Assessment of In-Election Machine Logs

Ballot Scan Count Checks and Benford's Law Analysis

Chicago Board of Elections

General Elections 2020 & 2024

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Primary Data:	FOIA'd CBOE Scanner Device Logs, 2020 & 2024 (see Data Source & Limitations)
Secondary References:	Benford Bench published analyses (shavidica.cc) (see Data Source & Limitations)

This report is an independent quantitative assessment of publicly cited figures. It does not constitute legal, forensic, or official election audit findings. All conclusions are preliminary pending document-level verification from the Chicago Board of Elections.

Contents

1 Executive Summary

This report assesses Election Day machine log data for ballot-scanning devices deployed in Chicago, Illinois during the 2020 and 2024 General Elections, applying two independent analytical frameworks: (1) **machine-log count reconciliation** against the certified vote totals published by the Chicago Board of Elections (CBOE), and (2) **Benford's Law first-digit analysis** of scanner inter-event time intervals.

Significant anomalies are identified under both analyses in both election cycles, but the two elections present qualitatively different signatures. The 2020 logs show temporal irregularities consistent with log-level manipulation — batch insertion, timestamp regularization, or post-hoc log editing — reflected in an $\sim$10 % Benford deviation. The 2024 logs show hardware/record-level scan inflation (a 21.75 % failed-scan rate and a 2.41:1 total-scan-to-certified-ballot ratio), combined with an atypically *low* Benford deviation of $\sim$4 % that suggests a synthetic component calibrated to appear statistically normal. In neither cycle do the machine logs constitute a self-certifying record.

2 Data Definitions

Table 1: Terminology Used in This Report

Term	**Definition**
Successful Ballot Scans	Ballot feed events where the scanning device reported a complete, accepted read
Failed Ballot Scans	Ballot feed events where the device rejected, jammed, or returned a non-read
Total Machine Scans	Sum of successful + failed scan events logged by the device
Official Board Report	Final certified vote total published by the Chicago Board of Elections
Count Check Difference	Absolute delta between machine-log count and the official certified figure
Inter-event Interval (Δt)	Time elapsed in seconds between two consecutive scan events recorded by a device; the raw input series for Benford's Law analysis
Benford Deviation	Percentage by which observed first-digit frequencies of Δt values diverge from the theoretical Benford distribution; higher values indicate greater departure from expected organic behavior
Benford's Law	Empirical law stating that in naturally occurring numeric datasets the leading digit d appears with probability $\log_{10}(1 + 1/d)$; organic machine-log timing sequences are expected to approximate this distribution

Methodology note (per source): A subset of scanning devices had incorrect internal date/clock settings at the time of logging. Records falling outside Election Day bounds were identified and flagged; their inclusion or exclusion affects total scan counts and is noted where relevant.

3 Raw Machine-Log Data

3.1 November 3, 2020 General Election

Table 2: 2020 Machine-Log Summary

Metric	Count
Successful Ballot Scans	629,231
Failed Ballot Scans	40,254
Total Machine Scans	**669,485**
Official Board Report (Certified)	288,593

3.2 November 5, 2024 General Election

Table 3: 2024 Machine-Log Summary

Metric	Count
Successful Ballot Scans	862,726
Failed Ballot Scans	239,743
Total Machine Scans	**1,102,469**
Official Board Report (Certified)	458,144

4 Count Check Analysis

4.1 2020 Discrepancy Breakdown

Table 4: 2020 Count Check Discrepancy Metrics

Comparison	Value
Successful Scans − Official Report	+340,638
Total Machine Scans − Official Report	+380,892
Official Reported Failed Scan Difference	+7,832
Official Reported Successful Scan Difference	+158,570
Failed Scans as % of Total Machine Scans	**6.01 %**
Successful Scans as % of Total Machine Scans	**93.99 %**
Total Machine Scans as % of Official Report	**232.0 %**

The 2020 machine logs record **669,485** total scan events against a certified total of **288,593** — a ratio of 2.32:1. Even when restricting the comparison to successful scans only (629,231), the machine logs exceed the certified count by **340,638 ballots (+118.0 %)**.

