Public crime and Public space

Bike and Car Theft
in Toronto

Amateurs in the Dataverse

Theft in Toronto

CBC

A 2020 file photo shows a man holding a small bicycle while riding down a street in Vancouver. Brandon police say bike theft is often a crime of opportunity and can happen anywhere, but there are steps owners can take, like registering for the free 529 Garage program. (Ben Nelms/CBC)

https://www.cbc.ca/news/canada/manitoba/bike-thefts-brandon-1.7153222

Theft in Toronto

A car was stolen every 40 minutes in Toronto last year, police chief says

More than 12,000 stolen cars last year valued at almost $800 million

The Canadian Press · Posted: Mar 18, 2024 1:42 PM EDT | Last Updated: March 19

https://www.cbc.ca/news/canada/toronto/car-thefts-2023-toronto-figures-1.7147387

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Tips on carjacking prevention

- be aware of your surroundings;
- have your vehicle keys or fob ready while walking to your vehicle so you can easily click on the emergency button to sound the horn if needed;
- always lock your vehicle as soon as you get in;
- reverse vehicles into parking spaces so you have a better sightline to vehicles and people approaching you.

https://www.toronto.com/news/crime/worried-about-losing-your-vehicle-to-thieves-here-are-some-tips-you-need-to-know/article_9f3e1f6f-0d36-54eb-ad56-4be122d704ca.html

We are all impacted by crime in public space

However, when it comes to crime, not all streets were created equal.

We wish to understand car and bike theft, and how it varies with temporal, spatial and social parameters

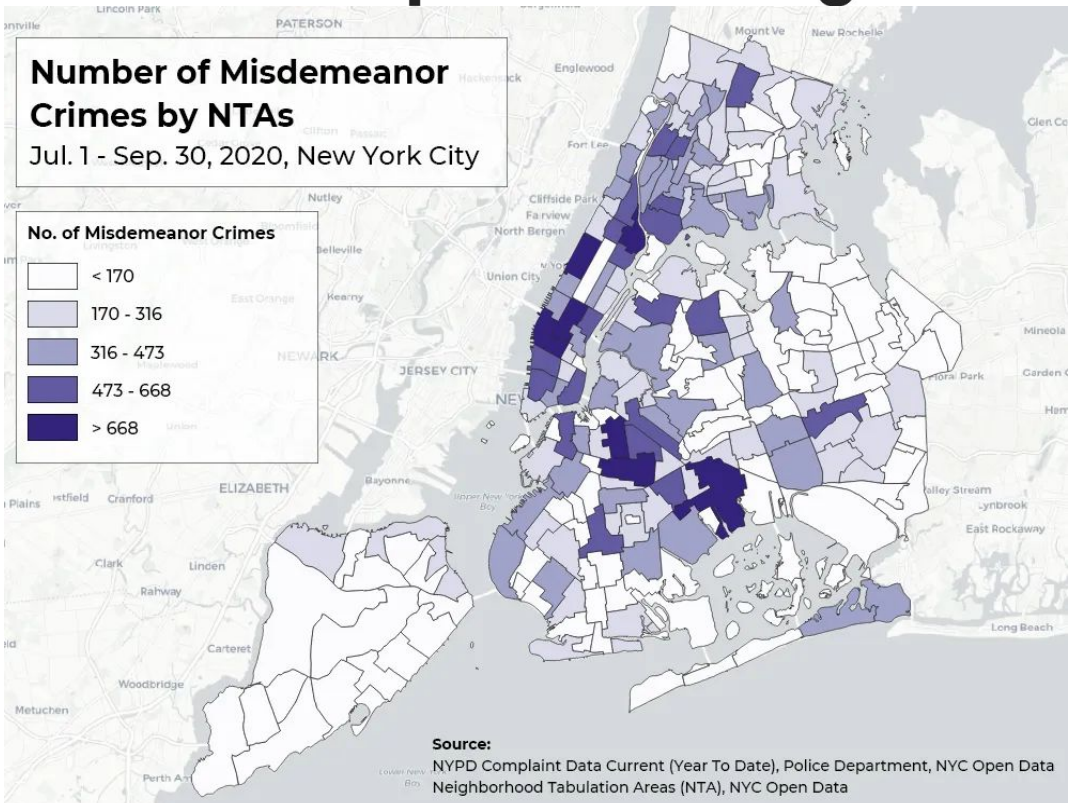
Our work would providing insights to law enforcements and residents alike

Background

Mapping the crime data in NYC

- Median income
- Crime normalized by population

Crime In New York City: linking to income and public housing



https://jingjing-ge.medium.com/crime-in-new-york-city-linking-to-income-and-public-housing-c81cfcc29a4b

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When normalizing for population size we gain new insights

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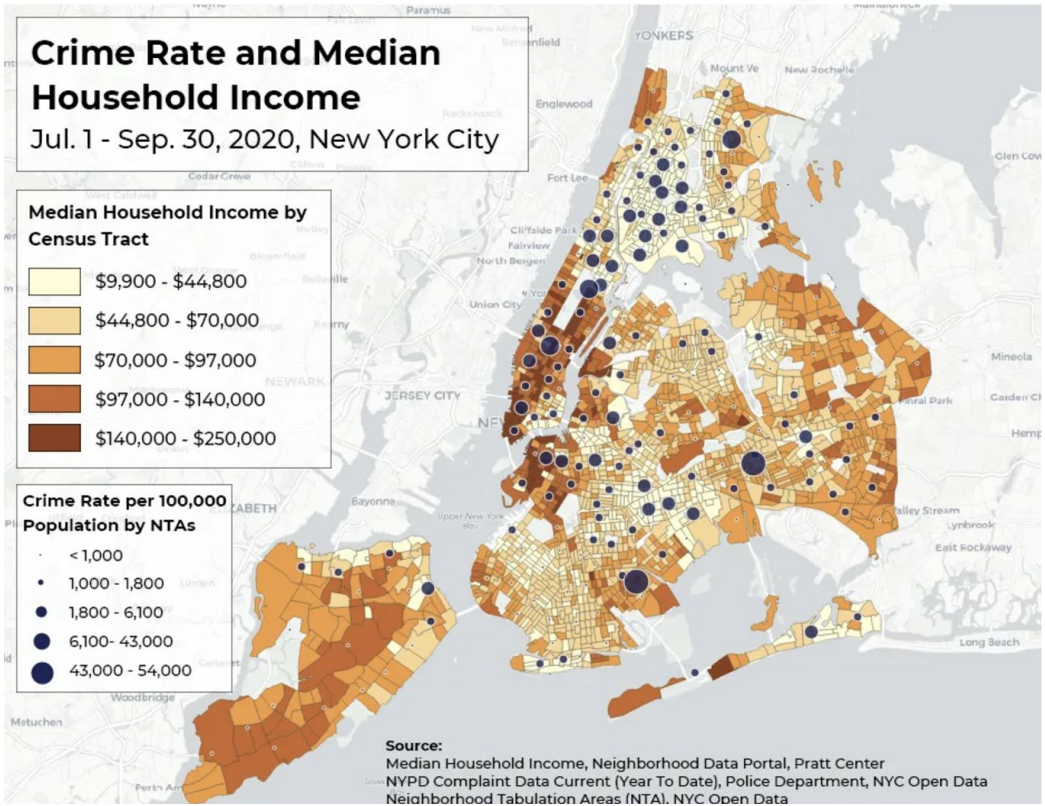

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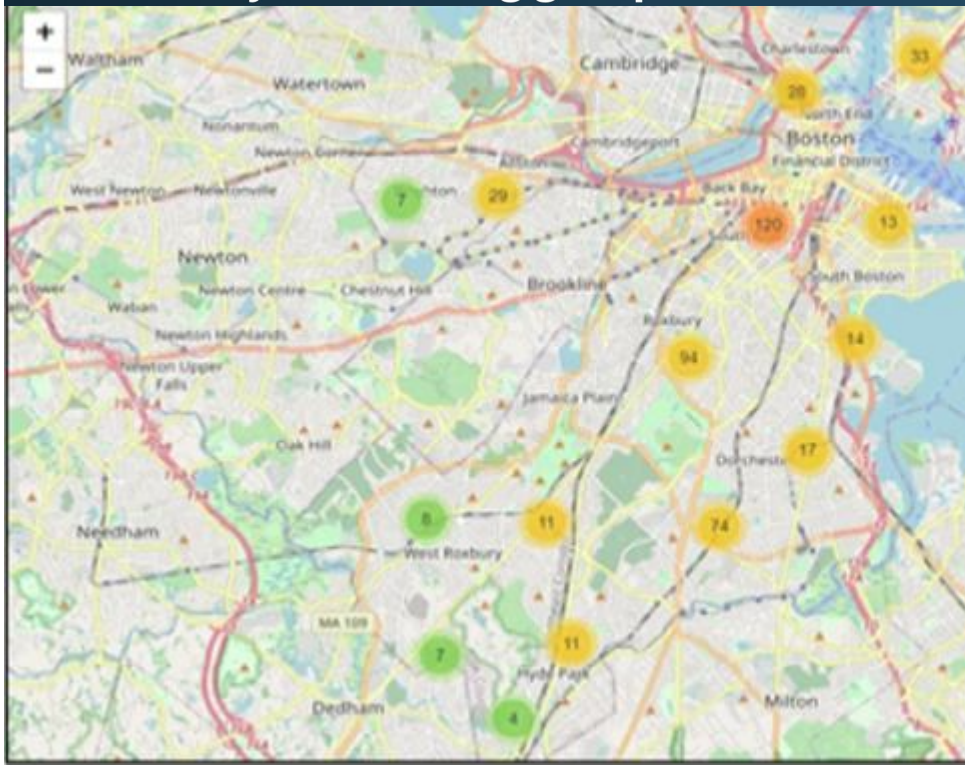
Background

Clustering crime data in boston

Allows to provide recommendations for the Boston police

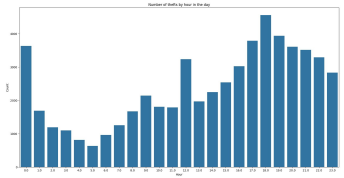
Machine learning based analytical approach for geographical analysis and prediction of Boston City crime using geospatial dataset



https://link.springer.com/article/10.1007/s10708-021-10485-4#Sec3

We want to explore

1. How do car and bike theft vary with time?
    - Is there seasonality, is there a trend?
    - Are there hours which are more susceptible to crime?



