## Efficient and Thrifty Voting By Any Means Necessary

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## Voting

## 

\#Projects: ~1500 Budget > \$200 million

Source: ideas.pbnyc.org


## Participatory Budgeting



## Example（contd．）

## 洅 <br> 

Cost： $10 \quad 20 \quad 15 \quad 17$ Budget： 30 35
$4 \quad 2$

Rank（by Value）：


Knapsack：
Threshold Approval（4）：
Value：


益3 島 5 4 442

## Cognitive Burden

## Communication Complexity: \#bits reported by each voter

- No. of alternatives: $m$
- Select just one alternative

Rank (by Value):
$\log m!=\Theta(m \log m)$
Knapsack:
$O(m)$

Threshold Approval:
$O(m)$

Value:
$\Theta(m b)$

## Performance

Social welfare: $\operatorname{sw}(a, v)=\sum_{i=1}^{n} v_{i}(a)$

Distortion(f):

## $\max _{v} \frac{\text { Maximum sw with } v}{\text { Expected sw of } f \text { on } v}$

${ }^{1}$ Rank (by Value):
$\Omega(\sqrt{m})$
Knapsack:
$\Omega(m)$
${ }^{2}$ Threshold Approval:
$\Theta(\log m)$
$\Theta(1)$ for $b=O(\log m)$
[1] Boutilier et. al., 2015;
[2] Benadè, Nath, Shah, and Procaccia, 2017

## Our Results

- Goal: Achieve distortion $d$.
- Question: What is the communication complexity of the ballot?



## Comparison with Prior Work

- Deterministic Ballot, Deterministic Outcome
- Simple Ballot:

1. Pick top- $t$ alternatives.
2. Place them in $\ell$ buckets.


## Looking Ahead

- Bridge the gap between upper and lower bounds.
$\star{ }^{1}$ Deterministic Ballot: $\tilde{\Theta}(m / d)$, Randomized Ballot: $\tilde{\Theta}\left(m / d^{3}\right)$
- Better understanding of Cognitive Burden: $\star$ Communication complexity is just a proxy. $\star$ Possible directions for HCl research.
- Structured valuations lead to improved distortion. $\star$ Can we learn such structures from data?
[1] Mandal, Shah, and Woodruff, 2019.


## Thank You!



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