

Investigating Bicycle Theft in Toronto: Trends and Patterns*

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In urban environments like Toronto, bicycle theft is as common as in any major city worldwide. This paper examines the trends and patterns of bicycle theft in Toronto from 2014 to 2022, focusing on the cost of bicycles and the types of locations where the thefts occurred. Data from this period show that the overall number of bicycle thefts did not significantly decline but began to decrease gradually from 2020, particularly in thefts occurring at residential properties and those involving high-end bicycles. These findings can inform community efforts and assist Toronto's public authorities in developing more effective strategies to protect citizens' property and reduce bicycle theft.

1 Introduction

Toronto is the most populous and densely populated city in Canada. As a result, traffic congestion makes it difficult for people to navigate the city, and many citizens report this as a significant issue. *This has led to an increase in the number of cyclists using bicycles for efficient point-to-point travel within the city. Currently, approximately 659 km of cycling routes are interwoven like a spider's web throughout Toronto.* Unfortunately, bicycle thefts remain a persistent problem for residents.

This paper examines reported bicycle thefts in Toronto from 2014 to 2022. The main objective is to observe and analyze the number of thefts, the locations of the incidents, and the price range of the stolen bicycles. Specifically, we will compare trends in the locations of incidents by year alongside changes in the price range of the targeted bicycles. Through this investigation, I confirmed that thefts steadily increased from 2014 until 2020, when the number of thefts began to decline. Additionally, there have been notable changes in the locations where thefts

*Code and data are available at: [LINK](#).

occurred and the price range of the stolen bicycles over the years. Understanding these trends and patterns will help prevent future bicycle thefts, and inform new measures by Toronto’s public authorities to enhance theft prevention.

The remainder of this paper is structured as follows: Section 2 discusses the data and process of data cleaning, and Section 3.1 discusses our findings, limitation of the study, and suggestions to reduce bicycle theft.

2 Data

2.1 Overview

The dataset used in the paper covers bicycle thefts reported to the Toronto Police system between 2014 and 2024. This dataset has been updated as of June 2024 and is considered reliable as it is based on the Toronto Police system.

The dataset was downloaded from OpenDataToronto, and its setup was completed with the help of tidyverse, janitor, and tidyr.

The original dataset contained 28 variables, but I used the following: ID, occurrence date, occurrence year, occurrence month, premises type, and bike cost. Then, I created a new group called “cost group” based on the bike cost, categorizing the bicycles according to their price range. Since the dataset is based on the date the theft was reported, I organized the data by the actual date of occurrence to reflect events from 2014 to 2022, excluding incidents that occurred before 2014. Additionally, during the data cleaning phase, observations with missing information were excluded. As a result, the dataset used in this paper contains 30,937 observations. (Table 1) shows an first 5 row of the data used.

Table 1: First 5 rows of data

id	occ_date	occ_year	occ_month	occ_hour	premises_type	bike_cost	cost_group
8	2014-01-01	2014	January	12	Apartment	1019	\$1000 < \$1500
12	2014-01-03	2014	January	8	Other	560	\$500 < \$1000
13	2014-01-04	2014	January	18	Apartment	200	< \$500
15	2014-01-04	2014	January	20	House	900	\$500 < \$1000
19	2014-01-05	2014	January	23	Commercial	1800	\$1500 < \$2000

2.2 Number of Occurrence by Year

First, we will examine how many bicycle thefts occurred by date. `fig-occur` is a line chart that records thefts on a daily basis. Bicycle thefts showed an increasing trend from 2014, followed by a noticeable decrease starting in 2020.

There were also clear differences by season. Each year, there was a sharp increase in thefts during the middle of the year, while the beginning and end of the year saw a sharp decline, showing a cyclical pattern. This indicates that thefts significantly increased during the summer season, while they were almost non-existent in the winter compared to summer.

