Crime Analysis

Spatial trends of auto thefts in Toronto

Arunima, Olivia, Darian
Group 14
Professor. Tingting Zhu
GGR381
12.05.23

Overview

The act of crime can be traced back to early civilizations, the human conscience of free-will enables individuals to live within the confines of an anarchic society. One can argue that it is entrenched in the base of human nature to act in a rebellious consciousness of societal norms. Safety and security allows the normative values of modern day western society to function with order - disruption of this, is the destruction of such function. A current rising trend in crime which is affecting a magnitude of people, is the act of larceny towards personal automobiles. This rise in auto crime may seem like a harmless non-violent act, but it has the potential to escalate in a more heinous nature. When a vehicle is being stolen on a residential premise, it poses a huge risk to individuals, whereas the escalation of such a situation can potentially lead to a violent occurrence. This comes about if an owner decides to confront these thieves during an incident, whereas it may lead to violent acts of crime and potential death of various parties.

The relevance to mitigate this risk is apparent in the nature of such crime, the reduction of risk to human life is truly a collective value of normative society, one has the rights and freedoms in the humanitarian sense to live in a civilization without fear of one's well-being. Knowing this type of spatial data we can focus efforts to warn individuals and the Toronto Police Service with PSAs to educate, mitigate and prevent an escalation occuring to reduce such an act of crime in a place that a collective whole calls home.

Research Question

With an emergence of grand theft auto throughout Ontario, specifically in Toronto, is there a spatial pattern amongst locational aspects of auto theft larceny?

Spatial Analysis

1. How many auto thefts have been committed at a radius of 500 meters from the major roads in Toronto?
2. How many auto thefts have occurred on each premise type and which premise type has the most auto theft?
3. How many auto thefts have occurred in each neighborhood and which neighborhood has the most auto theft?
4. Are there police stations within a kilometer of the neighborhoods with the most auto theft?

Site Suitability

In this analysis, one of the main site suitability aspects is to conduct a buffer collection of auto thefts within a 500 meter radius of major road networks in Toronto. Major roadways are a key traffic point access of both residential and commercial premise types which allows for criminals the ease of access to canvass for a target. Knowing this data, the team can create a defined dataset of which neighborhoods along major roads that have the highest auto thefts, this will allude to information that can be passed to Toronto Police whereas they can inform residents of the area. Another aspect is to see the location of most auto thefts and if there is a local Police Station within them. Scarecrow policing is a theory to explore spatially where having more police presence in such neighborhoods may reduce risk of auto thefts. Not only having such tactics present, but also the Police Station brings forth more patrol zones, thus indication again of a reduction risk tactic.

Relevance of Site

The team is interested in this site due to the spatial relevance it brings towards the research question at hand. Spatially, major roads and location of police stations intersect throughout the datasets, the group have collected; from the aspects of individual neighborhoods, amount of auto thefts in total and different premise types. The indication that the team believes it will bring forth a comprehensive analysis that will help reduce this type of larceny.

Data

The four datasets chosen are:

1. **Toronto Auto Thefts** - this data shows auto thefts from 2014 to current date, it's updated quarterly, there are over 55,000 rows in this dataset that shows metadata from location type, premise type date and longitude and latitude.
2. **Toronto Neighbourhood Boundaries** - this showcases the specific neighborhood boundaries in a shapefile for Toronto.
3. **Toronto Police Facilities Location** - this dataset is showing all Toronto Police Service facilities location and their respected metadata.
4. **Toronto Major Roads** - this data is a shapefile of all categorically major road networks amongst Toronto.

Data comes from the Public Safety Data portal of Toronto Police Service for datasets 1 and 3. The Municipality of Toronto Open Source Data site by the

Department of Social Development, Finance & Administration for set 2. Set 4 comes from DMTI Spatial inc (hosted by the University of Toronto Library) which is a leading GIS firm in analytics and mapping for Canada.

