Voting for Better Decisions

By Roy A. Minet

The Problem

The serious flaws of plurality voting have been known and studied for more than two centuries. Plurality is simply not capable of rendering an intelligent choice when there are more than two options and none receives a majority of the votes. In addition to this glaringly obvious problem, there are other more subtle, but equally pernicious aspects of plurality as well. For one example, when there are two candidates perceived to be strong (most likely to win) and a third weaker candidate, plurality engenders an almost irresistible pressure to "vote for the lesser-of-two-evils" between the two strong candidates, even though a voter may fervently prefer the weaker candidate. It can even be argued that there are *no* circumstances under which plurality can be counted upon to make the "best" choice.

Unfortunately, plurality's serious weaknesses do not appear to be widely recognized in the United States, in spite of the fact that two recent presidential elections have highlighted them.

The 2000 U.S. presidential election hinged upon Florida's electoral votes. But Bush and Gore were in a virtual dead heat and neither had a majority of Florida's popular vote. Plurality has no way to reallocate the votes that went to Nader (and other candidates with small percentages) if those candidates were to be eliminated, so the U.S. Supreme Court had to step in to ham-handedly resolve the situation.

In 2016, a solid majority of voters clearly did not like either Trump or Clinton. Polling data (Pew) revealed that Trump and Clinton had the support of only about 15% of voters each. Yet 46.3% of the popular vote actually went to Trump and 48.2% went to Clinton. The strong indication is that approximately 31% of voters voted for Trump, even though they disliked him, while 33% voted for Clinton, even though they disliked her. An incredible 64% of voters voted for a candidate they didn't like because they liked another candidate even less. That's more than double the number who voted for somebody they actually liked, which cannot be a healthy thing. This is the "vote-for-the-lesser-of-two-evils" phenomenon on steroids. It is engendered by plurality's serious limitations: voters may indicate only their first choice, which is insufficient information to enable voters to adequately express their desires.

Over the years, more than a hundred other voting systems with variants have been proposed and studied. Some would be worse than plurality while others would provide partial remedies. Some (e.g., Instant Runoff Voting, Approval Voting and Range Voting) have their advocacy groups. Where action has been taken (recently, in Maine), Instant Runoff Voting (IRV) seems to be the most "popular" or at least the best known alternative. IRV is just one of a number of methodologies which are members of a class called Ranked-choice Voting (RCV). All RCV methods allow voters to indicate their first, second (and possibly additional) choices. IRV does improve upon plurality some, but is far from the best of

the RCV methods.[1] There still are important common situations in which IRV can produce an obviously bad result.[2]

Purpose

An election is a process which gathers data from a set of voters that reflect their desires and processes that data to render a choice between or among two or more alternatives. It seems that this should be a reasonably simple thing, but a surprising amount of complexity and "trickiness" lurks beneath the surface. All voting methods involve tradeoffs. However, one would hope that we can comprehensively consider the problem and logically develop a much improved solution in the second decade of the 21st century.

Not Considered

We are interested only in non-trivial uses of voting where important decisions are made that can seriously affect the well-being of all those eligible to vote. Also note that three very key issues are not addressed:

- Ballot Access – Some requirements and procedures must determine what candidates' names are to appear on the ballot. It is legitimate to attempt to prevent large numbers of frivolous or "unserious" candidates from clogging the system. But who is to say which candidates are unserious? The normal solution is to require some minimal hurdle for a candidate to qualify. Typically, this is to demonstrate a "modicum" of public support by gathering approval signatures from some number of qualified electors. Unfortunately, career politicians of the two old parties have in many cases conspired to erect artificially high barriers so as to reduce their competition, which of course, also reduces voter choice. It is better to err on the side of too much choice rather than too little. There should be at least three or four choices in any race, even if a frivolous one occasionally slips through.
- Voter Registration and Screening – Voters normally must register to vote. They are then screened when entering the polling place. This process must be designed to insure that only voters authorized to vote at a particular polling place are admitted and that they do not vote more than once. Of course. Attempts to subvert the process are varied and manifold, including the classic example of dead people voting. A photo ID does not seem like an unreasonable requirement. It is ridiculous to cite the absence of voter fraud cases if there is no mechanism in place that could detect it.
- Gerrymandering – Drawing voting districts has become a modern art form. The "artists" are career politicians of the two old parties blatantly attempting to assure their reelection in perpetuity. Perhaps a requirement that the perimeter of a district may not exceed five times the square root of its area would help.