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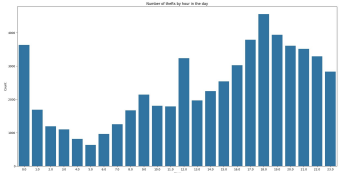

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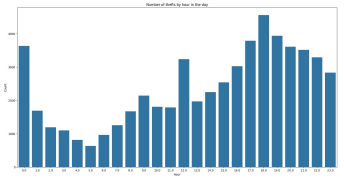
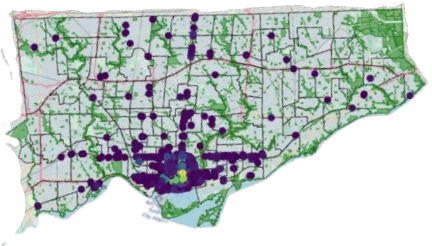
2. How do car and bike theft vary over different neighborhoods?
    - How does it vary with neighborhood density
3. How do car and bike theft vary over the public space?
    - Are there crime clusters within the city?
    - How do these clusters coincide with attributes of public space?





Data preparation

1. Clean car and bike theft data
    - Remove incidents before 1.1.2014
    - Remove theft at home
    - Remove rows with no location
    - Handle duplicates

```
[ ]  # Check what is the minmum and maximum data in which crime occurred
     print("car theft min date:", car.OCC_DATE.min())
     print("car theft max date:", car.OCC_DATE.max())

     #Remove crime before 1.1.2014
     car = car[car['OCC_DATE']>='2014-01-01']
     print("Updated min car theft max date:", car.OCC_DATE.min())
```

```
car theft min date: 1963-03-15 00:00:00
car theft max date: 2024-06-30 00:00:00
Updated min car theft max date: 2014-01-01 00:00:00
```

	LOCATION_TYPE	PREMISES_TYPE	BIKE_MAKE	BIKE_SPEED	BIKE_COLOUR	BIKE_COST
	Streets, Roads, Highways (Bicycle Path, Privat...	Outside	KHS	21.00	GRY	550.00
	Streets, Roads, Highways (Bicycle Path, Privat...	Outside	NORCO	21.00	BLKRED	1200.00

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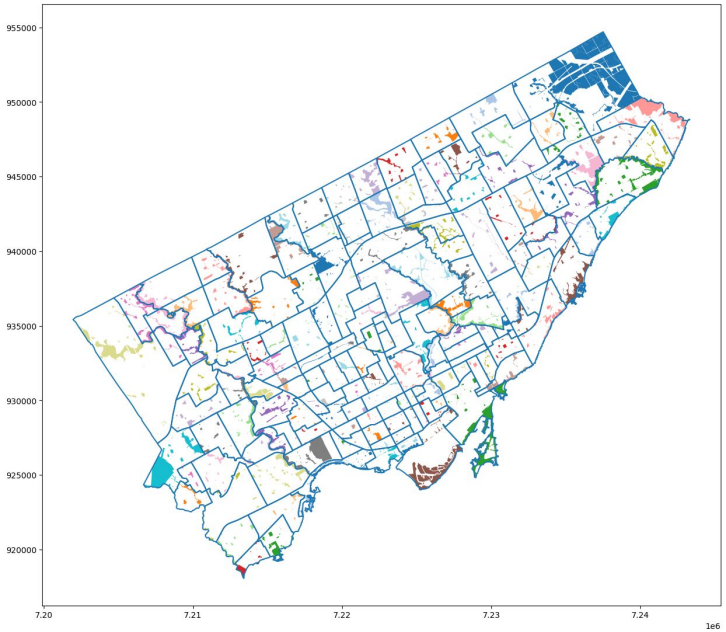
2. Clean neighborhood and park data
    - Move to Canada CRS
    - Calculate park and neighborhood area
    - Overlay park over neighborhood to calculate park density



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3. Geospatial merge car and bike data with neighborhood and park data

```
bike = gpd.sjoin(bike, Neighbourhoods, how="left", predicate="within")
bike
```

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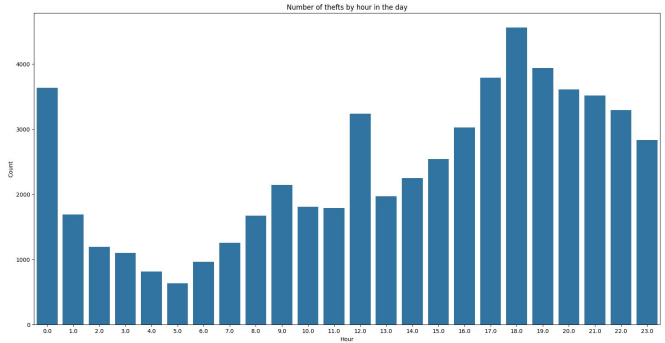
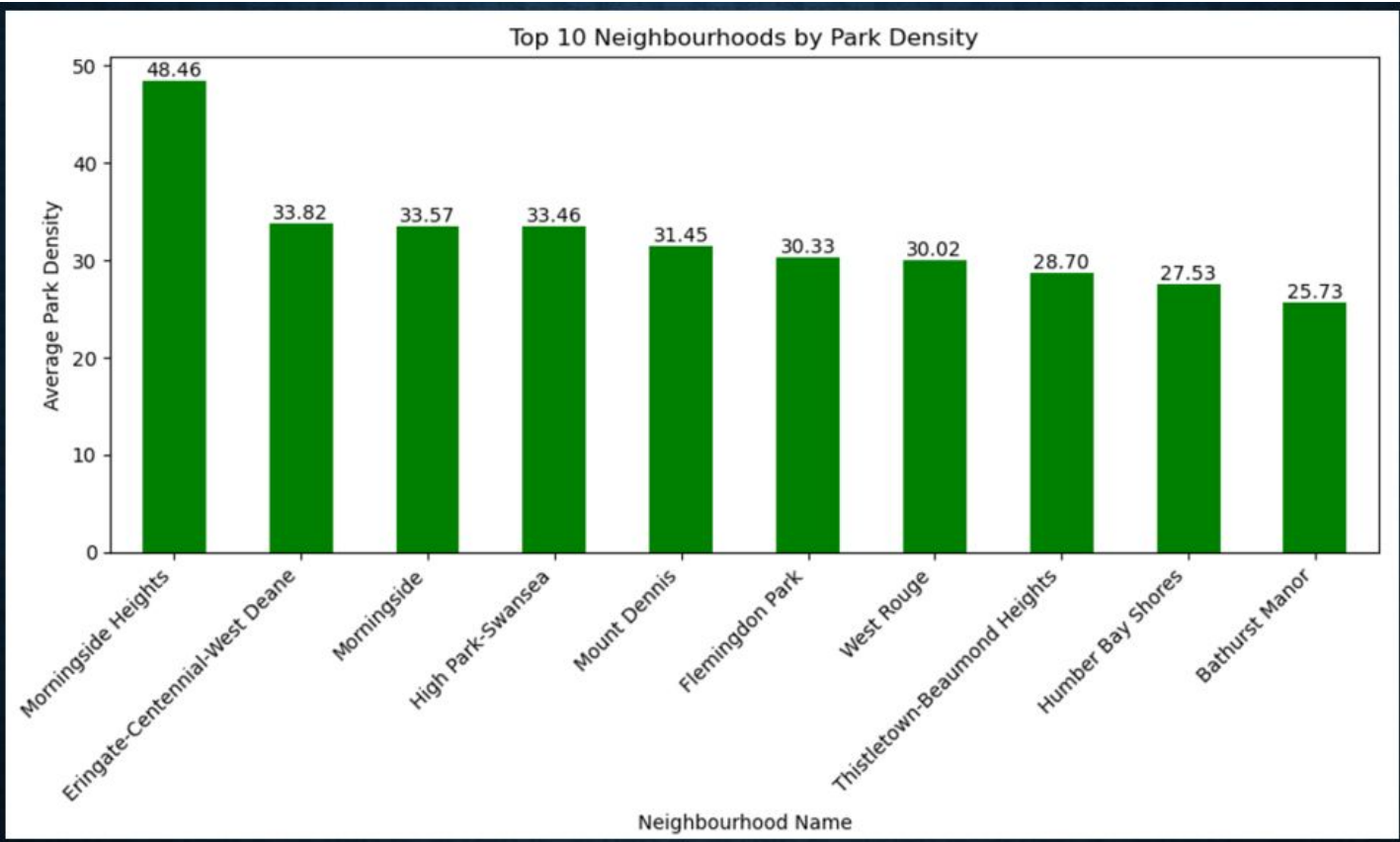
3. Geospatial merge car and bike data with neighborhood and park data
4. Exploratory Data Analysis



