



# Statistical Analysis of Post-Election Audit Data for the November 8, 2016 presidential elections

December 2, 2022

## Summary

This report presents an analysis of the returns from the post-election audit performed in the State of Connecticut following the November 8, 2016 presidential elections. This report is based on data that was collected by the Voter Center in 2017 but not reflected in an official report from that period. The analysis in this report was performed by the authors in 2022.

The audit involved analysis of 38 selected precincts in which ballots were cast. In each precinct so selected, the ballots cast on election day were hand-counted. The audit data received by the Center contains 654 records. Two of these records are excluded as the record contained obvious clerical errors (including a zero count for tabulator total). Among the remaining 652 records, the breakdown of discrepancy is as follows:

1. 470 records with no discrepancy,
2. 119 additional records with a discrepancy of at most .1%,
3. 34 additional records with a discrepancy of at most .2%,
4. 13 additional records with a discrepancy of at most .3%,
5. 10 additional records with a discrepancy of at most .5%,
6. 5 additional records with a discrepancy of at most 1%, and
7. 1 records with a discrepancy above 1% a with a discrepancy percentage of 1.358%.

These are discussed in more detail below. This distribution of discrepancies is consistent with anticipated errors arising from hand counts; in particular, this does not offer conclusive evidence of tabulator malfunction in the 2016 presidential election.

Town	District
Bristol	District-77-01
Colchester	District-3
Danbury	District-5
Danbury	District-7
East Lyme	District-2
East Windsor	District-1
Enfield	District-1
Fairfield	District-9
Glastonbury	District-4
Greenwich	District-2
Groton	District-6
Hamden	District-7
Hartford	District-8
East Windsor	District-1
Killingly	District-1
Meriden	District-8
Meriden	District-10
Middletown	District-2
Middletown	District-11
Middletown	District-14
Montville	District-3
Naugatuck	District-2-Feb
Norwalk	District-137B
Norwalk	District-141A
Norwalk	District-143B
Ridgefield	District-1
Ridgefield	District-3
Shelton	District-2.1
South Windsor	District-4
Southington	District-4
Stamford	District-6
Stonington	District-4
Stratford	District-1
Vernon	District-3
Watertown	District-68-01
West Haven	District-2
West Haven	District-5
Wolcott	District-2

Table 1: Audit precincts analyzed

## 1 Analysis Description

### 1.1 Expected Vote Ranges

For each record, the undisputed hand-counted mark total and questionable hand-counted mark total are used to define an *expected tabulator total range*. The range is defined as having a minimum that is equal to the undisputed mark count and a maximum that is equal to the sum of the undisputed mark count and questionable mark count. If the total as reported by the tabulator is at least the undisputed mark count and no more than the sum of the undisputed and questionable mark counts, the tabulated results are consistent with the hand-counted results. In this case, the tabulator is considered to be functioning properly.

### 1.2 Discrepancies

**Total Ballot Count Discrepancies.** If the tabulator total falls outside of this expected range then it is considered an unexplained discrepancy. If the total ballot count is different from the total number of ballots counted during the audit, and the discrepancy value falls somewhere between zero and the ballot count difference, then the source of the discrepancy is potentially attributable to the difference in ballot count. For this reason, it is important that auditors reconcile the tabulator ballot count and the audit ballot count. If these counts differ, then the audit’s conclusion is weakened—any significant differences between the tabulator ballot count and the audit ballot count are grounds for further investigation.

We evaluate discrepancy as a percentage of counted ballots. As the total number of hand-counted ballots is not reported in these records, we establish a lower bound on the total number of hand-counted ballots by:

1. In each district, summing the undisputed vote totals for all candidates in each reference race, and
2. Compute the maximum among undisputed vote totals for all reference races.

As all reference races permit ballots to include a vote for no more than one candidate, this total is a lower bound on the total number of hand-counted ballots—note that some ballots may have not a marked vote for any candidate or may have questionable marks. We then compute the discrepancy as a percentage of this value. Note that the resulting percentage is at least as large as the percentage that would result if computed as a fraction of the total number of hand-counted ballots.

**Anticipated Human Error.** We anticipate that a small amount of error will be present in a hand count. This error presumably depends on a wide variety of factors, including the complexity of the race to be audited, the operational details of the hand counting procedure, and the physical details of the ballots themselves. The study of Goggin, Byrna, and Gilbert [GBG12] observed an empirical error rate of 1.87% (with a standard error of .678%) for Optical Scan ballots; the study adopted simple two-candidate races and averaged over several counting methods. With this as a guide, we treat individual discrepancies not exceeding 1.87% of the audit ballot count as consistent with errors arising from human hand counting; in particular, such error rates are not a conclusive indicator of tabulator malfunction. Historically, we rarely experience individual discrepancies greater than 1% of the total number of cast ballots.

**Unexplained Discrepancies.** The analysis concludes by considering all unexplained discrepancies that are greater than 1.87% of the audit ballot count or significant disagreements between tabulator ballot counts and audit ballot counts. Any such discrepancies will trigger a recommendation for further investigation, but do not necessarily constitute evidence of a tabulator malfunction.

## 2 Analysis Results

As described above, two records did not include tabulator count and are excluded. Of the 652 usable records the discrepancy percentages are shown in Table 2. As shown, 470 (71.9%) exactly confirmed the tabulator count, the remaining 182 records showed a nonzero discrepancy. There are six records showing a discrepancy of at least .5%. The VoTeR Center contacted registrars of voters in several districts to discuss observed discrepancies.

**Further discussion of discrepancies.** Of the 182 records showing a discrepancy between the audit count and the machine count, 181 are within the 1% threshold of the audit ballot count, and the last audit record is within the 1.87% threshold and is therefore considered within the range of anticipated human error. This record is greater than the 1% error we historically observe in audits. All examined records are in single-candidate races so we do not believe the complexity of marking contributed to these discrepancies.

## 3 Conclusion

The University of Connecticut Center for Voting Technology Research (VoTeR Center) received data gathered in the post-election audit performed in the State of Connecticut following the November 8, 2016 election. Due a clerical error, a report was not published in a timely manner. This report is based on analysis conducted in 2022 of data collected in 2017.

Discrepancy %	#
Excluded	2
0	470
>0 and $\leq .1\%$	119
>.1% and $\leq .2\%$	34
>.2% and $\leq .3\%$	13
>.3% and $\leq .5\%$	10
.522%	2
.772%	1
.809%	1
.956%	1
1.358%	1
Total	654

Table 2: Discrepancy percentage across records.

The audit involved 38 randomly selected precincts at which ballots were cast; the audit returns were conveyed by the Office of the Secretary of the State (SotS) to the VoTeR Center. The audit data analyzed by the Center contains 654 records, where each record represents information about a given candidate: date, district, office, candidate, machine counted total, hand counted total of the votes considered unquestionable by the auditors, hand counted total of the votes considered questionable by the auditors, and the hand counted total, that is, the sum of undisputed and questionable votes.

While one always wishes for no discrepancies, the magnitude of the numbers for precincts that submitted complete information is consistent with human error. To conclude, the analyzed audits offer no conclusive evidence of tabulator malfunction in the 2016 presidential election.

## References

- [GBG12] Stephen N. Goggin, Michael D. Byrne and Juan E. Gilbert. Post-Election Auditing: Effects of Procedure and Ballot Type on Manual Counting Accuracy, Efficiency, and Auditor Satisfaction and Confidence. *Election Law Journal: Rules, Politics, and Policy*. 11(1): 36–51. March, 2012.