Does the Gini index represent people's views on inequality?

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Introduction

Introduction

The Pigou-Dalton principle of transfers: cornerstone of the theory of income inequality measurement (Kolm, 1969; Atkinson, 1970).

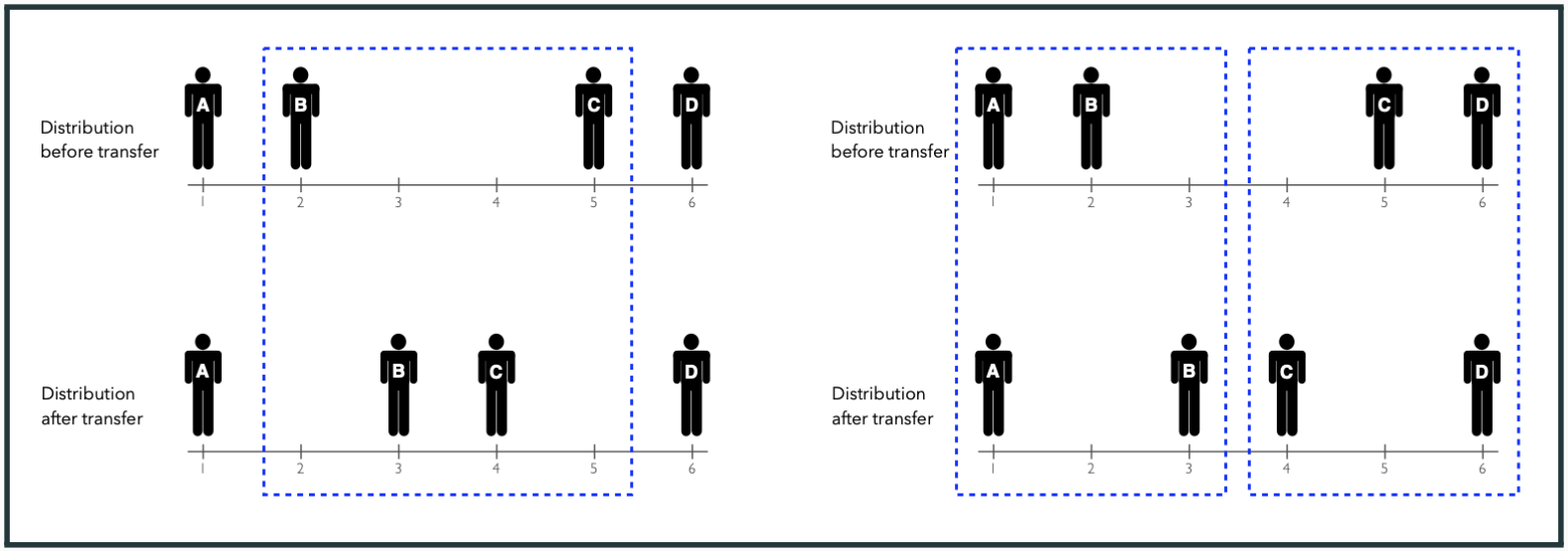
$\rightarrow$ a mean-preserving transfer of income from one individual to another who is relatively poorer always reduces overall income inequality.

Almost all the income inequality indices used today, including the Gini index, conform to this principle.

In this paper, we look at whether this approach is compatible with people's views on inequality.

Introduction

Why should the principle of transfers pose a problem?