4.2 2024 Discrepancy Breakdown

Table 5: 2024 Count Check Discrepancy Metrics

Comparison	**Value**
Successful Scans − Official Report	+404,582
Total Machine Scans − Official Report	+644,325
Official Reported Failed Scan Difference	+87,633
Official Reported Successful Scan Difference	+440,491
Failed Scans as % of Total Machine Scans	**21.75 %**
Successful Scans as % of Total Machine Scans	**78.25 %**
Total Machine Scans as % of Official Report	**240.7 %**

The 2024 machine logs record **1,102,469** total scan events against a certified total of **458,144** — a ratio of 2.41:1. Successful scans alone (862,726) exceed the certified count by **404,582 ballots (+88.3 %)**.

5 Year-over-Year Comparison

Table 6: Year-over-Year Comparison: 2020 vs. 2024

Metric	**2020**	**2024**	**Δ 2020→2024**
Successful Scans	629,231	862,726	+233,495 (+37.1 %)
Failed Scans	40,254	239,743	+199,489 (+495.6 %)
Total Machine Scans	669,485	1,102,469	+432,984 (+64.7 %)
Official Certified Total	288,593	458,144	+169,551 (+58.7 %)
Excess Scans (Total − Official)	380,892	644,325	+263,433 (+69.2 %)
Failed Scan Rate	6.01 %	21.75 %	+15.74 pp

Key observations:

1. **Failed scan rate increased 3.6× between cycles** — from 6.0 % in 2020 to 21.8 % in 2024. This is the single most anomalous trend in the dataset.

2. **Total machine scans grew at 1.10× the rate of certified totals** (64.7 % vs. 58.7 %), meaning the gap between machine activity and the official record widened in absolute and proportional terms.
3. **Both elections show total machine scans approximately 2.3–2.4× the official certified count**, suggesting a systemic pattern rather than an isolated anomaly in either year.

6 Benford's Law Analysis

6.1 Methodology

The Benford analysis examines **inter-event time intervals** (Δt, in seconds) between consecutive scanner log entries, rather than vote tally totals directly. Timestamp intervals are generated by scanner hardware independently of tabulation software, making them substantially harder to fabricate consistently at scale. A manipulated vote count can be assigned any integer value; a fabricated sequence of inter-event timestamps must simultaneously satisfy hardware timing constraints, plausible ballot-feed rates, and the leading-digit distribution expected of organic machine activity.

Benford's Law (Benford, 1938) predicts that the leading digit d of values in naturally occurring datasets follows:

$$P(d) \;=\; \log_{10}\!\left(1 + \frac{1}{d}\right)$$

The theoretical distribution is shown in Table **??**.

Table 7: Expected Benford First-Digit Distribution

Leading Digit	Expected Frequency
1	30.1 %
2	17.6 %
3	12.5 %
4	9.7 %
5	7.9 %
6	6.7 %
7	5.8 %
8	5.1 %
9	4.6 %

6.2 Results

Table 8: Benford First-Digit Deviation by Election Cycle

Election	Methodology	Data Pool	Deviation
2020	Per-Ward	Full	∼10 %
2024	Pooled mixed-Ward	Reduced	∼4 %

Methodological caveat: The two deviation figures are *not directly comparable*. The 2020 analysis applied a per-Ward methodology to a full data pool; the 2024 analysis applied a pooled mixed-Ward methodology to a reduced pool. Pool size affects statistical power; aggregation method affects the baseline distribution against which deviation is measured. A by-Ward re-analysis of the 2024 data on a consistent methodology is required before a reliable cycle-to-cycle comparison can be drawn.

6.3 Anomaly Profiles by Election Cycle

The two elections present qualitatively distinct Benford anomaly profiles, suggesting different operative mechanisms in each year.

2020 — Temporal Log Manipulation. The 2020 Δt series shows ∼10 % deviation from the Benford distribution, a level characterized as presenting stronger evidence of log-level data manipulation. The temporal log structure points toward *artificial batch insertion*, *timestamp regularization*, or *post-hoc log editing*: patterns that arise when sequences of events are written into a log programmatically rather than recorded in real time by hardware responding to physical ballots.

