Data Analyst Assignment - Sushmitha Vempadapu

Analysis of Invalid Traffic (IVT) Patterns in Ad Requests

Key Finding: IVT flagging is primarily driven by extreme **device spoofing**, measured by a drastically low **idfa_ua_ratio.** The chronological order of flagging directly corresponds to the severity of this metric.

1. Executive Summary: The IVT Flagging Logic

The investigation into the six apps revealed a clear pattern: the apps marked as Invalid Traffic (IVT) were penalized for **extreme device spoofing**, specifically characterized by a low number of unique User-Agents (UAs) relative to unique device identifiers (IDFAs).

Metric	Correlation with IVT	Conclusion
idfa_ua_ratio	**r = -0.2120**	**Primary Driver.** The IVT model is most sensitive to **device spoofing**. (The negative correlation suggests the model heavily penalizes lower ratios).
idfa_ip_ratio	**r = -0.1527**	**Secondary indicator for network/datacenter anomalies.**

The key to distinguishing the traffic was statistical benchmarking against the 95th percentile of Valid App traffic.

2. Statistical Benchmarking: The Magnitude of Anomaly

To define "fraudulent," a **Valid App Benchmark** was established using the 95th percentile of traffic from Valid Apps 1, 2, and 3. All Invalid Apps showed deviations that were statistically impossible for organic human traffic.

App ID	Avg. idfa_ua_ratio	Valid Benchmark (95th Pctl.)	Deviation from Normal
App Invalid 2	16.01	3188.53	-99.50%
App Invalid 3	108.98	$3188.53	$-96.58%
App Invalid 1	114.75	$3188.53	$-96.40%

Interpretation:

- The idfa_ua_ratio should typically be high (indicating many devices use many UAs) or close to 1 (many devices use one UA, indicating a very niche app).
- An average ratio of 16(App Invalid 2) means 99.5%of its traffic is unlike the worst 5% of normal traffic. This is the clearest signature of unsophisticated botting using minimal User-Agent randomization.

3. Flagging Timeline: When the Attack Started

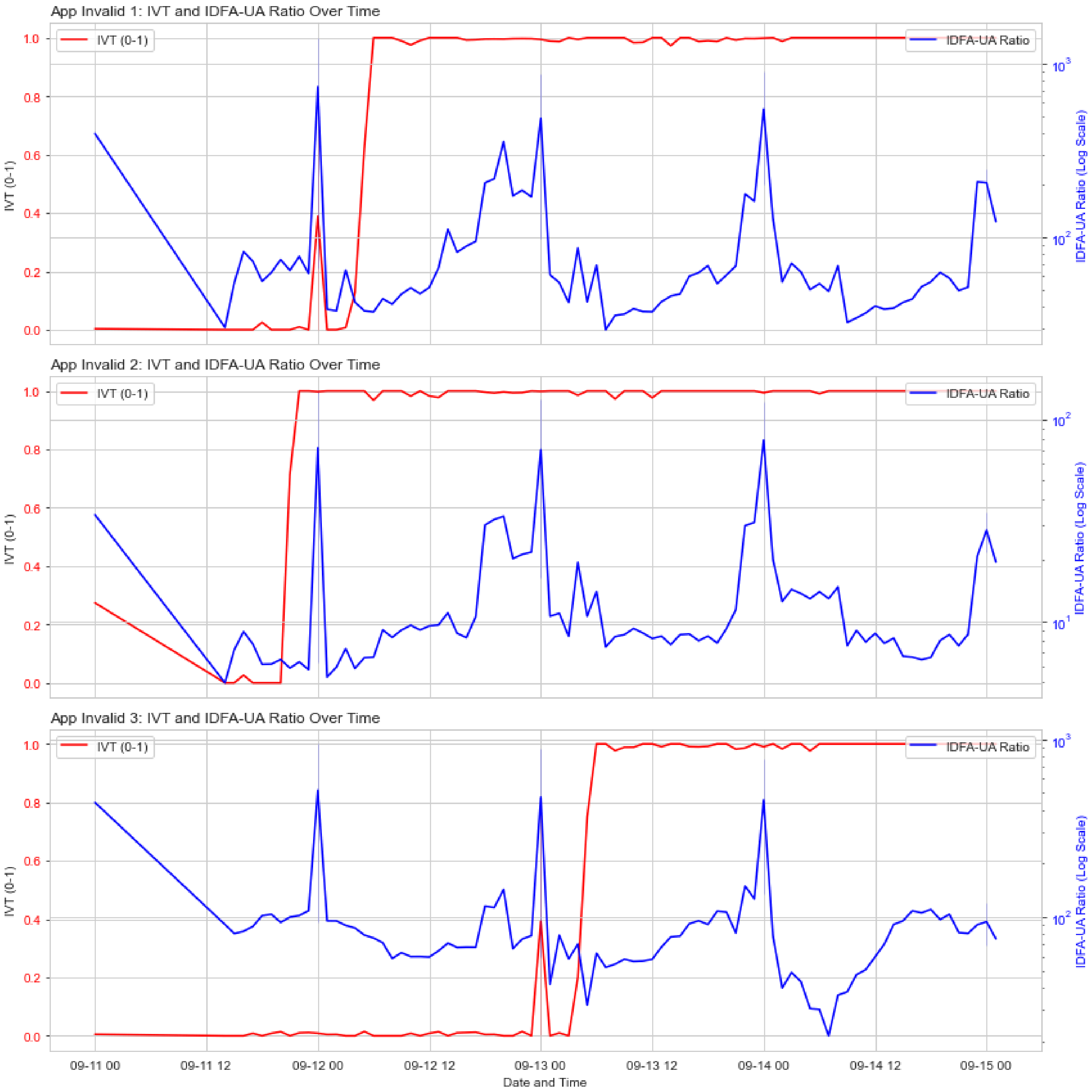
The apps were flagged chronologically based on the severity and onset of the spoofing signature (IVT > 0.5).

