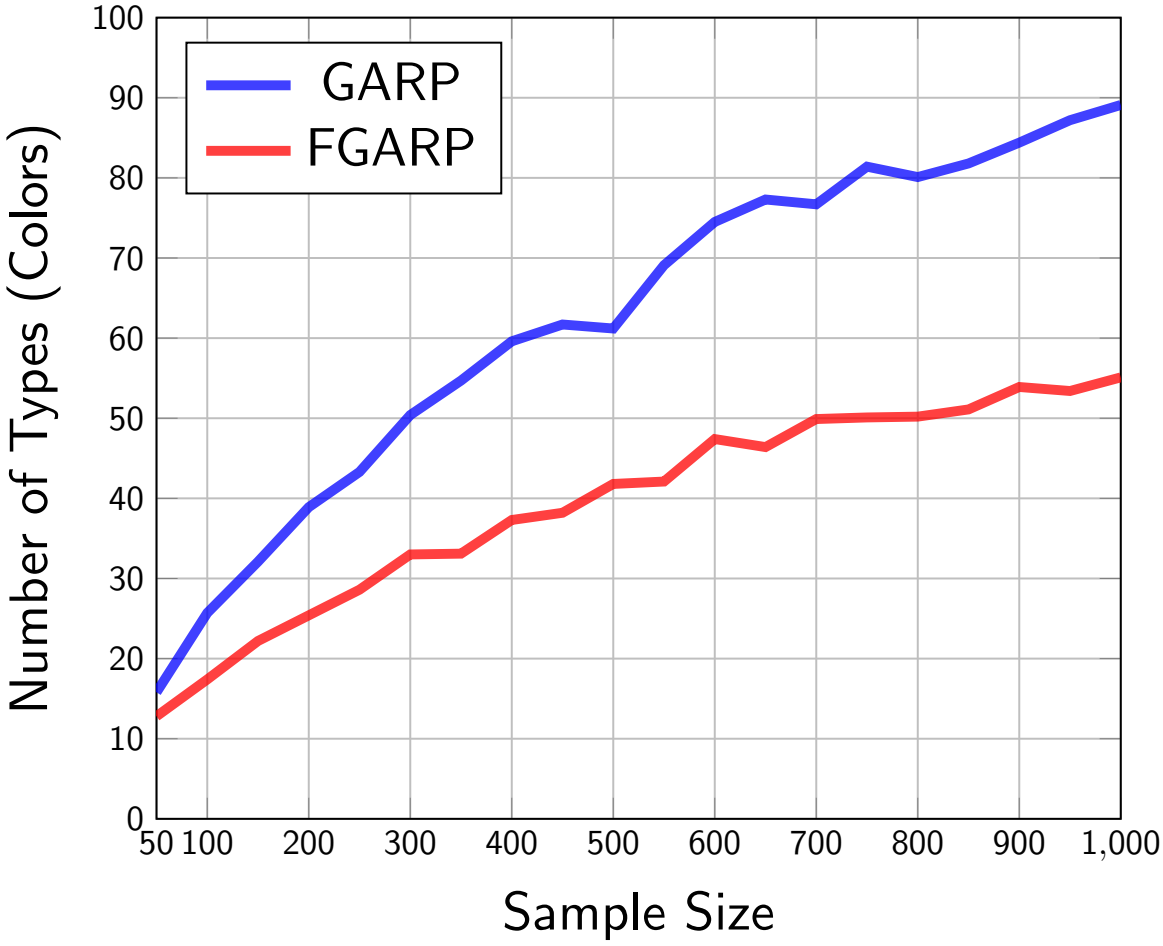


Figure: Number of Types

Main Findings

- Preferences are quite heterogeneous: The number of different preference types is as large as 135 (N=1,182)
- Males are different and more heterogeneous than females
- Preferences are idiosyncratic: less that 1% of variation in the *revealed different* relation can be explained by observable differences in individual characteristics
- Additional assumptions on preferences are demanding: When wrong, they add noise and prevent detecting differences in preferences

Thank you !

