

How ranked-choice voting strengthens election integrity

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Executive summary

Ranked-voting, including instant runoff voting and choice voting, using optical scan paper ballots, can greatly strengthen election integrity compared to current voting methods. The key is the use of redundant electronic and paper records of every vote that can be compared through manual audit procedures, providing the ability to perform audits all the way down to the ballot-level, rather than mere precinct-level audits. There are a handful of election integrity activists who have been repeating misinformation over the Internet, suggesting that ranked-choice voting will weaken voting integrity. These claims are incorrect and are refuted in this paper.

About the author

Caleb Kleppner co-wrote the instant runoff voting charter amendment adopted by the voters of San Francisco in March 2002 and worked for several years with all interested parties to ensure that the charter amendment was implemented correctly, accurately and transparently. He developed most of the testing protocols for the combined federal and state testing that occurred in February 2004, which he observed at the request of the California Secretary of State. He also drafted procedures for logic and accuracy tests for RCV systems, 1% manual tallies, and election reporting.

In 2005, the city of Burlington, Vermont hired Kleppner and a colleague to design the voter education campaign for the March 2006 ranked-choice voting election for mayor, to develop an RCV training module for election workers, to oversee the testing of voting equipment, and to conduct technical training for city staff on the RCV system.

He currently conducts chiefly private but also some public elections for TrueBallot, Inc.

1. Introduction

Ranked-choice voting (RCV) methods, also called instant runoff voting (IRV) or Choice voting can dramatically improve election integrity by allowing ballot-level audits, rather than mere precinct level sum audits. Unfortunately some emails and “reports” distributed on the Internet make numerous false or misleading claims about election integrity, turning this reality on its head. This paper analyzes seven of these erroneous claims. I first present the seven claims with very brief explanations of their flaws. Following that is a more detailed recounting of these claims, along with longer explanations of the false or misleading nature of those claims, including sources and concrete examples of how to manually audit RCV elections.

2. Summary of erroneous claims

1. Manual audits of RCV elections aren't possible because of the large number of possible ranking combinations.

Truth: San Francisco has demonstrated how to do this in 2004, 2005 and 2006, and the number of possible combinations is irrelevant.

2. San Francisco did not release the election data required to manually audit the election.

Truth: San Francisco releases in a timely manner all of the data needed to manually audit the election.

3. Manual counts of RCV elections with more than four candidates are “incredibly complex.”

Truth: In places like Australia where all elections used RCV, people don't think the counting process is “incredibly complex”; they think it's the only way to count ballots. In fact, they can't imagine not counting second choices when there is no majority winner.

4. Average members of the public aren't capable of verifying an RCV election by comparing electronic records of rankings with the original paper ballots.

Truth: It can be done with pencil and paper – nothing harder than making check marks on a list of rankings. I include a detailed example below.

5. San Francisco does not have public oversight of post-election manual audits, the reconciliation of printed, voted, spoiled and unused ballots, and ballot security.

Truth: All aspects of San Francisco's election are publicly observable, all the data is public, and the publicly observable official canvas reconciles all voted, unused and spoiled ballots.

6. “IRV is very destructive to the integrity of US elections.”

Truth: When implemented the way it has been done in San Francisco, Burlington or Pierce County, RCV dramatically boosts the integrity of US elections. If we applied the same provisions to non-RCV elections, we'd have much more secure elections.

7. “Prior to solving the spoiler and two-party domination problems, our first priority should be to ensure the fundamental integrity of election results, regardless of which voting method is used.”

Truth: When properly implemented, RCV dramatically boosts election integrity and verifiability.

3. Detailed analysis of these erroneous statements

1a. An activist in the election integrity area with a math background has mistakenly suggested that there is no procedure that is a valid check on the accuracy of any IRV election because IRV elections are not precinct summable unless all of the sum from $i = 0$ to $N-1$ of the $N!/i!$ vote counts in EACH precinct that are possible for EACH election contest (and that is a huge number as the number of candidates increases, are all publicly reported PRIOR to beginning the random selection of the precincts.”