[1] See: "Voting Designed for Better Decisions", Roy A. Minet, 2007.
[2] See: "Plurality Needs To Be Replaced, But NOT With IRV" (Instant Runoff Voting), Roy A. Minet, 2012

Obviously, the above issues deserve careful and full attention. But for the present purpose, we will blithely assume they are properly handled and consider only how decisions are made through the voting process.

The Primary Objective of an Election

We use voting as the decision making mechanism when selecting political leaders in order to keep decision making power from falling under the control of a small group or an individual. Note that (contrary to popular hype) this does not mean that all qualified electors have to vote, or even a very high percentage of them. It does mean that substantially all qualified electors must have the opportunity to vote if they have the desire to vote and if they are willing to exert the effort required to register and get to their polling place on election day.

The primary objective is that **elections should make the "best" decisions for the overall well-being of all eligible electors**. The only useful way to define "best" is to assume that, collectively, those voting have some reasonable idea what the right decision is; therefore, **that choice is best which results in the highest total satisfaction or happiness with the decision among those who actually voted**.

There certainly are other important secondary requirements that any voting system should meet. These are listed and discussed in Appendix A. One of these, "Fairness," is the shiny object that has captured most attention over the past several decades. Unfortunately, little or no attention has been paid to the primary objective, engineering a system to facilitate making the best decisions.

The Simplest Case

A "Yes" or "No" referendum question is on the ballot. Suppose that 51% of voters vote "No" and 49% vote "Yes." By traditional "majority rule" the measure is defeated.

However, further suppose that the 51% who voted "No" don't really have a very strong opinion regarding this particular issue. On the other hand, the 49% who voted "Yes" believe it to be a super-good thing and favor it very strongly. In this case, the majority rule decision to defeat the referendum would not be the best choice by the previously stated definition which requires that the decision result in the highest total satisfaction or happiness with the decision among those who actually voted.

With 49% strongly in favor and 51% only weakly opposed, it would appear that the measure probably should pass instead of fail. But obviously, there is no way to detect or determine that when voters are allowed only a "Yes" or "No" input.

Information Please

It should be obvious that there is no way to make better decisions with voting unless we collect and intelligently process additional data from voters. Meaningless, unreliable or insincere data is of no value. Indeed, it is quite detrimental. Voters have to understand what they are to provide plus be able and willing to provide it – sincerely.

When hand-marked and hand-processed paper ballots were the best available voting technology, only a very small amount of additional data and processing would have been feasible. Today's equipment and technology effectively remove such limitations.

However, the use of machines also introduces new pitfalls which must be carefully taken into consideration. Complex and inscrutable machines can have undetected "bugs," which are unintentional mistakes that may generate incorrect results. Worse, someone intent upon affecting the results of an election might intentionally introduce subtle defects that could bias the results. Careful design and testing of machines and procedures can almost, but not completely eliminate the possibility of such problems. It turns out to be substantially impossible to be certain that a complicated machine is functioning properly all of the time; thousands scattered all over the countryside are an even greater challenge.

We need to have complete confidence in our voting systems, period. Fortunately, there is a straightforward, tried-and-true way to accomplish that, even when employing complex modern technology. There must be a hard-copy audit trail which can be used with a reasonable amount of human time and effort to validate the final results at each polling place. We can feel free to enjoy the advantages of modern technology if the machine prints a paper ballot for each voter that the voter verifies before depositing into a traditional ballot box. These ballots become the final authority as to voters' intents and can be used for an immediate audit or in any future recount. This guarantees that any machine errors, unintentional or intentional, can be detected and corrected.

It is disturbing to note that some types of electronic voting equipment actually in service today do not produce a durable audit trail. Use of such equipment should be discontinued.

