

The Strategy of Rotten Tomatoes

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rottentomatoes.com

The screenshot shows the Rotten Tomatoes website homepage. At the top, the URL is <http://www.rottentomatoes.com/>. The main navigation bar includes links for HOME, MOVIES, DVDS, GAMES, THE VINE, FORUMS, and SHOP. Below this is a secondary navigation bar with links for News, Features, Top Movies, Tomato Picker, Certified Fresh, Multimedia, Celebs, Critics, and Company Blog. A search bar is prominently displayed, powered by Google, with a dropdown menu set to 'All'. The page is divided into several sections: a 'TICKETS & SHOWTIMES' section with a form to find showtimes by movie title and location; a 'MOVIES' section featuring a 'box office' list of top-grossing films; a 'SPOTLIGHT' section highlighting the movie 'The Return' with a description and links for reviews, trailers, and news; and a 'BlackBerry Pearl' advertisement. The 'box office' section contains the following data:

box office	
93% Borat: Cultural Lea...	\$26.5M
12% The Santa Clause 3:...	\$19.5M
78% Flushed Away	\$18.8M
29% Saw III	\$14.8M
92% The Departed	\$7.7M

Links for 'more...' and 'opening' are also visible.

Tomatometer



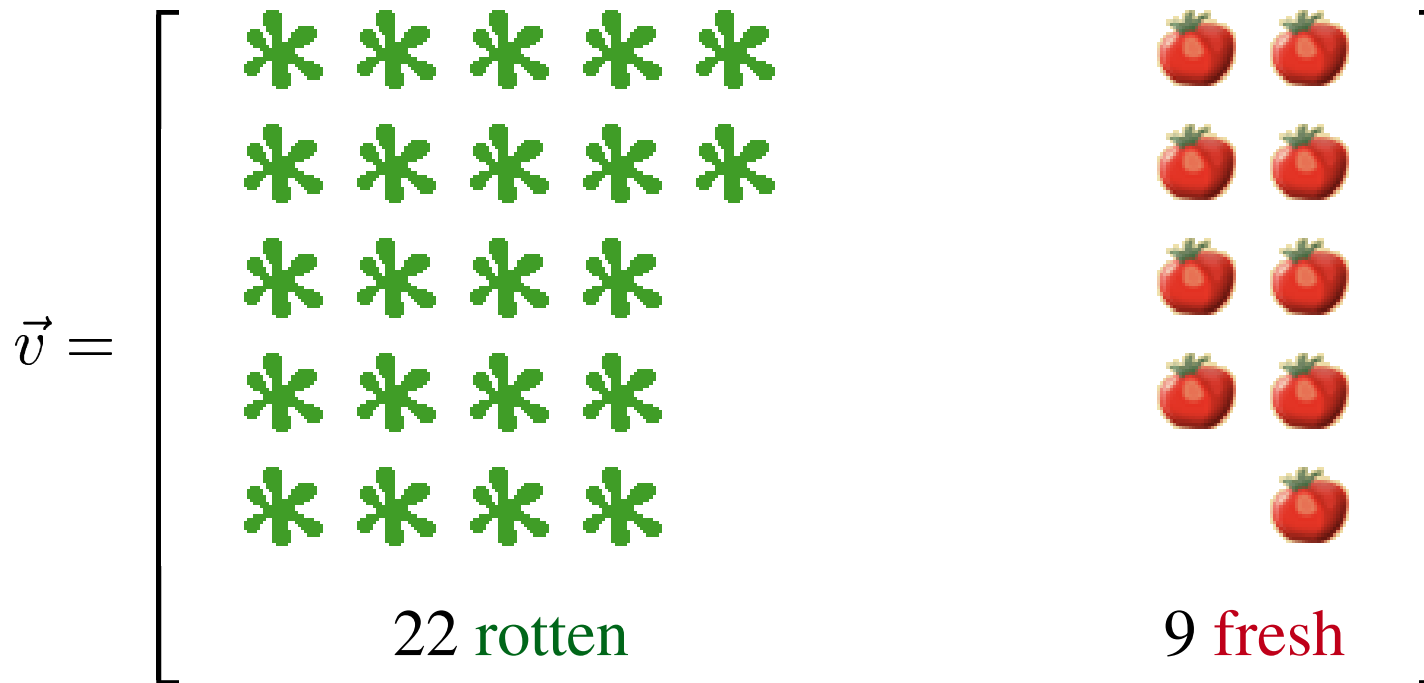
Saw III: 29%



Borat: 93%

Tomatometer

31 “votes” (from reviews) for *Saw III*:



