Post-Election Risk-Limiting Audit Pilot Program: Guide for Using the Software Tool for the March 2020 Election

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Risk-Limiting Audit Software Tool

All counties participating in the pilot program for the March 2020 election will use the following software tool to conduct a risk-limiting audit:

- For a ballot-level comparison risk-limiting audit, the software tool available at the following webpage: https://www.stat.berkeley.edu/~stark/Vote/auditTools.htm
- For a ballot polling audit, the software tool available at the following webpage: https://www.stat.berkeley.edu/~stark/Vote/ballotPollTools.htm

The webpages linked to above include the source code for each of the audit tools, which is open source. The source code can be viewed without restriction using standard software or any commercial web browser.

Purpose of This Guide

This guide is intended to provide instruction to county elections officials conducting risk-limiting audits under the pilot program and to public observers. This guide is not intended to represent step-by-step instructions for all aspects of conducting the risk-limiting audit.

This guide is intended to be read alongside the documentation present on the audit software tool webpage.

Notes for All Audit Types

The software tool is not configured to allow the audit tasks or results to be saved. You will need to complete the entire audit in one session—by keeping the webpage opened from the time the audit begins to the time it is completed. In the worst case, if the webpage or browser unexpectedly closes, you should be prepared to reenter all the information in order to continue with the audit. You will need to print the results of the audit after completing the audit to document how it was completed and what ballot cards were selected for audit.

The software tool uses a ballot manifest to identify ballot cards to audit. The ballot manifest cannot be uploaded into the software tool and must be copied and pasted into a free-form text box. The ballot manifest will be prepared according to the California Post-Election Risk-Limiting Audit Ballot Manifest Format document dated October 15, 2019. However, the completed ballot manifest must be saved as a Comma Separated Value (CSV) file, then opened using a plain text viewer like Microsoft Notepad and copied and pasted into the software tool.

Ballot-level Comparison Audits

1. Before beginning the audit, be sure to have the following information available:
   a. The ballot manifest for all ballot card(s);
   b. The results for all ballot card(s) tabulated for all contests in the election; and
   c. The cast vote records generated by the voting system for all ballot card(s) tabulated.
2. Open the software tool using any commonly available browser: https://www.stat.berkeley.edu/~stark/Vote/auditTools.htm
3. Proceed to the "Initial sample size" section and enter all of the information required:
   a. Ballots cast in all contests means the total number of ballot cards returned for the election. Count each ballot card one time regardless of the number of contests the voter voted in.
   b. To add additional candidates or contests, use the appropriate buttons and the software tool will add additional text fields to complete. Add all contests and candidates in the election.
   c. Ensure that the "Audit parameters" section shows a risk limit of 5% (include the % sign, not just "5").
   d. Leave the inputs for overstatements and understatements at 0.001.
   e. The Starting size should show a checkbox next to "Round up 1-vote differences" only.
   f. Click "Calculate size." This information will give you the total initial sample size.
      i. The software tool may indicate that a full hand count is expected. In that case, proceed with a full hand count of all contests of the election.
      ii. The software tool may indicate a starting sample size greater than the total ballot cards cast in all contests. This should be read to require a full hand count of all contests in the election.
   g. The software tool will automatically carry the total number of ballot cards and the initial sample size to the next section.
4. Proceed to the "Random sampling" section.
   a. Enter the 20-digit random seed you generated through die rolls consistent with the regulations for this pilot program.
   b. Leave the fields "Number of ballots" and "Draw this many ballots" unchanged. The software tool will have automatically filled in these figures using information from the previous section.
   c. Leave the field "Current sample number" unchanged. The software tool will update this field as needed as the audit progresses.

d. Click the button "draw sample" to generate a list of ballot cards to be audited. This will list a sequence of ballot cards showing the sample number followed by the ballot card number.

e. The section "Ballots selected, sorted, duplicates removed" shows the ballot cards that the software tool requires to be examined.

5. Proceed to the "Find ballots using a ballot manifest" section.

a. This section is optional. If you do not enter a ballot manifest, you must obtain ballot cards by numbering them sequentially and searching for each ballot card by its number in the entire sequence.

b. Save the ballot manifest as a CSV file.

c. Open the ballot manifest using a plain text editor like Microsoft Notepad. The ballot manifest should display as a series of lines with information separated by commas. The ballot manifest used for this software tool can only have two columns: a batch label and a designator about where the ballots are located. Instructions for appropriate data in these fields is documented in the software tool.

d. Copy and paste the ballot manifest into the free-form text field. If your ballot manifest has a header row, do not include this in the free-form text field.

e. Click "look up ballots." The software tool will create a sorted table of ballot cards to retrieve based on how they are displayed in the ballot manifest.