Although there are no longer any practical limitations on the data we can collect or how we can manipulate it, both are still limited by (Douglas) Jones' Rule: The entire voting process must be understandable by a bright high school student. It is especially critical that polling place personnel have a thorough grasp of what they are supervising.

Vote Weighting

The most information-rich and therefore useful data to obtain would be to allow voters to indicate how strongly they favor (or oppose) something. Suppose voters were allowed to specify the strength of their opinions on a scale of 0 to 100, where 0 is a non-vote, 1 is an extremely weak opinion and 100 is the strongest possible opinion. In the above referendum example, we might have 51 people against it, averaging 20 on the scale for a total of 51 x 20 = 1,020, and 49 people in favor, averaging 80 on the scale for a total of 49 x 80 = 3,920; the measure would pass overwhelmingly.

Unfortunately, it's not that easy. Voters would very quickly realize that they are more likely to have their way if they vote insincerely and always indicate 100, no matter how strongly they feel. The information content of the data would collapse to what it would have been with just a simple "Yes" or "No" vote.

The only way to obtain sincere vote weightings from voters is to require that they give up something of value, which they will only do in proportion to the strength of their feelings. It has to cost them. (Appendix B works through the logic and examines several possibilities.)

The only valuable commodity that will work and be acceptable as "payment" because it puts all voters on the same basis, is to have the cost be seconds of each voter's time. A vote weighting of 1 takes only a second to register, but a weighting of 100 requires 100 seconds. How many seconds of your life is it worth to you to have this referendum pass? Or fail?

The scale can be determined experimentally and the maximum seconds allowed would be two to three times the median time voters are willing to wait. Additional voting stations will be needed to maintain voter throughput, but the cost seems entirely justifiable if decision quality can be improved.

Choosing From Several Options

Voters are allowed to weigh in on one or as many candidates as they think justify an investment of their time. In essence, there is a separate referendum on each candidate. Instead of being forced to vote for candidate B in order to indirectly register displeasure with candidate A, voters may vote directly against any candidate(s) they strongly dislike while also voting for any candidate(s) they favor. Results are reported for each candidate as "Voters For", "Seconds For", Voters Against", "Seconds Against" and "Net Seconds" ("Net Seconds" equals "Seconds For" minus "Seconds Against"). The candidate having the highest (most positive) Net Seconds is the winner. When electing "n" candidates, the top n candidates win.

Minimum Voters Required

When voters may vote either for or against candidates, it is entirely possible that one or more strongly polarizing candidates could have net seconds which are near zero or even negative. This is true regardless of how many voters may have weighed in on a candidate. So, in extreme cases, it would be possible for a candidate to win with only a very few voters having weighed in (theoretically, even zero). Therefore, it should be required that some minimum qualifying number of voters have voted for a candidate (either for or against). So, in order to be qualified to win, a candidate must have received at least 2 + n / 100 rounded to the nearest integer voters (voters for plus voters against), where n is the largest number of voters (voters for plus voters against) who weighed in on any single candidate.

Who Should Vote

All eligible electors certainly do not have the same ability to choose the best option. Just some of the factors which result in widely differing abilities are:

- Motivation (the amount of time and effort put into studying the options and the surrounding circumstances)
- Age and life experience
- Intelligence
- The basic principles the elector holds

It follows that the quality of decisions made should be higher if those with the best decision making abilities are the ones voting. In the interest of some of the requirements discussed in Appendix A, this should not be too small a group. Perhaps the most competent third of all eligible electors would be about optimum.

Selecting the most qualified voters definitely is not a new idea. For most of our country's history, voter qualification tests were used, ostensibly in an attempt to accomplish exactly that objective. Unfortunately, these tests were subverted by some to accomplish other purposes, such as suppression of voting by minorities. Because of persistent abuses, voter qualification tests were essentially prohibited by the Voting Rights Act of 1965. However, the fact that abuses occurred does not mean that there is anything wrong with the basic concept of selecting the most qualified voters. What is needed is an unassailably fair way to accomplish this that cannot be corrupted. Obviously, these two requirements will have to take precedence, even if the efficacy of possible selection mechanisms is limited by them.

