Online Fair Division

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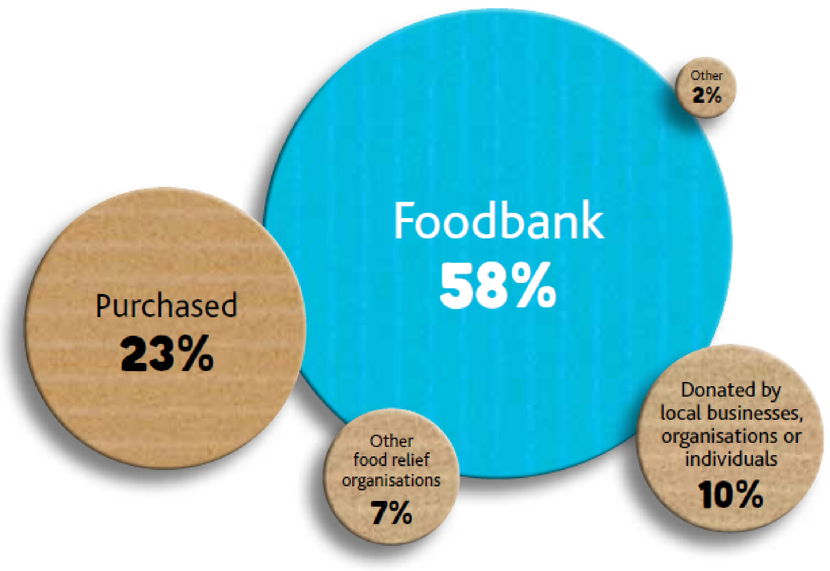
The Foodbank Problem



Sources of Food Relief in Australia for 2013/2014.

Foodbank Australia

. . . is the largest source of food relief,
. . . cooperates with more than 2500 charities,
. . . distributes almost 109,000 meals every day, BUT
. . . struggles with nearly 10% increased demand per year,
. . . needs almost 60,000 additional meals each year,
and requires more volunteering and financial support.
They are looking to improving their efficiency by working with US!

Methodology

1. In the basic setting
. . . there are K charities,
. . . there are N items,
. . . item j arrives at step j,
. . . agent i has utility for j,
. . . agent i bids for item j,
and a mechanism M allocates item j to an agent.

	1	2	3	4
a	1	1	2	0
b	0	1	0	2
c	3	0	1	2

2. We use 2 mechanisms:
The LIKE mechanism allocates item j uniformly at random to an agent that bids positively for it.
The BALANCED LIKE mechanism allocates item j uniformly at random to an agent that bids positively for it and currently has fewest items.

3. Our goal is to study
. . . their axiomatic properties,
and empirical performance.

4. We look into their
. . . strategy-proofness,
. . . envy-freeness,
. . . proportionality,
. . . competitive ratio,
and price of anarchy.

5. We assess welfare
. . . with $0/1$ random utilities,
. . . $0/1$ correlated utilities
and $0/1/\ldots/N-1$ (aka Borda) utilities, using both generated and real-world datasets.

Properties

LIKE is strategy-proof and envy-free ex ante

BALANCED LIKE is not strategy-proof

	1	2	3
a	1	1	1
b	0	1	0
c	1	0	1

agent a, item 1: sincere - 1, strategic - 0

1. Sincere play: agent a gets expected utility of $\frac{9}{8}$ by bidding 1 for item 1.
2. Strategic play: agents a gets greater expected utility of $\frac{5}{4}$ by bidding 0 for item 1.

