# A SURVEY OF VOTING METHODS

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# Why Consider a New Voting Method?

- In our current voting method (called Plurality), we vote for one candidate
- Problem: The “spoiler effect”
  - When two candidates in party A run against one candidate in party B, the party A vote is split, giving the victory to party B
  - This has happened occasionally in important elections
    - In 2000, Bush vs Gore, the spoiler was Ralph Nader
  - But *every* election is affected by it. Because third candidates are pressured to not run.
  - Result: We don’t have anyone good to vote for. We have to vote for the least awful candidate.

# Ranked Choice Voting (RCV)

- Because of the spoiler effect, there is a movement to switch to RCV
- Vocal groups advocating RCV exist all over the country
- It has been used in Alaska, Maine, New York City, Australia, and many other places

# How RCV Works

- The voter says “my first choice is Judy, my second choice is Paul, my third choice is Sandra, etc.”
- The polling station finds the winner via an “instant runoff” process
  - Look at the first place votes.  If no candidate has 50%, drop the person who has the least votes.  The votes for the dropped candidate are now replaced with votes for the second choice candidate.
  - Continue until someone has 50%

# Pros and Cons of RCV

- People who like RCV say
  - It ends the spoiler effect
  - It leads to friendlier campaigns
  - It lets the voter express his/her views more completely
  - It increases voter participation
- People who dislike RCV say
  - It is confusing
  - Figuring out who won is so complicated that it takes a long time and is prone to error
  - Many places that tried it have rejected it

# Alaska Election of 2022

- Special election for U.S. House of Representatives
- RCV was used
- Candidates
  - Two Republicans (Nick Begich, Sarah Palin)
  - One Democrat (Mary Peltola)
- The Democrat won
- Republicans had a 60% majority.  They blamed RCV for their loss.

# The Parties Have Taken Sides

- Following the Alaska election:
  - RCV was banned in 15 Republican states
  - The Heritage Foundation and the Wall Street Journal published articles condemning RCV
- Meanwhile, Democrats introduced a bill into Congress that would have required RCV in elections of members of Congress and presidents

# View of Scholars

- Experts from both parties agree that RCV does not favor either party
- However, many people who have studied voting believe that other methods are better than RCV
- Unfortunately, there is no academic consensus on which method is best

# The Author's Research

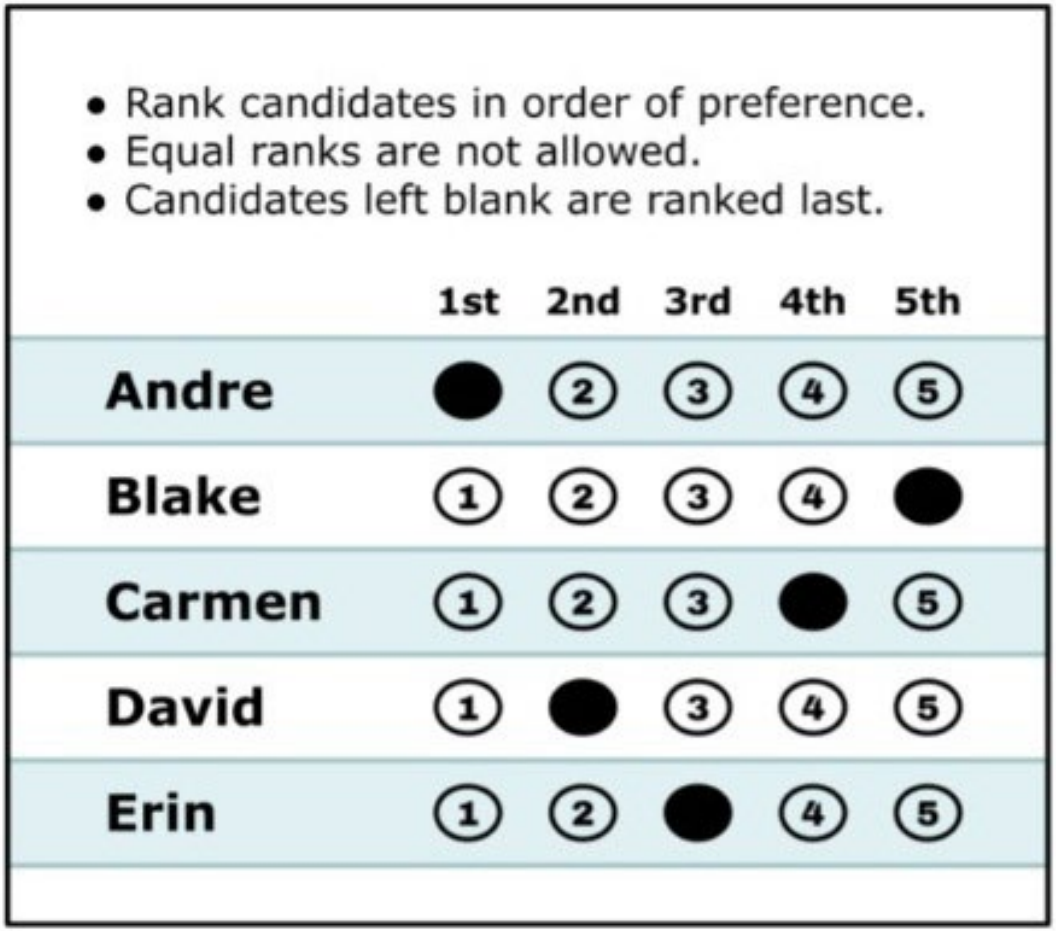
- Since the experts are divided, I wanted to find out for myself which method was best