Year	Number of Occurrences
2014	2511
2015	2724
2016	3249
2017	3321
2018	3418
2019	3103
2020	3278
2021	2643
2022	2491
2023	2479

Figure 1: Number of bicycle theft incidents

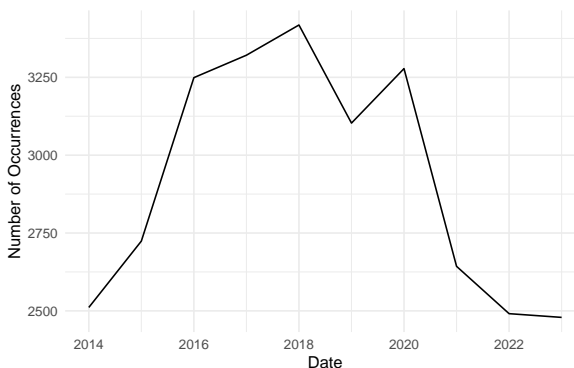


Figure 2: Number of bicycle theft incidents

2.3 Seasonal Effect

2.4 Time Effect

2.5 Types of Crime Scenes

In this dataset, crime scenes have been categorized into seven types: Apartment, Commercial, Educational, House, Outside, Transit, and Others. As seen in Figure 5, there has been significant fluctuation in crimes committed in residential areas. Residential areas are classified into two categories: apartments and houses. Among them, apartment-related thefts showed a steady linear increase until 2019, but in 2020, the number dropped by around 200 incidents in one year, returning to 2017 levels by 2022. House-related thefts followed a zigzag pattern, increasing from 2014 and reaching a peak in 2020, before dropping to less than half by 2022.

