Expanded Election Simulation Expands Understanding

By Roy A. Minet (Rev. 20260204)

[Abstract: A 2020 election simulation study emphasized the importance of enabling voters to express not only their satisfaction with candidates they like, but also dissatisfaction with candidates they do not like. A new voting method, Approve/Approve/Disapprove Voting (AADV), that functions in this manner was developed, tested, and recommended. This study confirms prior results and extends understanding by gathering data on elections where only one candidate is on the ballot and for the fictitious candidate "NOTA" (none of the above) which should be the "winner" when voters are not satisfied with any of the candidates. These aspects turn out to be important and were not investigated in the prior two simulation studies. In addition, a newer voting method that has gained some following, Score Then Automatic Runoff (STAR), was tested. AADV remains the strongly recommended voting method.**]**

Background

The serious shortcomings of the Plurality voting method have been recognized for well over two centuries. The ensuing 250-year-long debate has produced a healthy paper publishing industry, near-universal agreement that Plurality is awful and needs to be replaced, but no solid consensus on a best replacement. Many experts (including this author) realize that Plurality is an exacerbating cause of political polarization which is increasing to alarming levels in the US. Instead of just publishing papers for another century or two, plurality needs to be replaced soon, not with a perfect voting method (no "perfect" method is possible), but by one that makes a large improvement in single-winner elections. A method which can be easily extended to handle multi-winner contests is also desirable.

It is worth a short digression to consider why such an important problem remains unresolved after so much time, attention, effort, and debate. One main cause is an irrational fixation on ordinal methods — collectively and colloquially known as ranked-choice voting (RCV). This was initiated by none other than Nicolas de Condorcet and Jean-Charles de Borda who kicked off the whole voting methods debate when they pointed out some of plurality's problems and proposed their own ordinal replacement methods. The focus on ordinal methods was greatly intensified when Kenneth Arrow won a Nobel Prize for his impossibility theorem proof in 1951.

Plurality is the simplest of the ordinal methods — voters are allowed to rank only their first choice. It is not difficult to see why no ordinal method can be a very good replacement for plurality. *Every* ordinal method reduces to plurality for one-candidate and two-candidate elections — that is, their function is precisely the same as plurality, so they have not improved upon it at all. No one would argue that two-candidate elections aren't *very* important.

Using *any* ordinal method in one-candidate elections is ridiculous since the candidate automatically wins. Voters have no control over the outcome, so these are sham elections. Some might argue that one-candidate elections aren't important, but they'd be wrong. There are many races where only one candidate is on the ballot and voters should have control over whether or not that candidate is elected. It is possible that a write-in candidate could prevail, but write-ins are at such a severe disadvantage, and instances of them being successful in any large public election are so rare, that they have no practical significance.

The fact that no ordinal method works well for one-candidate or two-candidate elections strongly suggests that they may not work very well when there are three or more candidates on the ballot either. Their problems are just not as immediately obvious in many-candidate contests.

The other major category of voting methods is the cardinal methods. Each voter is allowed to score each of the candidates on some scale. The scores are then processed in some way (usually summed) to determine the winner. The simplest cardinal method is called Approval Voting and candidates are scored either 0 (no approval) or 1 (approval); the candidate receiving the highest score (largest number of approvals) wins. The cardinal methods can be further subdivided into ones which allow only positive scores and ones which allow negative scores that subtract from or offset positive scores.

It seems that the best replacement for plurality will have to be a cardinal method. Furthermore, in order to resolve the single-candidate problem, it obviously will need to be a cardinal method that utilizes both positive and negative scores.

Definitions and Rules

Before attempting to design anything (which certainly includes a voting method), it is essential to clearly define what the thing is intended to do. Incredibly, this step is often glossed over or skipped entirely. The following two foundational definitions underlie everything about elections:

> **The primary design objective for an election mechanism must be for it to most consistently render the best possible decisions** (with the caveat that decision-making power be kept reasonably dispersed).

This may seem to be a trivial and obvious definition. However, it is absolutely important to always bear in mind. There are plenty of examples where effort is expended to solve perceived problems that do not affect (or worse, adversely affect) consistently rendering the best possible decisions. The nebulous term "best possible decision" begs a specific and actionable definition.

> **The best possible decision is that result which maximizes voter satisfaction, net of dissatisfaction, when summed over all voters who voted.**

A voting method is a procedure at the heart of an election that gathers some specific information from voters, then utilizes that data in some manner to identify the candidate that will maximize the satisfaction, net of dissatisfaction, for all the voters who voted. *This is the overriding and <u>only</u> purpose that a voting method should have*.

A large amount of effort has been expended over the years investigating and arguing about peripheral issues – the "fairness" of various voting methods comes immediately to mind. Such issues are subsidiary distractions and are important only to the extent that they actually do affect consistently rendering the best possible decisions. But what could be fairer than always electing the candidate with which voters would be most satisfied?

When about to mark a ballot for a particular race, voters all have "opinions" in their brains about each of the candidates in that race. Sometimes, that opinion will be strongly positive for a candidate they consider to be very good—the voter would be very happy and satisfied if that candidate won. Sometimes, the opinion will be strongly negative, and the voter would be very dissatisfied if that candidate won. Of course, a voter's satisfaction regarding a candidate might be anywhere between strongly positive and strongly negative, including zero (no opinion). It also happens quite often that a voter's opinion of a candidate is zero because the voter is not informed and simply does not know enough about that candidate to have any opinion—elections with three and more candidates have especially large numbers of this type of no opinion.

