Piloting Risk-Limiting Post-Election Audits in Michigan

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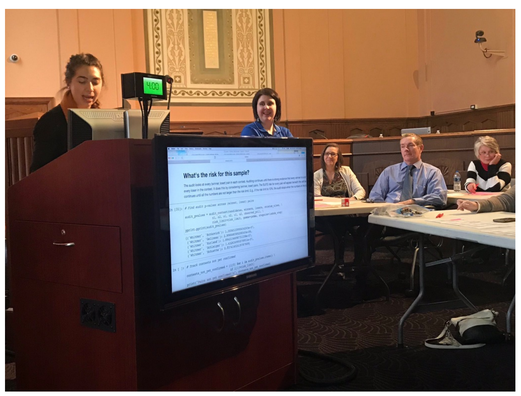
Risk-limiting Audits

- Risk-limiting audits (RLAs) are a statistical check that tabulation errors did not change the election outcome
- Risk limit is the maximum chance that the audit misses an incorrect outcome
- Frame the audit as a hypothesis test: Small p-value gives high confidence in the election results
- RLAs have been conducted in California, Colorado, Indiana, New Jersey, Ohio, Virginia, and Denmark, and are required by law in Colorado and Rhode Island

SUITE

SUITE is a general method for RLAs using stratified samples of ballots [1]

- Useful when there are natural groupings of ballots
  - Contests that span multiple jurisdictions
  - Vote-by-mail, provisional ballots, and in-person ballots
  - Ballots cast on heterogeneous voting equipment
- Operationalized as a union-intersection test to account for all the ways tabulation error could occur across strata
- Method is agnostic to the audit strategy in each stratum



The SUITE Tool

I created a Jupyter notebook to run calculations for a two-stratum SUITE audit from start to finish.

- Estimate initial sample sizes in each stratum based on reported results
- Sample ballots using a cryptographically-secure pseudo-random number generator
- Run the risk calculations for the observed samples
- Log each step in a JSON file

Use the Tool

Find a link to run the SUITE tool interactively at https://www.github.com/pbstark/CORLA18.

Creating the Ballot Manifest

- Stratified sampling requires a sampling frame for each stratum
- Record number of ballots in each physical grouping ("batch")

Cast Vote Record Files

- Records to link absentee votes on paper to their electronic interpretation
- Files are voting system dependent and difficult to process (e.g. JSON files with unintuitive coding)
- Election officials need to work with vendors to obtain human-readable files

Michigan Pilots

- 8 RLA experts traveled to 3 cities with the Bureau of Elections to pilot RLAs after the Nov. 2018 elections
- Used SUITE to combine ballot polling for election day ballots with ballot-level comparison for absentee ballots

City	Total ballots	Margin	Absentee rate	# Ballots audited
Rochester Hills	36,666	29%	0%	76
Lansing	21,328	12%	50%	260
Kalamazoo	27,666	55%	19%	40

Retrieving Ballots

- Locating the sampled ballot in a large batch is inefficient
- k-cut: shuffle batch like a deck of cards to approximate sampling [2]

Paper Handling

- Matching paper ballots to their cast vote records can be challenging
- Method 1: Store ballots in same order in which they were scanned (difficult)
- Method 2: imprint with a unique ID (security and anonymity concerns)

Conclusions

Pilot audits are critical to making RLAs the norm.

- Give election officials confidence in the process
- Shed light on practical barriers and unanticipated problems
- Demonstrate their efficiency over existing approaches

References

[1] K. Ottoboni, P.B. Stark, M. Lindeman, and N. McBurnett.
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[2] M. Sridhar and R. L. Rivest.
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