Risk-Limiting Audit Methods

VerifiedVoting

Differences Between RLA Methods:

Criteria	Ballot-Level Comparison	Batch Comparison	Ballot Polling
Brief description[1]	Cast vote record (CVR) totals are compared to contest results. Voter selections on randomly-selected individual paper ballots are compared with corresponding CVRs.	Sums of all batch subtotals are compared to contest results. Hand tallies from randomly-selected paper ballot batches are compared with corresponding machine counts.	Voter selections on randomly-selected paper ballots are interpreted manually.
Election infrastructure required	⊖ Voting system must export a machine readable CVR for each paper ballot.[2]	● Voting system must export machine readable batch tallies for each physical batch of paper ballots.[3]	⊕ Does not require matching ballots to tallies.
Number of ballots to examine[4]	⊕ Fewest ballots.	● More ballots, but organized in batches.	⊖ Comparable to ballot-level comparison for wide-margin contests, but grows rapidly as margin narrows.
Number of ballot containers to open[4]	⊕ Relatively few containers.	⊕ Relatively few containers.	⊖ Comparable to comparison methods for wide-margin contests, but grows rapidly as margin narrows.
Workload predictability based on reported margin[4,5]	⊕ Number of ballots to sample is completely predictable from reported margin.	● Number of batches is predictable. May be susceptible to handcounting errors.	⊖ Number to sample depends on "the luck of the draw," even when the margin is known.
Identification of misinterpreted ballots	⊕ Always identifiable during audit.	● May be possible with sufficient effort.	⊖ Not possible.
Observability & verifiability by public[6]	● Easiest to observe ballot interpretation. Verifiability is more difficult than ballot polling.	● May be difficult to observe tallies of all batches. Verifiability is more difficult than ballot polling.	⊕ Easy for public to observe ballot interpretation.

All Risk-Limiting Audits Require:

- Voter-marked paper ballots
- A ballot manifest[1]
- A properly maintained chain of custody on the ballots
- Randomly-selected ballots or ballot batches
- Human examination of the ballots or batches by hand

This chart was developed in consultation with Lynn Garland, Independent Advisor, and with the Brennan Center for Justice at NYU School of Law

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(see reverse for footnotes)

Footnotes

1. All three methods require manually interpreting voter intent directly from randomly-selected voter-marked paper ballots. All three require a ballot manifest, which describes in detail how the paper ballots are organized: a list of ballot containers and the number of ballots in each. Ballot-level comparison audits and ballot-polling audits involve drawing individual ballots at random; batch-level comparison audits involve drawing identifiable batches of ballots (e.g., all ballots tabulated by a particular scanner, or all ballots cast in a particular polling place) at random. The ballot manifest must not rely upon data from the voting system.

2. The export must make it possible to find the cast vote record corresponding to any particular physical ballot, and vice versa. Legacy voting systems in polling places generally do not make that possible.

3. It is important that the batch subtotals be for physically identifiable batches, which has implications for how jurisdictions organize and process ballots. The exported subtotals must also be machine-readable. Legacy systems generally do not export batch subtotals in a usable format.

4. These comparisons assume voting machines tabulated ballots correctly.

5. Reported margin refers to a single contest, but RLAs can be adapted for multiple contests. In this case, the audit should be designed using the margins of all targeted contests. It may also be possible to gather meaningful data for other contests on the audited ballots without including them in the audit design (opportunistic auditing), but care must be taken. Ballot comparison audits are the most likely to give meaningful data even if other contests are not audited to a risk limit. Batch comparison audits are more burdensome to extend, especially if ballots are not sorted by style. Ballot-polling audits can be problematic to extend to some contests.

6. Verifying that a comparison audit (ballot-level or batch-level) did not stop prematurely requires verifying that the exported CVRs or batch subtotals, when summed, reproduce the contest results and requires disclosing the CVRs or reported batch subtotals for audited ballots/batches. All three methods require (a) public disclosure of the seed used for random selection, (b) public disclosure of all algorithms used for the selection of ballots and for the risk calculations, and (c) allowing observers to see every audited ballot to check the auditors' interpretation of voter intent (and to check subtotals for batch-level audits). Because ballot-level audits (comparison or polling) generally involve inspecting fewer ballots than batch-level audits, checking auditors' interpretation of sampled ballots is easier. But because ballot-level audits involve pulling individual ballots from batches of many ballots, checking that the correct ballots were inspected may be harder. Imprinting ballots with unique serial numbers can help.