$$t = \frac{9}{31} = 29\%$$

RT's newest critic

Borat Sagdiyev, Kazakh Ministry of Information



“It is nice!”

Borat's first assignment

Flushed Away



$$r_{\text{Borat}} = .7$$

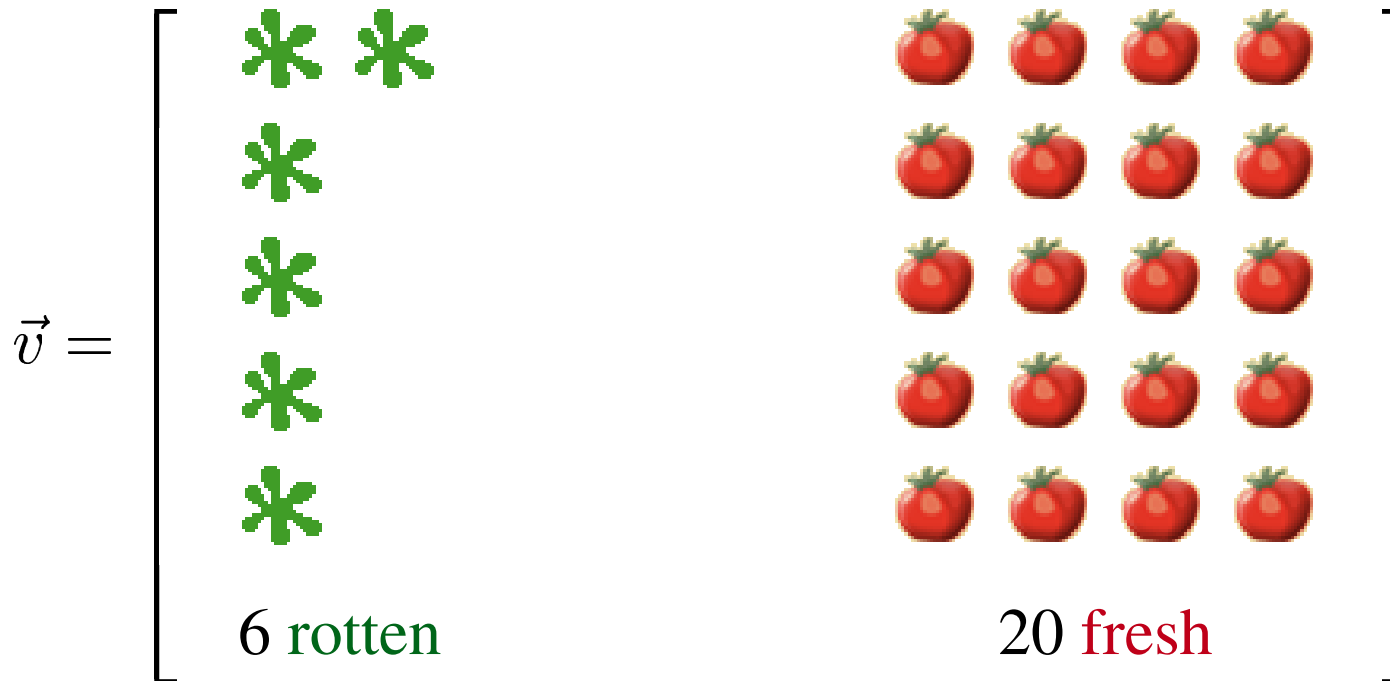
Borat says, “I like . . . 70% .”

Should he vote it fresh or rotten ?

$$v_{\text{Borat}} = 1 \quad v_{\text{Borat}} = 0$$

How should Borat vote?