- So I wrote a computer program to simulate voting
  - I have many years of professional experience writing simulations

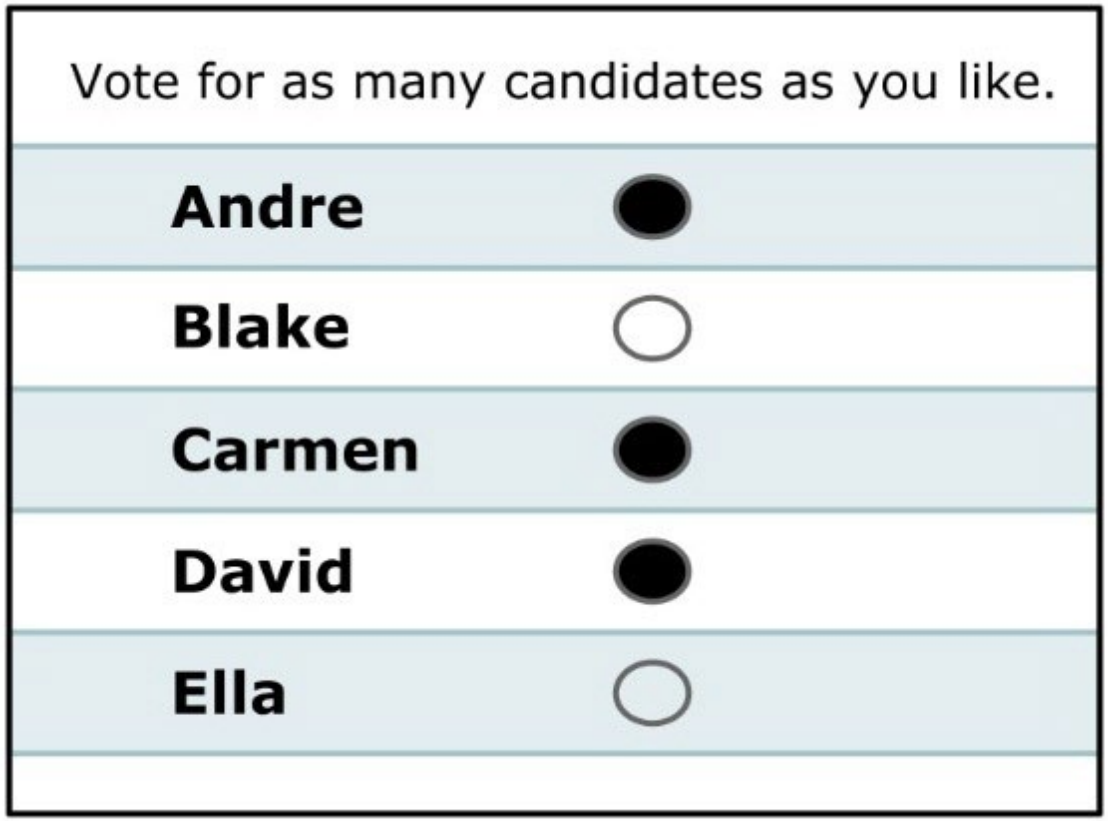
# Voting Methods Considered

- Plurality — The current method
- RCV
- Approval voting — Vote for many candidates
- STAR voting — 0-5 star ballot (like online shopping)<br>Top 2 candidates enter automatic runoff