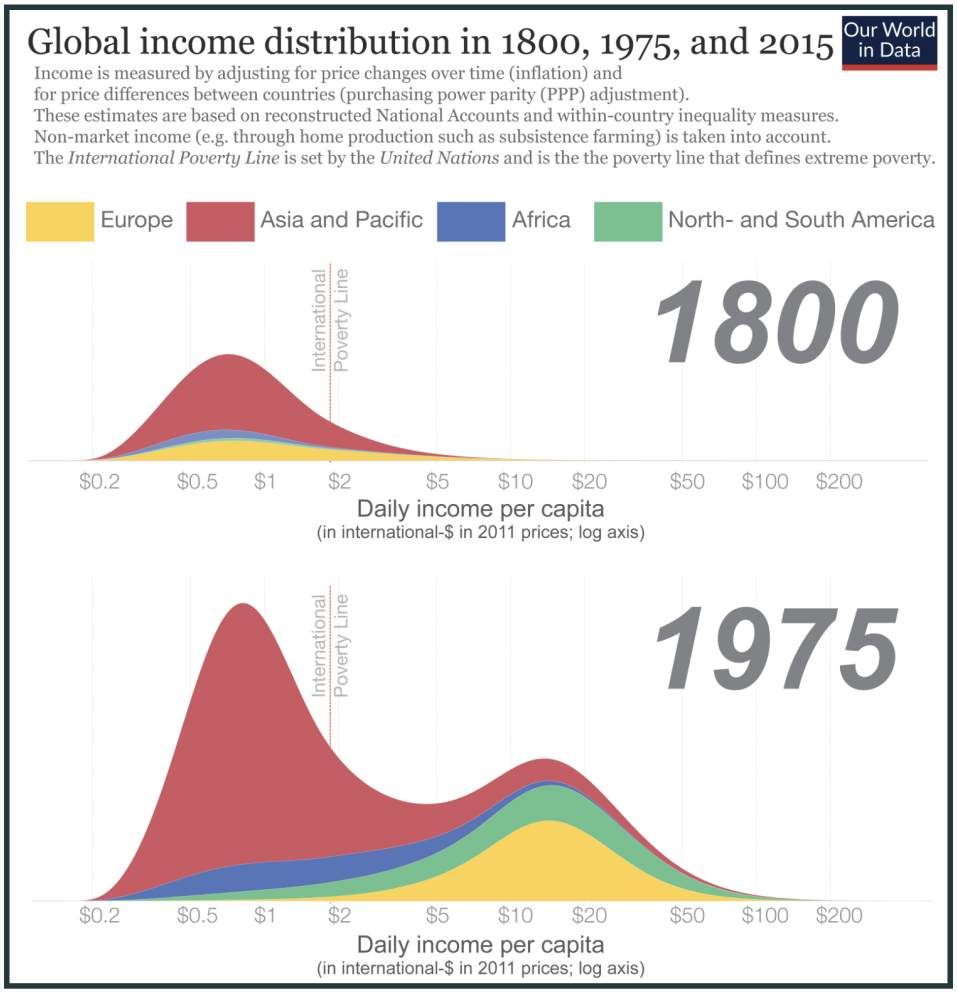


Inequality is reduced between the two people involved in a transfer . . .

. . . but the effect on the overall inequality may be ambiguous.

Introduction

Another example: the following trend (bipolarisation) is not necessarily inequality improving according to the Pigou-Dalton principle of transfers.



Literature

Amiel and Cowell (1992) were the first to observe the low approval of certain progressive transfers.

This finding has been largely confirmed (Amiel and Cowell, 2002; Gaertner and Namazie, 2003; Amiel et al., 2012, to name a few) . . .

. . . but few studies have sought to find an alternative to this principle that is more in line with people's preferences (Chateauneuf and Moyes, 2006; Magdalou and Moyes, 2009; Chateauneuf et al., 2025).

The paper

We report the results of a web-experiment conducted on a representative sample of the French population, with 1,028 participants.

Subjects were asked to compare, in terms of inequality, pairs of income distributions for an hypothetical society, where all individuals are clones.

We test the acceptability of the principle of transfers, but also of three alternative principles that impose constraints on recipients and donors.

We estimate for each participant, parametrically and non-parametrically, two standard SWF: utilitarianism and extended Gini.

Are participants' preferences compatible with the Gini index?

NO if participants are taken separately, YES for the median individual.

Standard approach to inequality measurement

The framework

We consider a population consisting of $n \geq 2$ individuals, identical in every respects other than their income.

An income distribution is a list $\boldsymbol{x} = (x_1, x_2, \ldots, x_n)$, where x_i is the income of individual i. It is assumed to be non-decreasingly ordered.

The mean income of distribution $\boldsymbol{x}$ is indicated by $\mu(\boldsymbol{x}) = \sum_{i=1}^{n} x_i/n$.