26 votes for *Flushed Away* so far:



$$t = \frac{20}{26} = 77\%$$

How should Borat vote?

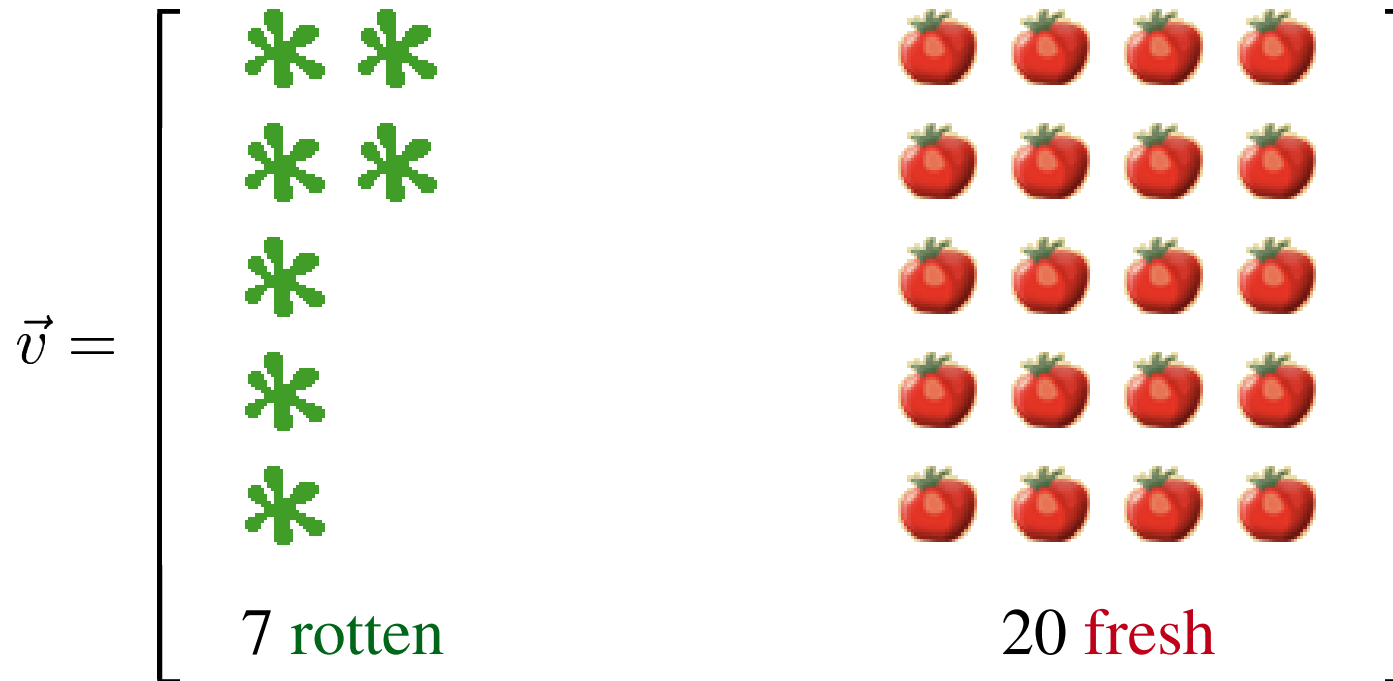
if Borat votes it “fresh”:



$$t = \frac{21}{27} = 78\%$$

How should Borat vote?

if Borat votes it “rotten”:



$$t = \frac{20}{27} = 74\%$$











Borat decides

He votes **rotten**.



- but the other critics are just as smart as Borat!
- if every critic manipulated like Borat, would chaos ensue?






Chaos, of a sort . . .

	Borat					
$\vec{r} =$	0	.2	.5	.7	1	
$\vec{v} =$						$t = \bar{v} = .4$
$\vec{v} =$						$t = \bar{v} = .6$

if Borat keeps trying to realize .5, a cycle results

Chaos avoided

but if partial votes are allowed:

$\vec{r} =$	0	.2	Borat	.5	.7	1	
$\vec{v} =$							$t = \bar{v} = .5$
	(0)	(0)	(.5)	(1)	(1)		

equilibrium is reached!

