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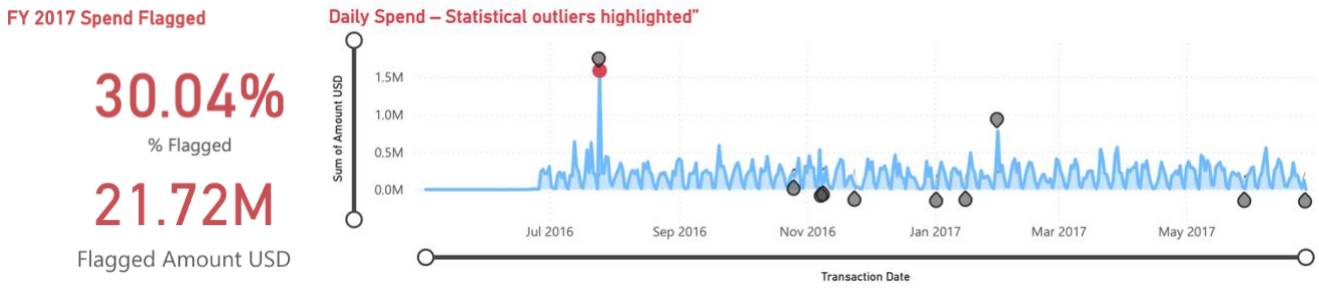
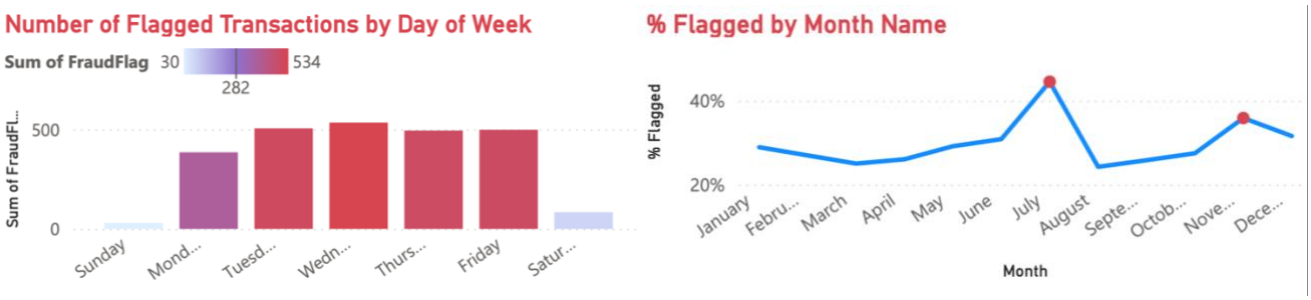
Departmental and Vendor Anomalies with Temporal Pattern

– FY-2017 Procurement Card Fraud Report

Visual Summary

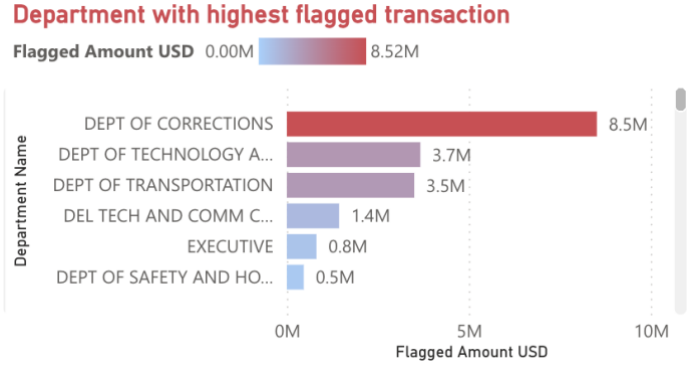
Applying a 3-sigma statistical rule, approximately **$21.72 million (30.04%)** of procurement-card transactions were flagged as anomalies. The **highest single-day spending spike occurred on July 25**, shortly after the Independence Day holiday, suggesting post-holiday procurement surges. Another major anomaly—on **February 2nd**—fell outside any holiday period, indicating that not all flagged activity is seasonal.

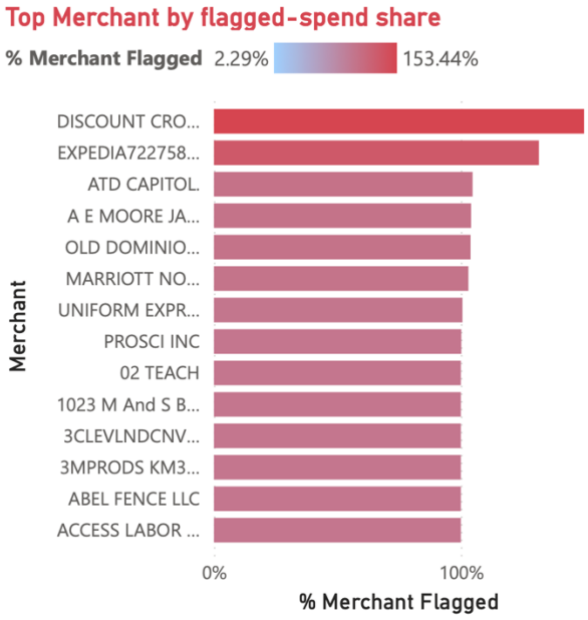




Flagged transactions were heavily concentrated between Monday and Wednesday, aligning with routine operational cycles. **July, November, and December** recorded the highest monthly flag rates, potentially linked to holiday pressures and year-end spending such as Independence Day, Black Friday, or Christmas.