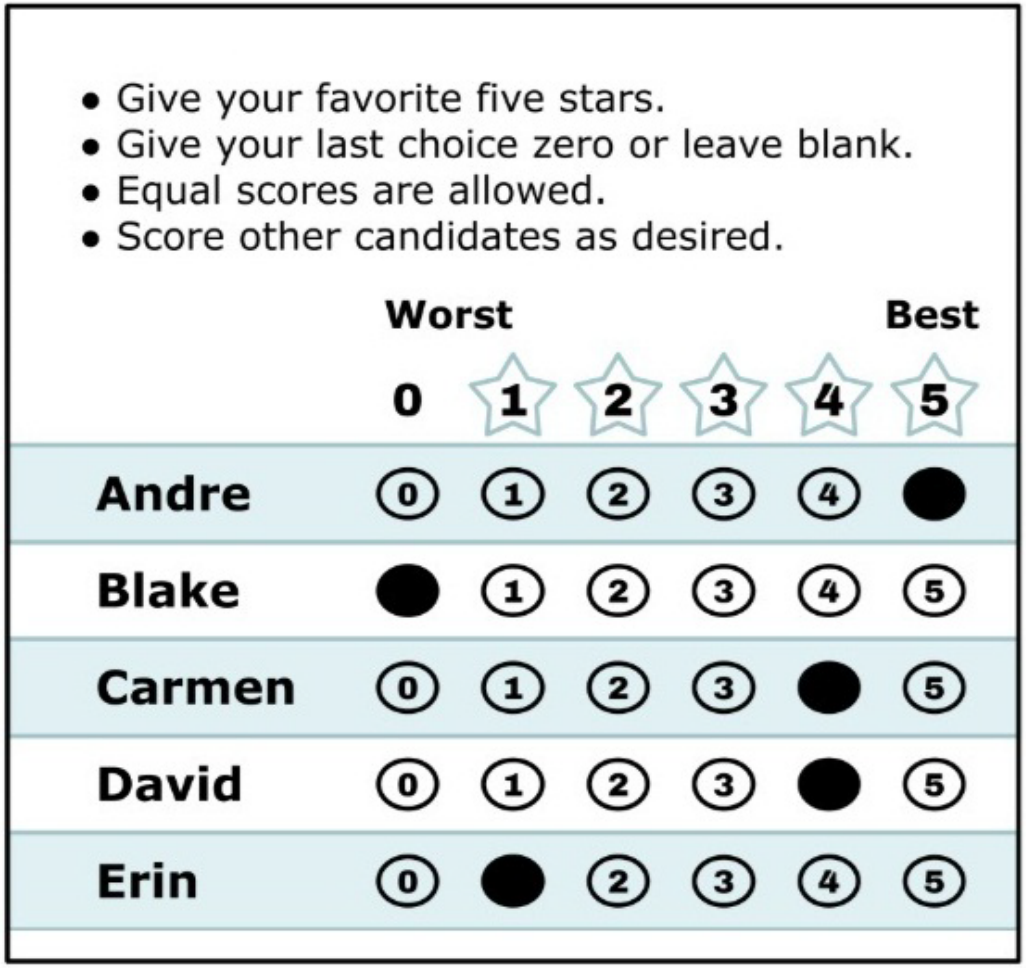
# Ranked Ballot



# Approval Ballot



# STAR Ballot


• Give your favorite five stars.
• Give your last choice zero or leave blank.
• Equal scores are allowed.
• Score other candidates as desired.
Worst
Best
0 1 2 3 4 5
Andre 0 1 2 3 4 ●
Blake ● 1 2 3 4 5
Carmen 0 1 2 3 ● 5
David 0 1 2 3 ● 5
Erin 0 ● 2 3 4 5