Existing Alternatives To Detect Heterogeneity of Preferences

Back

- Parametric (e.g. von Gaudecker et al, 2011).

  $\Rightarrow$ Why this function? How much heterogeneity is lost?

- Non-parametric (e.g. Moore & Eckel, 2003; *Gross, 1995; Crawford & Pendakur, 2013*):

  $\Rightarrow$ Concluding that differences in behavior reflect differences in preferences requires assuming that behavior is to some extent rational

Why do we explore a new approach? Back

Pollison et al (2015) using experimental data from Choi et al (2007):

- Only 2 % of subjects are consistent with Expected Utility (32% under 5% error level)
- Only 2 % of subjects are consistent with Disappointment aversion $\sim$ cumulative Prospect Theory in 2-goods world (38% under 5% error level)
- Only 17 % of subjects are consistent with GARP (66 % under 5 % error level)

$\Rightarrow$ Any comparison that invokes these comparison will have little power to detect differences...

Related Literature

Back

- Gross (1995) used revealed preference to test whether people have similar preferences
  $\Rightarrow$ Using Panel Study for Income Dynamics found that women have similar preferences (can be rationalized by same utility function) for childcare
- Crawford and Pendakur (2013) use revealed preference analysis to group people into types
  $\Rightarrow$ In a cross-section of Danish household (1 obs per HH), they find that the number of types rationalizing the demand for milk is at most 12

Did it work? ▸ Back

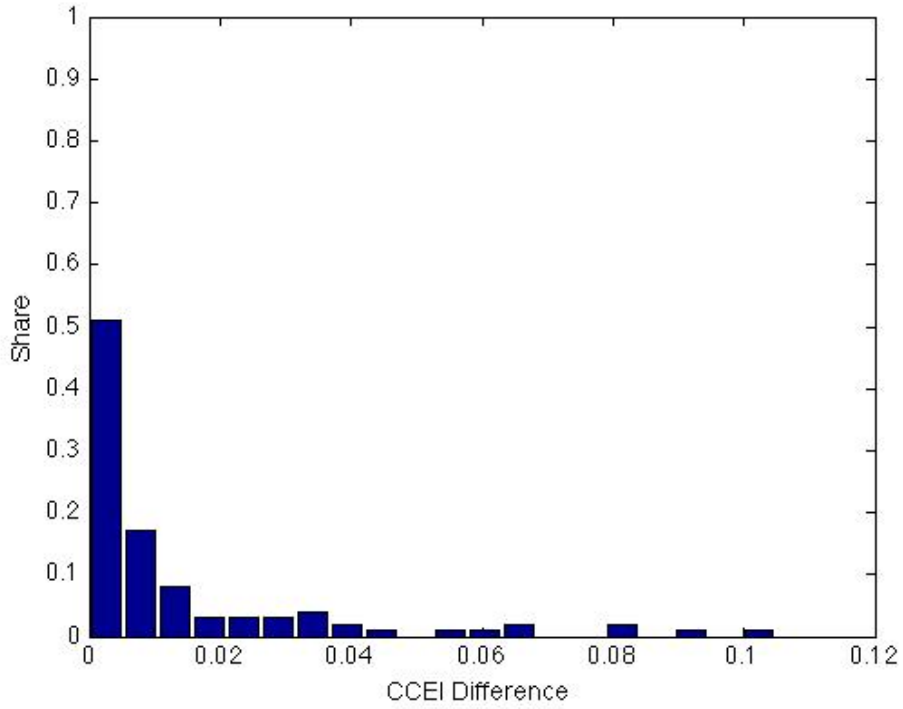


Figure: Change in CCEI from 25 to 50 budgets

When does it work? Back

Assumption 1

CCEI converges to the real value of CCEI as number of observations goes to infinity:
CCEI $\rightarrow \bar{\varepsilon}$, when $N \rightarrow \infty$

Assumption 2

The number of observations is large enough to elicit real CCEI:
Observed CCEI $\approx \bar{\varepsilon}$

If Assumption 1 is true $\Rightarrow$ *Assumption 2 is testable*.

