Effect of Public Transport on Crime-A study in Boston

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Introduction

Public transit system, the system builds for public to move from here to there. In today's world it is one of the most necessary components to run a city. Transit system helps commuters in many ways including affordable pricing, time saving and safety. It also helps in reducing congestion and air pollution. But does it also increase the rate of crime? Or instigates crime? Does its expansion increase crime hot spots? Research suggests that most people belonging to the lower economic group lives in the center of the city, as most of the major transport systems start from there and ends there. This system helps lower crime rates, as people engage more into jobs and travelling for jobs as they have easy access. While other researchers suggest there can be another angle to it. It has often been seen that criminals target crowded places such as transit stations, transit interchange connection stations, the area around transit stations. Also, when transit sections expand and connects the city to various suburban it gives various people direct access to the city, which can also lead to the increasing rate of crime.

Research Question

1.   To identify crime hotspots across transit stations in Boston

2.   To analyze the trend of crime across transit stops in the city of Boston

This paper tries to explore the effect of public transport and its expansion on crime. When public transit passes through an area, how does it affect the crime rate there. The before

and after effect on the crime rate of the areas after there has been an expansion on the route of public transit. The location for the proposed study would be Boston, Massachusetts.

<u>Crime hotspots</u>

Another way of looking at this scenario can be the easy route of escape. If a criminal commits a crime like robbing a house and then goes to a crowded bus stop or subway station it will be a very difficult job to catch hold of him. The question which arises here is why crime is generating around public transportation. Most researchers have found that Public transit stops are generally hotspots for crime, generally there are specific features that appears around these areas including vacant buildings, graffiti, liquor stores, abandoned areas. As the Broken Windows theory proposes that public disorder like this in an area, leads to an increase in some more crimes like robbery, drug sales and much more violent offences. This happens as the offender mostly assumes from the above-mentioned visual science of disorders that neighbors are either too afraid or too indifferent about giving attention to what is happening in the neighborhood. This scary perception thus encourages more crimes. This theory can easily be applied to a transit stop or neighborhood areas near transit stops which has been experiencing an increase in crime rates. An extensive body of literature exists on how different design features of transit locations are correlated with the variation in crime. Various experiments have also been done that examine crime before and after the opening of transit compared to other locations which provide proofs of transit bringing an increase in crime (MacDonald, 2015).

Thus, it can be said that public transit may help facilitate crime. Robbers and Pickpockets mostly target the crowds who gather at the bus/rail stops waiting for the next transport to arrive. Also, these transportation systems and its expansions give criminals greater access to the city in which they live: "Transit shapes the crime pattern of the city by moving large proportions of high-risk populations around the city along a limited number of paths and depositing them at a limited number of destination nodes". Now expansion of transport indeed is an important issue along with significant policy implications for the city governments. Cities along with considering the potential costs and benefits of public transit must also take into consideration various factors when making expenditure decisions regarding adding additional routes. This includes important safety and security factors. When an expansion is done in public transportation it results in its increased use, which in a way implies that the expansion was done in order to decrease the total transportation costs of its riders, but that does not really indicate if this process helps in decreasing total costs through monetary time. Now to take the decision to either use or not use public transport, depends mainly on two decisional factors monetary cost and time cost respectively. Although, theoretically it is convincing that improvement and expansion in public transportation systems reduces both monetary and time costs. Public transportation is always highly subsidized and therefore it is cheap, especially in cities where traffic and parking produce congestion and are time consuming, public transport is also faster and reliable than other modes of transportation. When there is an addition of new public transportation line be it bus or rail, it is always faster as well as cheaper than previous

methods of existing transportation. This also implies that its immediate effect on crime would be almost three times. The addition of public transportation would act as follows:

1. It will eventually decrease the transportation costs of committing crimes in neighborhoods which are distant and that contain public transportation stops

2. After the effect no 1, it will simultaneously increase the transportation cost of committing crimes in the neighborhoods where criminals' live relative to remote or distant neighborhoods for them

3. It further decreases the transportation costs which was associated with having a legitimate job.

Therefore, we can assume that the new and expanded public transportation system is cheaper and faster than previous modes of transportation, which means its effects should be to decrease crime in areas in which criminals live already, but at the same time it will increase crime near public transportation stops in neighborhoods not previously populated with criminals. Thus, while crime would decrease in areas currently populated by criminals, it theoretically will change ambiguously in areas not currently populated by criminals.