High-risk vendors like **Discount Crowd**, **Expedia** and departments such as **Corrections** and **Technology**, were consistently associated with flagged transactions, underscoring the need for improved oversight and targeted audits.





*Data source: Delaware State Employee Credit Card Transactions (FY2017). Outliers based on |z| > 3.

*This summary is adapted from the Power BI dashboard prepared for fraud investigation teams. See pages 3–4 for full dashboard screenshots and filters.

Report Justification

Methodology and Rule Used

We applied a statistical fraud detection method using z-scores within each category. A transaction was flagged if it exceeded 3 standard deviations above or below its category's average ($|z| > 3$). This 3-sigma rule is widely recognized for anomaly detection in financial systems (Bolton & Hand, 2002). While Power BI's built-in anomaly detection visually supported our findings, it could not be programmatically used for final classification in this build.

A flagged transaction is one that 'jumps out' well beyond typical spending, as if it were an outlier three times above the usual threshold.

Limitations

This dataset does not include confirmed fraud cases. Flagged transactions are statistical outliers, which may indicate errors, policy breaches, or fraud — but human review is necessary for confirmation.

Key Business Questions Addressed

- **What patterns indicate fraudulent activity?**

  Patterns that signal potentially fraudulent activity span five dimensions:

  1. **Statistical outliers** – 30.04 %, meaning nearly 1 out of 3 transactions of FY-2017 exceeded the 3-sigma threshold ($|z| > 3$), flagging US $21.72 million in unusual spend.
  2. **High-risk vendors** – A handful of merchants drive the bulk of risk: Discount Crowd and Expedia each show a 100 % flag rate, pointing to repeated misuse or lax vendor controls.
  3. **Departmental clusters** – The Department of Correction alone accounts for US $8.5 million in anomalies, with Technology and Transportation close behind—evidence of systemic gaps in these units.
  4. **Operational timing** – Flagged activity is heaviest Monday–Friday; weekends are virtually anomaly-free, so any future weekend spikes would demand immediate review.
  5. **Seasonal peaks** – Flag rates surge in July, November, and December, coinciding with Independence Day, Black Friday, and Christmas/Boxing-Day purchasing cycles. Although daily spikes like 2 February show fraud can occur off-season, these holiday-period surges highlight times when controls should be tightened.

- **How do flagged transactions vary by merchant or region?**

  Some vendors, including Discount Crowd and Expedia, recorded a >100% flag rate, reflecting persistent irregularities. The Department of Correction stood out with over $8.5M in flagged spend, indicating a major concentration of risk. These findings support closer vendor audits and departmental reviews.

- **Are anomalies concentrated during specific periods (e.g., holidays)?**

  Yes—particularly at the monthly level, where flagged transactions were highest in July, November, and December. These peaks strongly correlate with seasonal spending periods, including Independence Day, Black Friday, Christmas, and Boxing Day, suggesting holiday-related pressures drive a significant portion of anomalies. However, at the daily level, not all spikes aligned with holidays. For example, February 2nd, one of the year's largest single-day anomalies, occurred outside any major holiday window.

  Additionally, flagged transactions were most common on weekdays, indicating that regular operational cycles also contribute to anomaly patterns. These insights highlight the need to monitor both seasonal cycles and non-seasonal procurement surges.

- **What percentage of transactions fall outside typical spending patterns?**

  A total of 30.04% of transactions breached the 3-sigma threshold. This is nearly one in three—an unusually high rate for a public procurement environment, underscoring the urgency of strengthening policy compliance, monitoring tools, and exception reporting.

Recommendation

• Implement automated flagging alerts not just around holidays, but also for **sudden spend spikes outside seasonal norms** (e.g., Feb 2 anomaly).
• Require **merchant-specific caps** and dual approval for departments with a high anomaly history.
• Conduct **monthly audits** for departments with >25% flagged rate and cross-reference with documentation logs.
• Expand the dashboard to integrate machine learning-based anomaly scoring and predictive alerts.

This investigation aligns with findings from the Delaware Office of the Auditor of Accounts (2019), which reported over 9,700 procurement card transactions in FY2017 lacking required documentation or approvals. These governance lapses mirror the departmental anomalies identified in our analysis — particularly in high-spend, high-flag areas such as Corrections and Technology. Together, they underscore the urgency of enhancing oversight protocols and real-time fraud detection tools.

References

Bolton, R. J. & Hand, D. J., 2002. Statistical fraud detection: A review. Statistical Science, 17(3), pp.235–255.

Delaware Office of the Auditor of Accounts (2019) 'Purchase Card Inspection – Fiscal Year 2017.' Dover, DE.