

Risk-Limiting Audits

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Issue

This report describes risk-limiting audits (RLA), including how they work and where they are currently used in the United States.

Summary

A risk-limiting audit (RLA) is a type of post-election audit designed to (1) statistically limit the risk of errors in reported election outcomes, (2) establish confidence in the election results through a publicly verifiable and observable process, and (3) count the fewest number of ballots needed to achieve the desired risk limit.

An RLA statistically determines how many ballots must be counted to achieve a conclusive result (i.e., one supporting the reported election outcome) within the established risk limit. If there is no conclusive result after counting the required number of ballots, additional ballots must be counted until there is one, the reported outcome is disproven, or a full hand recount occurs.

In an RLA, several components must be implemented for risk identification, ballot organization, and secure audit performance. For example, RLAs require individual ballots to be identifiable and retrieved as needed by having unique ballot identifiers or storing ballots in numbered batches. There are three methods for conducting RLAs (i.e., ballot polling, ballot comparison, and batch comparison), each with strengths and weaknesses in achieving the audit's goals.

Three states have implemented full RLA programs (Colorado, Rhode Island, and Virginia) and four states authorize, but do not require, the use of RLAs (California, Ohio, Oregon, and Washington). Additionally, eight other states are currently conducting RLA pilot programs.

In 2021, the Connecticut General Assembly authorized a working group to review RLA policies and provide recommendations for state implementation. Legislation was drafted in 2022 to implement the working group's recommendations, but the bill did not advance out of committee.

The information in this report was drawn from several resources, some of which are listed here. For general information on RLAs, visit the [National Conference of State Legislatures \(NCSL\)](#). State-specific information and experiences on RLAs can be found in the reports from [Colorado](#), [Rhode Island](#), and [Virginia](#), as well as the [Connecticut working group's recommendations](#).

RLA Components

Target Contest

The first step in conducting an RLA is the selection of a target contest (i.e., an election for a particular office). All ballots that contributed to the reported result for that contest must be identified and available for the audit (generally by compiling a ballot manifest, see below). If multiple contests are conducted using the same ballot (e.g., statewide offices like governor and treasurer), then there can be simultaneous audits. However, contests with separate ballots must be audited independently.

Risk Limit

A risk limit is the percentage chance an RLA will not catch that the reported outcome (e.g., the declared winner) is incorrect. For example, if an RLA has a 5% risk limit, there is a 95% chance that the audit would catch an error in the reported outcome. The risk limit balances the need for accuracy with a full-hand recount's time and financial cost. An RLA with a lower risk limit requires examining more ballots but yields a higher likelihood of catching an error.

Sample Size

The sample size is the number of ballots needed for examination in an RLA. It is statistically determined by the (1) number of ballots cast for the target contest, (2) established risk limit, and (3) margin of victory. RLAs are designed to count the fewest ballots necessary to achieve the desired risk limit. Thus, if a target contest has a close margin of victory, the number of ballots to be examined for a conclusive result would be significantly higher than a contest with a landslide result.

Batches

To organize and identify ballots, all ballots may be grouped into unique batches (e.g., batch 1, batch 2, batch 3). If batched together, ballots are logged on the ballot manifest and may be used later to identify specific ballots chosen for audit.

Ballot Manifest

A ballot manifest is a detailed description of how ballots are stored and organized, listing at minimum the physical location of each ballot cast in the election. It is used to find and examine ballots during an RLA. The compilation and use of a ballot manifest depends on the RLA method (see below).

Cast Vote Record

A cast vote record (CVR) is a notation of how an electronic tabulator interprets a cast ballot. In other words, once a ballot is inserted into an electronic tabulator, a machine interprets the selections and creates a separate record (the CVR) showing how the machine understood the ballot. These records are generally aggregated into tables for subsequent reference. (CVRs are used in ballot comparison RLAs (see below).)

Ballot Identification

To conduct an RLA, ballots must be randomly chosen for audit. This ensures that the audit results cannot be pre-determined by selecting certain ballots. Current practices and procedures for ballot identification generally include generating a random seed, pulling ballots, and using unique ballot identifiers or a place identification method.

Random Seed

A random seed (i.e., a series of random numbers) is generated to begin the ballot identification process. The most common method is to roll a die until enough numbers are generated to create the seed. The sequence is entered into a computer program, which produces a “pull list” of ballots chosen for audit. Each random seed would result in the program creating a different “pull list,” thus ensuring a random ballot selection.

Pulling Ballots

After generating the pull list, the identified ballots are pulled. For ballots with unique identifiers, the pull list will contain specific ballots to be found and audited. If not, then, generally, the list identifies the physical location of the chosen ballots (e.g., a specific ballot batch and a sequence number within the batch).

