Canada's Battle Against Car Theft: Progress Amid Persistent Challenges*

Government measures and public vigilance show promise, but organized theft networks remain a concern.

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First sentence. Second sentence. Third sentence. Fourth sentence.

*Code and data are available at: https://github.com/vanessadyy/Car_Theft.

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1 Introduction

Vehicle theft has become a widespread public concern in Canada, leaving many citizens feeling helpless and frustrated. As car theft incidents continue to rise, police chiefs have made surprising recommendations, including advising residents to leave their car keys near the door to avoid violent confrontations during break-ins. This suggestion sparked public outrage, with many criticizing it online as absurd and unreasonable. The widespread public discourse escalated the issue into a national battle against crime.

1.1 The Scale of the Problem

The scale of vehicle theft in Canada is alarming, exposing government inefficiency in tackling the problem. The reaction from law enforcement has been equally unexpected, with officers treating theft as an inevitable occurrence and even providing rationales for its prevalence. While insurance companies offer quick resolutions for stolen vehicle claims, this comes at a cost. Insurers are not charitable organizations, and frequent claims could lead to higher premiums or even the loss of insurance eligibility for some car owners. The reliance on insurance as a remedy highlights the authorities' decision to abandon pursuit of stolen vehicles, shifting the burden onto vehicle owners to seek reimbursement.

1.2 The Vicious Cycle of Vehicle Theft

The indifferent attitude of law enforcement, coupled with lenient legal consequences, has fueled an annual increase in car thefts, pushing Canada into a vicious cycle of buying and stealing vehicles. The legal responsibilities surrounding car theft and the evasive accountability of international import companies reflect the complexities of organized crime. A large portion of stolen vehicles ends up in the Middle East and Africa, particularly Nigeria, where demand for high-quality second-hand cars is strong. The COVID-19 pandemic and geopolitical conflicts have exacerbated supply shortages, causing car prices in the Middle East to surge and further incentivizing theft.

1.3 The Global Supply Chain of Stolen Vehicles

The vehicle theft industry operates as an international supply chain, where cars of varying quality are allocated to different markets, creating a clear hierarchy. High-value vehicles are often shipped to affluent buyers, while lower-tier models serve other regions. The organized and systematic nature of these operations underscores the challenges faced by Canadian authorities in addressing this growing issue. Without comprehensive legal reforms and stricter enforcement measures, the country risks further entrenchment in this illicit cycle, with profound economic and social consequences.

1.4 Public Response and Anti-Theft Measures

Faced with insufficient responses from the police, many vehicle owners have begun implementing their own anti-theft measures. However, professional thieves often view these devices as minor obstacles, and even robust anti-theft systems have limitations. High installation costs and vulnerabilities in extreme weather conditions further undermine their effectiveness. Some individuals attempt to protect their vehicles by parking in neighborhoods with higher police presence or near police stations. However, such measures do not guarantee safety, as evidenced by reports of police chiefs' vehicles being stolen in broad daylight. These incidents highlight the audacity of thieves and have led to online ridicule of police authorities for failing to practice basic precautions.

1.5 The National Action Plan

Under pressure from the public and media, the Canadian government introduced a series of policies in early 2024 as part of a "National Action Plan" to combat auto theft. The key components of the plan include:

- **Amendments to Criminal Laws**: Revising legislation to provide law enforcement and prosecutors with enhanced tools to tackle vehicle theft.
- **Changes to the Radiocommunication Act**: Tightening regulations on radio devices commonly used in car thefts.
- **Enhanced Intelligence and Information Sharing**: Promoting better collaboration among municipal, provincial, federal, and international agencies.
- **Technology Deployment**: Leveraging advanced technologies such as scanning systems, data analytics, and GPS tracking to enhance inspection efficiency, particularly at ports and rail terminals.
- **Specialized Training**: Offering targeted training programs for law enforcement officers to improve their capacity to investigate vehicle theft cases.
- **Intergovernmental Task Force**: Creating a National Vehicle Theft Task Force to enhance coordination among government bodies.
- **Support for Anti-Theft Technology Development**: Encouraging innovation and wider adoption of commercial anti-theft technologies.