Pigou-Dalton Transfer (PT):
$\boldsymbol{x}$ is obtained from $\boldsymbol{y}$ by a Pigou-Dalton transfer if $\mu(\boldsymbol{x}) = \mu(\boldsymbol{y})$ and if $\exists \delta > 0$ and two individuals $1 \leq h < k \leq n$ such that $\boldsymbol{x} = \boldsymbol{y} + \boldsymbol{t}$ and:

INDIVIDUAL =	1	...	$h-1$	h	$h+1$	...	$k-1$	k	$k+1$	...	n
$\boldsymbol{t} =$	(0	...	0	δ	0	...	0	$-\delta$	0	...	0)

Standard approach

Utilitarian approach: $W_u(\boldsymbol{x}) = \frac{1}{n}\sum_{i=1}^{n} u(x_i)$.

Extended Gini approach: $W_f(\boldsymbol{x}) = \sum_{i=1}^{n}\left[f\left(\frac{n-i+1}{n}\right) - f\left(\frac{n-i}{n}\right)\right] x_i$.

(Extended) HLP Theorem
Let $\boldsymbol{x}$ and $\boldsymbol{y}$ such that $\mu(\boldsymbol{x}) = \mu(\boldsymbol{y})$. These statements are equivalent:

(a) $\boldsymbol{x} \leftarrow \boldsymbol{y}$ by a sequence of Pigou-Dalton transfers,

(b1) $W_u(\boldsymbol{x}) \geq W_u(\boldsymbol{y})$, for all concave functions u,

(b2) $W_f(\boldsymbol{x}) \geq W_f(\boldsymbol{y})$, for all convex functions f,

(c) $\frac{1}{n}\sum_{i=1}^{h} x_i \geq \frac{1}{n}\sum_{i=1}^{h} y_i$, for all $h = 1, \ldots, n-1$.

Inequality aversion $\Leftrightarrow$ concavity of u $\Leftrightarrow$ Pigou-Dalton transfer consistency

Alternative approaches? Focus on the extended Gini approach.

Alternative principles of transfers

$\boldsymbol{x}$ is obtained from $\boldsymbol{y}$ by a uniform transfer if $\mu(\boldsymbol{x}) = \mu(\boldsymbol{y})$ and if $\exists \delta, \epsilon > 0$ and two individuals $1 \leq h < k \leq n$ such that $\boldsymbol{x} = \boldsymbol{y} + \boldsymbol{t}$ and:

Uniform-on-the-right Transfer (UR):

INDIVIDUAL =	1	...	$h-1$	h	$h+1$	...	$k-1$	k	$k+1$	...	n
$\boldsymbol{t} =$	(0	...	0	δ	0	...	0	$-\epsilon$	$-\epsilon$	...	$-\epsilon$)

Uniform-on-the-left Transfer (UL):

INDIVIDUAL =	1	...	$h-1$	h	$h+1$	...	$k-1$	k	$k+1$	...	n
$\boldsymbol{t} =$	(δ	...	δ	δ	0	...	0	$-\epsilon$	0	...	0)

Uniform-on-the-right-and-left Transfer (URL):

INDIVIDUAL =	1	...	$h-1$	h	$h+1$	...	$k-1$	k	$k+1$	...	n
$\boldsymbol{t} =$	(δ	...	δ	δ	0	...	0	$-\epsilon$	$-\epsilon$	...	$-\epsilon$)

Experimental design

Design into three parts

The experiment was divided into three parts:

1. The respondents were presented with a list of (numerical) questions, in which they had to compare a pair of distributions A and B. They were asked to indicate which distribution they thought was less unequal.
2. The acceptability of the PT transfers and uniform transfers was tested with text-based questions.
3. The last part was a socio-demographic questionnaire.