TEMPORAL ANALYSIS

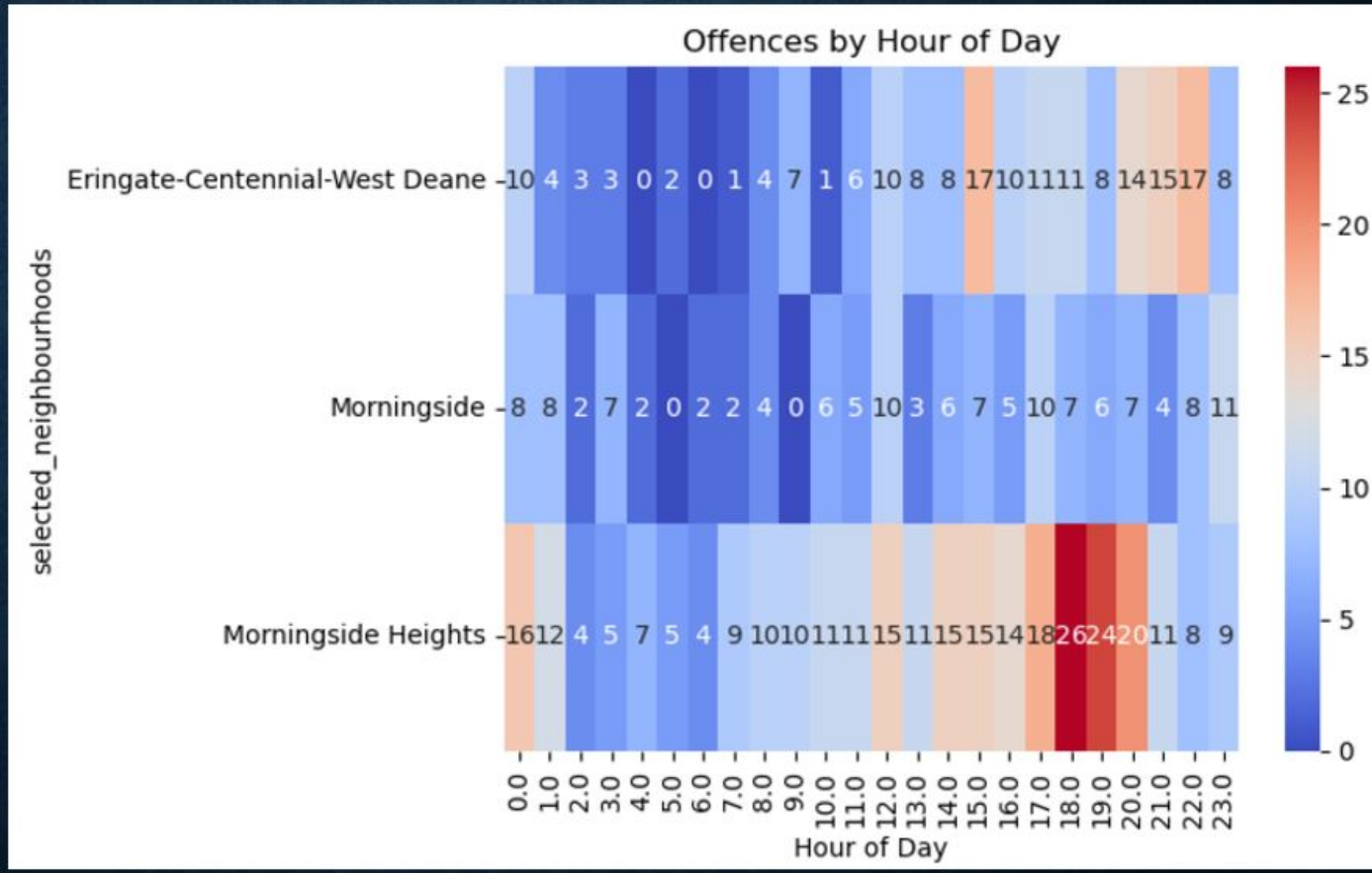


- Top **Three Neighbourhoods** with the **Highest Park Density- Morning Heights, Eringate-Centennial-West Deane and Morningside.**

- Highest Offences by **Hour of Day** is between **18.00-20.00** hours for the **Morningside Heights** Neighbourhood.

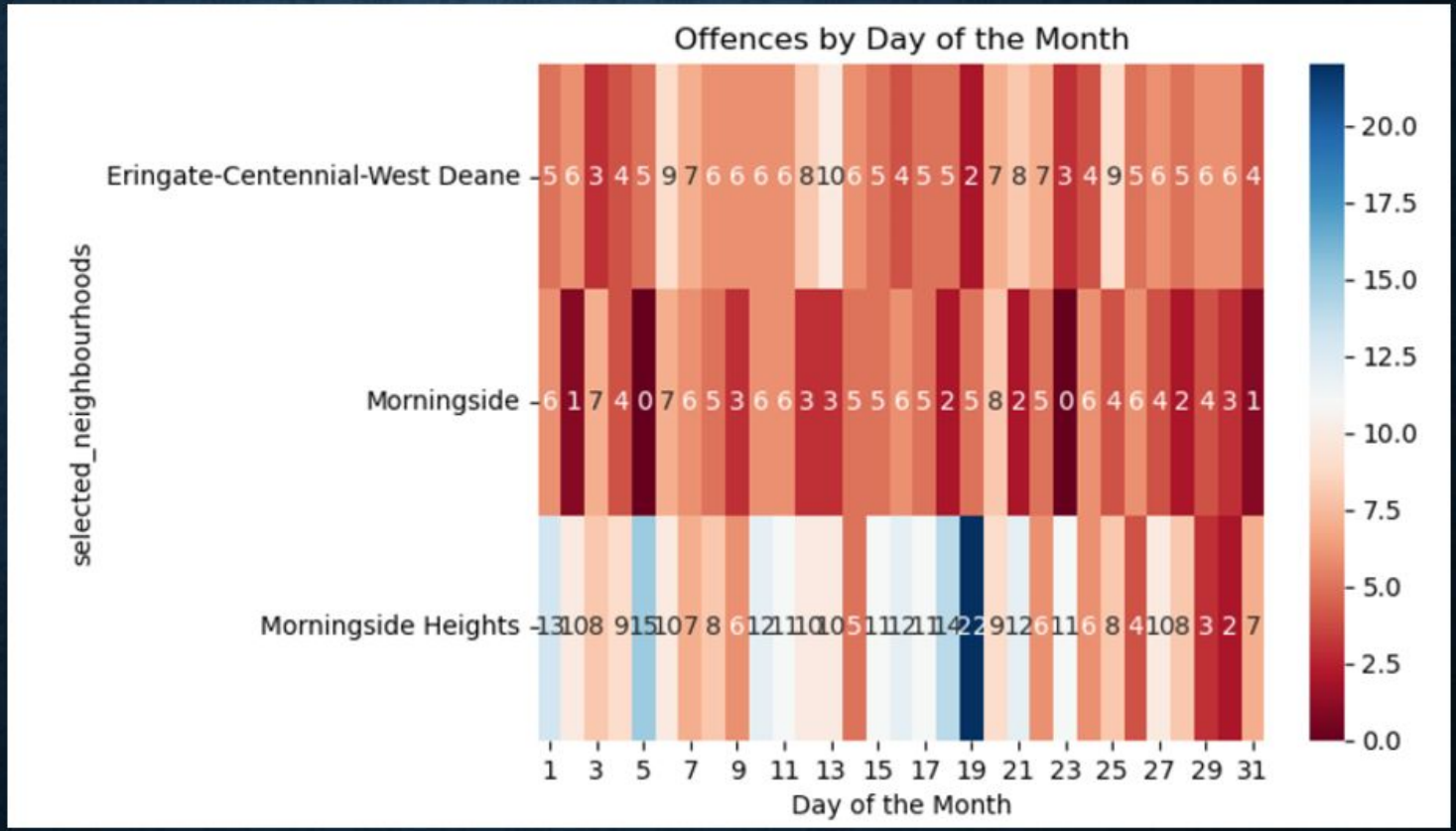
- **Peak Time** for the **Eringate-Centennial-West-Deane** is **17** at **15.00** and **22.00** hours.

- The **Peak Time** for the **Morningside** is **11** at **23.00** hours- Low Crime Rate.



- Highest offences by **Day of the Month** is on a **19th** for the **Morningside Heights** Neighbourhood.