1.6 Interim Result and Aim of the Paper

Several months have passed since the plan's implementation. Open Data Toronto has published theft-from-motor-vehicle data for Toronto reported from January 2014 to September 2024. To assess interim results, we analyzed this dataset to evaluate the effectiveness of the government's actions. Our objective is to produce statistically objective conclusions that quantify the plan's impact.

2 Data

Since 2014, the Toronto Police Service has been collecting auto theft data in digital format. The data is updated and maintained quarterly, with public access provided via Open Data Toronto. This dataset includes approximate locations of car theft incidents, facilitating the analysis of geographic trends over time. The latest update, released on October 19, 2024, covers reported theft cases up to September 30, 2024.

2.1 Data Source

The dataset used in this study was obtained from Open Data Toronto. The raw dataset comprises the following key fields:

Table 1: Raw Variable Description

Column	Description
_id	Unique row identifier for Open Data database
EVENT_UNIQUE_ID	Offence Number
REPORT_DATE	Date Offence was Reported
OCC_DATE	Date of Offence
REPORT_YEAR	Year Offence was Reported
REPORT_MONTH	Month Offence was Reported
REPORT_DAY	Day of the Month Offence was Reported
REPORT_DOY	Day of the Year Offence was Reported
REPORT_DOW	Day of the Week Offence was Reported
REPORT_HOUR	Hour Offence was Reported
OCC_YEAR	Year Offence Occurred
OCC_MONTH	Month Offence Occurred
OCC_DAY	Day of the Month Offence Occurred
OCC_DOY	Day of the Year Offence Occurred
OCC_DOW	Day of the Week Offence Occurred
OCC_HOUR	Hour Offence Occurred
DIVISION	Police Division where Offence Occurred
LOCATION_TYPE	Location Type of Offence
PREMISES_TYPE	Premises Type of Offence
UCR_CODE	UCR Code for Offence
UCR_EXT	UCR Extension for Offence
OFFENCE	Title of Offence
MCI_CATEGORY	MCI Category of Occurrence

HOOD_158	Identifier of Neighbourhood using City of Toronto's new 158 neighbourhood structure
LONG_WGS84	Longitude coordinate
LAT_WGS84	Latitude coordinate

2.2 Data Notes

This dataset provides detailed information about auto theft cases reported in Toronto. Each row corresponds to a unique occurrence and includes both temporal and spatial details about the offence. The data can be used to analyze trends over time and across neighborhoods in the city.

- **Temporal Variables**: Columns such as `REPORT_DATE`, `REPORT_YEAR`, and `OCC_DATE` provide insights into when offences were reported or occurred.
- **Spatial Variables**: Columns like `DIVISION`, `HOOD_158`, `LONG_WGS84`, and `LAT_WGS84` enable spatial analysis and visualization of offences across Toronto.
- **Categorical Variables**: Fields such as `LOCATION_TYPE`, `PREMISES_TYPE`, and `OFFENCE` classify the nature and context of the reported incidents.

2.3 Variables of Interest

Dependent or duplicated information was recorded using different variables in the dataset. To avoid redundancy, for each scenario, we selected representative variables from the categories of temporal, spatial, and crime severity information related to theft crimes. The selected variables are outlined below:

- **Temporal Information** We selected variables representing the occurrence date and excluded the reported date. The following variables were retained for analysis:
  - OCC_DATE
  - OCC_YEAR
  - OCC_MONTH
  - OCC_DAY
  - OCC_DOW
  - OCC_HOUR
- **Spatial Information** Key spatial information is represented by the police division number, as well as the longitude and latitude of the theft location. Additionally, the location type was included for further context. The following variables were retained:
  - DIVISION

  - LONG_WGS84
  - LAT_WGS84
  - PREMISES_TYPE

- **Crime Severity Information** To capture the severity of theft crimes, we selected the UCR code and offense title as indicators. The following variables were retained:
  - UCR_CODE
  - OFFENCE

2.4 Software and Packages

We used R 4.3 for analysis and followed a public template R Core Team (2023)Alexander (2023). and a collection of R packages were used in this study:

- tidyverse Wickham et al. (2019)
- here Müller (2020)
- lubridate Grolemund & Wickham (2011)
- ggplot2 Wickham (2016)
- scales Wickham, Pedersen, & Seidel (2023)
- knitr Xie (2024)
- kableExtra

2.5 Data Management

Data cleaning steps are described in the Appendix. A sample of the cleaned data is presented in Table 2-4. Among all variables, Year, Total_Death, Male, and Female are coded as integers, Month is coded as abbreviations in character format, and Time is coded in date format. After data cleaning, there are no missing values remaining in the dataset.