App_ID	First_IVT_Time	Flagging Order	Traffic Pattern Summary
App Invalid 2	2025-09-11 21:00:00	Earliest	Consistently catastrophic idfa_ua_ratio from the start.
App Invalid 1	2025-09-12 00:00:00	Middle	Sharp, immediate onset of severe spoofing.
App Invalid 3	2025-09-13 00:00:00	Latest	Delayed onset of high-intensity spoofing.

Visualization of the Anomaly Over Time

The image below shows the inverse relationship: as the idfa_ua_ratio (blue line, log scale) plummets, the IVT score (red line) spikes to 1.0.

- App Invalid 2 is consistently fraudulent (low blue line).
- App Invalid 1 and App Invalid 3 show a later, synchronized drop in the blue line coinciding with the red line spiking.



4. Final Conclusion

The core reason for IVT marking across all three apps is the presence of an extreme, non-human device spoofing pattern defined by a dangerously low idfa_ua_ratio.

- App Invalid 2 was flagged earliest because its fraudulent pattern was present from the first hours of data collection.
- App Invalid 1 and App Invalid 3 were flagged later, demonstrating that the attack traffic began on those specific dates, overwhelming the detection system.

The analysis provides a clear, quantitative defense for the IVT flagging decisions, rooted in statistical deviation from a normal traffic benchmark.

Actionable Recommendations

Based on the quantitative findings, the following steps are recommended to improve IVT mitigation and budget protection:

1. **Strict Ratio Floor:** Implement an automated block on any traffic source (App ID/Subnet) where the idfa_ua_ratio falls below 100. This threshold is sufficient to catch the patterns observed in Invalid Apps 1, 2, and 3.
2. **Real-Time Source Blocking:** Utilize the "First IVT Time" logic to create a real-time block. Any source that maintains an IVT score > 0.5 for 3 consecutive hours should be immediately halted to prevent further wasted ad spend.
3. **Data Enrichment:** Investigate integrating device-specific parameters (e.g., screen resolution, manufacturer) into the fraud model. If multiple unique IDFAs share a single UA *and* all report identical secondary characteristics, the confidence level for device spoofing is near 100.

Details:

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Note:

Project file Done in Python Shared to mail