The numerical questions

The pairs of distributions under comparison were constructed as follows. First, we considered 5 initial distributions, denoted $\boldsymbol{y}^1$, $\boldsymbol{y}^2$, $\boldsymbol{y}^3$, $\boldsymbol{y}^4$ and $\boldsymbol{y}^5$:

	Income scale								
Distributions	2	4	6	8	10	12	14	16	18
$\boldsymbol{y}^1$	2	-	6	-	10	-	14	-	18
$\boldsymbol{y}^2$	2	4	-	-	-	-	14	16	18
$\boldsymbol{y}^3$	2	4	6	-	-	-	-	16	18
$\boldsymbol{y}^4$	2	-	-	8	10	12	-	-	18
$\boldsymbol{y}^5$	2	4	-	-	10	-	-	16	18

The numerical questions (2)

We then considered all possible transfers of each type, limited to transfers between two individuals and of a single unit of income:

TRANSFERS		e_1	e_2	e_3	e_4	e_5
T1	URL	+1	0	0	0	-1
T2	UR	0	+1	0	0	-1
T3	UR	0	0	+1	0	-1
T4	UR	0	0	0	+1	-1
T5	UL	+1	0	0	-1	0
T6	UL	+1	0	-1	0	0
T7	UL	+1	-1	0	0	0
T8	PT	0	0	+1	-1	0
T9	PT	0	+1	-1	0	0
T10	PT	0	+1	0	-1	0

The numerical questions (3)

The initial distribution, before transfer, was always indicated as distribution A, and placed on the left of the screen.

The questions corresponding to the same initial distribution were presented in a single block.

Within each block, the questions appeared on the screen (one per screen) in a random order.

The block corresponding to initial distribution $\boldsymbol{y}^1$ always appeared first.

The order of the other initial distributions was randomly selected.

In order to limit the number of questions, we presented the respondent with only 4 of the 5 initial distributions: distributions $\boldsymbol{y}^1$, $\boldsymbol{y}^2$ and $\boldsymbol{y}^3$ and, by a 50/50 draw, either $\boldsymbol{y}^4$ or $\boldsymbol{y}^5$ (hence, total of 44 questions).

Sample of participants

A representative sample of the French population

The web-experiment was conducted in January 2021, with a sample of 1,028 respondents.

The sample was representative of the French population, based on the quota sampling method.

The following selection criteria are taken into account: gender, age (16 and over, including retired people), professional statuses and income.

Sampling was carried out by a private company and the respondents were paid approximately €2 for their participation.