There are many voters, all with their own sets of opinions about each of the candidates in the race. It is possible (virtually certain with large numbers of voters) that, for any particular candidate, some voters will have positive opinions and some will have negative ones. There will also be some no opinions.

It would be ideal if there were some way to read voters' minds and extract their sincere opinions. That not yet being possible, the only way a real-world voting method has to obtain any data from voters is to ask them for it. That is actually a rather fundamental and serious problem. There is no guarantee that voters will provide correct data. Voters can and do lie a lot. If voters believe (correctly or incorrectly) that indicating something other than their sincere opinions about the candidates will enable their ballot to have a greater impact on the election outcome in a way that they would prefer, they will not hesitate to lie. This well-known phenomenon is called *insincere* or *strategic* voting.

The most important theorem to be proven regarding voting methods is the Gibbard-Satterthwaite theorem. Messrs. Gibbard and Satterthwaite proved that *any* and *every* voting method (other than a dictatorship where a single voter has absolute control) can be manipulated to some extent by strategic voting. No voting method can be completely immune to such degradation, but some are much more susceptible to it than others. Minimizing the susceptibility to manipulation by strategic voters *must* be considered in the design or selection of a voting method.

Unless or until there is a way to obtain accurate and sincere opinions from voters, *all* real-world voting methods will sometimes make mistakes — that is, choose a winning candidate *other* than the one that would maximize overall voter satisfaction. If the mistake is to select a candidate nearly tied with the correct winner, then that would be a very small error. However, it would be a big mistake if a candidate decisively disliked by most voters were to win instead of one they actually like. The best voting method will be one which makes the fewest errors *and* avoids making such colossal blunders.

A rule that is often overlooked is the Jones Rule, named for Douglas Jones (Computer Science Department, University of Iowa), who stated it so succinctly:

> **Anything about elections must be understandable by a reasonably bright high school student.**

Of course, the rule covers more than just the voting method, but it certainly does include the voting method. If how elections work is a deep mystery, voters may suspect that "a man behind a curtain" may be manipulating the results. And, in fact, if you don't understand what is going on, there very well *could* be a man behind a curtain manipulating the results for all you know. No politician should vote to authorize the use of an election mechanism that they don't understand. Also, it will be difficult or impossible for everyone to implicitly trust election results, which will be endlessly disruptive as it currently is.

Details for this Simulation Study

Two previous simulation studies, one completed in 2019[1] and another completed in 2020,[2] covered a lot of ground and enabled valuable insights into how elections and voting methods function. The first step for this project was to verify backward compatibility. In doing so, many of the previous results were reconfirmed.

The prior projects neglected to specifically look into two aspects of election that actually are of rather fundamental importance. Data was generated for two-candidate through seven-candidate elections, but none for one-candidate elections. Also, the simulated elections did not give proper due to the fictitious candidate "NOTA" (None Of The Above). NOTA is the "candidate" that should "win" if voters do not like any of the real candidates on their ballot. Thirdly, a newer proposed voting method, STAR (Score Then Automatic Runoff), that has picked up something of a following was added to the list of tested voting methods.

[1] See "Election Simulation Sheds New Light on Voting Methods" at http://royminet.org/voting-elections/
[2] See "Follow-on Election Simulation Leads to Definite Proposal" at http://royminet.org/voting-elections/

All prior simulations identified as the correct winner the "real" candidate having the positive-most (or least negative) net voter opinion. Voting methods were rated by how often they chose this winner candidate, and when they didn't, how much worse the voters net opinion was for the candidate that was chosen. For this project, if all real candidates have negative net opinions, then NOTA is designated the correct "winner" with a net opinion score of zero. As before, voting methods were rated by how often they chose the correct winner, and when they didn't, how much worse was the net opinion of the candidate they did choose. When graphed, this data has a very understandable, but somewhat startlingly different, appearance. However, the relative performance of various voting methods remains mostly the same.

Additional attention was paid to making sure all possible election scenarios were being simulated with equal frequency. Here is the procedure for instantiating an election in more detail:

1. A Government object is responsible for instantiating a series of Election objects, complete with Candidates and Voters, for testing a set of VotingMethod objects, and for reporting the results. Voter opinions of or satisfaction for candidates occur on a scale of -100 to +100 "sats."
2. In a race in a real election, there are always candidates that are well-known to most voters, candidates that are less well-known, and some candidates which very few voters have even heard of. So, the first step in instantiating each Election is to assign a "notoriety" to each Candidate. A random number >=0 and <1 is generated for each Candidate. Before assigning these notorieties to Candidates, they are sorted into descending order so that the first Candidate is always the best known and the last is the least known. This does not cause any loss of generality, but does enable us to see roughly how a candidate's notoriety affects its win percentage.
3. Second, each Candidate is assigned an average opinion or average voter satisfaction by generating a random number evenly distributed between -60 sats and +60 sats.
4. Next, the Voters are instantiated. Each Voter is first assigned a randomly generated number <= 0 and <1 which models the Voter's knowledge. A zero indicates a completely ignorant Voter. On the other hand, a 1 would be an ideal perfectly knowledgeable Voter who is fully informed about each and every one of the Candidates. When (just before) voter opinions are generated for each candidate (see next step), the voters knowledge is multiplied times the candidate's notoriety. If this product is less than a no-opinion threshold, no opinion is generated for that candidate. The threshold was set to 0.04, which is believed to be a reasonable simulation of this effect as it occurs in real world elections. While this setting does affect the win percentages of low-notoriety Candidates as expected, the fact that varying it somewhat does not have much effect on voting method results relieves the need to investigate further.