# STAR: Figuring Out Who Won

Polling Station goes through the ballots twice

Step 1. Add the stars, find the top two candidates

Step 2. On each ballot, find which of the two was preferred

This is called the automatic runoff

# STAR Runoff Example

## Blake against Carmen

One voter's ballot


One vote for Carmen

Another voter's ballot


One vote for Blake

# My Simulation

- Inputs
  - Number of voters
  - Number of candidates
  - Number of issues that people care about (4 in this briefing)
- The computer analyzes 100,000 random elections
- Within each election, there are several steps…

# Simulation Steps

- Give each voter an opinion on each issue
- Give each candidate an opinion on each issue
- Let each voter assess the “goodness” of each candidate based on similarity in opinions
- Compute the average goodness of each candidate (over all voters)
  - This can be viewed as society’s assessment of how good the candidate is

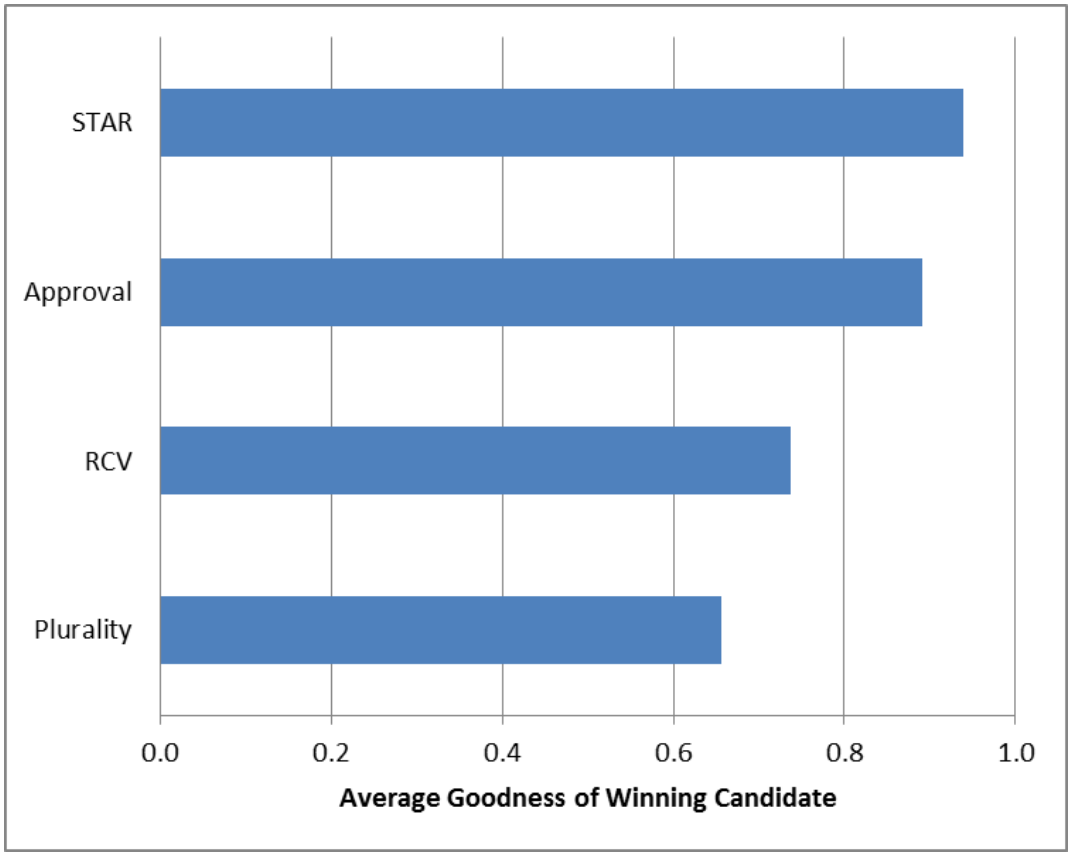
# Three Ways of Evaluating the Voting Methods

- Sincere voting
  - We want to elect the candidate with the largest “average goodness”
- Spoiler effect
  - We want to end the spoiler effect
- Strategic voting (“Gaming”)
  - We want to prevent groups from gaining by insincere voting