Diversity & Relevance

In order to answer the research question, which deals with finding patterns due to the increasing nature towards the total sum of auto thefts in Toronto, it is important to take various factors like the neighborhood, major roadways and police facilities into consideration. The use of major roads can be considered an important feature class, as it helps to determine how the analysis of buffer radius (500m) is in conjunction with the auto thefts amongst such roadways. This helps the authorities to understand and analyze those roads for further investigation for any possible entry and exit points for criminals to utilize. Similarly, acquiring the number of auto thefts in different premise types and neighborhoods, will help in the overall study of which areas are more prone to auto thefts. Furthermore, research about auto thefts - it is important to know the presence of police stations near the areas where the crime was committed. One can see the diversity in these datasets that the group has compiled together, it highlights the various concerns on both the law enforcement aspect of Toronto Police and other services working in conjunction, whilst protecting the individuals of each neighborhood from such larceny.

Metadata

Toronto Auto Thefts:

Attributes

OCC_Date	LOCATION_TYPE	PREMISE_TYPE	OFFENCE	NEIGHBOURHOOD_158	LONG_WGS84	LAT_WGS84

Data Type

Shapefile & CSV

Coordinate System

World Geodetic System 1984 (WGS84)

Toronto Neighbourhood Boundaries:

Attributes

_ID	AREA_ID	AREA_NAME	AREA_DESC	CLASSIFICATION

Data Type
Shapefile

Coordinate System
World Geodetic System 1984 (WGS84)

Toronto Police Facilities Location:
Attributes

_ID	FACILITY	ADDRESS	GEOMETRY

Data Type
Shapefile

Coordinate System
World Geodetic System 1984 (WGS84)

Toronto Major Roads:
Attributes

Location	CARTO	Left_Mun	UniqueID

Data Type
Shapefile

Coordinate System
World Geodetic System 1984 (WGS84)

Commands

In order to load the data on PgAdmin the group chose to use spatial reference SRID: 3857. The geodetic CRS is WGS 84 and it is considered a pseudo-Mercator. The reason for the use of this spatial reference is because of the limitations of the Auto Thefts dataset; transformation to another SRID was impossible without going out of bounds due to a stray polygon in the inherent data. The polygon does not affect any of the following queries or results, but is something to consider. Originally wanting to choose SRID 26917 i.e. UTM Zone 17N which is the Projected Coordinate Systems. The projected coordinate system can be considered as an optimal choice for spatial analysis as it tends to provide a reasonable applicability. The UTM Zone 17N is specifically focused on the region of Toronto, hence making it the ideal system to be used in this case as

it has the ability to give precise measurements of the distances and get accurate results with minimum distortion.

Below are the shp2pgsql commands used to upload the data into PgAdmin 4. The tables were aptly named with shortened versions of the dataset names in a database named “finalproject”.

```
shp2pgsql -D -s 3857 -g geom -I C:\Users\ozhou\Downloads\Auto_Theft_Open\Auto_Theft_Open_Data.shp Auto_Theft |psql -h localhost -U postgres -p 5432 -d finalproject
```

```
shp2pgsql -D -s 4326:3857 -g geom -I C:\Users\ozhou\Downloads\Police\Police.shp Police_Locations |psql -h localhost -U postgres -p 5432 -d finalproject
```

```
shp2pgsql -D -s 4326:3857 -g geom -I C:\Users\ozhou\Downloads\Neighbourhoods\Neighbourhoods.shp Neighbourhoods |psql -h localhost -U postgres -p 5432 -d finalproject
```

```
shp2pgsql -D -s 4326:3857 -g geom -I C:\Users\ozhou\Downloads\ONhrd\ONhrd.shp Major_Roads |psql -h localhost -U postgres -p 5432 -d finalproject
```

Analysis

Q1: How many auto thefts have occurred within a 500 m radius of a major road? What percentage of the total auto thefts is this? We are looking to see if there is a significant percentage.

A:

```
SELECT COUNT(DISTINCT a.objectid) AS count_of_thefts
FROM auto_theft a, major_roads m
WHERE ST_DWithin(a.geom, m.geom, 100);
```

Result: 46159 rows/thefts

```
SELECT COUNT(*) as row_count
FROM auto_theft;
```

Result: row_count

55338
(1 row)

The results of the two queries above can be used to calculate the percentage of the total auto thefts.

Q2: How many auto thefts have occurred on each premise type? Which premise type has the most?