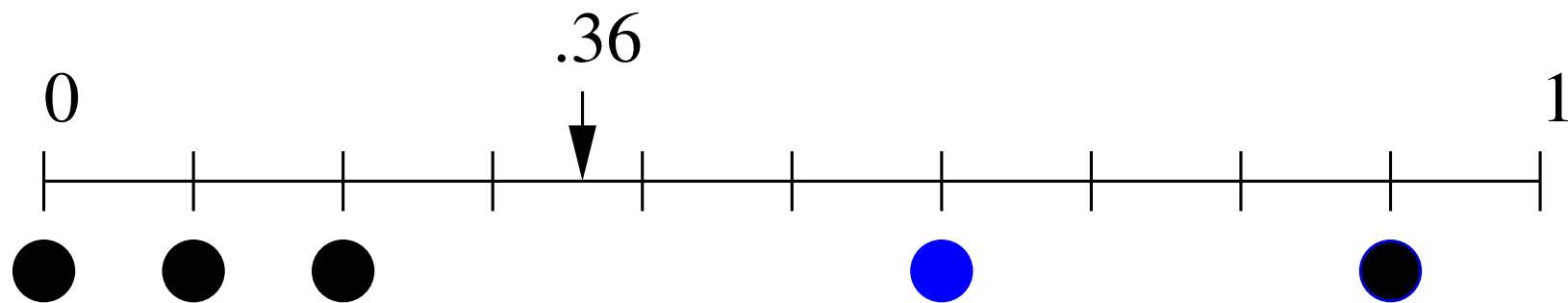
so, allow $(\forall i) 0 \leq v_i \leq 1$
(like `metacritic.com`)