Just such a test has been proposed by the author[3]. It asks one simple question, "For whom do you wish to vote?" The question is asked implicitly on the ballot by not showing the candidates' names for each race. Instead, the voter may either write in a name or select a name from an alphabetized list of all candidates for all races unadorned with titles or affiliations. Anyone standing in a voting booth unable or unprepared to choose the name of the candidate for whom they wish to vote from a list cannot possibly contribute anything of value to the selection process. No separate test is required and the question even acts specifically to each race (i.e., the voter may know the answer for some races, but not others). Although doubtless that someone will try, there is no valid way to argue that this simple question is "unfair" or biased in any way, except against those who clearly should not vote.

Conclusion

The proposed True Weight Voting (TWV) system unshackles voters and enables them to provide more complete, more sincere and much richer information about one or as many candidates as they have sufficiently strong opinions. It completely eliminates the vote-for-the-lesser-of-two-evils pressure that so frequently distorts plurality results. If polarizing candidates with "high negatives" are nominated, it will make it easier for other or new options to win since negative votes subtract from positive ones. Incorporation of a simple, unbiased and un-corruptible "voter qualification test" helps to screen out some of those who definitely should not be voting. Yet, just totaling up the weighted votes for each candidate is still simple enough to satisfy the Jones Rule. Much higher quality decisions should be facilitated. Furthermore, the effects should blow back to the candidate selection process and result in higher quality candidates being nominated.

It is interesting to speculate that, in the 2016 election, Trump and/or Clinton might have ended up with negative net-seconds!

Those irrevocably wedded to simple "majority rule" or who think True Weight Voting is "way far out" should then fall back to supporting the MRCV (Minet Ranked-choice Voting) method summarized in

[3] Voting Designed for Better Decisions, Roy A. Minet, 2007.

Appendix C. Although not as beneficial as weighted voting with cardinal data, it is the best possible voting method when restricted to ordinal data and is far superior to Plurality or any other RCV method.

Appendix A

Other Important Voting System Criteria

Although the primary design objective for a voting system must be to facilitate making the best decisions, there are several important additional criteria that voting systems should satisfy.

- Auditability – It must be possible to verify counts and results so that confidence is high that each input is being properly taken into account and that any fraud will be detected.
- Secret Ballot – Voters should have the right to freely cast their ballots privately and be free from force or coercion to vote any particular way.
- Transparency – Electors should be able to understand the voting methodology and how the whole process works. (This is doubly important for election officials, judges of elections and poll observers.) Everything should be as "observable" as possible, so that confidence can be high that voting, counting and auditing are being carried out in accordance with the prescribed rules and procedures.
- Fairness – A large majority of electors should feel that the process is "fair" (by whatever standards they may hold to be critical).
- Openness/participation – The process is open to any qualified voter *who has the interest and motivation to participate,* and a reasonable percentage (say, at least 25%) of electors actually do participate so that decision making power cannot fall into the hands of a small group or an individual.

A voting system lacking these characteristics is not likely to be widely accepted and supported, making its long-term viability questionable. Obviously, decisions are not likely to be in the best interest of eligible voters if the system can be manipulated, so insuring the system's integrity must be a critical consideration.

It might also be apparent that there are certain inherent conflicts that arise between and among the desirable characteristics. Auditability and transparency tend to work in opposition to maintaining the secrecy of the ballot. Designing to facilitate making the best decisions could conflict with fairness and openness/participation. So far, it appears that any voting system will involve tradeoffs and it is important to make thoughtful choices in this regard.

Appendix B

Obtaining More Meaningful Information from Voters

The Basics

Plurality voting only allows voters to indicate which one of the available options is his or her first choice. The option receiving the largest number of first choice votes is the winner, period. Plurality is only able to render an arguably reasonable result if the number of options is limited to just two. In all other cases, and there are lots of important ones, plurality is utterly incapable of making a reliably reasonable decision. Why brain-dead plurality continues to be used to make important decisions is mystifying.