Unique Identification or Place Identification

For ballots to be correctly identified and retrieved, some jurisdictions use measures to give each ballot a unique marking. This can be done before voting by printing serial numbers on each ballot, thus allowing the pull list to identify a series of serial numbers, or after voting but before an audit by “imprinting” ballots with bar codes, serial numbers, or QR codes.

If ballots are not marked with a unique identifier, there must be another way to identify and select them for auditing. In a place identification method, the pull list identifies certain ballot locations based on how the ballots are organized (e.g., the 67th ballot of batch 14). Four methods have been previously tested to identify the chosen ballot, but due to their imprecise nature, they may not pull the identified ballot. The methods are as follows:

1. *Counting Method* – Ballots are retrieved by counting from the top or bottom until arriving at the specific ballot in a batch.
2. *Ruler Method* – Using the paper’s thickness to determine where a specific ballot would be in a stack, a ruler is used to measure the chosen ballot’s supposed location.
3. *Scale Method* – Ballots are removed from the batch in order and placed on a scale. The scale weighs the ballots until the correct number of ballots are on the scale (e.g., if locating the 67th ballot in a batch of 100 ballots, the weight of the ballots on the scale should be the weight of 67 ballots, thus identifying the 67th ballot).
4. *K-cut Method* – The pull sheet lists how many ballots must be pulled from a specific batch. Then, a number between 1-99 is randomly chosen. Based on the selected number, the batch is split into two groups with one of the groups being approximately the percentage of the number selected (e.g., if the number 33 is chosen, then the top group should be about one-third of the batch’s ballots). The bottom group is placed on top, and the process repeated five more times. The ballot on top of the batch after six “cuts” is chosen for audit.

RLA Methods

There are three methods used to conduct RLAs: ballot polling, batch comparison, and ballot comparison. Each method varies in implementation, resulting in certain strengths and weaknesses, which this report briefly covers. More information about the pros and cons of these methods is in Rhode Island’s [report](#) (pages 10-11) and the Connecticut working group’s [recommendations](#) (section 4.1). For each method, if the RLA results are inconclusive, more ballots must be counted to obtain a conclusive result or disprove the reported outcome. In rare cases, a full hand recount may be necessary.

Ballot Polling

Ballot polling involves randomly selecting and manually tabulating ballots. After the manual count of the selected ballots, the margin of victory is manually tabulated for those ballots. The tabulated margin is then compared to the officially reported margin. Ballot polling evaluates if there is solid statistical evidence to support the reported outcome (similar to exit polling).

The main strength of ballot polling is that it needs minimal technology to implement. However, there are a few weaknesses. First, the closer the margin of victory, the greater the increase in how many ballots must be counted, especially compared to other methods. Second, ballot polling provides little opportunity to identify the cause of electoral errors, such as electronic tabulator malfunctions.

Batch Comparison

In a batch comparison audit, ballots are organized in “batches” and each batch needs an electronic tabulation of its totals. Then, several batches are randomly selected and manually counted. The manual count results are compared against the tabulated totals, looking for statistical evidence to affirm or disprove the result.

Compared to other RLA methods, the batch comparison method is most like existing auditing practices. Thus, it may be easier to implement. This method also provides an opportunity to identify the cause of errors. But the method generally requires counting more ballots than the other methods and may result in a full recount in elections with few ballots (e.g., local elections).

Ballot Comparison

Ballot comparison requires the use of a CVR. A ballot is randomly selected for audit and manually counted. That count is compared to the CVR for that ballot (i.e., the electronic tabulator’s interpretation of the ballot). Once a statistically determined number of ballots are counted, elections officials evaluate if the statistical evidence supports or disproves the reported outcome.

Comparing the physical ballot and its electronic interpretation has two main advantages: (1) if the electronic tabulators produce a CVR, the method provides the best opportunity to identify the cause of errors compared to other methods and (2) it requires the fewest ballots for review, even involving a target contest with close margins. But this method requires specific technology or, if the technology is unavailable, additional human resources and time to rescan ballots to produce a CVR.

RLA Use in the United States

RLAs have been used in the United States for over a decade, beginning with Colorado in 2009. Since then, two other states, Virginia and Rhode Island, have implemented full RLA programs. Four other states (California, Ohio, Oregon, and Washington) have optional RLA programs that state and local officials may choose to implement instead of traditional auditing practices. Additionally, according to [NCSL](#), eight other states have current pilot programs to test RLAs.

The Connecticut legislature established a working group to examine RLAs in 2021 ([PA 21-2](#), June Special Session, § 123). The RLA Working Group's [recommendations](#) provided, in part, that the state should adopt comparison RLAs for all federal year elections. During the 2022 legislative session, the Government Administration and Elections Committee considered a bill ([SB 472](#)) to implement RLAs for state elections but generally maintain existing post-election auditing processes for federal and state primaries and municipal elections. The committee reported the bill favorably, but there was no further action on the bill.

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