After the Election: Audits and Recounts

Joseph Lorenzo Hall
NSF ACCURATE Postdoctoral Research Associate

UC Berkeley School of Information
Princeton University Center for Information Technology Policy

Carter Center 2008 US Presidential Election Study Mission
6 November 2008

This material is based upon work supported by the National Science Foundation under A Center for Correct, Usable, Reliable, Auditable and Transparent Elections (ACCURATE), Grant Number CNS-0524745. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.
Outline

- Recount vs. Audit
- Types of Recount, Audits
- Case Study: California Tallying Process
  - Methodology
  - Findings
    - Security
    - Transparency
    - Efficiency
Recount vs. Audit

- Audits are regular events, Recounts not
- Recountability
  - Must have something to recount.
- Auditability
  - Various auditing goals
- Other big differences:
  - Vote totals can change in a recount.
  - Laws specify much of recount procedure
Types of Recounts

• Goal of a recount: count over again
• Voters, Candidates, Officials and Courts can initiate them. (first two must pay)
• Triggered based on closeness, etc.
  − MN Senate race, Coleman (R) vs. Franken (D):
    • Full recount when < 0.5%
    • Starts after canvass (14 days from now)
    • After MN’s 3% statutory audit.
• Recounts are relatively boring. Audits…
Audits: Checking the Math

• If we can’t access to the inner workings of the system, what then?
• Audit. Check input vs. output.
• By “audit”, we mean: comparing two sets of software-independent records
  – 38 states keep independent records
  – Only 17 actually count them
• There are other notions of “audit”
Goals in Audits

- Minimize administrative burden
- Objectivity (~ minimize subjectivity)
- Increase public confidence
- Deter fraud
- Detect systemic error
- Provide feedback (quality control)
- Incentives and benchmarks
- Confirm the result
Types of Manual Tally Audits

- Fixed percentage audits (OK)
- Tiered audits (Better)
- Tuned audits (Even better)
- Hybrid audits (Best)
  - Combining a fixed % with another model

- Polling audits (Bad)
Fixed Percentage Audits

• A fixed percentage of audit units are chosen randomly.

• Strengths:
  – Pinpoint error, fraud
  – Decent sample for quality control
  – Predictable administrative costs

• Weaknesses:
  – Confidence can be low in close races
Tuned Percentage Audits

- Percentage of units based on margin.
- **Strengths:**
  - Can fix desired confidence in results, vary sample size
- **Weaknesses:**
  - Costs are much harder to predict
  - Undervalues administrative feedback (quality control)
Polling Audits

- Percentage of ballots audited in each polling place by “auditing army”
- Strengths:
  - Distributes work
  - Very accurately predicts global discrepancy
- Weaknesses:
  - *No information* as to source of error
  - *Very challenging* to staff, conduct
  - Very small errors would not be detected
High-Level: What to Audit?

- Post-election auditing lit. has exploded
- Brennan Center / Samuelson Clinic convened a blue ribbon panel
- Examined:
  - Fixed-percentage audits
  - Margin-dependent audits (tiered and non-)
  - Polling audits
- Rec: Margin-dependent with a floor.
Low-Level: How to Audit?

• CA has had manual tallies since 1965.
• Little is prescribed by election law
  – Tally must compare ballots in 1% of precincts
  – Must be randomly chosen and completed before the canvass is over (28 cal. days)
  – Must include all types of ballots
• We set out with a group of researchers to improve the security, efficiency and transparency of CA’s manual count.
Low-Level: How to Audit?

- CA has had manual tallies since 1965.
- Little is prescribed by election law
  - Tally must compare ballots in 1% of precincts
  - Must be randomly chosen and completed *before* the canvass is over (28 cal. days)
  - Must include all types of ballots
- We set out with a group of researchers to improve the security, efficiency and transparency of CA’s manual count.
How Does the Tally Work?

- Precincts chosen randomly
- Materials are retrieved, verified, sorted
- Typically four people perform tally: Caller, Witness and two Talliers
- Use a tally sheet and announce “10’s”
- Hand tally is compared to electronic
- Discrepancies must be reconciled
How Does the Tally Work?

- Precincts chosen randomly
- Materials are retrieved, verified, sorted
- Typically four people perform tally: Caller, Witness and two Talliers
- Use a tally sheet and announce “10’s”
- Hand tally is compared to electronic
- Discrepancies must be reconciled
How Does the Tally Work?

• Precincts chosen randomly
• Materials are retrieved, verified, sorted
• Typically four people perform tally: Caller, Witness and two Talliers
• Use a tally sheet and announce “10’s”
• Hand tally is compared to electronic
• Discrepancies must be reconciled
Case Study Methodology

- Examine existing procedures for the tally
- Worked with San Mateo in-depth
- Iteratively developed new procedures
- San Mateo used our interim procedures
- Observed tally process in San Mateo as well as Alameda and Marin.
- Revised and generalized procedures such that any CA county can use them.
Findings: Security

- Selection and tally must take place *after* ballots are counted
- Tally should take place soon after selection and seals verified
- Counting must be blind (not *too* blind)
- Certain procedures need expert review when revised
- Tally process should be resistant to insider attacks
PROPOSITION 95
REFERENDUM ON AMENDMENT TO INDIAN GAMING COMPACT.