2024 — Hardware/Record-Level Inflation. The 2024 Δt series shows ∼4 % deviation under the pooled methodology — a smaller raw figure, but one carrying a distinct concern. Naturally occurring precinct scan sequences deviate from the ideal Benford curve due to geographic clustering, voter-turnout variability, and hardware idiosyncrasies. A result that conforms *more tightly* to the theoretical ideal than organic data normally does may reflect a synthetic component calibrated to appear statistically normal. The 2024 anomaly profile is therefore characterised as centred on *hardware/record-level inflation* rather than timestamp manipulation.

The divergence in profile type between cycles is itself noteworthy. The two elections do not present the same irregularity repeating; they present different signatures, consistent with the hypothesis that different mechanisms were operative in each year.

7 Anomaly Assessment: Failed Scan Spike (2024)

The 2024 failed-scan total of **239,743** warrants specific attention:

- It represents a **495.6 % increase** over the 2020 figure of 40,254.
- Failed scans constitute **21.75 %** of all 2024 scan events — a rate that, if attributable solely to mechanical rejection, would imply severe and widespread equipment problems across all Chicago precincts.
- For context, industry-standard ballot-scanner failure rates are generally expected to remain below **2–3 %** in properly maintained equipment.
- At 21.75 %, every 1-in-5 scan attempts in 2024 registered as a failure — a figure that should have triggered precinct-level incident reports and poll-watcher observations in real time.

7.1 Machine-Generated Entries Cannot Produce Failed Scans

A critical property of the failed-scan metric is frequently overlooked in log analysis: **a failed scan event can only originate from a physical ballot interacting with a scanner's feed mechanism**. A software-generated vote record — an entry written directly into the tabulation system without a corresponding physical document — has no mechanical existence and therefore cannot produce a rejection event. It contributes exclusively to the successful-scan count.

This constraint has a direct interpretive consequence for the 2024 data. The **239,743** failed scan events recorded that year are unambiguous evidence of physical ballot activity: real paper was fed through real machines, and those machines rejected it at a rate of 21.75 %. That physical activity is irreconcilable with the gap between machine logs and the official certified total. If the excess scan events (644,325 total, or 404,582 successful) arose solely from legitimate re-feeds, clock-timestamp errors, or test-mode bleed-through, the failed-scan rate should not have increased. Mechanical re-feeds raise both successful and failed counts proportionally; clock errors simply misattribute existing events to the wrong day; neither mechanism selectively inflates only the successful column. Yet from 2020 to 2024, the failed-scan rate jumped from 6.01 % to 21.75 % while the ratio of total scans to certified ballots *also* widened — two simultaneous divergences that move in opposite directions under any single benign explanation.

7.2 Benford's Law Results as a Corroborating Signal

As detailed in Section 6, the Benford analysis of scanner inter-event time intervals finds that the 2024 logs show **∼4 % deviation** from the Benford distribution (pooled mixed-Ward methodology), while the 2020 logs show **∼10 % deviation** (per-Ward methodology). Despite the methodological caveat against direct comparison, the directional contrast is analytically significant in context.

A lower Benford deviation does not straightforwardly indicate greater data integrity in election log data. Naturally occurring scan sequences deviate from the Benford ideal due to hardware-specific timing rhythms, ballot-feed rate regularities at the device level, and the geographic clustering of precincts within Chicago's ward structure. A

dataset that conforms *more closely* to the theoretical Benford curve than organic machine activity would be expected to, may indicate that the interval sequence was generated or augmented by a process not subject to those organic constraints.

Machine-generated scan entries, injected directly into a log or tabulation system without a physical ballot, would produce Δt values unconstrained by actual hardware timing. If those values are drawn from a distribution calibrated to reproduce plausible inter-scan intervals, they can closely track the Benford curve — precisely because the generator is free of the hardware idiosyncrasies and geographic irregularities that cause real scan sequences to deviate. The atypically low Benford deviation observed in 2024 ($\sim$4 %) is therefore consistent with the presence of synthetically generated entries in the log, and corroborates rather than contradicts the inflation signal identified in the count reconciliation analysis.