In order to enable making more intelligent choices, it is absolutely necessary to obtain more meaningful information from voters. We must take care that the information gathered can be used to facilitate better decisions (supports processing that can produce better decisions), is meaningful (not just noise) and is correct (accurately reflects voters' opinions/desires):

- Voters must clearly understand what information they are to provide
- Voters must be able to provide valid information
- Voters must be willing to provide the information
- Voters must be motivated to provide true and correct information to the best of their ability (that is, they must not be motivated to vote insincerely or strategically)

Ranking the Options

The easiest additional data to collect would be to allow voters to supply one or more choices which rank after their first choice (1st choice, 2nd choice, 3rd choice, etc.). Methods which request and process multiple choices from voters are called Ranked-choice Voting (RCV) and there are quite a few such variants.

Some RCV methods (e.g., Condorcet, Borda) apply an algorithm to the ordinal data which directly identifies the winner. Many of these ask voters to rank all the options. Any method that requires a complete data set (ALL voters must rank ALL options) is interesting from an academic standpoint only. In the real world, there is absolutely no hope that all voters will comply with that request. Furthermore, even if they were forced to provide it, the data would be fairly worthless noise. Very few voters will know enough about all the candidates to even form an opinion on their ranking, not to mention a meaningful opinion. Also, there is the problem of ranking write-ins. The only two approaches are to not allow write-ins (generally unacceptable) or to rank all write-ins last for voters who do not vote for a write-in; there is no justification for that and there would likely then be multiple "last" choices (logically contradictory). As we will see later, choices after the first two or three cannot have much relevance to or impact on choosing the winner.

Another group of RCV methods (e.g., Minet, IRV, Baldwin) apply an algorithm to the ordinal data which iteratively eliminates the weakest option. If a voter's first (or second) choice is eliminated, the

next lower choice is promoted and thereafter counts exactly as if it had originally been that higher choice. An option becomes the winner as soon as it has a majority of the first choices or is the only option remaining. The iterative RCV methods are inherently more "powerful" and superior for several reasons. There still is insufficient information to do a perfect job, even in theory, so the algorithms can make mistakes under some circumstances. However, the algorithm now does not have to be perfect (as it does when picking the winner directly); it only needs to be good enough to avoid eliminating the option that should be the winner. If the algorithm occasionally eliminates the second weakest option instead of the weakest, in most cases the method still can still go on to pick the correct winner; eliminating the option that should be the winner becomes exceedingly rare. Also very important, this type of RCV method completely eliminates "vote-for-the-lesser-of-two-evils" distortions. Voters can feel free to vote sincerely and choose a candidate they perceive as less likely to win as their first choice; they know that if their first choice is eliminated, their second choice becomes their first choice and they are still able to have a full voice in selecting the lesser of the two evils.

Consider now the algorithms that could be used to eliminate the weakest option. There are as many possibilities as someone might wish to dream up. However, there is one fundamental decision that has to be made for any and every such algorithm. That is, what importance is to be given the additional data we have obtained from the voters? What weight does the algorithm ascribe to the choice(s) after the first?

Think about an election in which there are three (or more) options. A voter has told us option A is the first choice, followed by B as the second choice. Let's say that our algorithm will consider the importance or weight of all voters' first choices to be 1.00 (to treat all voters equally). We know that the weight of B for this particular voter cannot be greater than 1.00 since it is the second choice. Option B would not have appeared in the ranking if the voter disliked B, so we know that the weight of B has to be greater than zero. We would like to know exactly how the voter actually feels about it, but the best information we have is that the weight of B falls somewhere in the range, $0.00 < B <= 1.00$. In fact, that is exactly all we know about the second choices of all voters. Some voters may consider their second choice almost as good as their first choice (high weighting up near 1.00) while others may not really like their second choice much at all (low weighting down near 0.00). The most reasonable assumption we can make is that the average weighting of all second choices is 0.50 (the middle of the possible range of weightings).

If we have a third choice, we can go through the same logic and conclude that the best assumption we can make is that, on average, third choices have half the weight of second choices. So our algorithm should consider second choices to have half the weight of first choices and third choices to have half the weight of second choices (or one quarter of the weight of first choices). This is exactly the basis for the Minet RCV method (see Appendix C). It encourages voters to rank up to a maximum of three options and does not make obviously awful decisions under any circumstances. The algorithm is good enough to directly pick the correct winner under most circumstances, so the probability that it would eliminate the would-be winner on any iteration is extremely small.