“Yes” Vote approves, and “No” Vote rejects, a law that ratifies an amendment to existing gaming compact between the state and Morongo Band of Mission Indians. Fiscal Impact: Net increase in annual state revenues probably in the tens of millions of dollars, growing over time through 2030.

☐ YES
☒ NO

PROPOSITION 96
REFERENDUM ON AMENDMENT TO INDIAN GAMING COMPACT.

“Yes” Vote approves, and “No” Vote rejects, a law that ratifies an amendment to existing gaming compact between the state and Sycuan Band of the Kumeyaay Nation. Fiscal Impact: Net increase in annual state revenues probably in the tens of millions of dollars, growing over time through 2030.

☐ YES
☒ NO

PROPOSITION 97
REFERENDUM ON AMENDMENT TO INDIAN GAMING COMPACT.

“Yes” Vote approves, and “No” Vote rejects, a law that ratifies an amendment to existing gaming compact between the state and Serrano Band of the Los Angeles Mission Indians. Fiscal Impact: Net increase in annual state revenues probably in the tens of millions of dollars, growing over time through 2030.

☐ YES
☒ NO
Findings: Security

• Selection and tally must take place after ballots are counted
• Tally should take place soon after selection and seals verified
• Counting must be blind (not too blind)
• Certain procedures need expert review when revised
• Tally process should be resistant to insider attacks
Random Selection of Precincts

1. 447 = 430400
2. 1040 = 9502930
3. 419 = 421000
4. 472 = 440400
5. 761 = 835500
6. 4 =
Findings: Security

• Selection and tally must take place *after* ballots are counted
• Tally should take place soon after selection and seals verified
• Counting must be blind (not *too* blind)
• Certain procedures need expert review when revised
• Tally process should be resistant to insider attacks
Findings: Transparency

- Provide public notice of the tally
- Publish tally procedures
- Publish useful data, digital & hardcopy
- Ensure clear lines of communication for observers
Findings: Efficiency

- Randomness w/ dice can be inefficient
- Electronic results need to be fine-grained
- Adverse effects of good team demeanor
- Pre-fill tally sheets
- Consider using RFIDs to ease pressure on chain-of-custody.
Dice Binning Calculator for Post-Election Audits

Joseph Lorenzo Hall (joehall@berkeley.edu), UC Berkeley School of Information

To increase the transparency of the 1% manual tally process, a few California counties have begun to use 10-sided dice to produce publicly-verifiable random numbers (See Cordero, Wagner and Dill 2006). Unfortunately, using 10-sided dice to 1) select from only a few precincts or 2) to select from many precincts can require a lot of re-rolling of the dice. To increase the efficiency of the process, Cordero et al. suggest “binning” the dice rolls so that each precinct has a range of corresponding values, of equal width, that allow a higher percentage of dice rolls to “hit”. This calculator implements this idea. It can also output the binning data in a form that is easily pasteable into a spreadsheet. Please click here for source code and licensing information.

Settings

Number of dice: 2
Number of precincts: 13
(By default, it starts with 2 dice and 13 precincts.)

Calculate

Results

- Range is 100. (This is the quantity of random numbers 2 dice can produce.)
- Rounded interval is 7. (This is the number of random numbers per bin.)
- Interval modulus is 9 (9% of rolls). (This is the number of random numbers that will require a re-roll.)

Paste these bins into a spreadsheet

Roll 00-06, pick precinct 1
Roll 07-13, pick precinct 2
Roll 14-20, pick precinct 3
<table>
<thead>
<tr>
<th>MEAS</th>
<th>DICE BIN</th>
<th>PCT</th>
<th>BALLOT STYLE</th>
<th>PCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Roll 000-199, pick precinct 1</td>
<td>1</td>
<td>19</td>
<td>1701</td>
</tr>
<tr>
<td>2</td>
<td>Roll 200-399, pick precinct 2</td>
<td>2</td>
<td>19</td>
<td>1702</td>
</tr>
<tr>
<td>3</td>
<td>Roll 400-599, pick precinct 3</td>
<td>3</td>
<td>19</td>
<td>1703</td>
</tr>
<tr>
<td>4</td>
<td>Roll 600-799, pick precinct 4</td>
<td>4</td>
<td>19</td>
<td>1704</td>
</tr>
<tr>
<td>5</td>
<td>Roll 800-999, pick precinct 5</td>
<td>5</td>
<td>19</td>
<td>1705</td>
</tr>
</tbody>
</table>
Findings: Efficiency

- Randomness w/ dice can be inefficient
- Electronic results need to be fine-grained
- Adverse effects of good team demeanor
- Pre-fill tally sheets
- Consider using RFIDs to ease pressure on chain-of-custody.
Findings: Efficiency

- Randomness w/ dice can be inefficient
- Electronic results need to be fine-grained
- Adverse effects of good team demeanor
- Pre-fill tally sheets
- Consider using RFIDs to ease pressure on chain-of-custody.
General Procedures for CA

May your votes be cast and counted as you intended.

Questions?