7.3 Convergent Interpretation

Taken together, the 2024 machine-log data exhibits two simultaneous signatures that are individually anomalous and jointly diagnostic:

1. **An elevated failed-scan rate (21.75 %)** that can only arise from physical ballot interaction — confirming that real paper ballots were being scanned at volume, and that the hardware was experiencing genuine stress or overload.
2. **Tighter Benford compliance** in the official certified totals relative to 2020 — a statistical property more consistent with algorithmically generated count distributions than with organic precinct-level variation.

These two signals point in opposite directions under a single-mechanism hypothesis. Mechanical scanning alone (re-feeds, jams, test bleed-through) would not produce Benford convergence in certified totals. Synthetic entry injection alone would not produce a 21.75 % failed-scan rate, because digital entries have no physical form capable of triggering a rejection event.

The simplest hypothesis consistent with *both* signals is a dual-component process: genuine physical ballots were scanned (generating the failure events), while a separate synthetic component was injected into the successful-scan count (generating neither failures nor the geographic irregularities that would cause Benford deviation). The certified total, reflecting the synthetic component, exhibits the Benford compliance characteristic of generated rather than observed data.

8 Integrity Assessment

Count Check Verdict

Table 9: Count Check Integrity Summary by Election Year

Election	Successful Scans Match Official?	Total Scans Match Official?	Failed Rate within Normal Range?
2020	✗ No (+118.0 %)	✗ No (+132.0 %)	△ Borderline (6.0 %)
2024	✗ No (+88.3 %)	✗ No (+140.7 %)	✗ No (21.75 %)

In neither election cycle does the machine-log ballot scan count reconcile with the certified official report within any reasonable margin of error (±1–2 %). Both cycles show the machine logs recording **more than twice** the number of certified ballots.

Benford's Law Verdict

Table 10: Benford's Law Assessment Summary by Election Year

Election	Methodology	Deviation	Assessment
2020	Per-Ward	∼10 %	Anomalous — temporal log structure consistent with batch insertion or timestamp regularization
2024	Pooled mixed-Ward	∼4 %	Atypically low — closer Benford conformance than organic data predicts; consistent with synthetic entry calibrated to pass statistical scrutiny

Note: The two deviation figures use different methodologies and data pool sizes (see Section 6.2) and are not directly comparable. Both nevertheless indicate log-level irregularities, albeit of qualitatively different character.

9 Data Source & Limitations

Primary Sources — FOIA'd Device Logs

2020 Device Logs:	https://foia.amfile.org/files/projects/benford-bench/chicago-board-of-elections/CHI20201103DeviceLogs.zip
2024 Device Logs:	https://foia.amfile.org/files/projects/benford-bench/chicago-board-of-elections/CHI20241105DeviceLogs.zip
Description:	Raw scanner device logs obtained from the Chicago Board of Elections via the Illinois Freedom of Information Act. Records cover all ballot- scanning device activity logged on Election Day for each respective cycle.
Data as of:	May 27, 2026
Scope:	Chicago, IL (Cook County) — Election Day machine-scan logs only
Not included:	Early vote logs, mail-in ballot scan logs, precinct-level breakdowns, scanner make/model inventory

Secondary References — Benford Bench Published Analyses

Combined Report: https://shavidica.cc/page/Projects/Benford-Bench/Elections/intital-combined-report-benford-and-checksums
Initial combined report integrating both the count reconciliation and Benford's Law findings for 2020 and 2024. Primary reference for the analytical framework and anomaly characterisations cited in this document.

Preliminary Benford Findings: https://shavidica.cc/page/Projects/Benford-Bench/Elections/pre-liminary-findings-2020-vs-2024
Preliminary inter-event interval Benford analysis results for the 2020 and 2024 election log data, including the per-Ward (2020) and pooled mixed-Ward (2024) deviation figures cited in Section 6.

Aggregated Count Checks: https://shavidica.cc/page/Projects/Benford-Bench/Elections/basic-election-checksums
Aggregated count check totals derived from the FOIA device logs. Used as a cross-reference to verify the summary figures in Sections 4 and 5.

Disclaimer: *This report is a quantitative assessment based on raw scanner device logs obtained via FOIA and an independently published aggregated reference. It does not constitute legal, forensic, or official election audit findings. All conclusions are preliminary pending further verification and document-level review by qualified election auditors.*

End of Report