# Analyzing Sincere Voting

- In each election, the program figures out which candidate won under each voting method
- The average goodness of the winner is then computed for each voting method

# Results: Sincere Voting




We want the Average Goodness to be large

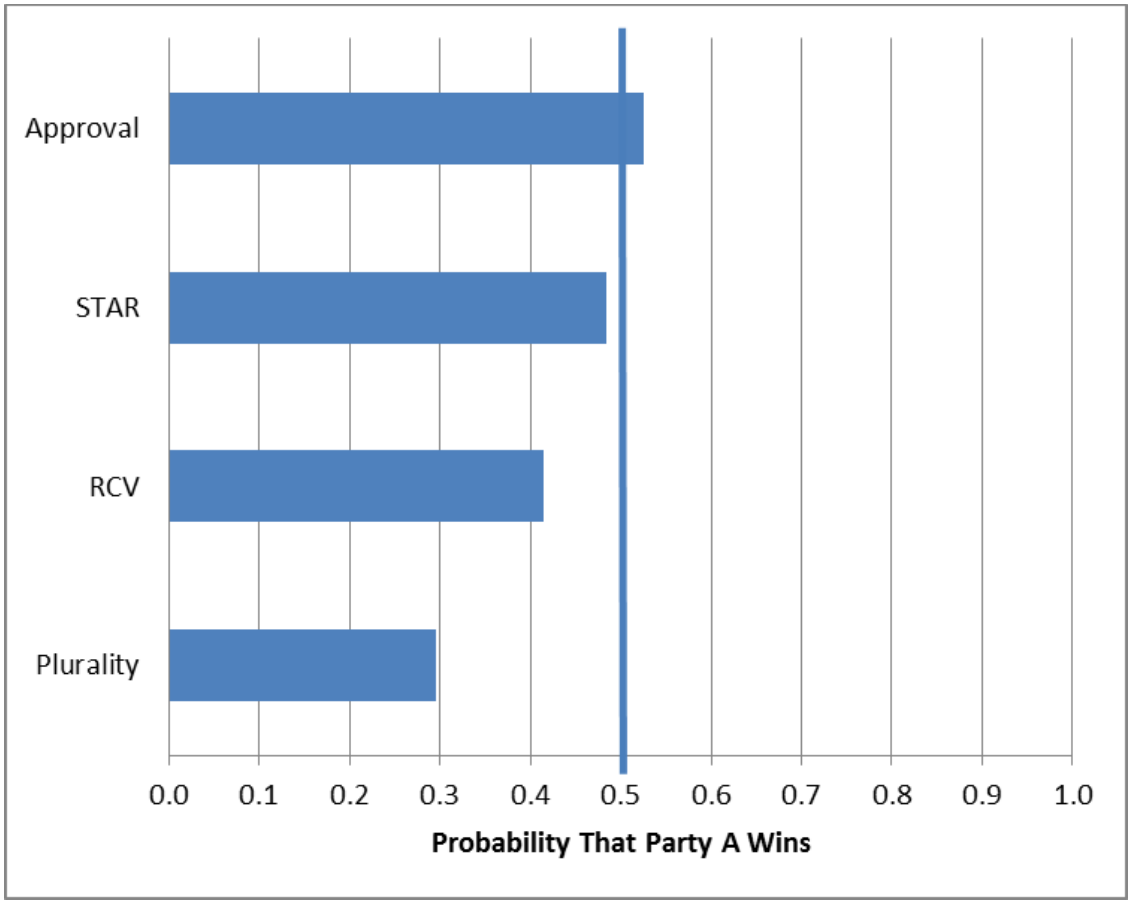
# Interpretation: Sincere Voting

- Plurality does far worse than the other methods
  - Hence, even without discussing the spoiler effect, we can see a good reason for dropping our current voting method
- Unfortunately RCV, the most popular reform method, does not do very well either, though it performs considerably better than Plurality
- Approval does pretty well.
- STAR does the best.