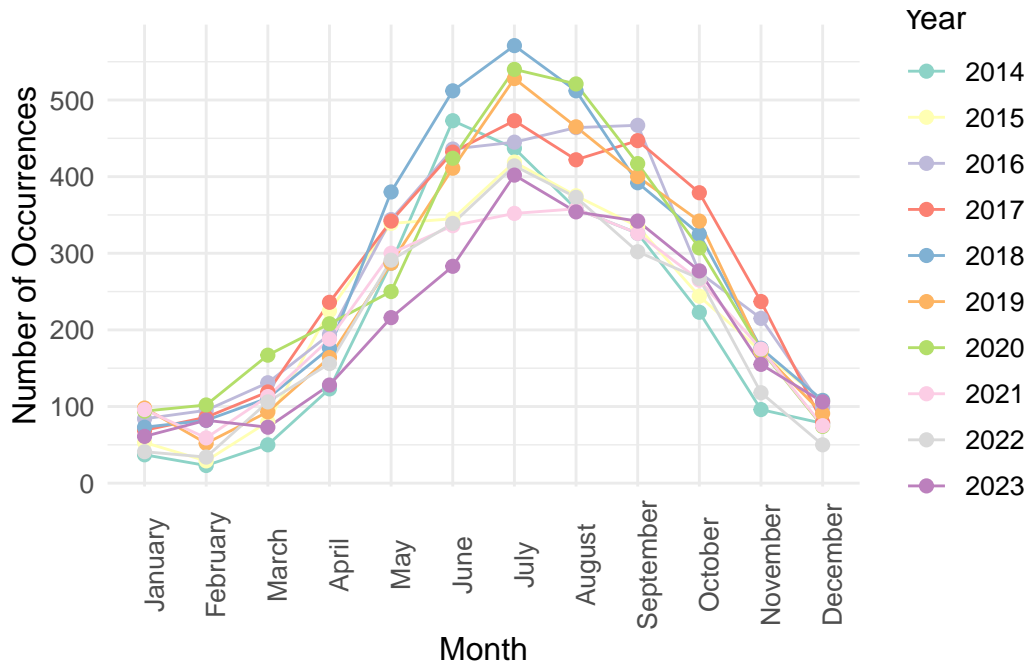


Figure 3: Number of bicycle theft incidents by month

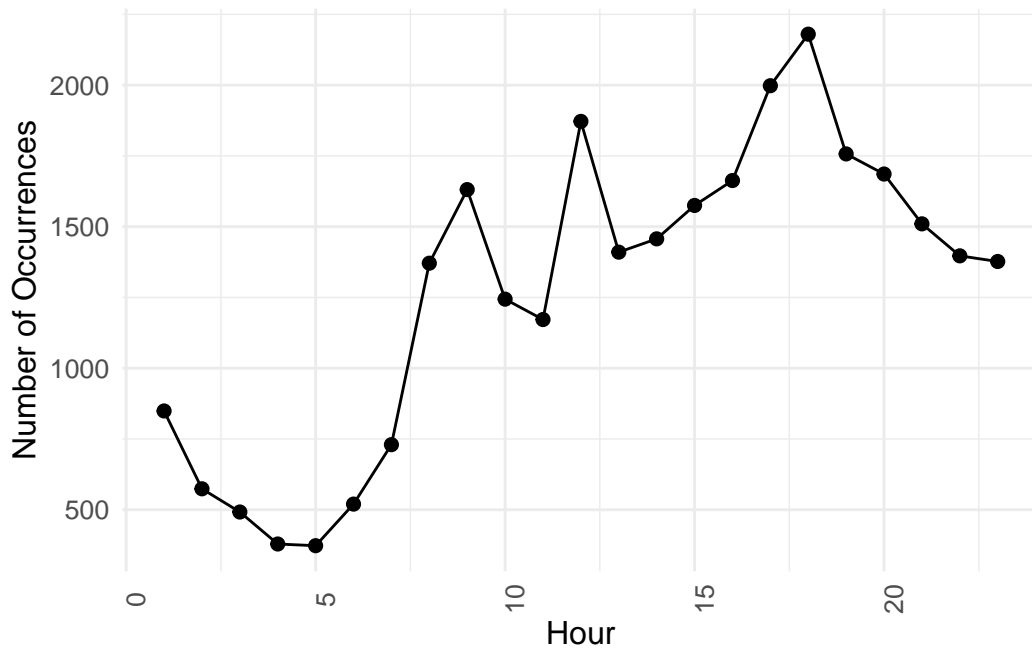


Figure 4: Number of bicycle theft incidents by hour

Another interesting point is that thefts committed outdoors were more frequent than those in apartments before 2019. However, starting in 2019, apartment thefts surpassed outdoor thefts, until 2022, when outdoor thefts once again became more common than apartment thefts.

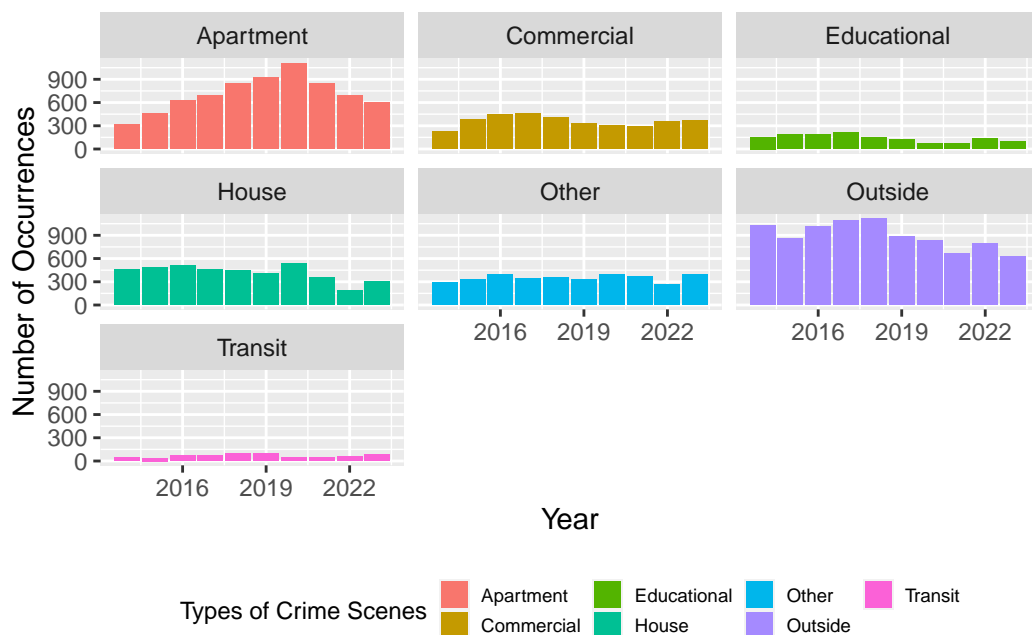


Figure 5: Number of occurrences categorized by crime scene

2.6 Cost of Stolen Bicycle

The original dataset includes a variable for the price of stolen bicycles, but it does not contain a variable for grouped prices. Therefore, I created a new variable called `cost_group` by grouping the prices in increments of \$500. Figure 6 shows a bar graph with number of bike stolen by year categorized by cost group. From 2020 to 2022, the thefts of relatively inexpensive bicycles, priced under \$1,000, have significantly decreased. On the other hand, high-end bicycles priced over \$2,000 were stolen about 250 times in 2014. But this number has steadily increased, reaching approximately 500 thefts by 2022.