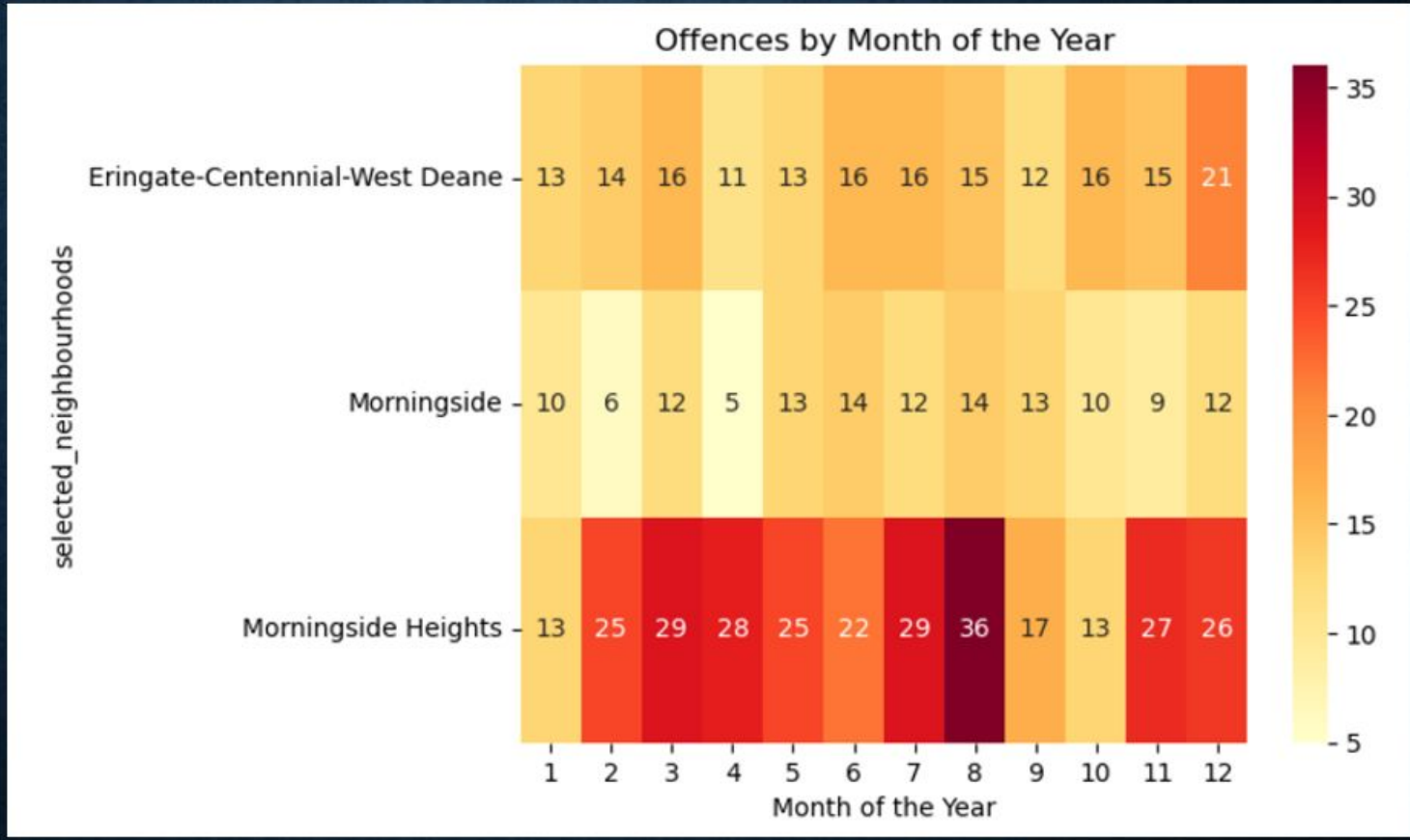
- The **Peak Days** for **Eringate** and **Morningside** are on a **13th** and **20th** respectively.



- Highest offence by **Month of the year** is in **August** for the **Morningside Heights** Neighbourhood.

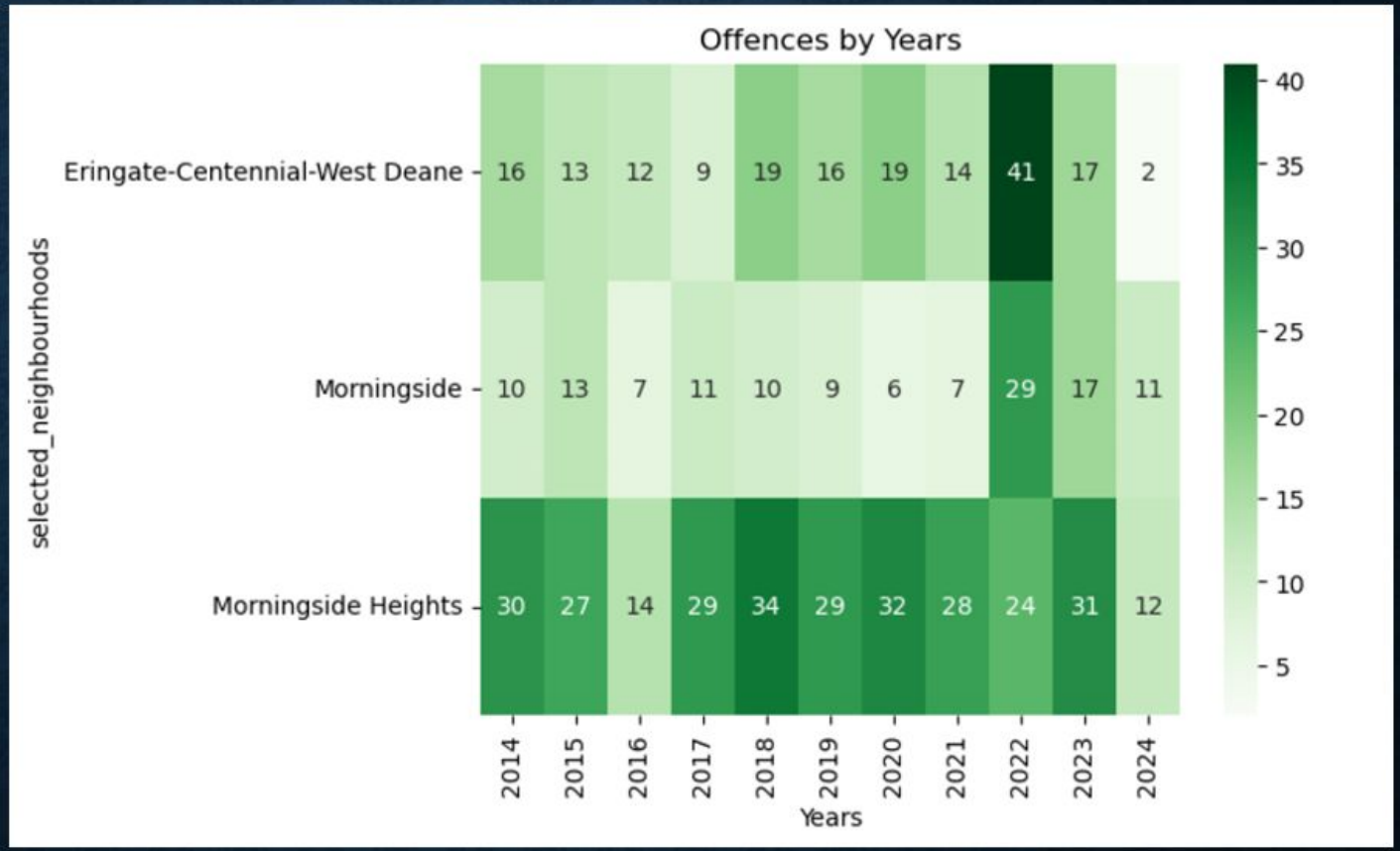
- The **Peak Month** for **Eringate** is in **December**.

- The **Peak month for the Morningside** is in **June** and **August**.



- Highest **Yearly** offence is in **2022** for the **Eringate** Neighbourhood

- The **Peak Year** for the **Morningside** and **Morningside Heights** are in **2022** and **2018** respectively.