5. Whenever a Voter knows enough about a Candidate (has an opinion), a (Gaussian) satisfaction centered on each Candidate's average opinion is generated. The random Gaussian opinions have a sigma of 20 sats and are truncated to a plus or minus two-sigma range so they cannot exceed the -100 to +100 range when centered around each Candidate's randomly-assigned average. When each satisfaction is generated, it is added to the Candidates total net satisfaction (which will determine the correct winner of the Election after all Voters have been instantiated). When a positive opinion/satisfaction is generated for a Candidate, it is also registered as a "yea" in a referendum for the Candidate. Whenever a negative opinion is generated, a "nay" is registered in the Candidate's referendum. Each Voter ranks all the Candidates according to its satisfactions and is able to provide the ranking and the satisfactions upon request (e.g., to VotingMethod objects or the Election object).
6. After each Election is completely instantiated, the Election determines the correct winner along with the winning (highest) net total satisfaction value. It also determines and tallies whether there was a majority winner, whether the majority winner was the correct or an incorrect winner, whether there was a Condorcet winner, whether the Condorcet winner was the correct or an incorrect winner, and also tallies the wins by Candidate.
7. Also after each Election is instantiated, the Government object hands it (read only) to each of the VotingMethod objects being tested. The same Voters with the same opinions vote multiple times, once for each method being tested and in accordance with each voting method's rules. Thus, VotingMethods are able to easily have Voters fill out their "ballots," tally the ballots, determine a winner and then see whether or not their algorithm has chosen the correct winner. Whenever an incorrect winner is chosen, how much lower the net total satisfaction was than that of the correct winner is recorded as the error.
8. When the last Election has been processed, each VotingMethod publishes its statistical results.
    - The percentage of incorrect choices made
    - The maximum error ("sats" on the -100 to +100 scale)
    - The average error
    - The RMS (root of the mean square) error
    - The RMS error divided by the RMS error for random selection times 100
    - The percentage of winners chosen that would lose their referendum.
    - The number of ties that had to be resolved by random selection

To summarize: Each Candidate has a notoriety and an average Voter opinion. Each Voter has an opinion for each Candidate (if the Voter is sufficiently informed about that Candidate), and the opinions for various Voters have a Gaussian distribution centered on the Candidate's average. All are randomly generated for each Election so that, over many thousands of Elections, all possible permutations and combinations occur with equal likelihood.

From the prior work, it is known that voting method errors for all methods increase with small numbers of voters, and about 1,000 voters are required to achieve the lowest error rates of which voting methods are capable. Thus, all published data was obtained using 10,000 voters in each Election. It is also known that runs of 100,000 elections yield three-digit reproducibility in the statistics. All published data was obtained using runs of 100,000 elections.

As a general check that all possible scenarios were being simulated with equal frequency, the cumulative total of all opinions for each candidate and for all candidates was monitored. Although the opinions for any given election will be all over the full -100 to +100 range, the cumulative totals should all be very near zero for a run of 100,000 elections. That was always the case.

A brief description of each of the voting methods tested follows:

1. **Plurality** — Voters are allowed to specify only their first choice of the candidates. First choices are totaled for each candidate. The candidate having the largest total of first choices is the winner. Plurality is the simplest ordinal method and most widely used of all methods.

2. **Instant-Runoff Voting (IRV)** — Voters are allowed to specify the order in which they prefer up to three of the candidates. The first choices for each Candidate are totaled. If one candidate receives a majority of the first choices, it is the winner. If no candidate has a majority of first choices, the candidate having the smallest number of first choices is eliminated from all ballots. If a ballot from which a candidate is eliminated has a lower-ranked choice, it is promoted to fill the vacancy. The process of totaling first choices is repeated until some candidate has a majority of the remaining first choices or until only one candidate remains. IRV is a considerably more complex ordinal method that has been adopted in Maine, Alaska, and some municipalities. IRV is often incorrectly called ranked-choice voting (RCV). RCV is a synonym for ordinal, which is a category of many different voting methods; IRV is just one of them.

3. **Score, Then Automatic Runoff (STAR)** — Voters are asked to score each of the candidates on a six-value scale of 0 to 5. The scores are totaled for each candidate. A runoff is then conducted between the two candidates with the top two scores. The ballots are again examined to determine which of the two is preferred by more voters. The more preferred of the two is the winner. STAR is a hybrid cardinal-then-ordinal method.