# Analyzing the Spoiler Effect

- To measure the severity of the spoiler effect, the program runs two candidates in party A against one candidate in party B
- This creates a spoiler situation
- The simulation keeps track, in 100,000 elections, of how often party A won
  - We want the answer to be 1/2

# Results: Spoiler Effect




We want the probability to be close to 0.5

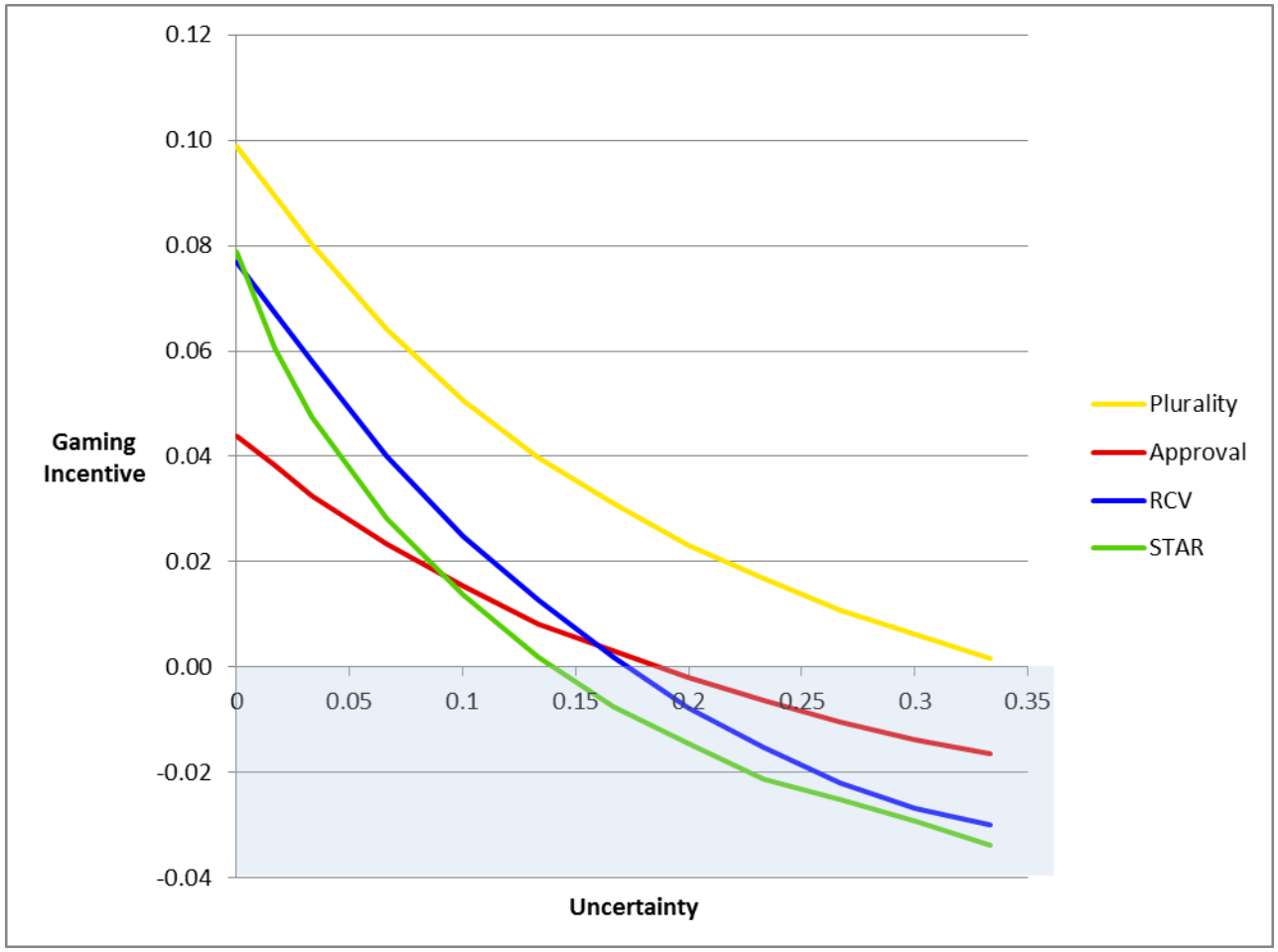
# Interpretation: Spoiler Effect

- Plurality does poorly (though better than we might expect)
- RCV does considerably better than Plurality
- With Approval, party A wins more than half of the time (52.5%). This is a *reverse spoiler effect*.
  - This is also a problem
  - It gives an advantage to running lots of candidates
  - However, Approval's score is very good (close to 1/2)
- STAR is the best (48.5%)