On the other hand, the Instant Runoff Voting (IRV) RCV method assigns weightings of zero to both the second and the third choices. Yep, after gathering this valuable additional data from voters, IRV

completely ignores it when making the all-important decision as to which option should be eliminated. It looks only at the first choices, just like plurality. When three (or more) candidates split the first choices somewhat evenly, IRV can easily eliminate the candidate who should be the winner. More specifically, the approximate conditions which cause IRV to fail are when the candidate which receives the third largest number of first choices gets more than 14% of them OR more than about 40% of the number of first choices of the candidate who received the second largest number of first choices. A good voting system should not render obviously bad decisions under any circumstances.

Obtaining Vote Weightings Directly from Voters

Plurality is doomed because it works with extremely meager data. We have seen how decision making can be significantly improved by having voters also provide their second and third choices and intelligently using this additional data. However, we have also seen that we would very much like to know how voters weight their choices relative to each other and, lacking that data, we have had to make reasonable assumptions about the average weightings in order to design an RCV method that works acceptably well. If we could get each voter to honestly and meaningfully convey the strength of their opinions on each option, we would have a very rich and complete data set that should enable significantly better (approaching the best possible) decisions.

There have been a number of proposals which would allow voters to weight their votes in proportion to the strengths of their convictions, say on a scale of 1 to 100. Such proposals have zero practical value since substantially all voters will vote insincerely, realizing that a weight of 100 (or whatever the maximum weighting may be) gives them the most influence over the outcome without any penalty to themselves.

The only way to ensure sincerity is to require that voters actually give up something of value, which they will only do in proportion to the strength of their convictions. The most common standard of value is money, so requiring payment for each vote should work. Many would protest that wealthy people would be able to control every election. OK, put a limit of say $20 on what can be spent on a single issue or race. If the limit is high enough, the control of the wealthy is not sufficiently curtailed. If the limit is low enough to solve the rich-guy-control problem, we are mostly back to the original situation where a large fraction of voters will vote the maximum amount all or most of the time.

Another possibility would be to award each voter an equal allocation of voting points, say 20 per issue or office to be voted upon. Up to a limit of 100 points may be applied to any given issue or race. The points take on a certain value as a limited (scarce) resource and allow voters to “spend” more points on the races they consider most important at the expense of having fewer points to apply to decisions they think are less critical. Additionally, points might be given a value by allowing unused points to be turned in for money, say $1 per point. This could provide a “social safety net” where those taking the money automatically forfeit their vote – a very important thing to preserving long-term stability.

Perhaps some sort of point system merits further thought, but administrative complexity would be high as would resistance to such a change. All of the forgoing serves to amply illustrate the intractability of engineering a way for voters to meaningfully weight their votes.

However, there may yet be a workable way. Suppose voters are required to pay with their time as the measure of their motivation. A minimal vote weighting of 1 takes only a second to register, but a heavy weighting of 100 requires 100 seconds of the voter's life. The median time voters are actually willing to wait to cast their vote can be experimentally determined and the limit set to two or three times the median. Although this approach may "take some getting used to," it actually is straightforward and workable. It is especially attractive in that it's hard to think of a better way to put all voters on a fair and equal footing. Obviously, voting times per voter will increase some, requiring additional stations to maintain throughput, but this is justified by better decisions.

Voters should be allowed full flexibility to convey their desires. A zero vote for an option is a "Don't Care" (at least not enough to spend any of my time on it). Alternatively, they may vote either some number of seconds "For" the option or some number of seconds "Against" it. The "For" seconds and "Against" seconds are separately totaled for all options, then the "Total Against" seconds are subtracted from the "Total For" seconds to give "Net Seconds" for each option. Voters may vote for or against one, several or all options as they may be sufficiently motivated to spend their time. The option having the highest "Net Seconds" is the winner that results in the highest overall satisfaction among those who voted. As additional information, the number of "Voters For" and "Voters Against" should also be shown for each option.

