Risk-Limiting Audits for Denmark and Mongolia

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All vote counting methods can make mistakes

- Internationally, most concerns are with electronic vote tabulation, but hand counting errs, too.
- Denmark counts votes by hand, twice (or more).
- Mongolia uses Dominion imaging PCOS system
- Can we save effort and assure accuracy by auditing?
- What roles could audits play in Danish and Mongolian elections?

Two questions

- As shipped from the manufacturer, on a laboratory bench, can the equipment count votes on perfectly (machine-marked) ballots to a pre-specified level of accuracy?
- As maintained, deployed, etc., on election day, did the equipment count the actual voter-marked ballots accurately enough to determine who really won?

What do we want an audit to do?

Quality control in general.

Ensure that the electoral outcome is correct;
If outcome is wrong, correct it before it's official.

Outcome means the set of winners, not exact counts.

How can an audit correct a wrong outcome?

- If there's an adequately accurate audit trail, the audit could count all the votes by hand (again).
- Want to correct the outcome if it is wrong, but to do as little counting as possible when the outcome is right.
- Use statistical techniques to decide whether you have checked enough.
- "Intelligent" incremental recount: stop when there's strong evidence that there is no point continuing.

Why not just count all votes by hand (repeatedly)?

- Unnecessarily expensive and slow; accuracy decreases with fatigue.
- Instead, make a first count, then check a random sample.
- Keep checking until there's convincing evidence that the outcome is right—or until all ballots have been hand counted.
- Fatigue, staff quality, etc., may make a full hand count less accurate than a focused audit of a small random sample.
- An audit of hundreds or thousands of ballots can be more transparent than a full count: Public could actually observe the whole process.

Risk-Limiting Audits

- Endorsed by: U.S. Presidential Commission on Election Administration, American Statistical Association, Common Cause, Verified Voting Foundation, Citizens for Election Integrity Minnesota, et al.
- Mandated in law in California (AB2023, SB360) and Colorado
- Piloted in California, Colorado, Ohio
- Piloting in Denmark this week for EU Parliamentary Election!
- Rely on manual inspection of a random sample of ballots
- Audit stops when there's strong evidence that the outcome is correct
- Big chance of correcting wrong outcomes
- Use statistical methods to keep the workload low when outcome is right

"Stirring" is key to reducing work

- Don't have to climb into the bathtub to tell if it's hot: can just stick your toe in—if the water is stirred well.
- Don't have to drink a whole pot of soup to tell if it's too salty: a teaspoon is enough—if the pot has been stirred. (Doesn't matter whether the pot holds 0.5ℓ or 100ℓ.)

Requirements

- Requires sound procedures for protecting, tracking, and accounting for ballots.
- Denmark is far better than the USA in ballot accounting.
- I don't yet know how Mongolia accounts for ballots.
- New requirement: *ballot manifests*.
- Calculations are simple; web tools are available.
- Public ritual (including dice rolling) adds transparency and trust

Denmark's elections are amenable to RLAs

- Features that make auditing easier:
  - Paper ballots with excellent ballot accounting
  - Ballots have ≤ 1 [valid] vote for at most 1 party or candidate
  - Ballots are routinely sorted by party and candidate
  - Bundles of ballots are small (≤ 100 ballots)
- But, rules for "compensatory round" quite complicated.

Mongolia's elections are amenable to RLAs

- Features that make auditing easier:
  - Paper ballots with unique barcodes
  - Dominion equipment captures image; CVR can be matched to paper ballot
  - Relatively simple ballots (compared with California, for instance)
- Would need to investigate ballot accounting and creating "ballot manifests"

Questions/concerns about Mongolia's election administration

- Ballots have unique barcodes
  - makes ballot accounting and auditing easier
  - requires special care to ensure voter identity cannot be linked to ballot, breaking voter anonymity
  - mitigation: shuffle blank ballots; shroud barcode from poll workers
- Central tabulator and individual machines not airgapped—modem (and Internet?) connected
  - makes reporting results very fast
  - open to hacking, spoofing, denial-of-service attacks
  - mitigation: use second channel to confirm data transmission; rigorous ballot accounting and risk-limiting audits
- What are the procedures & security measures for curating memory cards and ballots? Need seals, seal protocols, rigorously logged & audited chain of custody, etc.

Miscellaneous notes about Mongolia's elections

- approximately 1.8 million voters; 68% turnout in last election
- approximately 2000 Dominion PCOS machines that capture ballot images
- some of the software developed in Mongolia
- ballots and memory cards from each election retained until next election
- next election: mid-June 2016

More reading:

- http://arstechnica.com/tech-policy/2012/07/saving-american-elections-with-10-sided-dice-one-stats-profs-quest/
- http://www.huffingtonpost.com/american-statistical-association/leave-election-integrity-_b_3580649.html
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- Lindeman, M. and P.B. Stark, 2012. A Gentle Introduction to Risk-Limiting Audits. *IEEE Computing Now, 10*, 42–49. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6175884&tag=1
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