Sample of participants

Variables		Full sample		Restricted		(R-F)	INSEE
Name	Value	Nb.	%	Nb.	%	%	%
Gender	Woman	531	51.65	232	51.79	0.14	51.6
	Man	497	48.35	216	48.21	-0.14	48.4
Age	15 – 29 years	123	11.96	53	11.83	-0.13	21.2
	30 – 44 years	236	22.96	102	22.77	-0.19	22.5
	45 – 59 years	281	27.33	105	23.44	-3.89	23.9
	60 – 74 years	240	23.35	108	24.11	0.76	20.7
	75 – 89 years	147	14.30	79	17.63	3.33	10.0
	$\geq$ 90 years	1	00.01	1	00.22	0.21	01.6
Number of children	No children	384	37.35	172	38.39	1.04	49.4
	1 child	190	18.48	76	16.96	-1.52	21.9
	2 children	285	27.72	128	28.57	0.85	19.6
	3 children	125	12.16	46	10.27	-1.89	06.7
	4 children or more	44	04.28	26	05.81	1.53	02.4
Marital status	Married/Civil-union	516	50.19	230	51.34	1.15	47.5
	Cohabiting/Common-law	101	09.82	50	11.16	1.34	11.0
	Widower	37	03.60	18	04.02	0.42	06.8
	Single	374	36.38	150	33.48	-2.90	34.7
Employment status	Employed	530	51.56	221	49.34	-2.22	49.3
	Active but unemployed	76	07.39	25	05.58	-1.81	06.8
	Student	66	06.42	34	07.59	1.17	07.9
	Retired	278	27.04	140	31.25	4.21	29.4
	Other inactivity situation	78	07.59	28	06.25	-1.34	06.6
Occupation category	Farmers	16	01.56	7	01.56	0.00	01.3
	Artisans/shopkeepers/company owners	49	04.77	23	05.13	0.36	06.6
	Managers/higher intellectual professions	217	21.11	124	27.68	6.57	17.2
	Intermediate occupations	215	20.91	105	23.44	2.53	22.4
	Employees	297	28.89	115	25.67	-3.22	22.6
	Manual workers	145	14.11	35	07.81	-6.30	19.9
	Not concerned	89	08.66	39	08.71	0.05	10.0
Education	Primary education	34	03.31	6	01.34	-1.97	22.2
	Lower secondary education	92	08.95	18	04.02	-4.93	06.0
	Upper secondary education	338	32.88	123	27.46	-5.42	38.2
	Short cycle tertiary education	224	21.79	98	21.88	0.09	11.8
	Bachelor	144	14.01	84	18.75	4.74	11.2
	Master/Doctorate	196	19.07	119	26.56	7.49	10.6
Gross monthly income	$\leq$ €1,200	132	12.84	43	09.60	-3.24	D1
	€1,201 – €1,500	113	10.99	36	08.04	-2.95	D2
	€1,501 – €1,800	85	08.27	33	07.37	-0.90	D3
	€1,801 – €2,200	112	10.89	56	12.50	1.61	D4
	€2,201 – €2,600	117	11.38	52	11.61	0.23	D5
	€2,601 – €3,000	104	10.12	38	08.48	-1.64	D6
	€3,001 – €3,500	90	08.75	34	07.59	-1.16	D7
	€3,501 – €4,200	118	11.48	67	14.96	3.48	D8
	€4,201 – €5,400	93	09.05	58	12.95	3.90	D9
	> €5,400	64	06.23	31	06.92	0.69	D10
Vote last presidential election	Yes	847	82.39	381	85.04	2.65	85.0
	No	181	17.61	67	14.96	-2.65	15.0
Political opinion	Do not wish to reply	338	32.88	99	22.10	-10.78	–
	Extreme left	21	02.04	15	03.35	1.31	–
	Left	224	21.79	121	27.01	5.22	–
	Centre	214	20.82	120	26.79	5.97	–
	Right	162	15.76	73	16.29	0.53	–
	Extreme Right	69	06.71	20	04.46	-2.25	–
Number of observations		1028		448			

Descriptive results

Acceptation rates for the numerical questions

Below PT means ‘non-uniform Pigou-Dalton transfers’.

TRANSFERS	ACCEPTED	REJECTED	NEUTRALITY
URL	66.80%	8.43%	24.78%
UL	59.30%	12.02%	28.68%
UR	51.97%	14.08%	33.95%
PT	39.38%	18.47%	42.15%
All transfers	**51.88**%	14.21%	33.91%

All the differences are significant (χ^2 Statistics).

Econometric estimations

Econometric strategy

The subject compares two distributions $\boldsymbol{x}$ and $\boldsymbol{y}$.

By indicating which distribution is considered as more equal, he provides an indication on $\Delta_W(\boldsymbol{x}, \boldsymbol{y}; \alpha)$, with $\alpha > 0$:

$$\Delta_W(\boldsymbol{x}, \boldsymbol{y}; \alpha) = \alpha \left[W(\boldsymbol{x}) - W(\boldsymbol{y}) \right] ,$$

If $\boldsymbol{x}$ (resp. $\boldsymbol{y}$) is strictly preferred, then $\Delta_W(\boldsymbol{x}, \boldsymbol{y}; \alpha) > 0$ (resp. < 0).

If the level of inequality is considered to be the same in both distributions, then $\Delta_W(\boldsymbol{x}, \boldsymbol{y}; \alpha) = 0$.

Econometric strategy

Although preferences are assumed to be deterministic, some errors are possible when the respondent answers the questions.

To this end we add a white noise, normally distributed. We obtain a stochastic specification for the estimation model:

$$\Delta^{\star}_{W}(\boldsymbol{x}, \boldsymbol{y}; \alpha) = \Delta_{W}(\boldsymbol{x}, \boldsymbol{y}; \alpha) + \varepsilon\,, \qquad \text{where } \varepsilon \sim N(0; 1)\,.$$

$\Delta_{W}(\boldsymbol{x}, \boldsymbol{y}; \alpha)$ is positive if the distribution $\boldsymbol{x}$ is preferred.

