2016
Post Election Audits
IN MARYLAND
Background

• The 2016 was the first year that Maryland used a statewide paper voting system.

• The voting system captured and stored images of all ballots cast in the election. This meant that the election results could be audited at a ballot level while also eliminating the need to physically handle the voted ballots.

• We piloted 3 audit methods after the 2016 primary election
What is an audit?

- A comparison of 2 independently produced results that are derived from the same data.

Why audit election results?

- To protect and ensure the integrity of the election process
- To verify and confirm the accuracy of the voting systems reported results
- To ensure that the voting system is accurately tabulating ballots
- To ensure that the winners of each contest are called correctly
- To increase confidence in the election results
What types of audits did Maryland pilot after the 2016 primary election?

- Ballot level audit applying risk limiting principles – The sample size of ballot images was determined by the margin of victory in the contest and the ballot images were tabulated manually.

- Fixed percentage audit – 100% of all ballot images in 1% of randomly chosen precincts were manually tabulated.

- Independent Automated Software Audit – Relied solely on independent software to tabulate the ballot images.
Ballot Level Audit Applying Risk Limiting Principles

- Consulted with Dennis McGrath, PhD, a statistician and professor at the University of Baltimore.
- Dr. McGrath selected the contest with the smallest margin of victory.
- Dr. McGrath used Dr. Philip Stark’s publicly available tools and formulae to determine the number of ballot images to review and which ballot images to review.
- The ballot images and associated Cast Vote Records were placed into batches and were manually reviewed and tallied in teams of 2.
Fixed Percentage Audit

• Consulted with Dr. Dennis McGrath

• Dr. McGrath applied statistical methodologies to ensure that each ballot cast in the county had an equal chance of being selected, regardless of the precinct size.

• Based on the number of votes cast by precinct, Dr. McGrath assigned a range for each precinct in each county.

• The local election officials used a ten-sided dice to roll a six-digit number and selected the precinct that fell within that range.

• Ballot images from that precinct were put into batches and tallied manually.

• The total for the precinct was compared to the voting systems precinct result report.
Independent Automated Software Audit

Pre-Election

• Ballot PDFs were sent to the vendor for the purposes of creating the ballot definition files (oval positions)

• Voting System’s zero reports by precinct were also provided to the vendor

Post-Election

• Local election officials sent voted ballot images to the vendor

• Vendor provided the State Board of Elections the independent result reports for comparison

• State Board of Elections sent the vendor precinct level voting system result reports

• Vendor provided 4 different audit reports by county – Comparison of Cards Cast, Comparison of Ballots Cast by Precinct, Comparison of Votes Cast and Contest Discrepancy Threshold report
Ballot Level Audit Applying Risk Limiting Principles

- Is unpredictable because it is dependent on the margin of victory in any given contest.
- Is complex and requires the assistance of a statistician.
- Would be extremely difficult to implement statewide because of the highly variable number of ballot images that must be reviewed.
- The planning process cannot begin until the day after the election
- Local election officials cannot accurately budget or anticipate staffing needs for this type of audit because the number of ballot images to audit is unknown until after the election
- A close margin could necessitate an almost complete manual re-tabulation of the ballot images
- Human error required an additional review of the ballot images and the Cast Vote Records
Fixed Percentage Audit

• Does not generate a high level of confidence because only ballot images from a single or small number of precincts are audited
• Requires the assistance of a statistician
• Is unpredictable because the size of the randomly selected precinct is unknown
• Raises the question of effectiveness and thoroughness because a small precinct (15 ballots) could be selected when hundreds of thousands of ballots could have been cast in that county
• Human errors could require a 2\textsuperscript{nd} or 3\textsuperscript{rd} manual review of the ballot images
Independent Automated Software Audit

• Re-tabulates 100% of the ballot images using tabulation software that is different than the voting system
• Maximizes the use of technology in election administration (a Maryland legislative mandate)
• Requires very little resources from state and local election officials
• Can be completed prior to election certification deadlines
• Eliminates the subjective and error-prone human element
• User friendly
What criteria guided Maryland in the selection of an audit method?

• Maximize the technological functions of the new voting system
• Minimize human error and eliminate chain of custody issues by using securely stored ballot images, rather than actual voter paper ballots
• Minimize the use of valuable staff time at the local election office in the days following the election
• Complete the audit prior to legally binding certification and swearing-in deadlines
• Be conducted at the ballot-level
• Be independent of the primary voting system
For all the reasons mentioned...
Maryland selected to use an independent automated software audit for the 2016 general election. The vendor selected to perform this audit was the Clear Ballot Group.

This audit confirmed the accuracy of the voting system and we discovered a lot more.
What additional discoveries were made as a result of the tools provided with the independent automated software audit?
Folds through write-in area resulted in votes

Note: Maryland tabulates write-in votes whether the oval is filled in or not
The ability to see the full ballot allowed us to see the fold clearly.

This issue was identified prior to certification and was corrected.
Residue and scratches on the scanner lens resulted in overvotes
The ability to see the full ballot allowed us to see the lines clearly. This issue was identified prior to certification and was corrected.
Double Pull Issues on high speed scanners
This is when the scanner picks up 2 ballots and scans them as 1.
Hovering over the multi-feed ballots showed different contests than the one we expected to see. The ability to see the full ballot allowed us to see that more than one ballot was scanned. This issue was identified prior to certification and was corrected.
What kinds of questions can be answered using an independent automated software audit that are challenging, if not impossible, to answer without one?
There is a large number of overvotes in the Presidential contest. Why would voters show up to the polls and vote for more than one candidate for President?

After reviewing the overvoted ballot images, we were able to determine that they were true overvotes.
There is a large number of undervotes in the Presidential contest. Why would voters show up to the polls and not vote for any Presidential candidate?

After reviewing the undervoted ballot images, we were able to determine that they were true undervotes.
There is a large number of blank ballots cast. Why would voters show up to the polls and decide to cast blank ballots?
What else can an independent automated software audit identify?
Identify voting locations where additional poll worker training is necessary

During the review of the unreadable ballot images, the vendor discovered that the stubs had been scanned. The stub should have been removed by the poll worker prior to scanning.
These issues were discovered by the vendor during the review of unreadable ballots. In all these cases, the voting system tabulated the ballots correctly.
Anything else?
You can easily see the interesting ways that voters mark their ballots
And...

- Helps resolve recount issues or allows for more targeted recounts
- Informs election administrators on issues with ballot design that lead to voter confusion (high percentage of voter error)
- Can assist election administrators in evaluating how certain precincts are doing
What about the future?

• Use the technology to analyze Logic & Accuracy images to identify and address issues with voting equipment prior to an election.

• Include an algorithm that can detect ballot images that are longer than expected to programmatically identify ballots scanned with stubs and double pull issues.

• Compare the voting system cast vote records and the independent automated software audit cast vote records to identify differences at the ballot level.
Questions?