Data analysis project

Toronto P-Card: Behind the Swipe

Identifying Anomalies and Enhancing Spending Controls

December 2025

Agenda

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Context

City staff use **P-Cards** for **operational purchases essential to public services**. Because of their **flexibility**, P-Cards also **might present fraud and misuse risks** that require proactive monitoring.

P-Card Usage Guidelines

Small purchases

The purpose of the P-card is small non recurrent purchases. Everything above $5K should follow standard purchasing procedure.

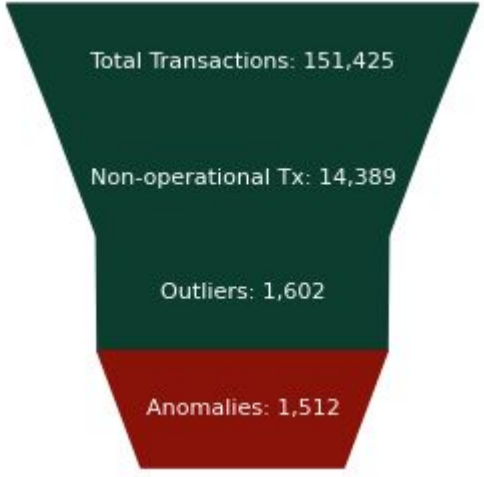
Working hours

P-Card spending should occur during business hours (Mon–Fri, 7 a.m.–6 p.m.) and normally limited to local transactions.

Merchants

P-card spending on merchants should match the expected vendor categories according to each Toronto Government Division.

Fraud detection Funnel



A small fraction of P-Card activity exhibits patterns that **may indicate elevated fraud risk**, totaling up **$6M (11% of expenditure)**

How and When do Toronto Staff swipe?