TOTAL OFFENCES BETWEEN 2014 TO 2024

NEIGHBOURHOOD_NAME	TOTAL OFFENCES
MORNINGSIDE HEIGHTS	290
ERINGATE-CENTENNIAL-WEST-DEANE	178
MORNINGSIDE	130

RESULT HIGHLIGHT

- **Eringate Neighbourhood had the most offences in a particular year.**
- **However, between 2014 to 2024, Morningside Heights Neighbourhood had the maximum total crime occurrence.**

Social economical Analysis

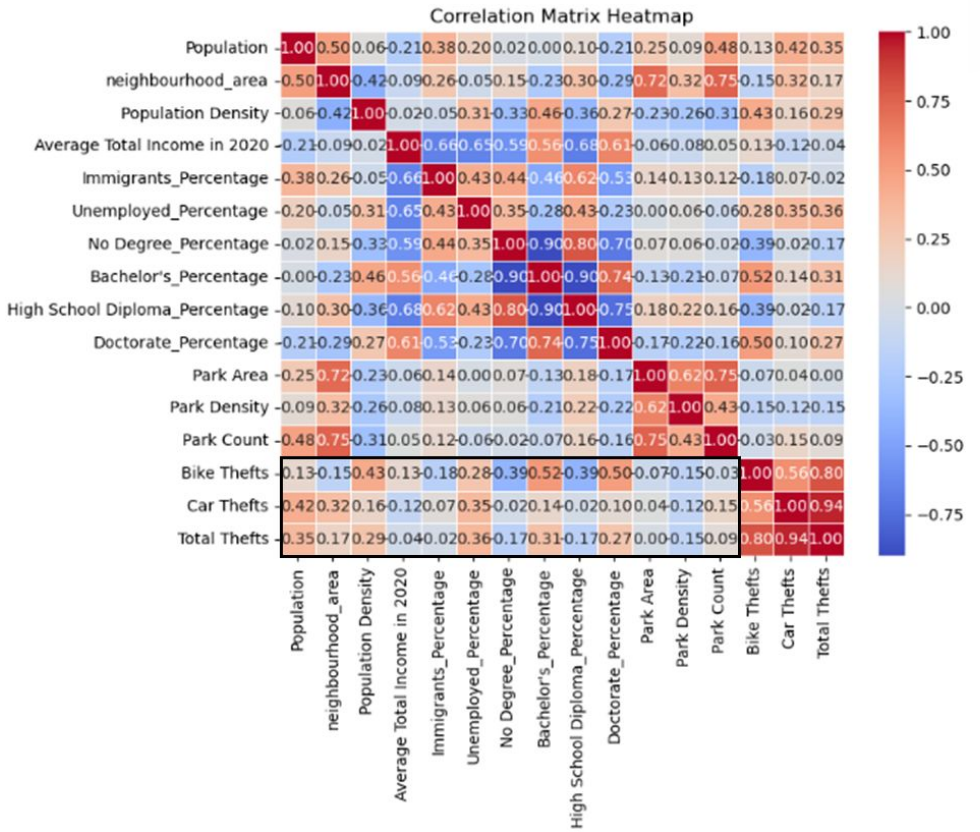
- Correlation matrix was constructed as a baseline for the analysis.
- Prominent correlations:

  Bike theft and pop. density

  Bike theft and education level

  Car theft and unemployment

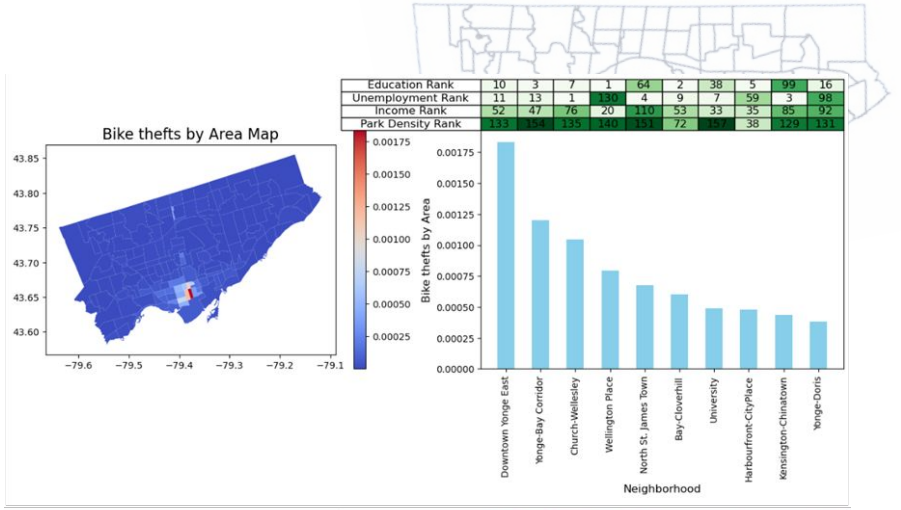
- Correlation is not causality!

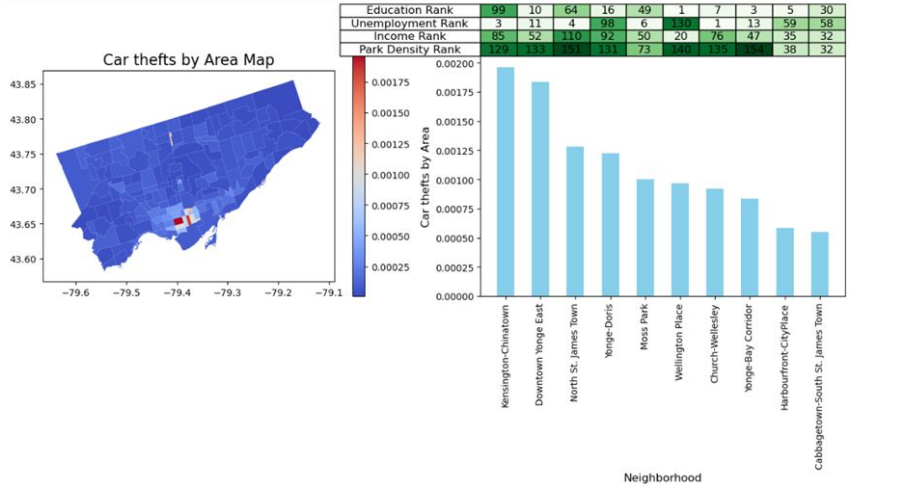


Social economical Analysis

- Normalization by both population and area was performed
- Concentration of thefts in downtown Toronto (UofT area)
- Top 10 neighbourhoods are characterized by:

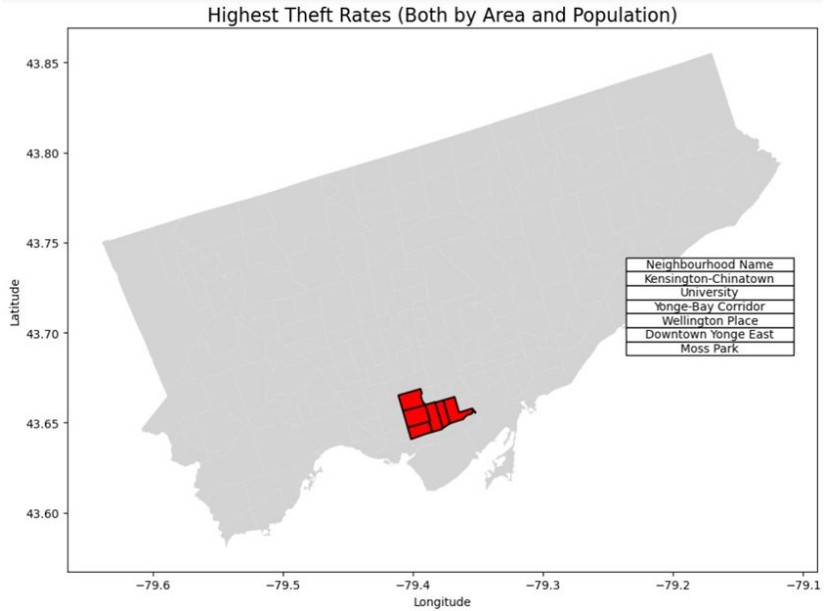
  Higher levels of education
  Higher levels of unemployment
  Lower park density

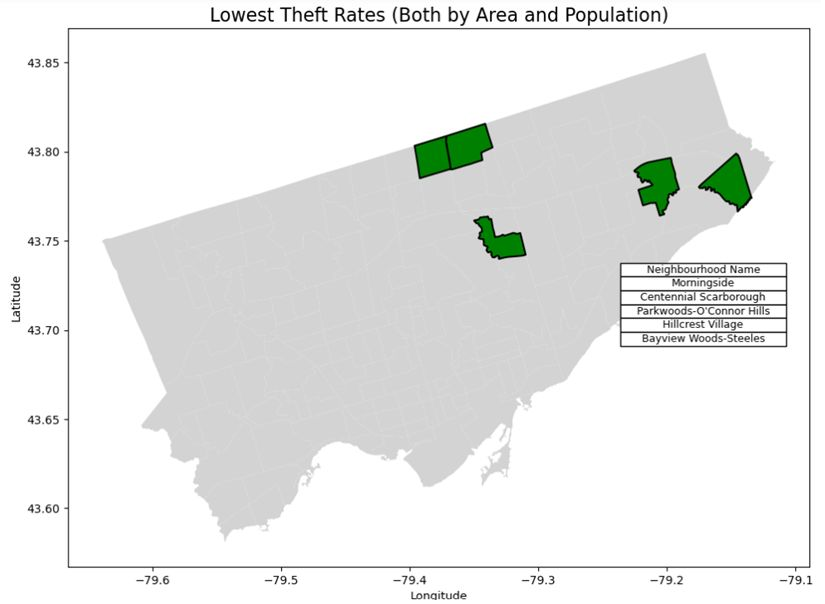




Social economical Analysis

- No. of total thefts was normalized by both area and population, and overlapping neighbourhoods were extracted:





Clustering Analysis

- Analyzing data strictly within neighborhood boundaries risks overlooking critical insights
- Theft doesn’t adhere to administrative lines