Methodology

For my analysis, I have decided to identify the crime hotspots of transit stops. For this I have carried out the following steps:

1. Identified transit stops and area around it from each of the MBTA train lines

2. Identified the rate of crime around or near the transit stops

3. Classified on the type and intensity of crime

According to my second research question to identify the trend of crime in Boston around Transit Stops, the second step towards my analysis were as follows

1. Identified transit stops from each of the MBTA train lines

2. Performed trend analysis of rate of crime in and around the transit spot

3. Identified crime trend through the years 2017-19

Datasets

I have obtained the datasets from the website of Analyze Boston (https://data.boston.gov/), Massachusetts GIS data website (https://www.mass.gov/) and the website of Boston Area Research map (http://worldmap.harvard.edu/boston/).

Data Name	Description	Data type
Boston Neighborhood data	The data comprises of the neighborhoods in Boston, along with the total acre of area they spread too	Shapefile

Boston MBTA bus stops	The data comprises of all bus stops in Boston	Shapefile
Boston MBTA lines	The data comprises of all transit lines of MBTA train spread across the city of Boston	Shapefile
Boston MBTA Train stops	The data comprises of all train stops of MBTA train spread across the city of Boston	Shapefile
Crime Incidents in Boston 2015 -19	The dataset comprises of crime incidents in and across Boston from the year 2015- 19	CSV file
Boston Median Monthly Household Income	The data comprises of average monthly household incomes for the population of city of Boston	Shapefile

Data scale and accuracy

Scale: All the data had different projections from each other, I projected the datasets into required projections. There were few Null values in the data which I cleaned and sorted. The crime incident data was extracted from a pdf file to csv file and then converted to use in ArcMap. There were some latitude and longitude coordinates which were missing in the data and they were cleaned to use for ArcMap.

Accuracy: There could have been accuracy issues while cleaning the data. Especially while deleting the null values and adjusting the coordinate values. Also, while extracting from the pdf to csv file. The datasets from crimes incidents were also too big and ArcMap stopped responding multiple times while the dataset was loading.

Data Limitation:

Data was only available for Boston, I wished data was also available for the satellite cities so that I could do an overall analysis for them.

Results and Analysis

a) Crime Hotspots

I started with first joining the Boston neighborhood and crime reports datasets so that I could do a query analysis on both together. My first step was to identify two regions with multiple transit stops and the number of crime incidents reported there. I did this separately for different MBTA lines. I also joined the MBTA Lines and MBTA station datasets for better analysis.

1) **Neighborhood:** Dorchester
2) **Crime type:** Firearm Violation and Drug Addiction reports
3) **Crime Month:** January – May and June - December (2018)

Out of the Boston neighborhood file I selected the Dorchester neighborhood using query builder. Then using the select by attributes tool, I chose the crime types as Firearm Violations Drug Addiction reports. After this I joined the tables of MBTA line and crime reports. I used the select by attribute tool to choose the month from January to May and then June to December. Then using select by location tool I chose the MBTA transportations and stops in the area. I changed the symbology of the respective datasets to make it more visually attractive.

As it can be seen from the map most of the crime incident occurred in and around the transit stops. Also there has been multiple crimes for each type in the area through the month of January- May 2018. I have depicted the crime reports with a different symbol. I have created another map which depicts the same type of incidents from the month of June to December 2018.

Crimes (January-April, 2018)


Legend

⊤	MBTA Train Stop
📍	Drug Addiction Report
◆	Firearm Violation
■	MBTA_Bus stop
—	MBTA Tline
▭	Boston_Neighborhoods

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

0   0.3   0.6   1.2 Miles

Map 1- Dorchester

Crimes (June-December, 2018)

Legend

⊤	MBTA Train Stop
•	Drug Addiction Report
◈	Firearm Violation
■	MBTA_Bus stop
—	MBTA Tline
▭	Boston_Neighborhoods

0   0.3   0.6   1.2 Miles

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map 2: Dorchester

As it can be seen from the maps, the number of crime rates is bit more higher in the month of June

to December 2018 than January to May 2018. The number of crimes reported in Jan-May is **200**

including both firearm violations and drug addiction reports while for June-December it is **700**.