6. Complete audit tasks outside of the software tool, such as retrieving the ballot cards and having audit board(s) evaluate voter selections.

a. For each ballot card, the audit board should record its interpretation of the votes cast for all contests, without referring to the cast vote record.

b. Subsequently, for each ballot card, the audit board compares its interpretations to the interpretations in the corresponding cast vote record. Any differences should be noted. Then, the ballot card should be classified as a 1-vote overstatement, a 2-vote overstatement, a 1-vote understatement, a 2-vote understatement, or none of these. Consult the discussion on the webpage under "Should more ballot cards be audited?", including the examples in Tables 1 and 2, for detailed instructions on how to classify ballot cards. (It is permissible to begin this step before the preceding step is completed.)

7. Proceed to the "Should more ballots be audited?" section.

a. In the "Stopping sample size and escalation" section, enter the discrepancies identified by the audit board(s).

b. Click "Calculate" to determine whether the audit is complete or should continue. The software tool will make this determination based on the reported discrepancies related to the total sample.

c. If the discrepancies prevent the software tool from confirming the result of the election within the 5% risk limit, the software tool will indicate "Audit incomplete." The software tool will display a new number of ballot cards to audit. If the number for "If no more differences are observed" exceeds the total number of ballot cards cast (or at your discretion), proceed with a full hand count of the election. Otherwise, continue the audit.

8. If the audit is not complete based on the initial selection, additional ballot cards need to be audited.
   a. Document the total number of ballot cards to audit from the previous section under "If no more differences are observed."
   b. Return to the "Random sampling" section and update the field next to "Draw this many ballots" with the new figure from the previous step. Click "draw sample" to have the software tool generate a new list of ballot cards to audit.
   c. Complete audit tasks outside of the software tool for all new ballot cards selected for audit. Do not re-evaluate voter choices for ballot cards that were already reviewed in previous audit steps.
   d. Return to the "Should more ballots be audited?" section and enter updated discrepancy (overstatement and understatement) figures.
      i. These figures should include discrepancies identified in earlier audit samples (rounds). For example, if one one-vote overstatement was identified in the initial selection, and one additional one-vote overstatement was identified in the second selection, the number of one-vote overstatements should be reported as "2."
   e. Click "Calculate" to determine if the audit is complete. If the audit is not complete, repeat the steps in this section until the audit is complete or the figure in "If no more differences are observed" meets or exceeds the total number of ballot cards cast in the election.

Ballot Polling Audits

1. Before beginning the audit, be sure to have the following information available:
   a. The ballot manifest for all ballot card(s); and
   b. The results for all ballot card(s) tabulated for all contests in the election.
2. Open the software tool using any commonly available browser: https://www.stat.berkeley.edu/~stark/Vote/ballotPollTools.htm
3. Proceed to the "Initial sample size" section and enter all of the information required:
   a. Ballots cast in all contests means the total number of ballot cards returned for the election. Count each ballot card one time regardless of the number of contests the voter voted in.
   b. To add additional candidates or contests, use the appropriate buttons and the software tool will add additional text fields to complete. Add all contests and candidates in the election.
   c. Ensure that the "Audit parameters" section shows a risk limit of 5% (include the % sign, not just "5").
   d. The software tool will automatically display the "Expected sample size" after you click out of the last text box of required information.
      i. The software tool may indicate that a full hand count is expected. In that case, proceed with a full hand count of all contests of the election.
      ii. The software tool may indicate a starting sample size greater than the total ballot cards cast in all contests. This should be read to require a full hand count of all contests in the election.

4. Proceed to the "Random sampling" section.
    a. Enter the 20-digit random seed you generated through die rolls consistent with the regulations for this pilot program.
    b. Leave the field "Number of ballots" unchanged. The software tool will have automatically filled in this figure using information from the previous section.
    c. Enter the "Expected sample size" from the previous section into the field next to "Draw this many ballots."
    d. Click the button "draw sample" to generate a list of ballot cards to be audited. This will list a sequence of ballot cards showing the sample number followed by the ballot card number.
    e. The section "Ballots selected, sorted, duplicates removed" shows the ballot cards that the software tool requires to be examined.
5. Proceed to the "Find ballots using a ballot manifest" section.
    a. This section is optional. If you do not enter a ballot manifest, you must obtain ballot cards by numbering them sequentially and searching for each ballot card by its number in the entire sequence.
    b. Save the ballot manifest as a CSV file.
    c. Open the ballot manifest using a plain text editor like Microsoft Notepad. The ballot manifest should display as a series of lines with information separated by commas. The ballot manifest used for this software tool can only have two columns: a batch label and a designator about where the ballots are located. Instructions for appropriate data in these fields is documented in the software tool.
    d. Copy and paste the ballot manifest into the free-form text field. If your ballot manifest has a header row, do not include this in the free-form text field.
    e. Click "look up ballots." The software tool will create a sorted table of ballot cards to retrieve based on how they are displayed in the ballot manifest.
6. Complete audit tasks outside of the software tool, such as retrieving the ballot cards and having audit board(s) evaluate voter selections.
    a. For each ballot card, the audit board should note the voter selections for all contests in the election.
    b. After all ballot cards have been evaluated, find the total number of votes for each selection (in all contests) among the audited ballot cards.
7. Proceed to the "Should more ballots be audited?" section.
    a. Enter the vote totals for each selection, as determined in the preceding step, for all contests in the election.
    b. The software tool will indicate whether the risk limit has been met for each contest based on the voter choices entered. After voter selections are entered and you click outside of the text box, the software tool will display the risk for each contest. If the risk exceeds the risk limit, it will be shaded red. If it meets the risk limit, it will be shaded green.
    c. If the risk for any contest exceeds the risk limit, select additional ballot cards to examine. Do this until the risk limit is met for every contest in the election.
    d. To identify additional ballot cards to audit, return to the "Random sampling" section. In the text box next to "Draw this many ballots," enter an additional number of ballot cards to audit and click "draw sample." New ballot cards to audit will be displayed in the bottom of the "Ballots selected" box, sequentially.