Note that it certainly is possible for an option to end up with negative "Net Seconds." (It would seem unlikely for this to happen more than once or twice as extreme care would be taken in the future to avoid nominating candidates with such "high negatives.") If nearly all candidates ended up very near zero or negative, it is theoretically possible that an option which received only a small number of votes could win. And under such incredibly sad circumstances, this would indeed seem to be the best outcome! It should be emphasized that all voters have the opportunity to vote for all candidates. Deciding not to vote for a candidate is a valid voter input indicating that the voter doesn't care (even one second) one way or the other about that particular candidate.

The theoretical possibility that an unknown write-in with just a very few votes could win needs to be eliminated. In any election, to be considered a viable candidate, a minimum number of voters must have weighed in on that candidate. It should be required that the number of voters ("Voters For" plus "Voters Against") who weighed in be at least 2 plus 1% of the largest number of voters who weighed in for any single candidate in a given race, rounded to the nearest integer.

Although weighted voting should make it easier for new options to gain traction, this was in no way a design goal. The sole objective was to devise a system which enables voters to fully and honestly input their desires (as well as the strengths of those desires), and which then utilizes that information to render the decision that results in the greatest overall satisfaction of those who voted.

Appendix C

The Minet Ranked-choice Voting Method (MRCV)

Each elector may rank his or her first, second and third choices. Any choice may be a write-in. A choice may not be repeated. Electors are not forced to rank three choices, but are limited to a maximum of three. The outcome will be determined by the following (sometimes) iterative procedure:

1. **Determine Winner** – Total the first choices. If any option has a majority of the first choices, it is the winner. If only one option remains, it is the winner. If there is no winner, proceed to step 2.
2. **Eliminate Weakest Option** – Assign weighting points to the choices on each ballot. A first choice receives 4 points, a second choice receives 2 points and a third choice receives 1 point. Total the points for each option across all ballots. Eliminate the option having the lowest point total. If there is a tie, eliminate the tied option having the smallest total of first choice votes. If still a tie, eliminate the tied option that has the smallest total of second choice votes. If a tie persists, eliminate one of the tied options at random.
3. **Promote Choices** – If a ballot's first choice has been eliminated, promote the second choice (if any) to first. For any ballot where the second choice has been promoted or eliminated, promote the third choice (if any) to second. Any eliminated or promoted choice that has no lower choices will cease to exist. Go back to step 1.

It is argued elsewhere that MRCV is the best possible ordinal or ranked-choice voting method.

A comprehensive software implementation is available. "Election Manager" handles everything from setting up jurisdictions, elections, candidates and races to managing the voting in each precinct and totaling the results. Use of Election Manager is royalty free for non-commercial uses.

Appendix D – How To Run An Election

What's Wrong with Old-fashioned Paper Ballots?

Not much. Procedures have been fine-tuned over the years and paper ballots marked and counted by humans have served their purpose fairly well. In fact, careless attempts to introduce new technology have often been steps backwards and substantially none has actually been an overall improvement over paper ballots. Transparency and Auditability have frequently taken major hits. So, many regard paper ballots as still the "gold standard," offering stability and a good balance of the many tradeoffs.

How Technology Might Improve Upon Paper Ballots

An obvious approach is to start with paper ballots as the standard and look for ways that technology can be utilized to improve weaknesses without significantly sacrificing strengths. Here is a menu of some opportunities (6 and 7 below were developed in greater depth by the author in a 2007 paper titled *Voting Designed for Better Decisions*):