Did it work? ▸ Back

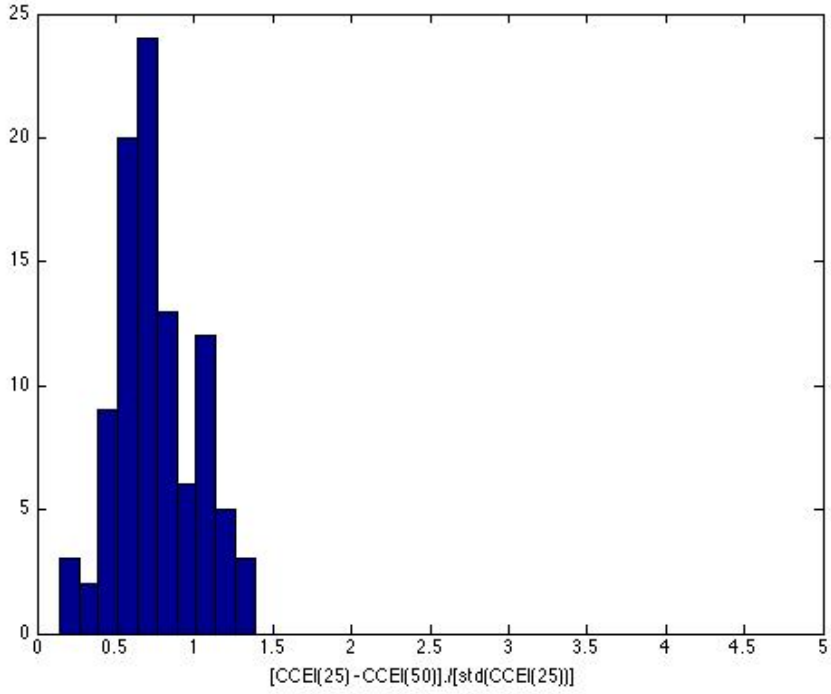


Figure: Looking for significant differences: $\frac{C\bar{C}EI(25)-CCEI(50)}{\sigma(CCEI(25))}$

Robustness

Back

- **Measurement error:**
  $RD = 1, if \ \min\{CCEI(x); CCEI(y)\} - CCEI(x \cup y) - > \epsilon,$
  where $\epsilon > 0$ is computational error;
- **Median difference:**
  $RD = 1, if \ \min\{CCEI(x); CCEI(y)\} - CCEI(x \cup y) > .01;$
- **95% Confidence interval:**
  $RD = 1, if \ \min\{CCEI(x); CCEI(y)\} - CCEI(x \cup y) > .07;$
- **Certain bound:**
  $RD = 1$, if
  $\min\{CCEI(x); CCEI(y)\} - CCEI(x \cup y) > .1.$