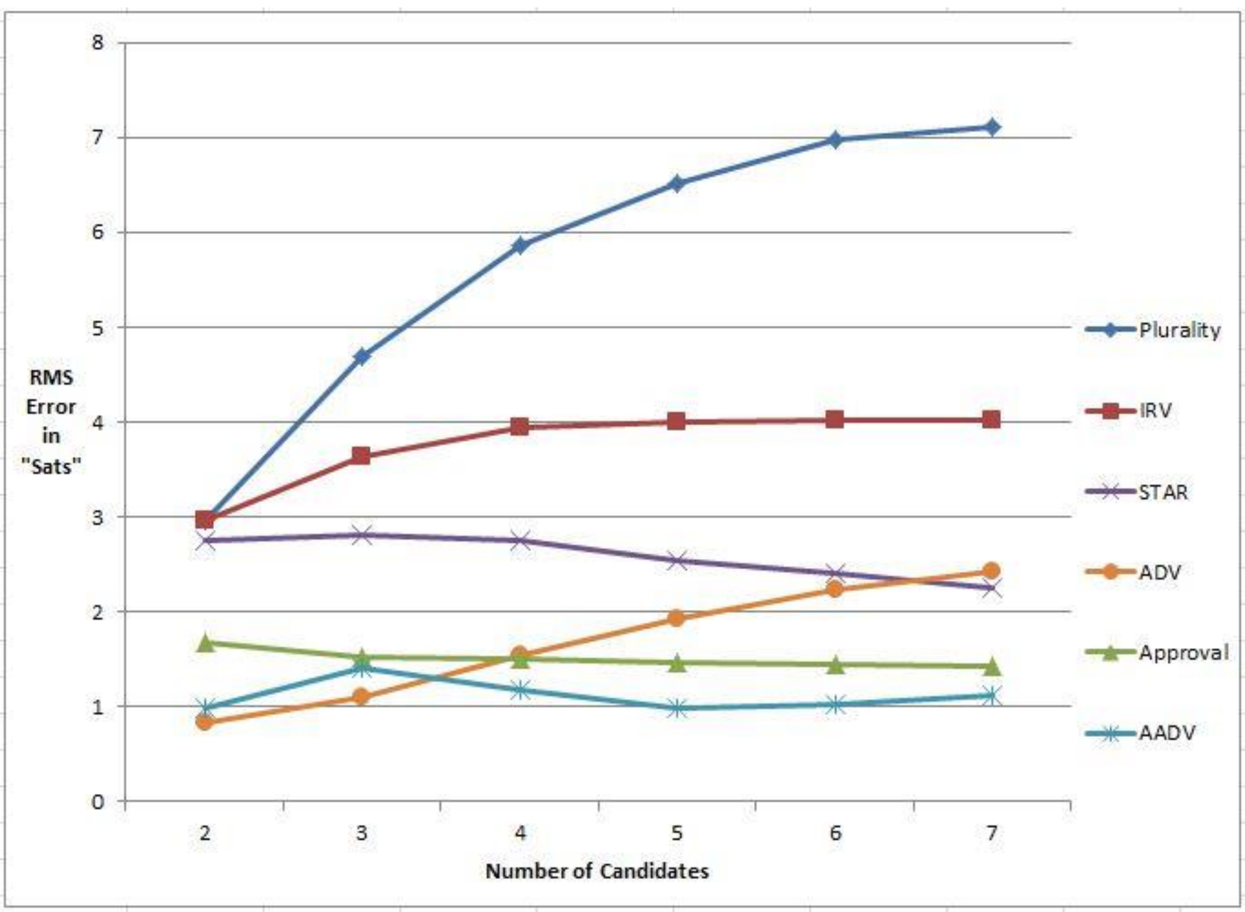
4. **Approval Voting (AV)** — Voters are asked to score each candidate on a two-value scale of 0 to 1 (1 is an approval and 0 is no approval). The scores are totaled for each candidate. The candidate having the largest score (most approvals) is the winner. AV is the simplest cardinal method.

5. **Approve/Approve/Disapprove Voting (AADV)** — Each voter may approve of either 0, 1 or 2 of the candidates, and may also disapprove of either 0 or 1 candidate. Approvals and disapprovals are separately totaled for each candidate. Each candidate's disapprovals are subtracted from its approvals to yield its net approvals. The candidate having the largest number of net approvals that is greater than zero is the winner. If no candidate achieves greater-than-zero net approvals, all candidates are disqualified and a new election must be held. AADV is a cardinal method that scores on a three-value scale of -1, 0, and 1.

6. **Approve/Disapprove Voting (ADV)** — ADV is identical to AADV except that each voter is limited to one approval instead of two.

Results

The first chart immediately below presents data that was generated during verification of prior results and backward compatibility. That is, the correct winner was deemed to be the "real" candidate that voters as a whole most favored (even when the most favored Candidate had a negative net satisfaction). It is presented for three reasons: first, the STAR voting method was not tested in prior work, but is now included; second, to contrast the change with the new data; and third, to show that choice for the best performing voting methods remains the same using either methodology.



All the data from this point on was obtained by including the fictitious candidate NOTA (None Of The Above). To reiterate, in cases where all "real" candidates had negative net voter satisfactions, NOTA was deemed the correct winner with a net score of zero.

The table below is a summary of 700,000 elections, 100,000 for each number of candidates from 1 through 7. These results are derived from a total of 28 billion voter opinions of candidates. These are just the statistics for the elections themselves and so far have nothing to do with the voting methods being tested.