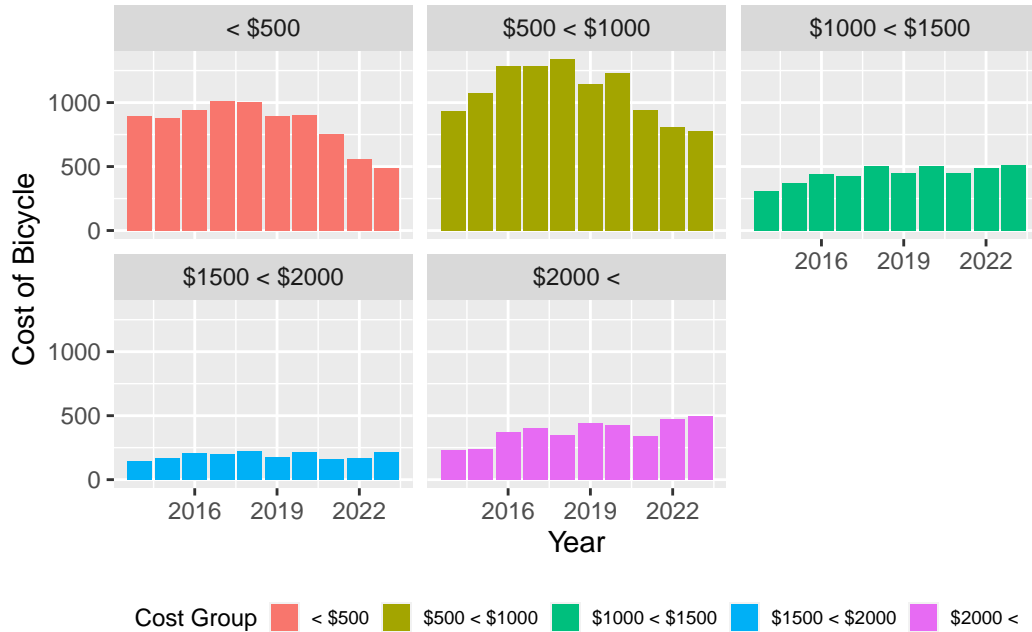


Figure 6: Total cost of bicycle by year

3 Discussion

3.1 Overall

The analysis of bicycle theft in Toronto has revealed trends and patterns over the nine years of theft incidents. All trends shifted starting in 2020, which appears to be a result of the lockdowns due to the pandemic. First, the overall number of thefts began to decrease from 2020, indicating a significant reduction in outdoor activities. Bicycle owners were riding their bikes less frequently, and thieves were also unable to engage in outdoor activities due to the lockdowns.

One of the most notable trends is that the daily theft graph exhibits a cyclical pattern. This indicates that most crimes occur in the summer, while very few happen in the winter. The winter in Toronto, with its snow and cold weather, makes cycling difficult for both owners and thieves, which likely explains the lack of activity in both groups during this season.

When examining thefts by location, we observed significant changes in residential area thefts. With the increase in remote work and online learning, more people have been at home, leading to a substantial decrease in thefts within residential spaces.

There were also intriguing observations regarding the price range of stolen bicycles. Year after year, the number of thefts of more expensive bicycles has been on the rise. This can be interpreted in two ways: either bicycle thieves have started to specifically target high-end bicycles, or the prices of bicycles available on the market have increased. What is clear is that the rising theft rates of expensive bicycles have led to more severe property losses for citizens. Bicycle theft may be considered a minor issue, but it is a clear crime that deprives someone of their valuable property or an essential means of transportation for their life.

3.2 Implication

According to this data, the Toronto Police should strengthen patrols and response efforts during the summer to prevent bicycle thefts. As of the data up to 2022, thefts in residential areas have significantly decreased; however, with the end of the lockdown, there is a possibility that these incidents may rise again. Therefore, it would be beneficial to conduct preventive campaigns targeting residential areas.

Regardless of their price, all bicycles are important, but there has been a recent trend of increasing thefts of high-end bicycles. To protect citizens' property, it is essential to deliver messages of caution to the community.

3.3 Weaknesses and next steps

This dataset has a significant amount of missing data, and unfortunately, I had to drop some parts of the dataset. Additionally, only theft incidents that were reported are included, meaning that incidents that were not reported for various reasons are not accounted for. These missing pieces of information may have influenced the trends or patterns identified in this paper.

Appendix

A References