Males vs Females: GARP + ($e = 0.07$) Back

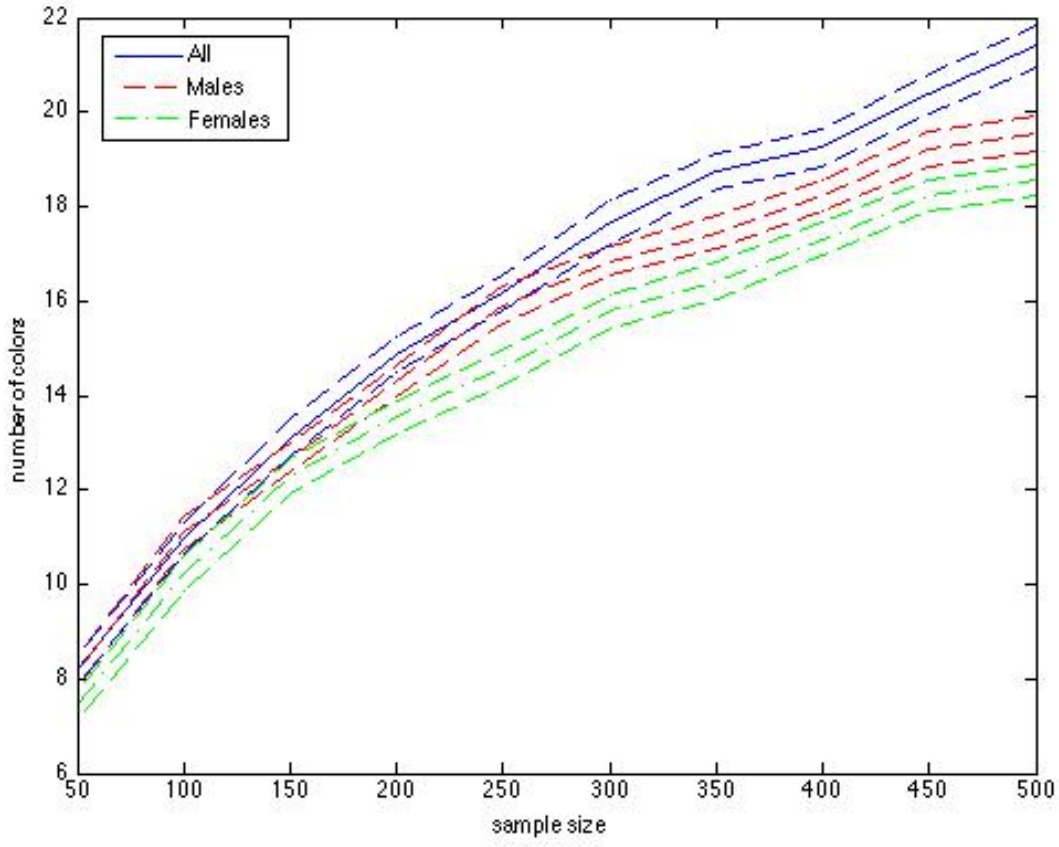


Figure: Number of colors (with respect to GARP) with 95% Confidence Intervals

How much heterogeneity? ▸ Back