i. For example, if the software tool initially identified 50 ballot cards to audit and the audit results indicate you should continue auditing, you would enter 1 additional ballot card under "Draw this many ballots" and the 51st ballot card selected, by sequence, would be the new ballot card to audit. The software tool would indicate next to "Current sample number" that 51 ballot cards have now been selected for audit.

ii. You may add as many additional ballot cards to audit as you like for each subsequent audit selection. In general, the further you are from meeting the risk limit in all contests, the larger this number should be.

Special Instructions for a Two-Phase Audit

To simplify the instructions that follow, we introduce some shorthand and abbreviations for key numbers:
- We shorten "ballot cards" to "cards."
- "Early-counted cards" are the cards tabulated before Phase 1 of the audit.
- "Late-counted cards" are the cards tabulated between Phase 1 and Phase 2.
- T1 is the number of early-counted cards.
- S1 is the number of cards selected in Phase 1 (including any duplicates).

Ideally, in a two-phase audit, most of the auditing occurs in Phase 1. In Phase 2, it may be necessary to audit additional early-counted cards, or to remove some cards from the Phase 1 sample. It may also be necessary to audit some late-counted cards. The detailed steps are as follows:

Phase 1:
1. Create a ballot manifest for all early-counted cards.
2. In the tool, enter the reported results for all early-counted cards. ("Ballots cast in all contests" will equal T1.)
3. Note S1, the number of cards to sample.
4. Click "draw sample" to draw the Phase 1 sample.
5. Copy and paste the unsorted list of selected cards into a text document or spreadsheet (for use in phase 2).
6. Audit the selected cards. Keep track of understatements and overstatements and the cards they occur on. Note if any of these cards are duplicates in the sample. (It is not necessary to attain the risk limit in this phase.)

Phase 2 (after tabulating the remaining cards):
1. Update the ballot manifest to reflect the late-counted cards.
2. Update the reported results in the tool, including "ballots cast in all contests."
3. Click "reset" in the sampling part of the tool.
4. Click "draw sample" to draw a new sample of the size the tool indicates.
   a. This size could be greater or less than, or equal to, S1.
5. Examine the sorted sample list. Note how many are early-counted cards -- that is, how many ballot numbers are less than or equal to T1.
   a. We'll call this number, the number of early-counted cards in the new sample, X.

6. If X is greater than S1, then from the unsorted sample list, use a spreadsheet to remove the first S1 ballot (card) numbers that are less than or equal to T1.
    a. This leaves numbers for some early-counted cards to audit in Phase 2, as well as any numbers for late-counted cards.
    b. Put the reduced list into the "ballots to look up" text area.
7. If X is less than or equal to S1, then from the sorted list of sampled ballots, remove all ballot (card) numbers that are less than or equal to T1, leaving only the numbers for late-counted cards.
    a. Put the reduced list into the "ballots to look up" text area. (See further instructions below.)
8. Look up the ballots and audit them, noting overstatements and understatements.
9. If X is less than or equal to S1, remove all Phase 1 audit results after the first X sampled cards, in unsorted order, from the final audit results.
    a. For instance, if X = 43 and S1 = 47, the results for the last four sampled cards -- sequence numbers 44 through 47 -- would be removed. (Note: This removal process should respect duplicates. Continuing the example: if the same card had both sequence number 14 and sequence number 45 in the Phase 1 sample, the audit result for this card would occur once instead of twice in the final audit results.)
10. Combine the (possibly updated) Phase 1 results and the Phase 2 results to obtain totals for each kind of overstatement and understatement. Enter these totals to see if the risk limit has been attained.
11. If the risk limit has not been attained, the audit now proceeds just like a one-phase audit.
    a. Refer to Step 7 of the instructions for Ballot-level Comparison Audits or Ballot Polling Audits, depending on the type of audit you are conducting.