Number of Elections	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Number of Voters	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Number of Candidates	1	2	3	4	5	6	7
Majority Winners	100,000	99,999	92,455	84,939	77,255	69,925	62,647
Incorrect Majority Winners	49,988	25,331	10,906	4,426	1,667	640	262
Additional Condorcet Winners	0	0	7,337	14,037	20,874	26,811	33,477
Incorrect Add'l Cond. Winrs	0	0	4,539	5,647	5,534	4,722	3,973
Negative "Winners"	49,962	24,923	12,556	6,224	3,086	1,528	764
Average Winning Sats	13	22	28	32	36	38	40
Zero Opinions (millions)	152	304	459	613	763	908	1,060
No Opinions (millions)	126	253	379	505	632	803	939
No Opinion % of All Opinions	12.60%	12.70%	12.60%	12.60%	12.60%	13.40%	13.41%
NOTA "Wins" (%)	49.96%	24.92%	12.56%	6.24%	3.09%	1.53%	0.76%
Candidate A Wins (%)	50.04%	39.19%	31.18%	26.06%	22.24%	19.17%	17.28%
Candidate B Wins (%)		35.89%	30.29%	25.26%	21.70%	19.12%	16.89%
Candidate C Wins (%)			25.97%	23.45%	20.41%	18.28%	16.13%
Candidate D Wins (%)				19.00%	18.60%	17.07%	15.73%
Candidate E Wins (%)					13.97%	14.85%	14.07%
Candidate F Wins (%)						9.98%	11.79%
Candidate G Wins (%)							7.34%

First, look at the row labeled "Majority Winners." When there is only one candidate, that candidate must always be a majority winner. In the two-candidate case, one of the candidates must be a majority winner except in the case of an exact tie (there was one tie in this particular run of 100,000 elections). As the number of candidates increases beyond two, the probability that there is a majority winner declines.

The next row, "Incorrect Majority Winners," is a tally of the number of majority winners that were not the correct winner. That is, the majority winner candidate was not the candidate that had the highest voter satisfaction net of voter dissatisfaction, which is the correct winner in accordance with the above definition. For one-candidate elections, half of the majority winners aren't the correct winner. As the number of Candidates increases, there are fewer majority winners, but they are increasingly likely to be the correct winner. With seven candidates, majority winners decline to 62,647, but only 262 of them were not the correct winner. Some may find the idea that majority winners aren't always the correct winner counter-intuitive or perhaps even sacrilegious; but it is nevertheless so. This footnoted book[3] presents detailed explanations with examples for this and other important characteristics of elections.

A majority winner is also a Condorcet winner by definition. The "Additional Condorcet Winners" row tallies Condorcet winners in elections which had no majority winner. Condorcet winners are held in extremely high regard by many students of voting methods. However, note in the next row, "Incorrect Additional Condorcet Winners," that well over half of the additional Condorcet winners in three-candidate elections were not the correct winner! Like majority winners, Condorcet winners are increasingly likely to be the correct winner as the number of Candidates increases.

The lower portion of the table summarizes the win percentages of the various candidates. NOTA heads the list followed by the seven "real" candidates, "A" through "G."

Look first at the column for one-candidate elections. Since all possible elections are simulated with equal frequency, one can expect that net voter satisfaction for "A" is going to be positive for half the elections and negative in the other half. Note that "A" and NOTA do split their 100,000 elections down the middle quite accurately.

In the two-candidate column, the same argument that applies to "A" also applies to "B." Just as with "A," "B" will enjoy positive net voter opinions randomly in half the elections and have negative nets in the other half. Thus, we can expect that voters will dislike both of them in 25% of elections. It is comforting that NOTA wins are indeed very close to 25%.

The same applies to each and every additional candidate. Thus, the probability that voters will dislike all of the candidates in the same election is reduced by half for each added candidate and NOTA "wins" are therefore halved with each additional candidate.