The truth: Because RCV elections on optical scan equipment involve two independent steps – capturing rankings and performing the RCV tally – it is possible, and in fact preferable, to manually audit the election using the stored rankings rather than precinct-summable vote totals. I will give a brief explanation of how this can be done, and I’ll provide a more detailed example later in this paper.

Let’s suppose you’re trying to manually audit the RCV results from a precinct with 100 votes cast, and you’ve got a printout of the 100 electronic records of the rankings from that precinct. You simply pick up the first ballot in your stack, find an electronic record that corresponds to that ballot, and put a check mark next to the ranking. Go through all your ballots, and if you’ve got one check mark next to every ranking and you don’t have any extra ballots, you’ve verified the storage of the rankings. If there is a discrepancy and you didn’t make an error during the audit, the voting equipment failed to store the rankings correctly. [I’ll give more details below, along with an explanation of how to audit the application of the RCV tallying method to those records.]

Note that this method only requires the storage of 100 records for this precinct, regardless of the number of candidates, rather than the sum of $i=0$ to $N-1$ of $N!/i!$. Also note that this method involves verifying the storage of the rankings from each individual ballot rather than the double-checking of vote sub-totals from groups of ballots. ***In other words, it’s a more powerful audit.***

Furthermore, there are two other major problems with the formula. First, it vastly overstates the number of voting combinations possible in San Francisco or Pierce County. That’s because these jurisdictions only allow three rankings. Since they store codes for undervotes and overvotes, the number of possible combinations is approximately $(N+2)^3$. For 10 candidates, the formula gives nearly 10 million when the actual number is closer to 1,700. For 18 candidates

(the number of candidates in the 2007 San Francisco mayoral election), the formula's number is 17×10^{15} when the true number is around 8×10^3 , a factor of 12 orders of magnitude.

Second, even if you wanted to store precinct-summable vote totals, the number of possible combinations is irrelevant; what matters is the number of combinations actually used. The number of ranking combinations used is obviously never bigger than the number of votes cast in a precinct. In San Francisco in 2007, with 18 candidates, the greatest number of votes cast in a precinct was 461. That's your worst case scenario, but the greatest number of ranking combinations actually used in a precinct was only 131. The total number of rankings used citywide, in over 500 precincts with 150,000 ballots cast, was 1,684, which is a great deal smaller than the 8,000 possible combinations. It is certainly possible to manually audit 131 precinct-summable vote totals in a precinct or 1,684 citywide, although it's easier to use the method I described above.

[Source: Official SF Department of Elections ballot image data, analyzed by author, data available on request.]

1b. One activist has suggested it would be extremely difficult or impossible to manually audit an IRV election when there are for each precinct or voting machine a huge number of possible ranking combinations (that same formula of the sum from $i = 0$ to $N-1$ of $N!/i!$ where N is the number of candidates). This statement implies that manually auditing an RCV election is either not possible or so burdensome that it takes 30 days or longer (several opponents of RCV have referenced the month it took for final results in San Francisco in 2007) because the number of possible voting combinations for each precinct or machine is equal to the sum from $i = 0$ to $N-1$ of $N!/i!$ where N is the number of candidates.

The truth: The number of voting combinations is irrelevant to the manual auditing of an RCV election, as demonstrated above, and the assertion that the large number of combinations makes a manual audit burdensome is false, as I will show here and below. San Francisco manually audited its RCV elections in 2004, 2005 and 2006 in the same amount of time as non-RCV tallies. There was no RCV tally in 2007 because all affected races were settled by absolute majorities in the first round; delays in producing final results in 2007 were due to a 100% manual tally of 4 ballot measures races and had nothing to do with RCV. Later in this paper I'll describe in detail how one can manually audit an RCV election and why manual audits of RCV elections that also have electronic records of all rankings are in fact much more thorough than manual audits of non-RCV elections.