We only observe $\Delta^{\star}_{W}(\boldsymbol{x}, \boldsymbol{y}; \alpha)$, which is positive if $\boldsymbol{x}$ is chosen.

Econometric strategy

Given that only the ordinal information of Δ is meaningful here, we replace Δ by a discrete variable γ, such as:

$$\begin{cases} \gamma = 0 & \text{if} \quad \Delta_W^\star < \tau_1 \,, \\ \gamma = 1 & \text{if} \quad \tau_1 \leq \Delta_W^\star \leq \tau_2 \,, \\ \gamma = 2 & \text{if} \quad \Delta_W^\star > \tau_2 \,. \end{cases}$$

The threshold parameters τ_1 and τ_2 have to be estimated, with $\tau_1 \leq 0$ and $\tau_2 \geq 0$.

We obtain an ordered probit model, estimated by applying maximum log-likelihood methods (Hey and Orme, 1994).

Parametric estimation of the utilitarian model

The Atkinson-Kolm-Sen class of inequality indices is derived from $W_u(\boldsymbol{x}) = \frac{1}{n}\sum_{i=1}^{n} u(x_i)$, with:

$$u_\epsilon(x_i) = \begin{cases} \frac{1}{\epsilon}\, x_i^\epsilon\,, & \text{if} \quad \epsilon \neq 0\,, \\ \ln x_i\,, & \text{if} \quad \epsilon = 0\,. \end{cases}$$

(inequality aversion if $\epsilon < 1$)

The Donaldson-Weymark class of inequality indices is derived from $W_f(\boldsymbol{x}) = \sum_{i=1}^{n} \left[f\left(\frac{n-i+1}{n}\right) - f\left(\frac{n-i}{n}\right)\right] x_i$, with:

$$f_\eta(t) = t^\eta\,, \quad \eta \geq 1\,.$$

(inequality aversion if $\eta > 1$, Gini if $\eta = 2$)

Parametric functions u_ϵ and f_η

As expected, for a large majority of subjects, the utility function is concave, and the weighting function is convex.

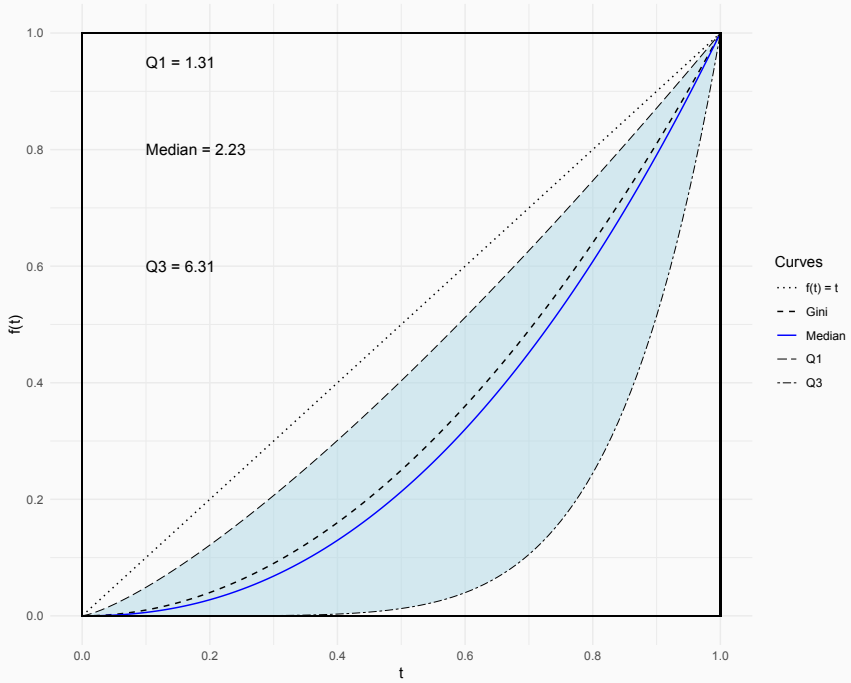
	SANN Algorithm			BFGS Algorithm		
Model	Concave	Linear	Convex	Concave	Linear	Convex
Utilitarianism (ϵ)	**87.72**%	–	12.28%	**98.44**%	–	1.56%
Extended Gini (η)	18.75%	–	**81.25**%	2.90%	–	**97.10**%