A:
SELECT DISTINCT premises_t
FROM auto_theft;

Result: Transit, Other, Apartment, Educational, Outside, House, Commercial

	Transit	Other	Apartment	Educational	Outside	House	Commercial
SQL cmd	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Transit';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Other';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Apartment';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Educational';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Outside';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'House';	SELECT COUNT(*) AS count_residential FROM auto_theft WHERE auto_theft.premises_t = 'Commercial';
Total # of thefts	166	1627	1549	66	29232	17707	4991

The total number of auto thefts in the table add up to 55338, which means the need to check if there are null values/uncategorized auto thefts are mitigated.

Q3: Which are the top 5 neighborhoods with the most auto theft?

A:
SELECT neighbourh, COUNT(*) AS theft_count
FROM auto_theft
GROUP BY neighbourh
ORDER BY theft_count DESC

LIMIT 5;

```
neighbourh                |    theft_count
--------------------------------------------------
West Humber-Clairville  |      4563
York University Heights  |      1431
Etobicoke City Centre    |      1177
Humber Summit            |      1009
Milliken                 |       860
```

The above query gives the top neighborhoods with the highest number of thefts where West Humber-Clairville has the maximum number of thefts with an amount of 4563.

Q4: Are there police stations located at least 1 km away from the neighborhoods with the most auto theft?

```
CREATE TABLE top_theft_neighbourhoods (
   neighbourh VARCHAR(255),
   theft_count INT,
   geom GEOMETRY );
INSERT INTO top_theft_neighbourhoods (neighbourh, theft_count, geom)
SELECT neighbourh, COUNT(*) AS theft_count, ST_Collect(geom)
 AS geom
FROM auto_theft
GROUP BY neighbourh
ORDER BY theft_count DESC
LIMIT 5;

SELECT t.neighbourh
FROM top_theft_neighbourhoods t, police_locations p
WHERE ST_DWithin(t.geom, p.geom, 1000);
```

```
Result:
 neighbourhood
----------------------
 Etobicoke City Centre
 Humber Summit
 Humber Summit
(3 rows)
```

Etobicoke City Centre and Humber Summit are the only neighborhoods in the top 5 that have police facilities within a kilometer.

Interpretation of Queries and Results

Q1. This command selects for a distinct objectid (distinct auto theft) from table auto_theft where the distance is within 500 meters using STD_Within and the geometries from the auto_theft table and the major_roads table geom columns. The second SQL command counts the total number of auto thefts by counting the total number of rows in table auto_theft.

Q2. To find each premise type, we executed the first command. It only looks for the first distinct values in the premise_t column. The next seven commands count how many rows have a premise_t value equal to the premise type we wanted to count.

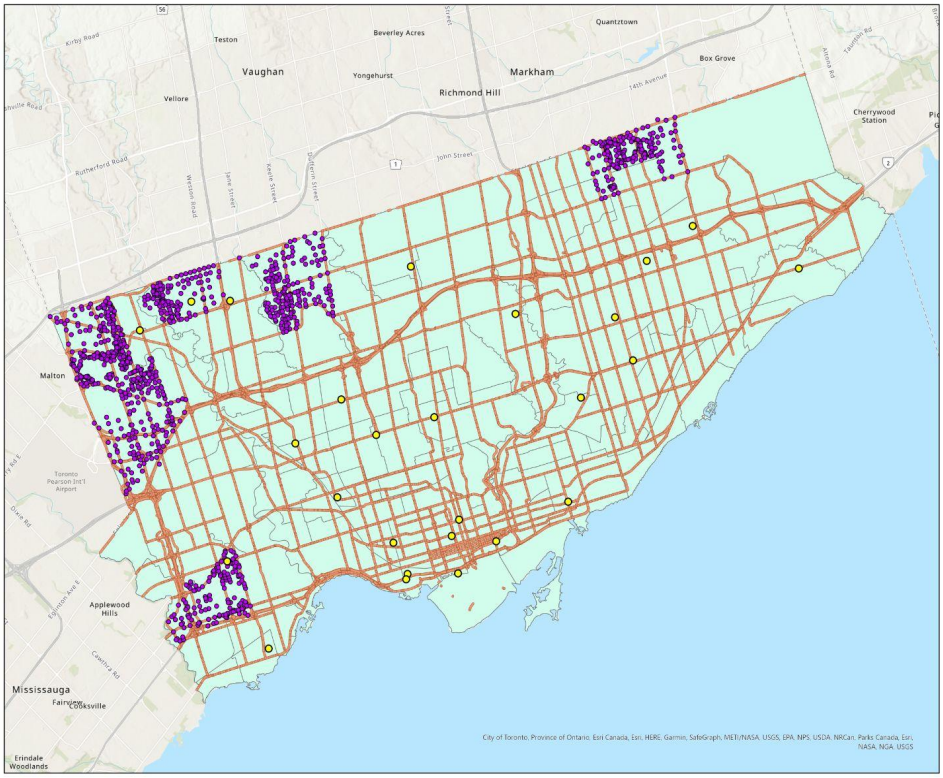
Q3. From the auto theft table in the "*neighbourh*" column, the text tells us which neighborhoods the theft took place. The query counts the number of neighborhoods represented in the table and orders the results in descending order, and limits the output to five rows to only get the top five neighborhoods that had the most auto theft.