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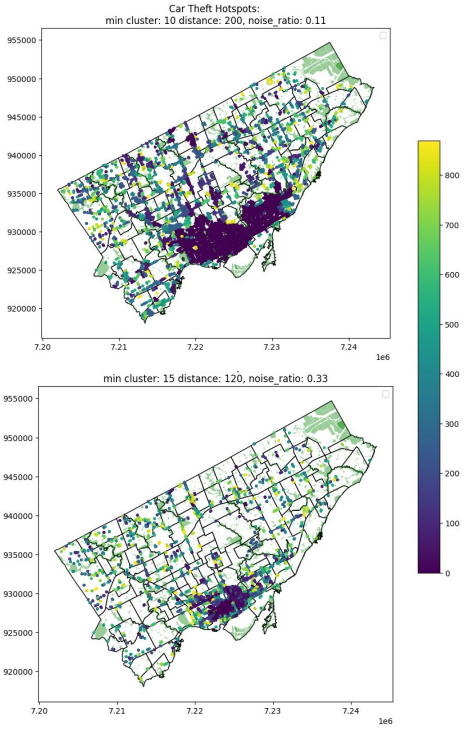
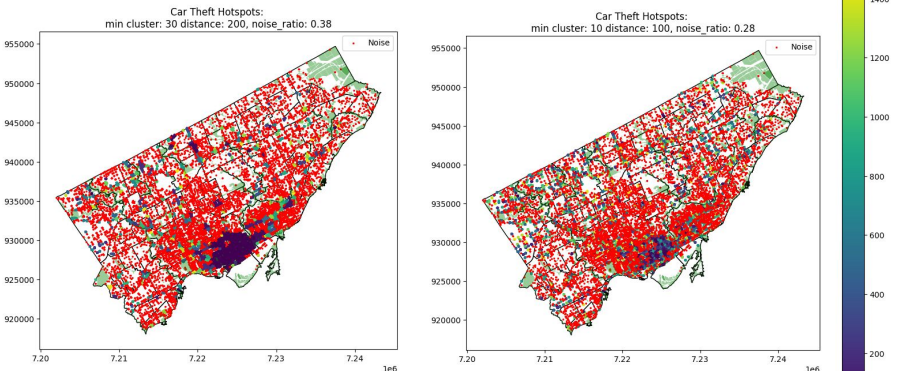
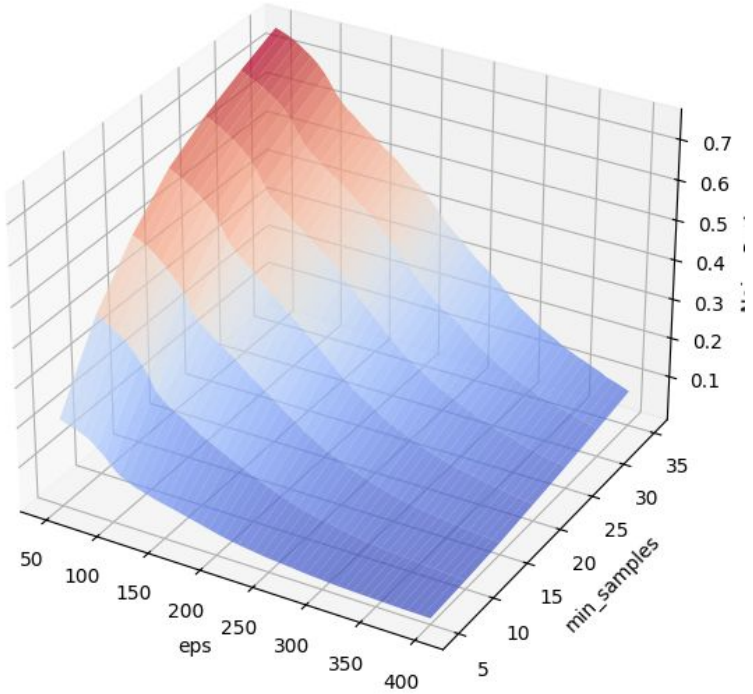
- Analyzing data strictly within neighborhood boundaries risks overlooking critical insights
- Theft doesn’t adhere to administrative lines
- DBSCAN is a density-based clustering
  - Handles noise and outliers
  - Detects clusters of arbitrary shapes
  - Allows flexible parameter



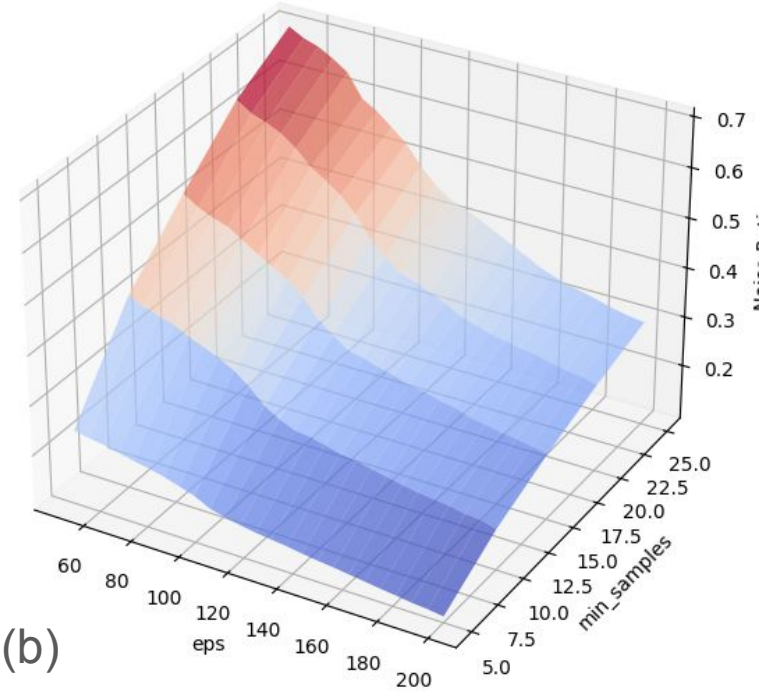


Car vs. Bike

Effects of min samples and distance on noise ratio

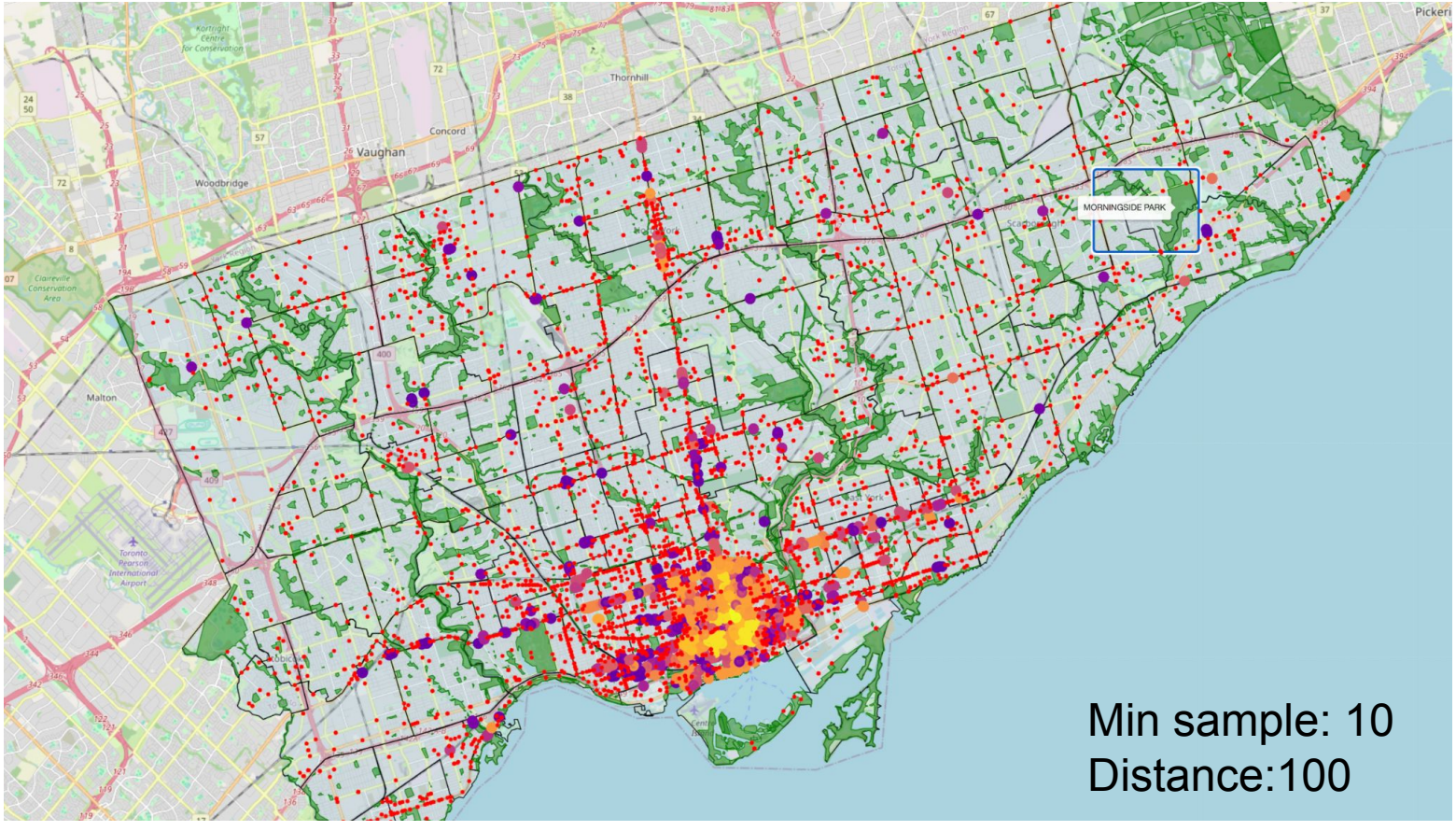


(a)