1. Speed and Efficiency – This is the most often cited benefit of new technology. Clearly, if voters' intents can be accurately captured electronically, they can be quickly summarized, formatted to be both human and machine readable, published and forwarded to a central tally location as soon as the polls close. (Needless to say, this will be an improvement only if it does not significantly sacrifice any important characteristics.)
2. Improve the Paper Ballot – If voters' intents have been electronically captured, they can be printed on paper in a standard form that is clear, unambiguous and human-readable. Arguments over the style of marking boxes or interpretation of handwriting (resulting in disputed ballots) can be substantially eliminated. Voters verify their printed ballots before depositing them into a traditional ballot box. The ballots become the ultimate authority on voters' intents. The ballots are used to verify and validate the published results of each polling place and if a recount becomes necessary. Initial results can be considered tentative until audits are completed.
3. Virtually Eliminate Spoiled Ballots – Voters are able to easily make, review, modify, re-review and re-modify all selections until they are completely satisfied with all choices. Over-votes and duplicated choices are not allowed. Voters must double-confirm their selections, but once the ballot prints and is verified, no further changes are allowed. A very clear and unambiguous ballot can be printed. If the ballot fails to clearly print or does not match the selections that were made, that would, of course, be an alarm condition requiring the immediate attention of the judge of elections.
4. Eliminate Ballot Position Bias – A randomly selected half of voters can see their candidates listed in alphabetical order. The other half always sees candidates in reverse alphabetic order. Substantially eliminating the known statistical bias associated with ballot position may tend to improve the quality of the decisions made.
5. Facilitate Faster Audits – With voter-verified paper ballots and good auditing, there can be high confidence that any "computer mistakes" (unintentional or deliberate) will be detected and corrected in the published results. Although all software and hardware should ideally be open to public examination, solid auditing renders this far less important and, indeed, strongly discourages any attempt to influence results by jimmying the system. It is possible to provide auditors with aids (more detail later) that will usually allow completion of a thorough audit within a few hours of the polls' closing.
6. Implement a Better Voting Methodology – It has been known for hundreds of years that the plurality voting method is seriously flawed in the case where no candidate receives a majority of the

votes (e.g., the 2000 U.S. presidential election). TWV (True Weight Voting) or a good ranked choice voting method (MRCV) can remedy the problem, but necessarily adds some complexity. Although it could conceivably be done manually, the extra work would be child's play for a computer. This is important as it could be expected to improve the quality of the decision making. Plurality engenders insincere voting in many contests, especially when some voters fear "wasting" their votes on their preferred candidate who is perceived to be weaker; they instead choose the "lesser of two evils" between two candidates they believe to be stronger. Note that Instant Runoff Voting (IRV) seems to be the best known of the ranked choice voting methods, but it definitely is NOT the best.

7. Reduce Impact of Uninformed Voters – It is reasonable to think that decision making quality would be improved if voters not informed or caring little about a given race refrain from casting any vote in that race. This already happens to some extent now (undervotes). Certainly eliminate any device (such as "straight ticket" voting) which facilitates thoughtless votes. A consolidated, unadorned, alphabetized candidate selection list could be built containing all candidates from all contests. Voters would select from this same list for all races (or write in a name). A voter unable to select the candidate that s/he wishes to vote for from such a list could at best only contribute noise to the selection process.

Things To Do and NOT Do

Processes or operations for which it is important to guarantee that correct procedure has been followed should be confined to the polling places during the hours immediately preceding, during and following an election (or to similar controlled settings where a recount has been scheduled). All eyes are on the polling places on election day. Arrangements have been made to have qualified poll workers in appropriate numbers in place (election judge(s), observers from opposing factions, constables and possibly media representatives).

Polling places are decentralized and locally controlled; this is good as anyone intent upon influencing an election will have much more difficulty doing it at many places simultaneously. Avoid having any critical operation performed at a centralized location or at a time other than on election day. Minimize the use of absentee ballots to those cases where they are absolutely needed for bona fide reasons.

The entire election process should be understandable to a bright high school student. This has been called (Douglas) Jones' Rule and it is a good one. Certainly, all election judges, poll observers and election officials must have a clear and deep understanding of all critical operations, processes and procedures. At least for the foreseeable future, these considerations would appear to rule out cryptography-based end-to-end approaches. A famous science fiction author once pointed out that sufficiently advanced technology is indistinguishable from magic. Any form of modern cryptography would be the same as magic to most people. They may fear, with some justification, that some "magician" behind a curtain could control elections.

Don't print anything on a ballot intended to be verified by the voter that is not human readable. A voter cannot verify anything s/he can't read and understand. If the ballot is to be made machine readable, use an OCR font. However, introducing additional machines into the process is likely to create more problems than are solved. Voter-verifiable ballots do not enable auditing of such additional machines, so can they be trusted? It is probably wiser to adhere to the old KISS approach (Keep It Simple, Stupid).