# Analyzing Strategic Voting

- Strategic voting occurs when a group votes insincerely to maneuver for a better outcome
- To succeed, the “strategic voting group” (SVG) must estimate how other people will vote
- The simulation computes how much the SVG can gain (the “gaming incentive” or GI) depending on how much uncertainty exists in their knowledge of other voters

# Results: Strategic Voting




We want the Gaming Incentive to be small

# Interpretation: Strategic Voting

- Plurality (yellow) is most susceptible to gaming over the entire range.
- Comparing the other three voting methods, it is hard to say which is best
  - STAR (green) is best for large uncertainty
  - Approval (red) is best for small uncertainty
  - RCV (blue) does pretty well over all
- For STAR, Approval, and RCV, the GI becomes negative by the time uncertainty reaches 0.2
  - So strategic voting doesn't pay
- In contrast, for Plurality, uncertainty has to go to about 0.34 to bring the GI below zero.

# Conclusions

- Plurality is terrible by any measure
- RCV is much better than Plurality by any measure.  And it does well in resisting strategic voting.
- However, STAR and Approval do much better than RCV in sincere voting and the spoiler effect
- STAR is strong by all three measures.  It is the best of the four in two out of three measures.

# Organizations

- There are many organizations advocating advanced voting systems:
  - FAIR VOTE. Advocates RCV. (fairvote.org)
  - CALIFORNIA RCV. Also advocates RCV. (calrcv.org)
  - EQUAL VOTE COALITION. Advocates STAR voting. (equal.vote)
  - CENTER FOR ELECTION SCIENCE. Advocates Approval voting. (electionscience.org)

# Caveat

- The research summarized here does not claim to have the final answers. Every analysis makes simplifying assumptions, and many papers have been written on this subject. It is my hope that this research will add confidence to the conclusions of other studies by demonstrating that similar conclusions can be reached by different research methods. I also hope that some of the methods presented here will be of use to other researchers.

# BACKUP SLIDES

Historical background

# The Middle Ages

- Approval voting was used to elect the Pope in 1294-1621 and to elect the Doge of Venice in the 1200s

- But a scientific inquiry into voting methods did not start until the approach of the French Revolution

# France, 1770

- Jean-Charles de Borda was a French scientist
  - Played a role in inventing the metric system
  - Invented a navigation system for the French Navy

- Invented Borda voting
  - Uses a ranked ballot (like RCV)
  - Translates ranks into votes and adds the votes
    - Least favorite gets 0 votes, next gets 1 vote, next gets 2 votes, etc
  - Was used by the French Academy of Sciences for a while
  - Influenced many other methods

# France, 1785

- Nicolas de Condorcet was a French philosopher and mathematician
  - Worked with Leonard Euler and Benjamin Franklin
  - Advocated free markets and constitutional government
  - Arrested by French Revolution and died in prison
- Invented Condorcet voting
  - Uses a ranked ballot (typically)
  - The winner is the candidate who beats all other candidates in hypothetical two-person elections
  - Problem: such a candidate may not exist
  - But the Condorcet winner became an important concept

# Next 200 Years

- Mathematicians continued inventing voting methods and proving theorems
- England, 1884. Lewis Carroll, author of “Alice in Wonderland”, invented several voting methods
- United States, 1951. Arrow’s Impossibility Theorem showed that every ranked voting method behaves irrationally sometimes
- United States, 1973. Gibbard’s Theorem showed that every voting method is vulnerable to strategic voting

# Inadequacy of Mathematics

- To decide how good a voting method is, mathematicians proved that certain properties hold always, sometimes, or never
  - For example, Plurality, RCV, and Borda *sometimes* fail to elect the Condorcet winner (when one exists)

- Problem: Using math, it is hard to prove how voting methods work on the average

# 1980 and Later

- Computer simulation came into wide use
- This made it possible to study the average behavior of voting methods:
  - How “well liked on the average” is the winner with each method?
  - How strong is the spoiler effect with each method?
  - How often does each method elect the Condorcet winner?