One approach: Average

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, .6, .9]$$

$$\text{outcome } t = \bar{v} = .36$$

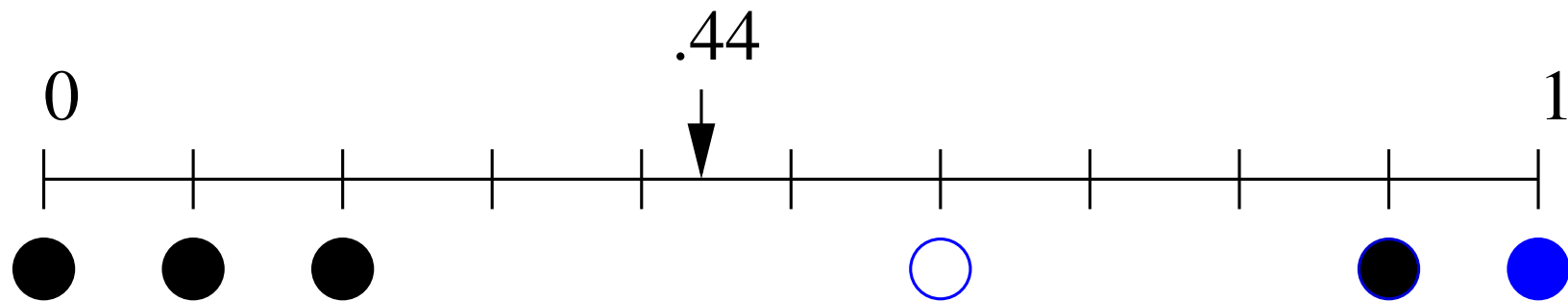


One approach: Average

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, 1, .9]$$

$$\text{outcome } t = \bar{v} = .44$$

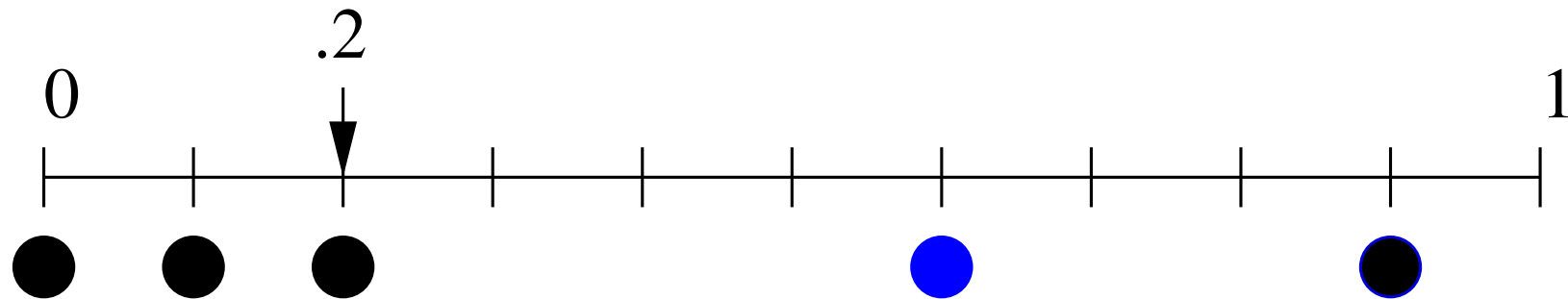


Another approach: Median

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, .6, .9]$$

$$\text{outcome } t = \tilde{v} = .2$$

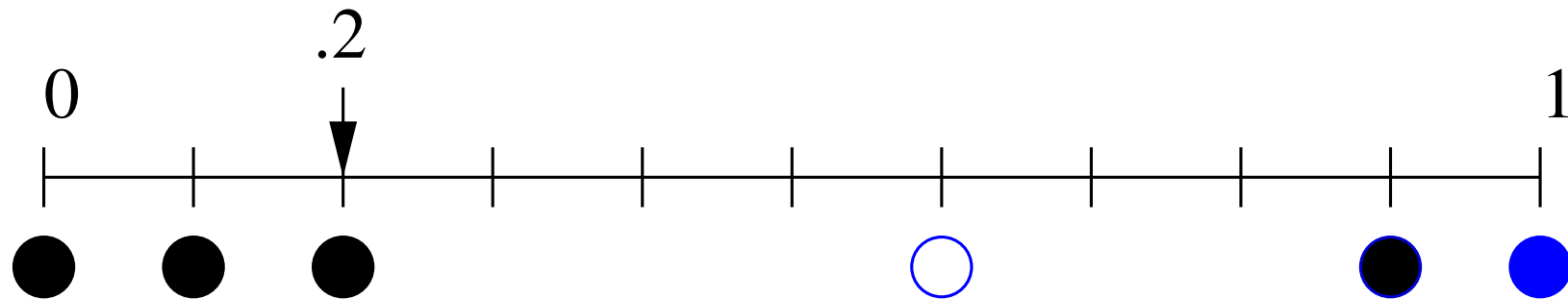


Another approach: Median

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, 1, .9]$$

$$\text{outcome } t = \tilde{v} = .2$$



Another approach: Median

- nonmanipulable
 - voter i cannot obtain a better result by voting $v_i \neq r_i$
 - if $\tilde{v} < v_i$, increasing v_i will not change \tilde{v}
 - if $\tilde{v} > v_i$, decreasing v_i will not change \tilde{v}
- allows tyranny by a majority
 - $\vec{v} = [0, 0, 1, 1, 1]$
 - $t = \tilde{v} = 1$
 - no concession to the 0-voters
 - so not ideal for Rotten Tomatoes—what now?

Formalizing Borat's thinking

- for $1 \leq i \leq n$, voter i should choose v_i to move outcome as close to r_i as possible
- choosing $v_i = r_i n - \sum_{j \neq i} v_j$ would give $\bar{v} = r_i$
- optimal vote is $v_i = \min(\max(r_i n - \sum_{j \neq i} v_j, 0), 1)$
- after voter i uses this strategy, one of these is true:
 1. $\bar{v} < r_i$ and $v_i = 1$
 2. $\bar{v} = r_i$
 3. $\bar{v} > r_i$ and $v_i = 0$

What happens at equilibrium?