San Francisco's post-election audit of RCV elections included two parts. First, the city manually tallies raw first, second and third totals as though these were three separate races. Then, the city performs a true manual RCV tally of the ballots from the randomly-selected precincts.

[Source: http://www.sfgov.org/site/elections_index.asp and *Ranked Choice Voting (RCV) Procedures for the ES&S Optech Eagle equipment*, first released June 2002, section 4.5: 1% Manual Recount.]

2. It has been claimed on the Internet that San Francisco never publicly reported ranking numbers, and has thus failed to take the first fundamental step required for all auditing in any field, which is to “commit the data” prior to beginning the audit.

The truth: Repeating this claim does not make it true. San Francisco in fact reports all the key data that allows independent verification of the official counts as well as post-election audits. This data includes:

1. Raw first choice totals reported in all the election reports (http://www.sfgov.org/site/elections_index.asp?id=68841)
2. The complete set of RCV rankings, sortable by precinct (<http://www.sfgov.org/site/uploadedfiles/elections/ElectionsArchives/2007/november/BallotImage.txt>)
3. The round-by-round RCV tally (in the years, unlike 2007, when an RCV tally actually occurs) (for example, http://www.sfgov.org/site/elections_index.asp?id=61583), and
4. Statement of vote showing precinct and absentee totals for all candidates in all precincts (<http://www.sfgov.org/site/uploadedfiles/elections/ElectionsArchives/2007/november/SOV071106.txt>)

All of this data is released starting on election night and updated through the counting of absentee and provisional ballots.

[Source: http://www.sfgov.org/site/elections_index.asp]

3. One election integrity activist has asked on the Internet: Have *you* ever participated in a hand count of an IRV election with more than four candidates that occurred in a district that was in more than one jurisdiction so that you could see how incredibly complex it is? I doubt it.”

The truth: Many election reformers and administrators have participated in such counts or observed the manual counts in Cambridge, MA (pre-1997), the RCV count for president of Ireland, local or federal elections in Australia, local election in Ireland and Northern Ireland, and so on. Hand counting RCV elections is not “incredibly complex.” You simply sort ballots by first choice, count the pile, add up the votes for all candidates, determine the candidate to eliminate, redistribute ballots for the eliminated candidate to each voter’s next choice, tally the new totals, and repeat the process. Because most ballots stay with the voter’s first choice in most elections, an RCV hand count is only marginally more difficult than a plurality hand count in most cases. If, as commonly happens, the two frontrunners receive a combined 90% of the vote, you only have to re-tally 10% of the ballots.

In 2004, I led a team of volunteers in counting the ballots in San Francisco's first public RCV election. This election, for student member of the Board of Education, took place in October 2004, just a couple weeks before the Department of Elections implemented RCV for the first time in November 2004. Nearly 8,000 students from all of San Francisco's public and private high schools cast ballots. There were 12 candidates running, and it took 10 rounds of RCV to determine the winner. Counting the ballots took 10 volunteers about 8 hours.

4. It has been suggested that average members of the public are not capable of verifying an RCV election by comparing electronic records of rankings with paper ballots.

The truth: Here is how it can be done. Let's assume that you have 100 paper ballots from a precinct and the corresponding 100 electronic records. The first 25 records from Burlington's 2006 RCV election for mayor in Ward 2 look like this:

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000021-00-0001,10001,001,1) C03 [1], C04 [2], C02 [3]
000021-00-0002,10001,001,1) C04 [1], C02 [2]
000021-00-0003,10001,001,1) C03 [1], C02 [2]
000021-00-0004,10001,001,1) C03 [1], C04 [2]
000021-00-0005,10001,001,1) C02 [1], C04 [2], C05 [3], C01 [4], C03 [5]
000021-00-0006,10001,001,1) C03 [1], C04 [2]
000021-00-0007,10001,001,1) C03 [1], C02 [2]
000021-00-0008,10001,001,1) C04 [1], C02 [2], C03 [3]
000021-00-0009,10001,001,1) C04 [1]
000021-00-0010,10001,001,1) C03 [1], C06 [2]
000021-00-0011,10001,001,1) C03 [1]
000021-00-0012,10001,001,1) C02 [1], C04 [2]
000021-00-0013,10001,001,1) C03=C06 [1], C05 [3], C01 [4], C02 [5]
000021-00-0014,10001,001,1) C03 [1], C02 [2]
000021-00-0015,10001,001,1) C04 [1], C03 [2]
000021-00-0016,10001,001,1) C03 [1], C04 [2]
000021-00-0017,10001,001,1) C03 [1], C06 [2], C02 [3]
000021-00-0018,10001,001,1) C02 [1], C04 [2]
000021-00-0019,10001,001,1) C03 [1]
000021-00-0020,10001,001,1) C04 [1], C03 [2]
000021-00-0021,10001,001,1) C02 [1]
000021-00-0022,10001,001,1) C03 [1], C04 [2]
000021-00-0023,10001,001,1) C03 [1]
000021-00-0024,10001,001,1) C03 [1]
000021-00-0025,10001,001,1) C04 [1]
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The first record shows that in Ward 2, memory card 1, ballot #1, ballot style 10001, the first choice was candidate C03, the second choice was candidate C04 and the third choice was candidate C02.

[Source: <http://www.burlingtonvotes.org/20060307/21.PRM>]

Here are the codes corresponding to the candidates:

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.CANDIDATE C01, "Louie The Cowman Beaudin"
.CANDIDATE C02, "Kevin J. Curley"
.CANDIDATE C03, "Bob Kiss"
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.CANDIDATE C04, "Hinda Miller"
.CANDIDATE C05, "Loyal Ploof"
.CANDIDATE C06, "Write-ins"

[Source: <http://www.burlingtonvotes.org/20060307/2006%20Burlington%20Mayor.in>]

So how does your "average American" verify this data? As with any election audit, it is only the individuals authorized by law to observe or handle the ballots who can know for sure what is marked on each ballot. This should be a public process with representatives from all candidates and parties included.

Here's the easiest way to do it. First, print out the rankings. Then, pick up the first ballot from your stack, find a ranking in the data that corresponds to the marks on the ballot and put a check mark next to that ranking on your print out. Place that ballot face down, pick up the next ballot, and continue the process until you've checked every ballot against the records.

At this point, if every record has a check next to it and there are no remaining ballots, you've verified the rankings. If not, you need to double-check your work and determine if you made a mistake or if the equipment stored the rankings incorrectly. This is called "reconciling the discrepancies" and must be done anytime you do a manual audit of an election (if there are any discrepancies).

Now, once you've got the complete set of rankings for the entire race, you can literally tally them by hand (tick marks on sheets of paper), drop them into a spreadsheet for easy sorting and counting, or use a variety of free-open source software packages to do the tally. Detailed steps for doing this in a spreadsheet are posted at:

<http://www.burlingtonvotes.org/20060307/manualverification.php> .

So here are my quick answers to some of the Internet RCV auditing questions (rhetorical, I assume) marked by three asterisks ***:

"And what exact voting system is required that enables election officials to conveniently publicly post all its ballot records and exactly how may the average citizen verify the integrity of your alleged "audit" procedure?"

*** *So far, all three big vendors (ES&S, Diebold/Premier, and Sequoia) have developed RCV capability on their existing scanners.*

"Does your audit procedure require that most US jurisdictions purchase new voting systems?"

*** *No! As San Francisco did and Pierce County is doing, they just have to upgrade the firmware and software for RCV functionality.*

"Does your audit procedure require that the average US citizens acquire new computer skills and equipment and programs that they are currently lacking?"