Also, it is evident from the map that crime is clustering mostly around the transit stops (including

train and bus stops) and they can be referred to as crime hotspots.

Further I did similar analysis on a different neighborhood. Out of the Boston neighborhood file I selected the Jamaica Plain neighborhood using query builder. Then using the select by attributes tool, I chose the crime types as Homicide and Auto theft. After this I joined the tables of MBTA line and crime reports. I used the select by attribute tool to choose the month from January to May 2018. Then using select by location tool I chose the MBTA Transportations and stops in the area. I changed the symbology of the respective datasets to make it more visually attractive.

1) **Neighborhood:** Jamaica Plain
2) **Crime type:** Criminal Harassment
3) **Crime Month:** January - May (2018) and June – December (2018)
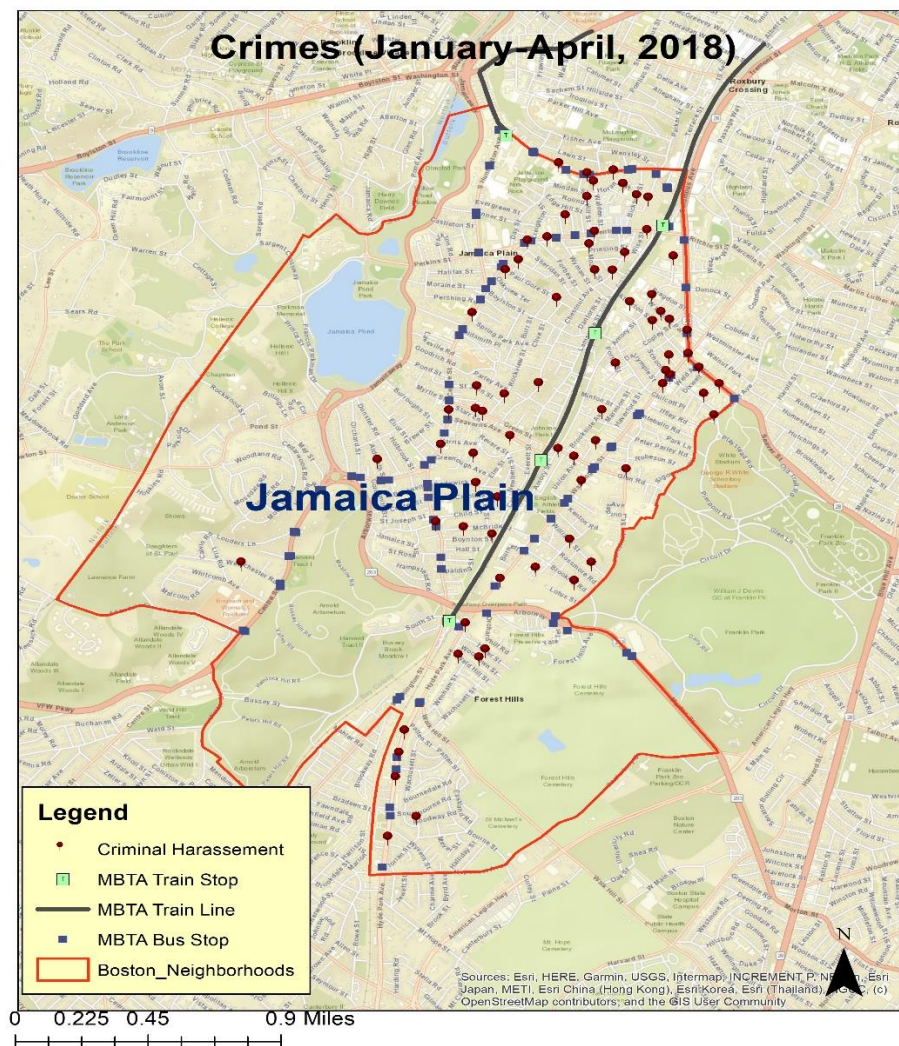
Map 3- Jamaica Plain