- the optimal strategy recommends that no voter change
- so $(\forall i) \bar{v} < r_i \longrightarrow v_i = 1$
- and $(\forall i) \bar{v} > r_i \longrightarrow v_i = 0$
- (equivalently, $(\forall i) v_i \neq 0 \longrightarrow \bar{v} \leq r_i$)
- therefore any average at equilibrium must satisfy two equations:
 - (A) $\bar{v}n \leq |\{i : \bar{v} \leq r_i\}|$
 - (B) $|\{i : \bar{v} < r_i\}| \leq \bar{v}n$
- but will an equilibrium always exist? (conjecture: yes)

Multiple equilibria possible

$$\vec{r} = [.2, .3, .5, .5, .8]$$

$$\vec{v} = [0, 0, .5, 1, 1]$$

$$\vec{v} = [0, 0, .6, .9, 1]$$

$$\vec{v} = [0, 0, .75, .75, 1]$$

in each case:

$$t = \bar{v} = .5$$

Only one equilibrium average

$$A(\phi) \equiv \phi n \leq |\{i : \phi \leq r_i\}|$$

$$B(\phi) \equiv |\{i : \phi < r_i\}| \leq \phi n$$

- theorem:

$$A(\phi_1) \wedge B(\phi_1) \wedge A(\phi_2) \wedge B(\phi_2) \longrightarrow \phi_1 = \phi_2$$

- proof considers two symmetric cases:
 - assume $\phi_1 < \phi_2$
 - assume $\phi_2 < \phi_1$
- each leads to a contradiction

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
- $|\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}|$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
- $|\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}|$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \quad (A(\phi_2))$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
- $|\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}|$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \quad (A(\phi_2))$
- $|\{i : \phi_1 < r_i\}| \leq \phi_1 n \quad (B(\phi_1))$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
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- $|\{i : \phi_1 < r_i\}| \leq \phi_1 n \quad (B(\phi_1))$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}| \leq \phi_1 n$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
- $|\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}|$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \quad (A(\phi_2))$
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- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}| \leq \phi_1 n$
- $\phi_2 n \leq \phi_1 n$

Only one equilibrium average

case 1: $\phi_1 < \phi_2$

- $(\forall i) \phi_2 \leq r_i \longrightarrow \phi_1 < r_i$
- $\{i : \phi_2 \leq r_i\} \subseteq \{i : \phi_1 < r_i\}$
- $|\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}|$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \quad (A(\phi_2))$
- $|\{i : \phi_1 < r_i\}| \leq \phi_1 n \quad (B(\phi_1))$
- $\phi_2 n \leq |\{i : \phi_2 \leq r_i\}| \leq |\{i : \phi_1 < r_i\}| \leq \phi_1 n$
- $\phi_2 n \leq \phi_1 n$
- $\phi_2 \leq \phi_1 \quad (\text{contradicting } \phi_1 < \phi_2)$

Only one equilibrium average

- case 1 shows that $\phi_1 \neq \phi_2$
- case 2 is symmetrical and shows that $\phi_2 \neq \phi_1$
- therefore $\phi_1 = \phi_2$ \square