*** *No! Pencil and paper worked to count and audit RCV elections for a hundred years, but spreadsheets are easier and more verifiable.*

5. An anti-RCV election integrity activist has stated on the Internet that not one State seems to use all these fundamental measures that are required to ensure election integrity:

- public access to all election records and data necessary to evaluate the integrity of the electoral process,
- observable post-election independent manual audits of vote count accuracy,
- post-election ballot reconciliation of all printed, counted, unused, and spoiled ballots with voter process records, and
- public oversight of ballot security.

The truth: This is false and misleading. While many states have not put such procedures in place, San Francisco in fact does all four of these things, and the measure on which it is weakest – public oversight of ballot security – has nothing to do with RCV. How does San Francisco meet these standards?

1. It publicly releases all necessary electronic records as described above that, when combined with the paper ballots, allow a full manual tally of the election as well as an independent audit of all election results and audits.
2. Under state law, all election procedures are publicly observable, including the required post-election manual audits, pre-election logic and accuracy test.
3. The official canvas, which is required by law and is publicly observable, includes the reconciliation of all printed, counted, unused and spoiled ballots and voter records.
4. All aspects of ballot transport, counting and storage are publicly observable. Access to certain areas inside city hall and staging grounds is limited, but some members of the public (official election observers, grand jury members) are allowed to go everywhere.

[Source: http://www.sfgov.org/site/elections_index.asp]

Pierce County, Washington's November 2008 implementation of RCV on a different vendor's equipment (Sequoia) will include all of these features, too.

[Source: Email from Pierce County Auditor Pat McCarthy on June 25, 2008]

6. A couple of election integrity activists who are worried that RCV may lead to paperless voting machines are promoting the claim that it is very destructive to the integrity of US elections.

The truth: None of the jurisdictions adopting ranked voting are moving towards touch screen voting, and advocates of RCV oppose DRE voting technologies. Because RCV elections on optical scan equipment produce an electronic, auditable record of every ballot that can be compared to the paper ballot, RCV elections are more secure and more verifiable than non-RCV elections. Many people seem to think that there are small “d” democratic benefits of RCV, too.

7. Some have suggested that “Prior to solving the spoiler and two-party domination problems, our first priority should be to ensure the fundamental integrity of election results, regardless of which voting method is used.”

The truth: If this is the way they sees things, they should continue to work on ensuring fundamental election integrity. Unfortunately, poor analysis and understanding of RCV elections is causing some to fight RCV on a ground – election integrity – that RCV actually improves when properly implemented.

4. Conclusion

I have attempted to correct the false and misleading statements that have recently begun to be repeated on the Internet about election security and ranked-choice voting. I believe the commitment to election integrity of these individuals is rock solid, but I believe they made a key wrong assumption – that a manual audit of an RCV election requires precinct-summable vote totals for all possible voting combinations – that caused them to reach incorrect conclusions about the implications on election integrity of ranked-choice voting elections. I have also attempted to give very concrete examples of how you can manually audit an RCV election based on published electronic records of each ranking.

The public RCV elections held in San Francisco and Burlington, Vermont were the most transparent, verifiable public elections ever held up to that point. They were far more secure even than elections that are counted purely by hand because they combine paper ballots with electronic records of every single ballot. Burlington even made the RCV tally code and program available for the public to use, inspect, test and modify.

The key to election integrity is neither paper ballots nor voting equipment. It’s neither a paper-trail nor electronic records. It is the combination of redundant paper and electronic records, along with public observation of all processes, and rigorous post-election manual audits. The four San Francisco RCV elections (2004, 2005, 2006 and 2007) set new standards for election integrity for both RCV and non-RCV elections. The country would be well-served if other jurisdictions adopted these standards for transparency and verifiability of elections.

5. For further information

If you’ve read this far and have any questions or wish to discuss these issues, please don’t hesitate to call or email.

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