





#### 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.)



## **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:

 $\Theta(mb)$ 

#### Performance

Social welfare: 
$$sw(a, v) = \sum_{i=1}^{n} v_i(a)$$
Distortion(f): $\max_{v} \frac{\text{Maximum sw with } v}{\text{Expected sw of } f \text{ on } v}$ 1Rank (by Value): $\Omega(\sqrt{m})$ 1Rank (by Value): $\Omega(\sqrt{m})$ Knapsack: $\Omega(m)$ 2Threshold Approval: $\Theta(\log m)$ Value: $\Theta(1)$  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.
  - \* <sup>1</sup>Deterministic Ballot:  $\tilde{\Theta}(m/d)$ , Randomized Ballot:  $\tilde{\Theta}(m/d^3)$
- Better understanding of Cognitive Burden:
   \* Communication complexity is just a proxy.
   \* Possible directions for HCI research.

Structured valuations lead to improved distortion.
\* Can we learn such structures from data?

[1] Mandal, Shah, and Woodruff, 2019.

# Thank You!



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