Table 2: Sample of Clean Data: Part 1

_id	OCC_DATE	OCC_YEAR	OCC_MONTH	OCC_DAY	OCC_DOW
1	2014/1/1	2014	January	1	Wednesday
3	2014/1/1	2014	January	1	Wednesday
15	2014/1/1	2014	January	1	Wednesday
16	2014/1/1	2014	January	1	Wednesday
18	2014/1/1	2014	January	1	Wednesday
19	2014/1/1	2014	January	1	Wednesday

Table 3: Sample of Clean Data: Part 2

OCC_HOUR	DIVISION	PREMISES_TYPE	UCR_CODE
8	D51	House	2142
11	D42	House	2142
0	D14	Outside	2142
1	D23	House	2142
3	D14	Outside	2142
1	D51	Commercial	2142

Table 4: Sample of Clean Data: Part 3

OFFENCE	LONG_WGS84	LAT_WGS84
Theft From Motor Vehicle Under	-79.37453	43.65707
Theft From Motor Vehicle Under	-79.27716	43.81731
Theft From Motor Vehicle Under	-79.40111	43.65227
Theft From Motor Vehicle Under	-79.56457	43.71941
Theft From Motor Vehicle Under	-79.41877	43.65445
Theft From Motor Vehicle Under	-79.37524	43.64635

Estimand paragraph

Results paragraph

Why it matters paragraph

Telegraphing paragraph: The remainder of this paper is structured as follows. Section 3….

3 Data

3.1 Overview

We use the statistical programming language R …. Our data …. Following , we consider…

Overview text

3.2 Measurement

Some paragraphs about how we go from a phenomena in the world to an entry in the dataset.

3.3 Outcome variables

Add graphs, tables and text. Use sub-sub-headings for each outcome variable or update the subheading to be singular.

Some of our data is of penguins (), from .

Talk more about it.

Talk way more about it.

3.4 Predictor variables

Add graphs, tables and text.

Use sub-sub-headings for each outcome variable and feel free to combine a few into one if they go together naturally.

4 Model

The goal of our modelling strategy is twofold. Firstly,...

Here we briefly describe the Bayesian analysis model used to investigate... Background details and diagnostics are included in Appendix.

4.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$y_i|\mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \tag{1}$$
$$\mu_i = \alpha + \beta_i + \gamma_i \tag{2}$$
$$\alpha \sim \text{Normal}(0, 2.5) \tag{3}$$
$$\beta \sim \text{Normal}(0, 2.5) \tag{4}$$
$$\gamma \sim \text{Normal}(0, 2.5) \tag{5}$$
$$\sigma \sim \text{Exponential}(1) \tag{6}$$

We run the model in R

4.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular...

We can use maths by including latex between dollar signs, for instance θ.

5 Results

Our results are summar

6 Discussion

6.1 First discussion point

If my paper were 10 pages, then should be be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

6.2 Second discussion point

Please don't use these as sub-heading labels - change them to be what your point actually is.

6.3 Third discussion point

6.4 Weaknesses and next steps

Weaknesses and next steps should also be included.

Appendix

A Additional data details

B Model details

B.1 Posterior predictive check

B.2 Diagnostics

Appendix

Data Cleaning Steps

Raw data from Open Data Toronto were prepared, so we did not need to perform many cleaning steps. A few cleaning steps are as follows:

- Recode missing values for genders other than male or female.
- Standardize column names.
- After realizing that there were too many missing values for other genders (over 90%), we dropped that variable.
- Create a new Time variable to represent the first day of each recorded month in date format.

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