The extended Gini model dominates utilitarianism for 70% of the subjects, according to the AIC criterion:

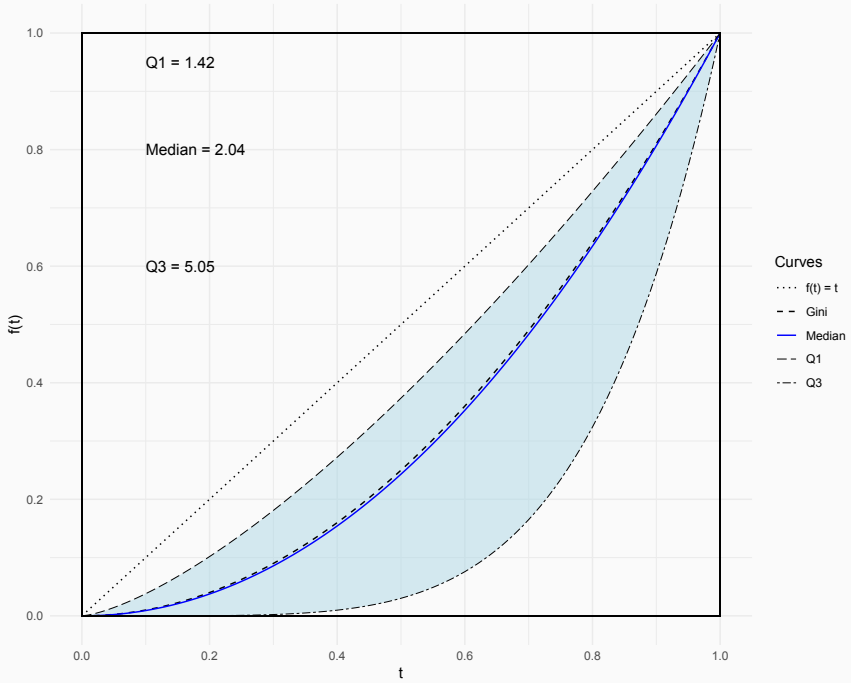
Model	SANN Algorithm	BFGS Algorithm
Utilitarianism (ϵ)	19.64%	17.63%
Extended Gini (η)	**71.43**%	**68.08**%

Median value of η for f_η

The weighting function $f_\eta(t) = t^\eta$ with $\eta = 2$, which corresponds to the Gini index, fits very well the preferences of the median individual!



SANN Algorithm ($\hat{\eta} = 2.23$)



BFGS Algorithm ($\hat{\eta} = 2.04$)

Non-parametric estimations of f

Point-by-point estimation: $f(0.2)$, $f(0.4)$, $f(0.6)$, $f(0.8)$, recalling that $f(0) = 0$ and $f(1) = 1$.

