Evidence-Based Elections

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30 June 2012
IACREOT
Albuquerque, NM

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Evidence-Based Elections

- Bold Claim: Law should require LEOs to give convincing evidence outcomes are right.
- Certifying equipment isn't enough: How was the equipment used?
- Election should generate hard evidence, checked for integrity.
- Audit trail is key. Needs to be created, curated, and scrutinized to confirm or correct the outcome.
- Why regulate equipment but not curation of the audit trail?
- Voting systems should make it easy—instead they make it hard.

What do we want Elections to do?

Purpose of Elections (Wallach)

Convince the loser he lost.

Evidence-Based Elections (Stark & Wagner)

Produce convincing qualitative and quantitative evidence that it found the right winners—or report that it cannot.

What's the proper role of certification? Who benefits?

Evidence-Based Elections

$$\text{Evidence} = \text{Auditability} + \text{Auditing}$$

$$\text{Strong Software Independence} = \text{VVPR} + \text{Compliance Audit}$$

$$\text{Evidence} = \text{Strong Software Independence} + \text{Risk-Limiting Audit}$$

This approach has a large chance of correcting its own errors.
If it can't, it says so.

Ingredients for Convincing Evidence

Audit trail

Typically, VVPR.

Compliance Audit

Is the system, as maintained & used, strongly software independent? Was audit trail complete and accurate when generated, and curated adequately since?

Risk-limiting Audit

To pass, need convincing evidence that full hand count would find the same outcome—or a full hand count.

Large, known chance of requiring a full hand count if the outcome is wrong, no matter why.

Risk is biggest chance of not correcting a wrong outcome.

Risk-Limiting Audits

Required by Colorado Revised Statutes 1-7-515
Pilot mandated by California AB 2023.

- Doesn't absolutely guarantee the electoral outcome is right, but guarantees a large chance of correcting the outcome if it is wrong.
- "Intelligent" incremental recount: stops only when there is convincing evidence that a full hand count won't change the outcome.
- Until the evidence is strong, counting continues, possibly to a full hand count.
- Absent a full hand count, will not alter election outcomes:
  Can correct wrong outcomes, but can't harm correct outcomes.

Pilot risk-limiting audits

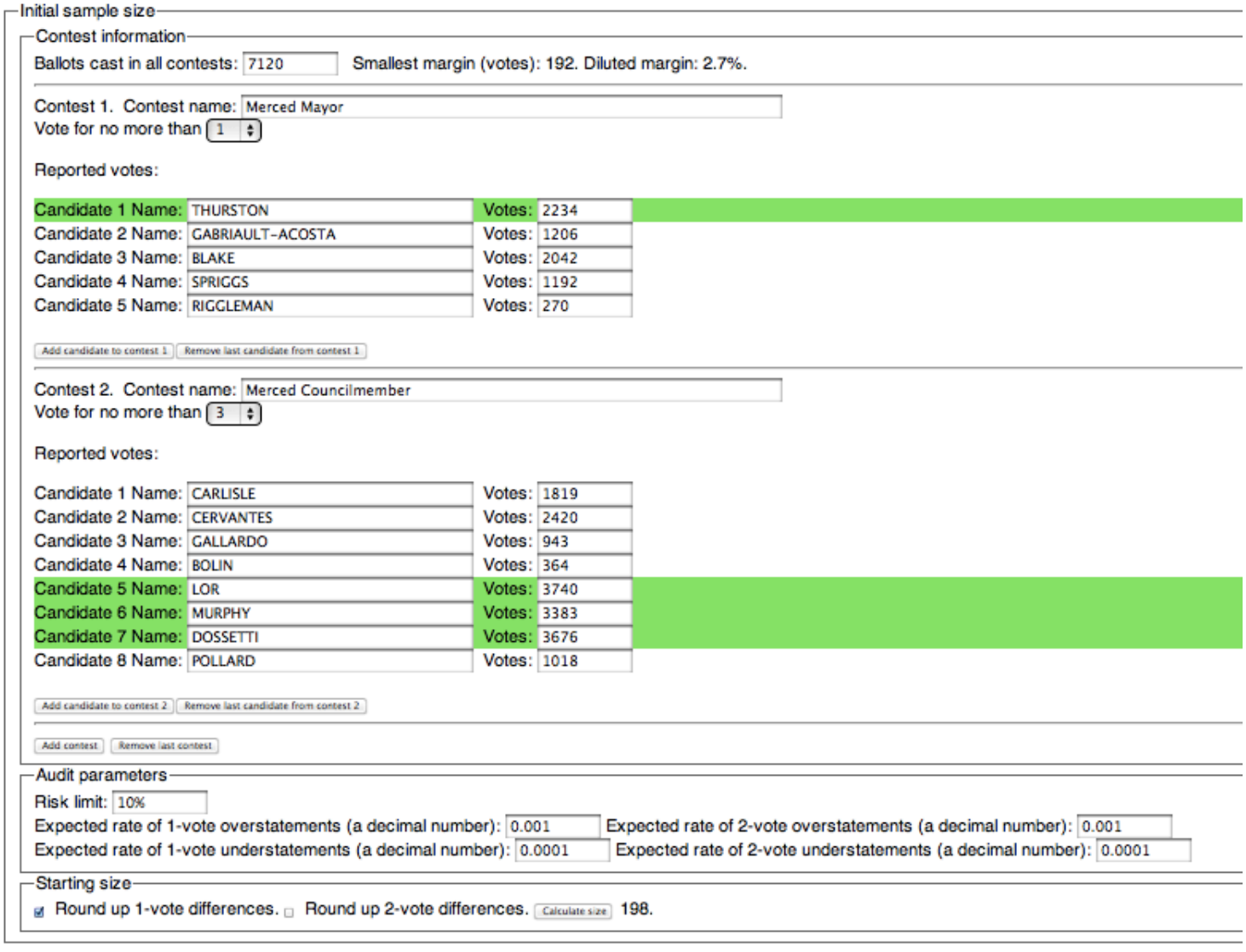
- Simple measures, super-majority measures, simple contests, vote-for-*k* contests. 200–121,000 ballots; burden 16–7,000 ballots.
- California pilots. Mix of voting technology, contest sizes, county sizes, contest types:
  Alameda 4c, Humboldt 3c, Marin 2e2c, Merced 2c, Monterey 1c, Orange 1c, San Luis Obispo 2c, Santa Cruz 1c, Stanislaus 1c, Ventura 1c, Yolo 2e3c
- Boulder, CO; Cuyahoga, OH
- NM: "almost" risk-limiting.
- EAC funding for CA and CO; CA and CO laws
- 7/2012: Madera, Marin, Napa, Orange (entire ballot), Santa Cruz, Yolo...
- 11/2012: More. $\geq$ 20 counties in all under CA AB 2023