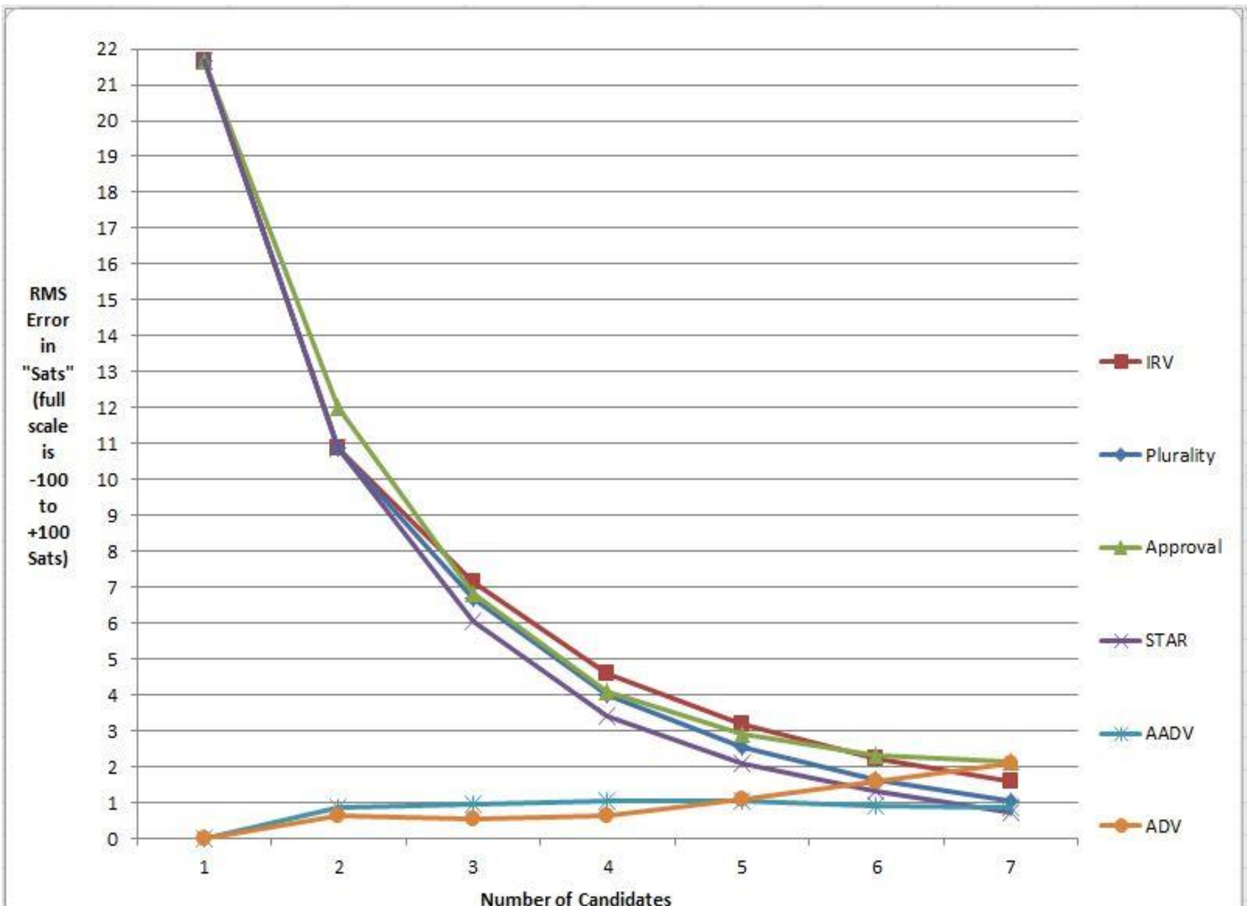
Finally, lower notoriety does reduce a candidate's win percentage as expected.

The Voters in the Elections summarized in the above table also voted six more times, once using each of the six voting methods being tested. The chart immediately below shows how each voting method performed in terms of its RMS (Root of the Mean Square) error. There are many ways to compare voting method performance and the RMS error probably is the best single measure. That is because the RMS error is much more sensitive to large errors than it is to small ones. Thus, voting methods are penalized more severely when they make big blunders than when they make small mistakes, just as they should be.

[3] *Elections Are Broken — How to Fix Them*, Roy A. Minet, ©2025, https://books2read.com/ElectionsAreBrokenByRoyMinet

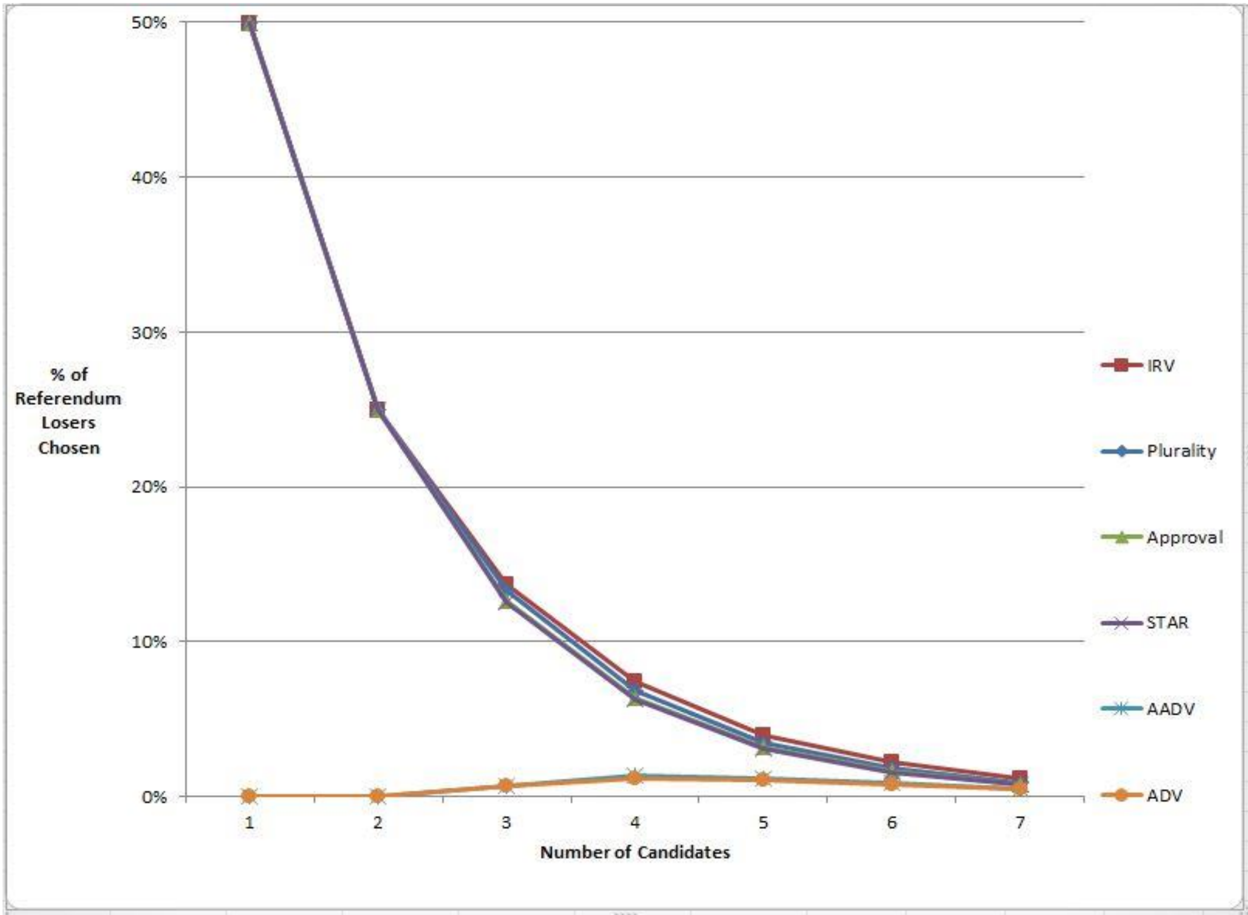
For a perfect voting method, which unfortunately is impossible, the RMS error would be zero for any number of candidates. The errors relate to the full scale of -100 sats to +100 sats. Thus, a one sat error is only 0.5% of full scale.