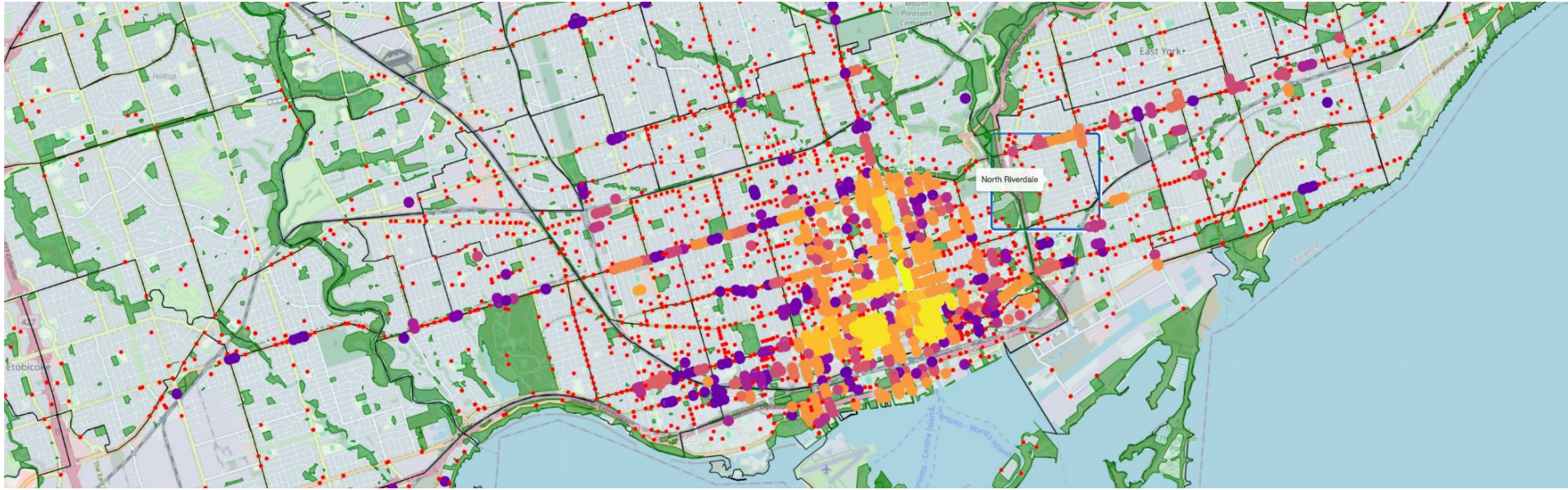
(b)