Q4. The first query creates a table to store the geometries of the top five neighborhoods with the most auto theft. The second query inserts the results of the query from the last question into the new table. The last query directly compares the geometries of the police stations with those of the neighborhoods; it checks which neighborhoods are within a kilometer of a station and excludes the ones that are not.

By carrying out queries, there were results acquired that helped in understanding and answering the main research question.The result of the first question implied that there is a correlation between the location of auto thefts and their proximity to major roads. An overwhelming majority of the crimes committed were located near major roads; 46159/55338 x 100 = 83.4% of all total auto thefts were committed 500 meters or less within major roads. This has imperative implications; the City of Toronto should focus their resources on policing near major roads which leads to a streamlining of processes in the capturing of thieves. The second result showed us that cars were most likely to be stolen when they are left outside or near homes. These two premise types constitute the majority of auto crime scenes, meaning that more resources should be allocated to these premise types in favor of the other types listed. In a similar vein, the third and last questions directed our attention to the neighborhoods most susceptible to auto thefts. Toronto Police should not only allocate more resources in those neighborhoods, but also set up a station, community outreach center or heightened patrol zone in West Humber-Clairville, York University Heights, and Milliken since those three do not currently have any facilitated resources nearby and could greatly benefit from having one.

Visualization of Data

Auto Theft Crime in Toronto



Legend

- Police Facility
- Most Thefts-Neighbourhoods
- Roads & Highways
- Neighbourhoods

Spatial Reference
Name: WGS 1984 Web Mercator Auxiliary Sphere
PCS: WGS 1984 Web Mercator Auxiliary Sphere
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere

The map shows the neighborhoods with most auto thefts along with other features like the police facility stations, and the major roads and highways in Toronto.

Data Source- Toronto Open Data

N

0 5 10 20 Kilometers

Conclusion

In conclusion, it can be inferred through the spatial analysis of each dataset, query and visualization, that there are a significant number of patterns to recognize. Auto thefts near major roads are a key placement factor for criminals based on the above data. Similarly, the neighborhoods that do not tend to have police facilities in their vicinity result in a higher occurrence of auto thefts. Toronto Police should allocate resources in these areas to reduce the risk of a theft occurring. This research has helped towards the

betterment of Toronto in the efforts of showcasing areas and ways of combating the crime of auto theft through spatial analysis. Carrying out this information, the city needs to increase its efforts to tackle such larceny, as again, disruption in the societal norms of peace and security, thus of one's property and risk to life, is the destruction of society.

References

1. TorontoPoliceService. (2023). Auto Thefts Open Data. Retrieved from https://data.torontopolice.on.ca/datasets/TorontoPS::auto-theft-open-data/explore

2. Social Development, Finance & Administration. (2022). Toronto Neighbourhoods. Retrieved from https://open.toronto.ca/dataset/neighbourhoods/

3. TorontoPoliceService. (2023). Toronto Police Divisions. Retrieved from https://data.torontopolice.on.ca/datasets/TorontoPS::police-divisions/about

4. DMTI Spatial. (2012). CanMap RouteLogistics Toronto, city subset. Retrieved from https://mdl.library.utoronto.ca/collections/geospatial-data/canmap-routelogistics-toronto-city-subset