The voting methods clump rather dramatically into two groupings. The methods that empower voters to express dissatisfaction with candidates they do not like have much lower errors, while ones that restrict voters to only positive inputs have higher errors.



Note that Pairwise/IRV (Condorcet) is substantially identical to IRV.

Another measure (shown below) is the percentage of winners chosen by the voting method that would lose in a Yes/No referendum if held for just that one Candidate. This is interesting data to look at, but be aware that Candidates can occasionally have positive net satisfactions and still lose their referendum; also, the reverse is true. This occurs for the same reason that majority winners are not always the correct winner. Again, for a complete explanation of this and other counterintuitive phenomena, see the above-footnoted book.



Note that the voting method performance measured in this project is the best case. That is because all voters voted sincerely in the simulation. However, it is known from the Gibbard-Satterthwaite theorem that *all* voting methods are subject to degradation from strategic or insincere voting, some methods much more so than others. A voting method's accuracy will be reduced by whatever extent it is vulnerable to strategic attack.

Discussion

Some may wonder how important the NOTA thing is from a practical standpoint. That depends upon how much importance is placed upon avoiding the election of a candidates that the voters clearly do not like or want. Its criticality should be obvious for one-candidate elections.

Are candidates ever actually elected that voters dislike? They definitely are! Furthermore, this almost certainly occurs more often than we know. Because good data are seldom available for real-world elections, it's difficult to prove conclusively one way or the other. However, there are some high profile cases that can be cited for which adequate data happens to be available.

Immediately prior to the 2016 presidential election, polling by Pew Research indicated that only 32% of registered voters said they were either "very warm" or "somewhat warm" for candidate Donald Trump, while 55% indicated they were "very cold" or "somewhat cold" toward him. On the other hand, only 36% said they were either “very warm” or “somewhat warm” toward candidate Hillary Clinton, while 53% said they were “very cold” or “somewhat cold” toward her.

Another Pew poll revealed that only 33% of voters were happy with the choice of candidates, while a whopping 63% were not happy with any of their choices. Other polls (e.g., Gallup) confirmed this bleak scenario as well.

Suppose that a simple “Yes or No” referendum had been held on whether voters wanted Trump to be president. The data clearly indicate that he would have lost decisively. If a similar “vote Yes or No” referendum had been held for Clinton, it appears that she too would have lost nearly as decisively.

So, a solid majority of voters disliked Trump, and a solid majority also disliked Clinton, yet Trump was nevertheless elected. A very similar situation existed for the 2020 election. A solid majority of voters opposed Trump, and a solid majority also opposed Biden; nevertheless, Biden was elected.

Allowing voters to vote both for candidates they like and against candidates they do not like greatly improves the ability of a voting method to more accurately and consistently choose the correct winner; it also *qualitatively* improves elections. As long as there is no way to vote against them, highly polarizing candidates are a great way to win elections by increasing turnout of the base voters. However, that strategy backfires if voters are empowered to vote for and/or against candidates. Polarizing candidates will attract lots of negative votes and not fare well. It will then become necessary to nominate more unifying candidates with broad support and few negatives in order to win elections; much healthier.

Another important question to be asked is, “How well does the universe of all-possible-elections-with-equal-probability correspond to real-world elections?” Unfortunately, there is no way to answer that definitively. It is virtually impossible to gather accurate and complete data about a real-world election, not to mention data on all or even many of them. Also, if data about all real-world elections were somehow magically available and a certain type of election had never occurred, it very well might occur as the next election.

Of course, the beauty of simulating elections is that we do have every bit of data in fine detail and can investigate anything we like to any desired precision. Simulated elections are totally transparent. It is reasonable to assume that a voting method which accurately and consistently identifies the correct winner in all possible kinds of elections and does not make huge blunders very likely is a very good choice for real-world elections.

Conclusions

1. Plurality is a truly horrible, error prone voting method that is highly vulnerable to strategic voting (vote for the lesser evil). It is totally worthless for one-candidate elections. It elects

candidates that the majority of voters dislike. It is exacerbating polarization to truly dangerous intensities. It is urgent that plurality be replaced as soon as possible.