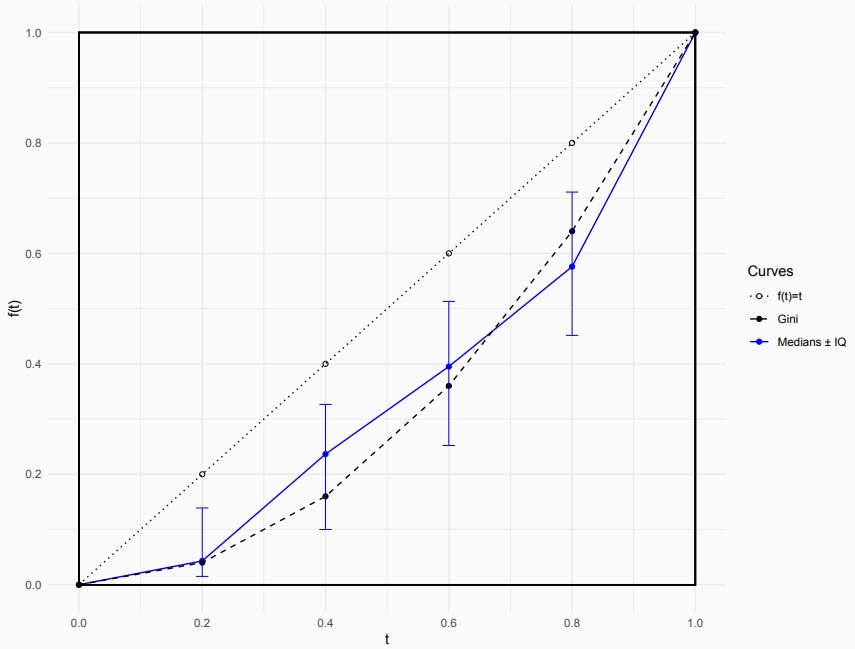
% of participants for whom f is consistent with the different classes of weighting functions ($\mathscr{F}_{PT} \subset \mathscr{F}_{UR} \subset \mathscr{F}_{URL}$ and $\mathscr{F}_{PT} \subset \mathscr{F}_{UL} \subset \mathscr{F}_{URL}$).

Very low success of the convex functions, consistent with PT.

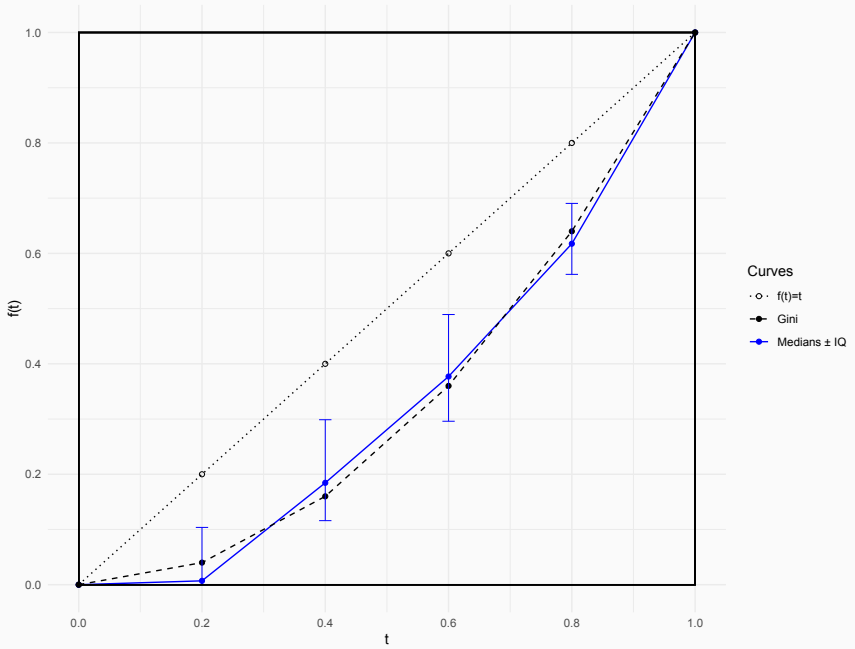
ALGORITHM	$f \in \mathscr{F}_{URL}$	$f \in \mathscr{F}_{UL}$	$f \in \mathscr{F}_{UR}$	$f \in \mathscr{F}_{PT}$
SANN	**76.34**%	57.14%	23.44%	10.49%
BFGS	**77.01**%	64.06%	55.13%	36.38%

Non-parametric estimations of f

But again, the weighting function of the median individual is very close to that of the Gini index !



SANN Algorithm



BFGS Algorithm

Conclusion

Conclusion

Clear rejection of progressive transfers in the middle of the distribution.

In contrast, transfers that promote solidarity at both the top and bottom of the distribution (URL transfers) receive significantly higher approval.

UL transfers $>$ UR transfers: greater prioritization of poverty reduction over the mitigation of extreme wealth.

The Extended Gini approach fits individual preferences much better than utilitarianism measures.

The Gini index represents the preferences of very few individuals . . . but the Gini index adjusts well median individual's preferences.

Thank you for your attention.

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