Friendly Tools for Risk-Limiting Audits

The rules are not hard, and the tools can be simple:

`http://statistics.berkeley.edu/~stark/Vote/auditTools.htm`

auditTools in action



Should more ballots be audited?

Stopping sample size and escalation

Ballots audited so far: 198

1-vote overstatements:	0	Rate: 0
2-vote overstatements:	0	Rate: 0
1-vote understatements:	0	Rate: 0
2-vote understatements:	0	Rate: 0

Estimated stopping size

Calculate Audit complete

If no more differences are observed: 178.
If differences continue at the same rates: 178.
Estimated additional ballots if difference rates stay the same: 0.

Four Options to Move Forward

Assume jurisdiction has VVPRs and a “ballot manifest.”

1. Ballot-polling audits: no export from VTS required.
   Not as efficient as possible, but surprisingly economical.
2. Upgrade voting systems to next-next.
   (Systems currently in review for certification won’t do it).
   Expensive.
   Many jurisdictions can’t afford to replace current systems.
3. “Parallel” audit: Re-scan ballots or export images (e.g., Hart).
   Base the audit on CVRs extracted from scans by unofficial software.
   Time-consuming. Have to touch ballots twice.
4. Replace the system with one that makes auditing easy:
   Travis County approach. Re-visit the role of certification.

VTS Certification and Risk-Limiting Audits

Question 1

In the lab, can the vote-tabulation system—as delivered from the manufacturer—count votes with a specified level of accuracy?

Question 2

As maintained, deployed, and used in the current election, did the vote-tabulation system find the true winners?

Only care about Q1 insofar as it matters for Q2.

Certification addresses Q1. Risk-limiting audits address Q2.

Advantages of a Current Unofficial System (Wagner et al.)

- Makes ballot-level auditing easy.
- Drastically reduces costs: much cheaper to buy & maintain than any commercial system.
- Can be based on COTS scanners—cheap to lease or buy.
- Not locked into contracts, maintenance, etc.; easy upgrades: "agile."
- Speeds development/improvement cycle.
- Can capture voter intent better, improve accuracy.
  (cf Merced, San Luis Obispo, Stanislaus, Ventura).
- Requiring convincing evidence aligns incentives: more accurate CVRs means less hand counting in the audit.
  LEOs gain by using the most accurate and economical system.

Simplest incarnation

- Paper ballots designed by current EMSs.
- CCOS using COTS high speed scanners.
  $16k scanner can image about 3,500 ballots per hour.
- Scanner prints identifier on the ballots as they are scanned.
- Open-source software interprets images.
- Open-source software lets LEOs inspect images, resolve hard cases. (Sort on mark density, undervotes, over votes, etc.; images could be deleted after this step.)
- Post results at whatever level of geography statutes require.
- “Commit” cast vote record for each ballot.
- Compliance audit to ensure audit trail is complete.
- Risk-limiting audit at the ballot level using simple tools.

Paths to Economical Evidence-Based Elections

- Strong evidence doesn't require radical transparency, just observing a few key processes
- VVPR, preferably "accessible" VMPB
- Systems that export CVRs linked to the physical ballots.
- Certify things that have to work on election day—not tabulation accuracy
- Laws/regs to provide affirmative evidence outcome is right: Security, custody, compliance audits, risk-limiting audits (group is drafting model legislation for risk-limiting audits)
- Functional requirements, not dictating equipment or procedures
- Align incentives with need for evidence