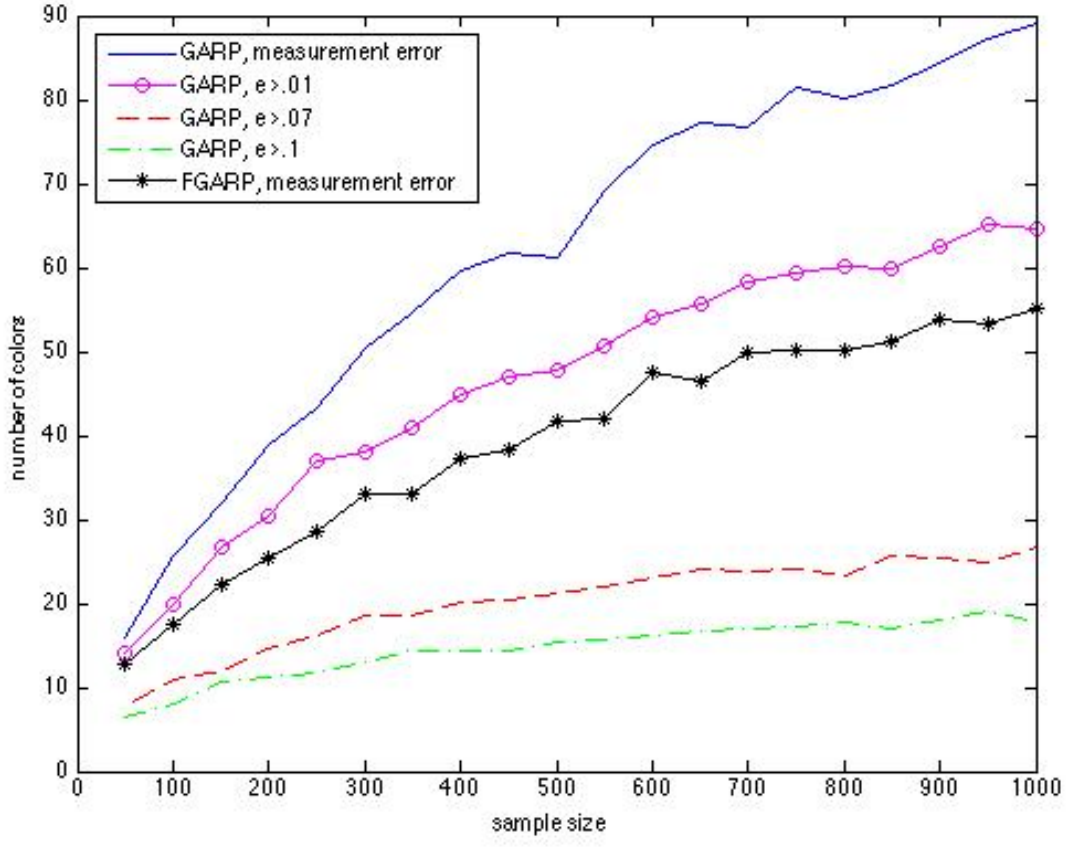


Figure: Number of types (Differences are significant with $p < 0.001$)

How much heterogeneity? ▸ Back

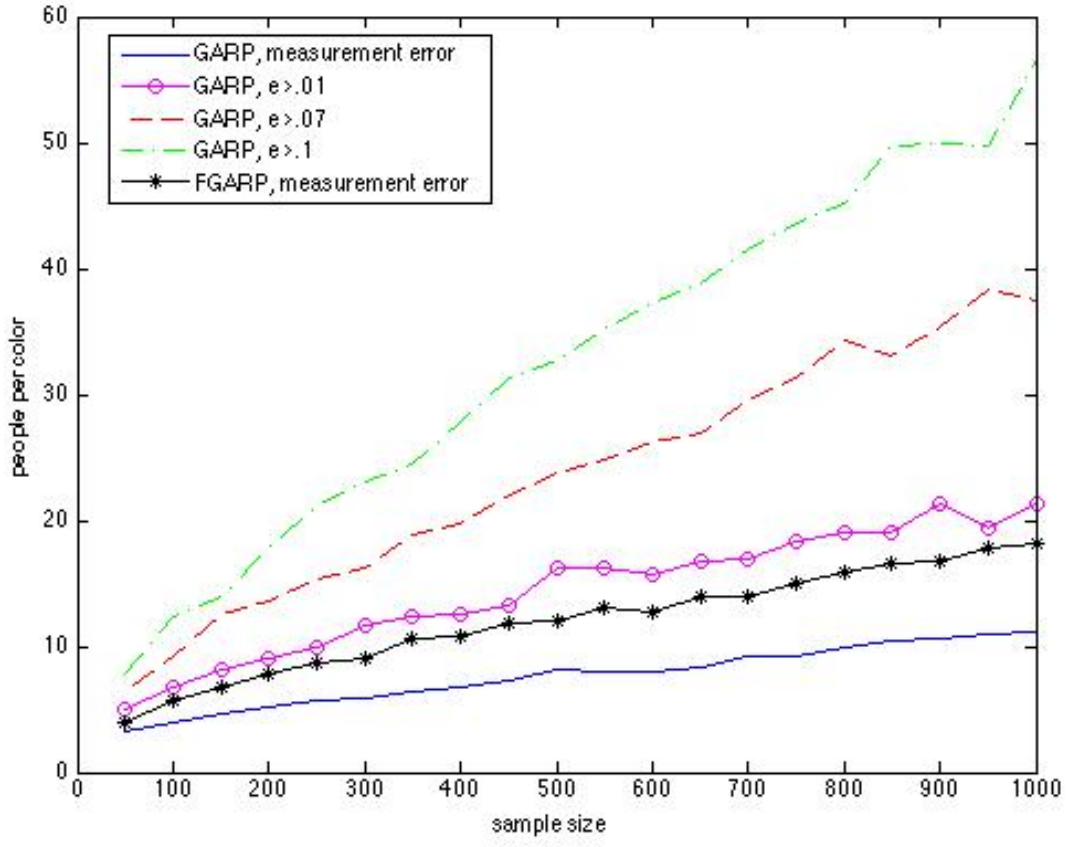


Figure: Number of people per type