Overall Statistics

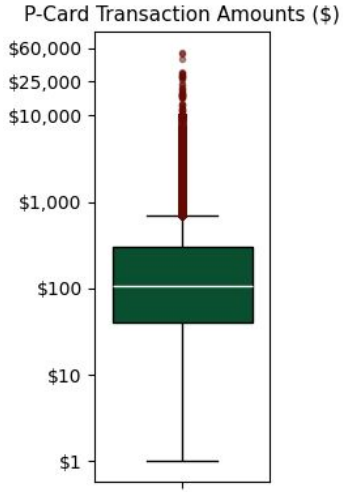
151.4 K
Total trx

$50.4M
Total amount

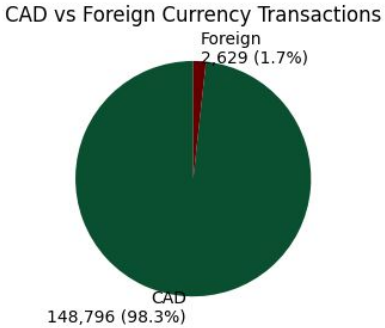
$330
Avg trx amount

$103
Median amount

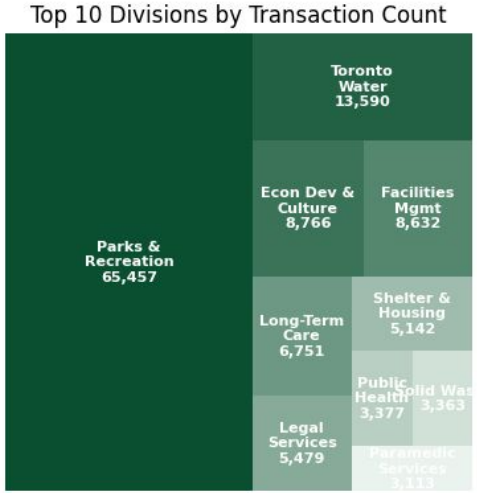
81
Divisions

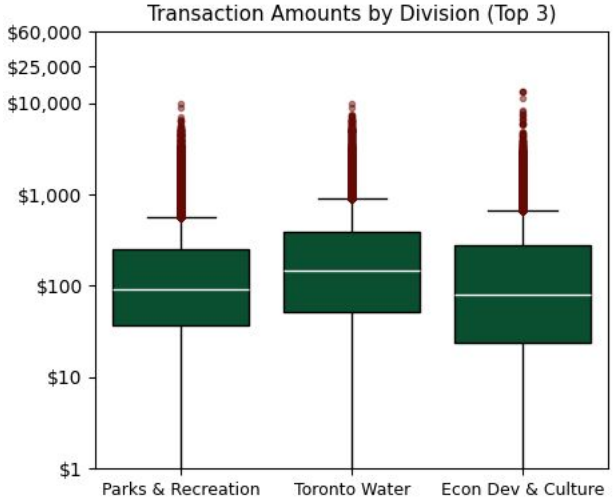


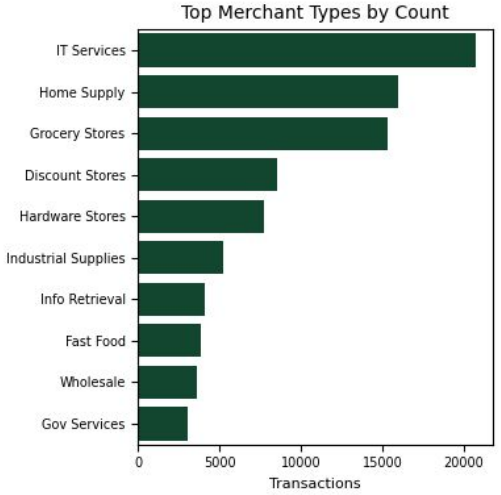
- **Most trx** are **low-value**, with **75% under $300**, and only a **small number of outliers** reaching **up to $53K.**
- **Spending** remains stable month-to-month with **no seasonal patterns**. **Weekend** transactions are **lower in value and volume** than weekday purchases, but s**till represent 8% of total transactions.**
- Only **1.7%** of transactions occur in foreign currencies, but **higher in value**, with an **average of $622 vs $328 for CAD.**



Where are P-cards used?







- **A few key divisions** dominate activity: **Parks & Recreation** accounts for over **40% of trx**, followed by **Toronto Water** and **Econ, Dev & Culture**.
- The top divisions exhibit **nearly identical spending behavior**, dominated by **small purchases and occasional high-value outliers.**
- **Spending is concentrated in a few merchant categories,** led by IT services and home improvement suppliers, **reflecting the city's operational and maintenance priorities.**

Fraud Detection Strategy

The analysis reveals **no consistent misuse signals** across time, weekends, transaction amounts, or merchant activity.
Fraud may be subtle and hard to detect, which requires a multi-layered, merchant-driven detection framework enhanced with machine learning.

Machine learning approach

Potential fraud is detected by combining **machine learning with merchant-level insights and business rules**.

The model understands typical spending patterns for each merchant, helping to highlight transactions that don't fit the expected behavior.

Machine learning results

Pattern	Flags	Trx	Amount	Avg amount
🤖+🔴	2	412	$4M	$10k
🤖+🔴 + 🌍	3	109	$554K	$5k
🤖+🌍	2	402	$538K	$1k
🤖+🔴 + 🕒	3	72	$403K	$6k
🤖+🕒	2	168	$304K	$2k
🤖+🌍 + 🕒	3	338	$90K	$0.3k
🤖+🔴 + 🌍 + 🕒	4	11	$65K	$6k

🤖= ML Model 🔴= Outlier 🌍= Foreign trx 🕒= Weekend

All **trx** shown are **flagged** by the **ML fraud model**, which considers merchant patterns, while **business-rule flags determine priority**

Fraud Detection Review

False positives consume operational capacity and reduce trust in the process. Because each alert requires time and resources to review, patterns with more flags, higher financial exposure, and larger average transaction amounts are prioritized.

Review examples by division

Economic Development & Culture

Pattern	Flags	Trx	Amount	Avg amount
🤖+🔴	2	412	$4M	$10k

- A $**13,154** charge to **Executive LA Limousine** service
- The merchant type might be aligned with activities in this division, but the amount seems too large
- Does this expenditure comply with city travel and transportation policies?

Parks, Forestry & Recreation

Pattern	Flags	Trx	Amount	Avg amount
🤖+🔴+🌍+🕒	4	11	$65K	$6k

- A **$6,026 purchase** from **PC-Canada** for an **LCD projector**
- This merchant and item **do not immediately appear aligned** with typical Parks, Forestry & Recreation activities
- Was this purchase appropriate for this division's mandate?

Summary

Stronger data, merchant controls, and ML-enhanced analytics together enable a smarter, more effective fraud detection framework. These are the top recommended improvements to strengthen oversight and reduce misuse risk.

Data Model

Include **employee_id** and **employee category** to detect **abnormal spending** at **individual level**.

Capture **transaction time** to identify **suspicious timing patterns**.

Collect **fraud labels** to train accurate **fraud-detection models**.

Merchant Whitelist & Blacklist

Implement a **merchant whitelist** to ensure spending aligns with **approved vendors** by division.

Implement a **merchant blacklist** to automatically **flag high-risk or inappropriate merchants** by division.

Multi layered Fraud Strategy

Implement a **multi-layered fraud detection approach** that combines merchant insights, division behavior, and machine-learning signals