BALANCED LIKE is not envy-free ex ante

	1	2
a	0	u
b	ϵ	$u-\epsilon$

agent b: envy and not proportional

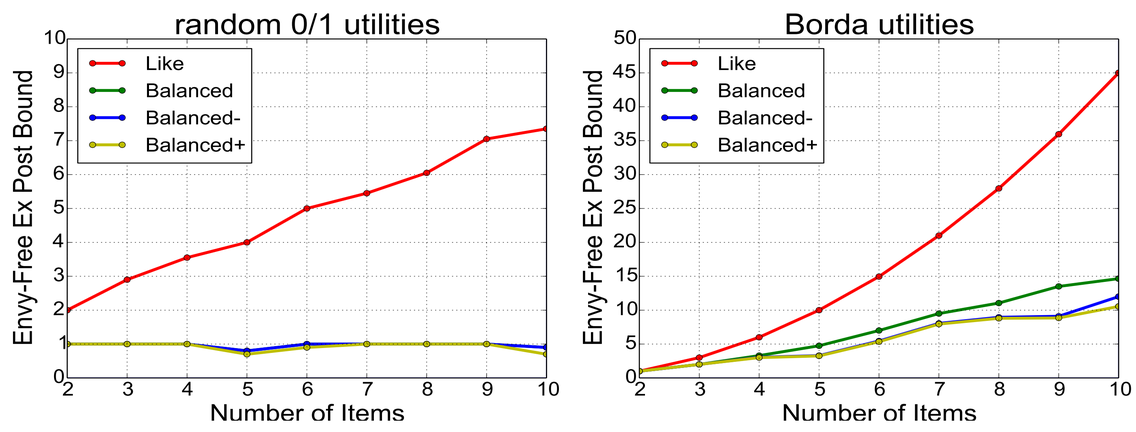
Agent a gets 2 and agent b gets 1. Their envy is $u-2\cdot\epsilon$ which can be unbounded. The allocation is also not proportional as their utility $\epsilon \in (0, \frac{1}{2})$.

mechanism	LIKE		BALANCED LIKE	
utilities	binary	general	binary	general
strategy-proof	✓	✓	×	×
envy-free (ex ante)	✓	✓	✓	×
bound envy-free (ex post)	×	×	✓	×
proportional (ex ante)	✓	✓	✓	×
competitive ratio (e)	K	K	K	∞
competitive ratio (u)	1	K	1	∞
price of anarchy (e)	K	K	K	K
price of anarchy (u)	1	K	1	K

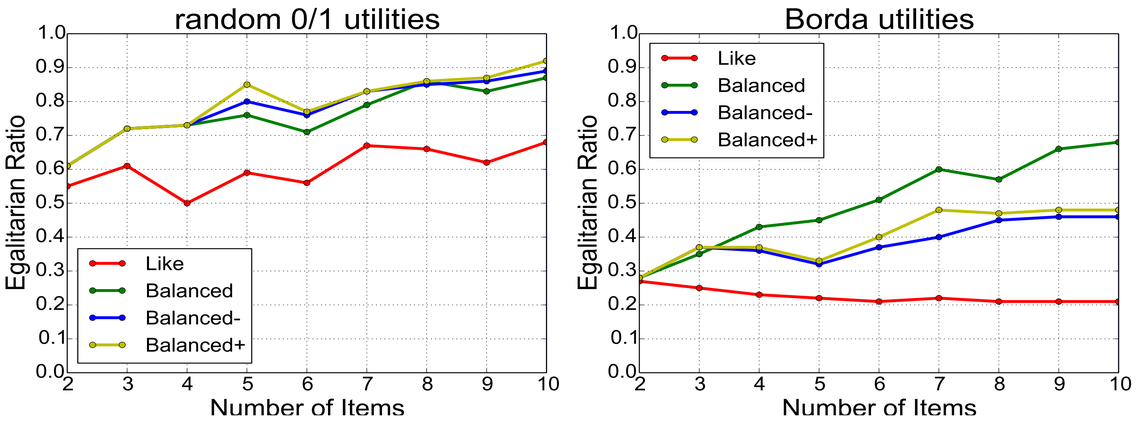
Overview for K charities: (e) = egalitarian, (u) = utilitarian.

Experiments

Colour Map: Like, Balanced - competitive ratios, Balanced-, Balanced+ - anarchy ratios



Envy-freeness.



Impact on Social Welfare.

References

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N. Mattei and T. Walsh. PrefLib: A library of preference data. In *ADT, The 3rd Inter. Conf.*, Lecture Notes in AI, pages 259–270. Springer, 2013.

From imagination to impact

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