Bike clustering



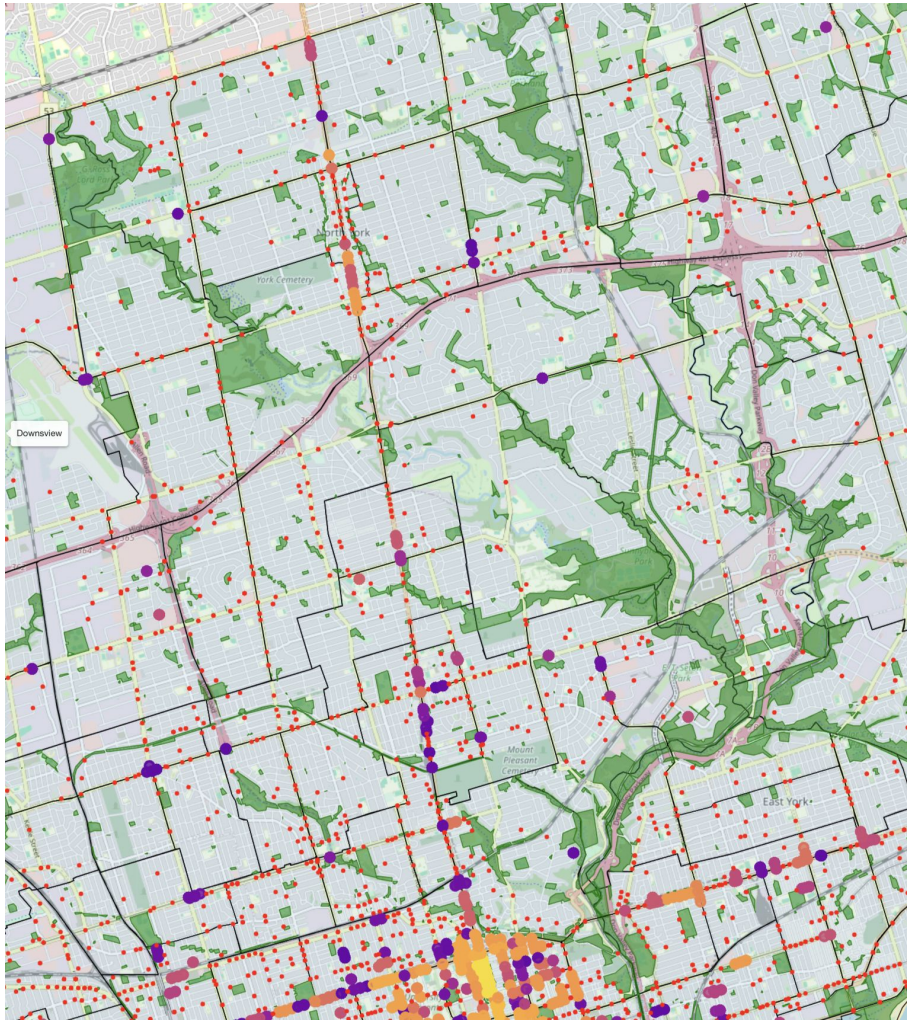
Bike clustering - zoom in

Bloor street & downtown Toronto

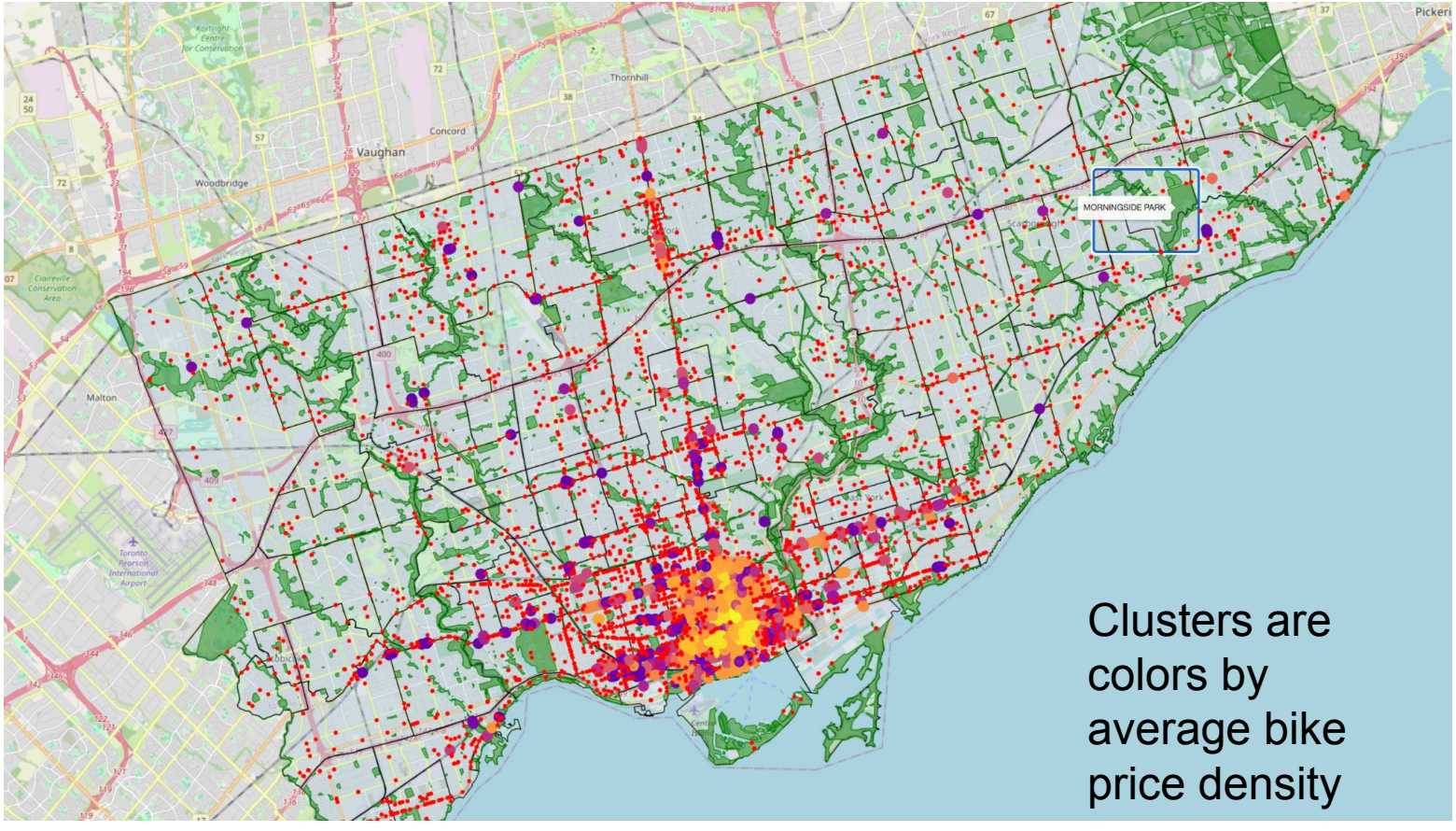


Bike clustering - zoom in

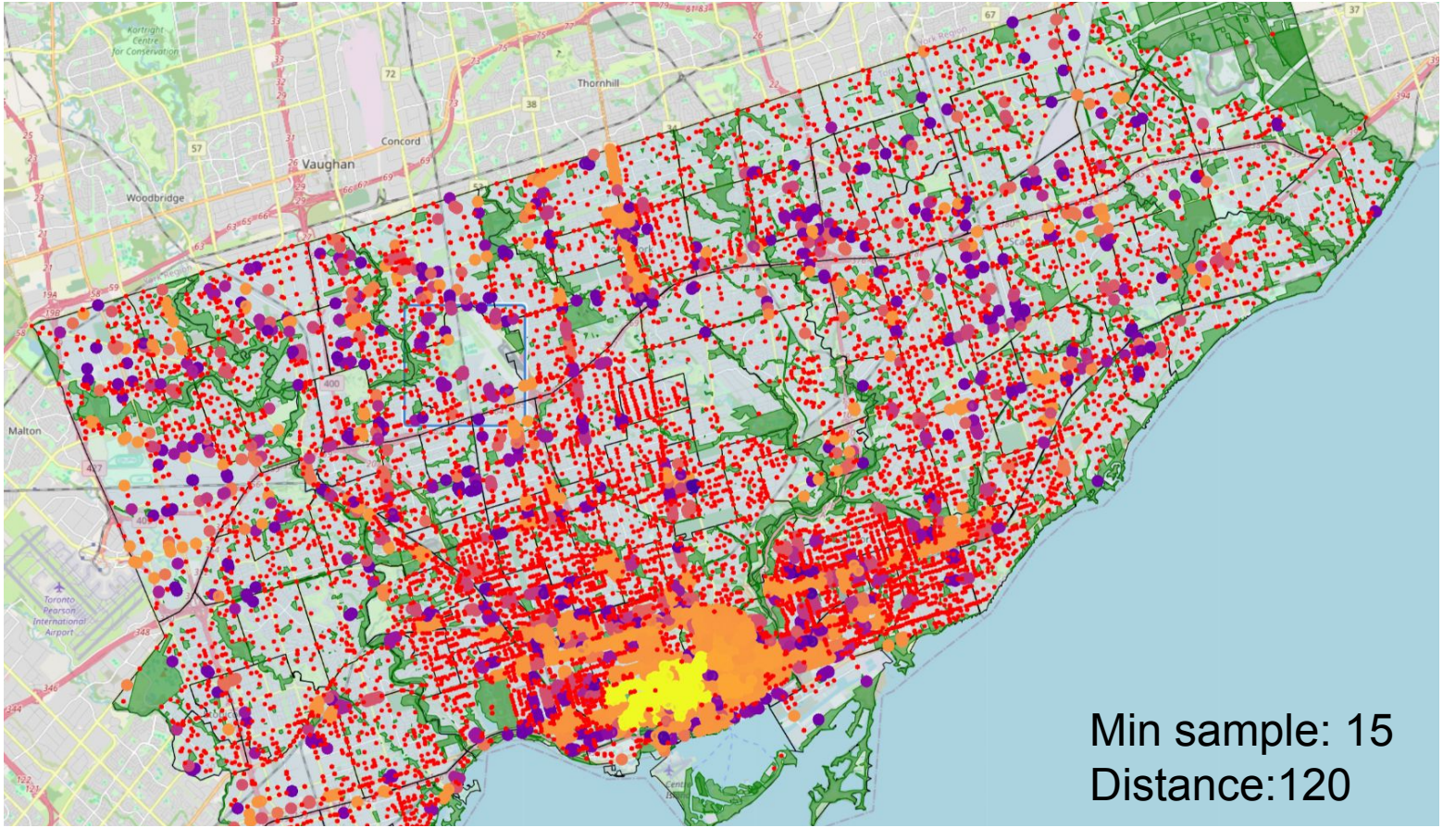
Yonge street



Bike clustering - average price



Car clustering



What have we learned?

- Car thefts are more prevalent in less educated, sparser neighborhoods, reflecting socio-economic vulnerabilities.
- Bike thefts are more common in denser, educated areas like the University of Toronto.
- Major streets like Yonge and Bloor are hotspots for both car and bike thefts, while neighborhood centers are generally safer.
- Higher park density correlates with lower theft rates, possibly due to increased community engagement and natural surveillance.

In Conclusion - Policy Recommendations

For Law Enforcement:

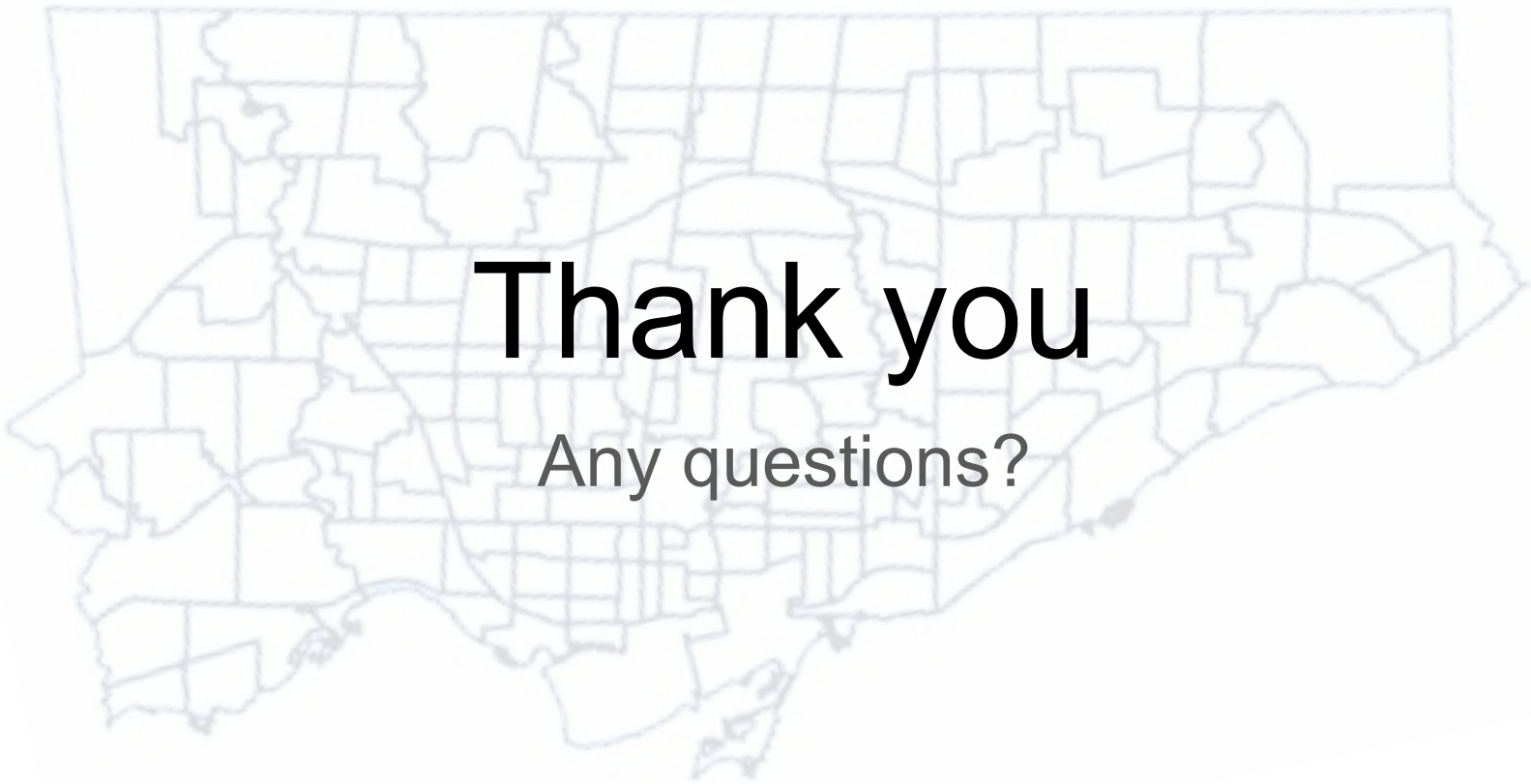
- Increase surveillance and patrols in high-theft areas, such as Yonge and Bloor and the UofT campus.
- Divert resources from northern and eastern areas of the city towards the downtown area.

For the General Public:

- Be more aware and alert when parking vehicles or bikes in areas that were found high-risk for theft.

Urban Planning Insights:

- Foster development of parks and green spaces to potentially reduce crime.
- Promote balanced urban density with adequate security measures to mitigate theft risks in both urban and sparse areas.



Thank you

Any questions?

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