therefore, given \vec{r} , the average at equilibrium is unique

Declared-Strategy Voting

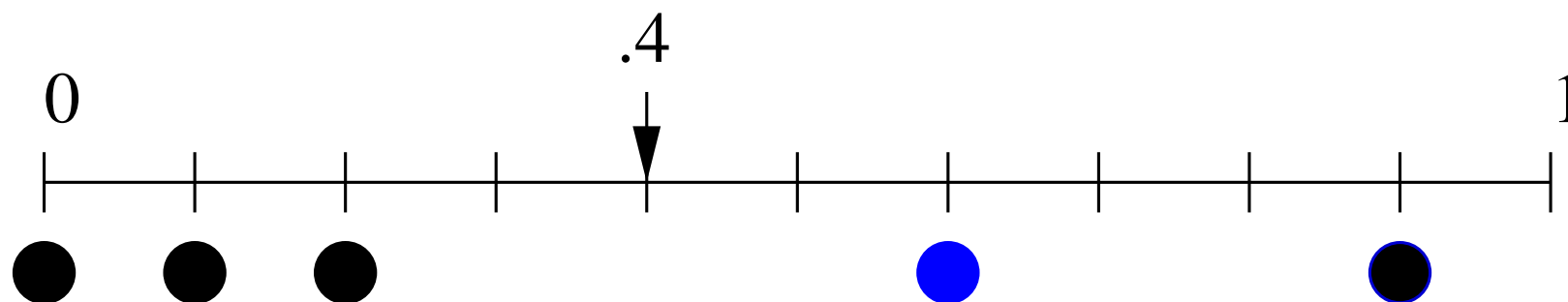
- move the manipulation from voter into voting system?
- DSV [Cranor & Cytron '96] treats voters' input as sincere preferences and strategizes for them
- DSV aims to encourage sincerity by embracing manipulation
- apply DSV to Average
 - \bar{v} at equilibrium can be defined as a function $f(\vec{r})$
 - $f(\vec{v})$ gives a new system: Equilibrium Average

Equilibrium Average

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, .6, .9]$$

$$\text{outcome } t = \hat{v} = .4$$

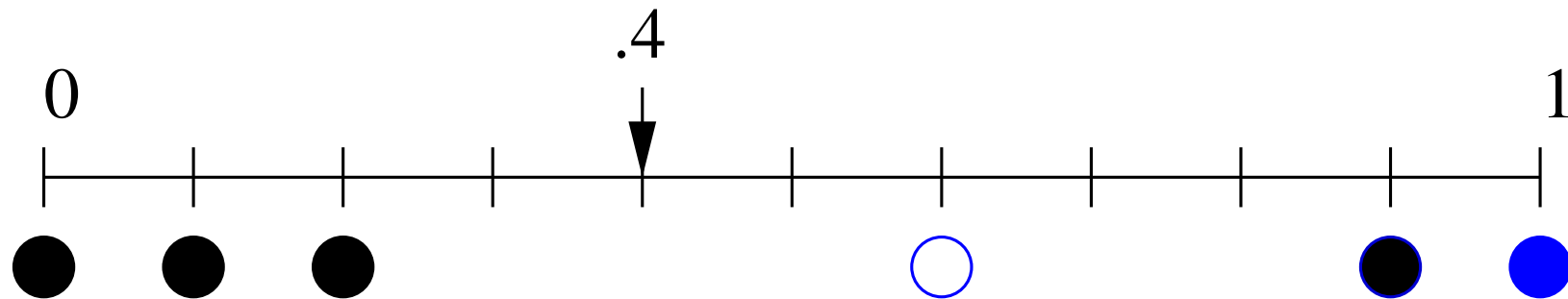


Equilibrium Average

$$\vec{r} = [0, .1, .2, .6, .9]$$

$$\vec{v} = [0, .1, .2, 1, .9]$$

$$\text{outcome } t = \hat{v} = .4$$



Equilibrium Average (cont.)

- conjecture: Equilibrium Average is nonmanipulable
 - intuitive reasoning is similar to case of Median: if $\hat{v} < v_i$, increasing v_i will not change \hat{v}
- no tyranny by a majority
 - $\vec{v} = [0, 0, 1, 1, 1]$
 - $t = \hat{v} = .6$

Contributions

- applied DSV framework to a new kind of voting system
- found rational strategy for Average
- showed that the strategy leads to unique outcomes
- defined a new system, Equilibrium Average, which
 - is a computable function
 - encourages sincerity

Future work

- finish proof that an Average equilibrium always exists
- finish proof that Equilibrium Average is nonmanipulable
- explore effects of DSV on other systems

[Cranor & Cytron '96]: Lorrie Cranor and Ron K. Cytron. “Towards an Information-Neutral Voting Scheme That Does Not Leave Too Much to Chance.” Paper presented at the Midwest Political Science Association Annual Meeting, 18-20 April 1996

Thanks!

to

Ron Cytron, the DOC Group, Aaron Stump
and you, the attentive audience



Questions?

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