- Result: Finally we have a way of knowing which voting methods are best

# Further Information

- Wikipedia has many articles
- Articles on the equal.vote website
  - Wolk, S., Quinn, J., Ogren, M. (2023). STAR Voting, equality of voice, and voter satisfaction: considerations for voting method reform. *Constitutional Political Economy (2023) 34:310–334*, https://doi.org/10.1007/s10602-022-09389-3
  - Huang, John. (2021). Strategic Voter Simulations.
- Braver Angels panel discussion, June 2024
  - On YouTube, search for Braver Angels Alternative Voting Methods

# BACKUP SLIDES

Information about some other voting methods

# Some Other Voting Methods

- Score voting

  STAR voting without the runoff

- Borda count

  Ranked ballot. Number of votes for each candidate depends on rank. Worst gets 0 votes, next gets 1 vote, next gets 2 votes, etc.

- BAR

  Borda with automatic runoff

- Minimax

  Ranked ballot. Winner is found by considering the outcomes of two-person elections

# Summary of Simulation Results

- Plurality is a terrible voting method by any measure
- RCV is much better than Plurality by any measure. However, in terms of sincere voting and the spoiler effect, it falls far short of many other methods.
- Borda and Score are excellent with respect to sincere voting, but doubtful because of their reverse spoiler effect and susceptibility to strategic voting. BAR and STAR, by adding a runoff to Borda and Score, are successful in correcting these problems. They are both promising methods.
- Approval, like Borda and Score, has a reverse spoiler effect, though a milder one. It does well in regard to sincere and strategic voting. So, overall, Approval is a good choice.
- Minimax is strong in all areas, especially strategic voting

# Author's Thoughts

- People who are thinking about adopting RCV because they like the ranked ballot may wish to give their support to BAR or Minimax instead
- Likewise, cities and states that are currently using RCV and are having difficulties with it may wish to consider switching to BAR or Minimax.  This would allow them to keep the same ballot system.
- People who dislike complex ballots may wish to advocate Approval
- People who are adventurous about ballots may wish to consider STAR voting

# Summary of Voting Systems - 1

- Plurality voting
  - Our current voting system.  You get to vote for only one candidate.
  - Also called "choose-one" and "first past the post".
- Ranked choice voting (RCV)
  - Uses a ranked ballot.
  - The process of figuring out who won consists of several rounds.  In the first round, everyone's first choice gets one vote.  If no candidate received 50% of the votes, the candidate with the least votes is eliminated and everyone's ranking is adjusted.  (For example, if the dropped candidate was your first choice, your second choice moves into first place.)  Then a second round of voting occurs, and another candidate is eliminated.  This process continues until somebody has 50% of the votes.

# Summary of Voting Systems - 2

- Approval voting
  - You can cast one vote for as many candidates as you want.
- Score voting
  - Similar to shopping online, where products receive up to five stars.
  - You give each candidate a number of stars, from 0 to 5. You should give five stars to your first choice and zero to your last choice. You are allowed to give the same number of stars to several candidates.
  - The candidate with the most stars is the winner.
- STAR voting
  - The voting process is the same as with score voting. However, the winner is selected differently.
  - The two candidates with the most stars go into an automatic runoff. In this process, each ballot is examined to see which of the two candidates got more stars. This counts as one vote for that candidate. The candidate with the most votes is the winner.
  - STAR stands for Score Then Automatic Runoff.

# Summary of Voting Systems - 3

- Borda count
  - Uses a ranked ballot.
  - Your last choice gets 0 votes, your next-to-last choice gets 1 vote, the next person gets 2 votes, etc.
  - The candidate with the most votes wins.
- BAR
  - Uses a ranked ballot.
  - There are two steps. In the first step, each candidate receives votes as in the Borda method. In the second step, the two candidates with the most votes enter an "automatic runoff", as in the STAR method.
  - BAR stands for Borda with Automatic Runoff. It is not a well-known method.

# Summary of Voting Systems - 4

- Minimax
  - Uses a ranked ballot.
  - For every pair (X,Y) of candidates, we can figure out from the ranked ballots the number of people num(X,Y) who would vote for X if he/she were running only against Y. We then define score(X) to be the smallest value of num(X,Y) over all Y. The winner of the election is the person with the largest score.
    - Example. If score( Fred ) = 700, this means that no matter who Fred runs against, he will always get at least 700 votes.