2. IRV is identical to plurality for one-candidate and two-candidate elections. Its performance remains quite close to plurality when there are three or more candidates. IRV's greatly increased complexity clearly violates the Jones rule. It is somewhat better than plurality for resistance to strategic voting. However, it is a big mistake and should be banished along with plurality.
3. STAR has measurably improved accuracy in identifying the correct winners and is the best of its peer group in that regard. However, the improvement is not large. Its six-value scoring scale will tend to function as a four-value scale as a result of strategic voting, but four values is plenty of resolution for large public elections. Though not quite as complex as IRV, STAR probably still violates the Jones rule.
4. Approval is simple and more resistant to strategic voting. AV may provide a small improvement in accuracy. However, it is worthless in one-candidate elections. It would be the third choice of the voting methods tested.
5. AADV is very much better at more consistently choosing the correct winner. It even works extremely well for one-candidate elections. It was engineered to minimize the motivation and the opportunities for strategic voting, although it certainly is not completely immune. AADV is still simple enough to satisfy the Jones rule. It would reduce, rather than exacerbate, polarization. Importantly, AADV empowers voters to reject *all* of the candidates whenever appropriate! Overall, AADV is believed to be the best voting method known and it is strongly recommended. AADV has a generalized form (GADV) that can be used for multi-winner contests. The complete description and rules for AADV and GADV can be found in an appendix to this paper.
6. ADV is a slightly simpler variant of AADV and shares many of its characteristics. It is excellent up to four candidates, but not quite as good as AADV at identifying the correct winner when there are more than five candidates. It is also somewhat more susceptible to strategic voting. ADV is the second choice of voting methods.

AADV Instructions for Voters and Election Officials

AADV (Approve/Approve/Disapprove Voting) is a simple, directly-scored voting method. It also has a generalized form which enables it to be used both for single-winner and multiple-winner contests.

AADV Ballot

	Approve	Disapprove
Candidate A	☐	☐
Candidate B	☐	☐
Candidate C	☐	☐
Candidate D	☐	☐

AADV Instructions for Voters: Mark an "**X**" in the "**Approved**" box for any one or two candidate(s) (if any) that you really like and believe would be the best one(s) to win this race. Mark an "**X**" in the "**Disapproved**" box for any one candidate (if any) that you strongly believe would be the worst choice and which you would not want to win this race. If you do not know enough about a candidate or do not have a strong opinion one way or the other, leave both boxes unmarked. Do not mark more than one box for any single candidate.

AADV Instructions for Election Officials: Disqualify any ballots which have more than two candidates marked "Approved." Disqualify any ballots which have more than one candidate marked "Disapproved." Total the "Approved" votes for each candidate; call this total "A." Total the "Disapproved" votes for each candidate; call this total "D." Add "A" and "D" for each candidate; call this sum "V." Eliminate any candidate whose "V" is less than one plus two percent of the largest "V" of any single candidate (rounded to the nearest number of voters). Subtract "D" from "A" for each remaining candidate; call this difference "N." Eliminate any candidate which has a zero or negative "N." The remaining candidate (if any) that has the largest positive "N" is the winner.

GADV (Generalized Approve/Disapprove Voting): Generalized Approve/Disapprove Voting provides for races which have any number of winners (e.g. electing multiple school board members from a pool of candidates). When electing n winners, voters may approve up to n + 1 candidates and disapprove of up to (n + 1)/2 candidates (use integer division or round down). The instructions to voters and for election officials are basically the same as for AADV above except for the number of candidates voters may approve and disapprove. The winners then are simply the candidates having the top n positive net approvals.

NOTES:

1. User-friendly electronic voting supervision can easily prevent spoiled ballots and therefore eliminate the need to check for and disqualify these during the tally process. Software (called Election Manager) is available which can completely automate and run elections (including touch screen voting) using either the AADV or Plurality voting methods. The tally process for AADV is completely automated.
2. It is possible, though unlikely, that there could be no winner; that is, no remaining candidate with a positive “N”. (Candidates with such “high negatives” would simply not be nominated, especially if AADV were used during the nominating process.) It would, of course, be easy to provide a rule to crown the “least awful” candidate the winner. But it does not seem wise to elect a candidate that more people dislike than like. Therefore, if there should be no winner, another election should be held. No candidate that received a zero or negative “N” should be allowed to run again. This is a refinement of the common practice of always having the option to vote for NOTA (None Of The Above). It is a defect of Plurality, IRV, Approval, STAR, Score and virtually all other voting methods that they are unable to sensibly handle this situation (they can easily force the election of a candidate disliked by a majority of voters).
3. Because it is at least a possibility that all candidates on the ballot could be pretty “lackluster,” the winning net vote total could be fairly low. Conceivably, a write-in (or other obscure) candidate could then achieve a winning score with a very few voters. That might very well be the best outcome, but many people would find it disquieting. To keep a virtually unknown candidate from winning with an extremely small number of votes, it is required that a candidate must have received at least a “reasonable” amount of voter interest in order to qualify. Therefore, the total number of voters weighing in on each candidate (either for or against) is totaled to obtain “V.” Any candidate is eliminated that has a “V” less than one voter plus two percent of the largest “V” of any single candidate (rounded to the nearest voter). (See the specific tally instructions for AADV for greater clarity.) Results should be displayed showing “A,” “D” and “N” with the candidates in order of descending “N,” followed last by any candidates disqualified for low voter interest in order of descending “V.”