A very interesting observation can be seen from the map 3, as the map depicts most of the crime occurrences are happening around transit stops only and there are smaller number of crimes towards the end of the boundary and along the boundaries of Jamaica Pond.
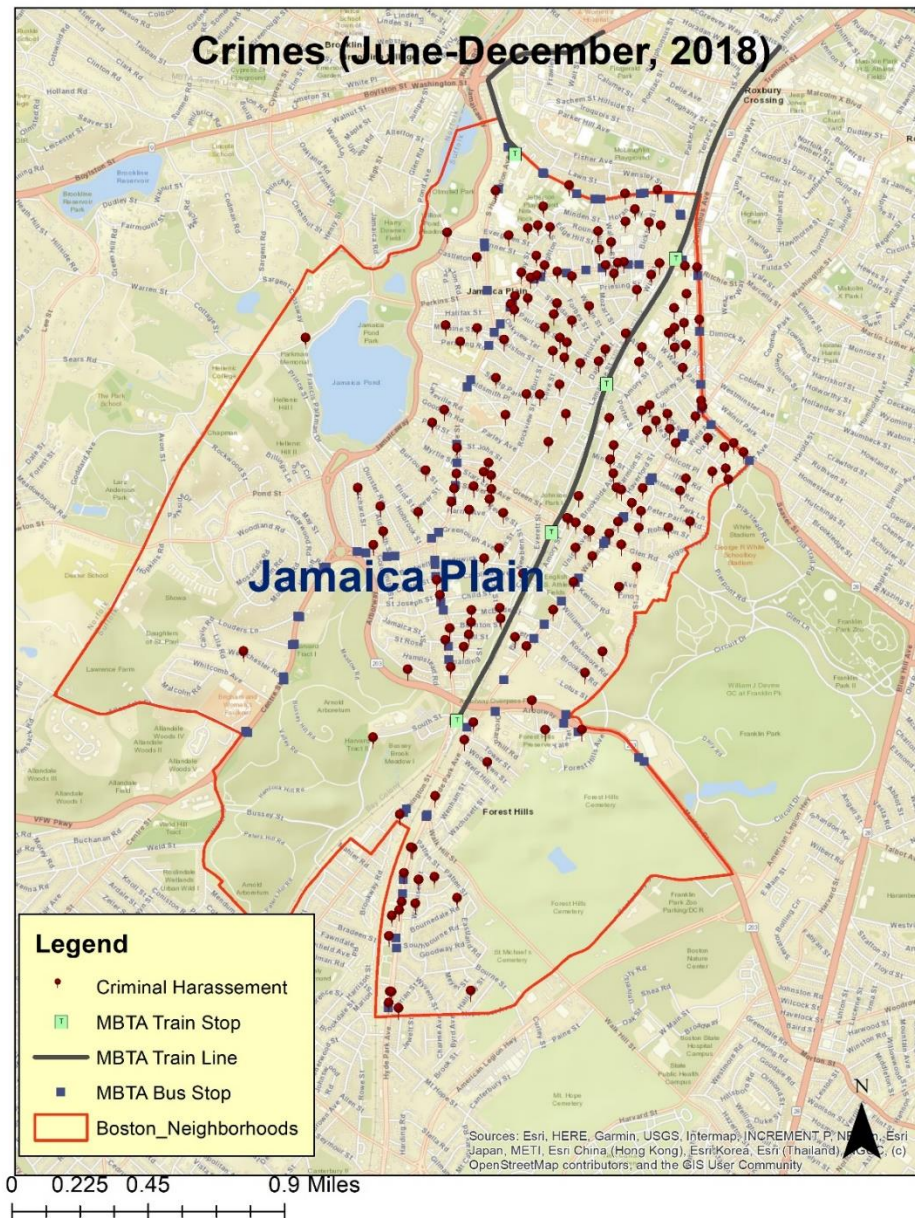
Map 4: Jamaica Plain

The map 4 also depicts similar results as the previous one. Further there is a lot more increase in the number of crimes for criminal harassment.
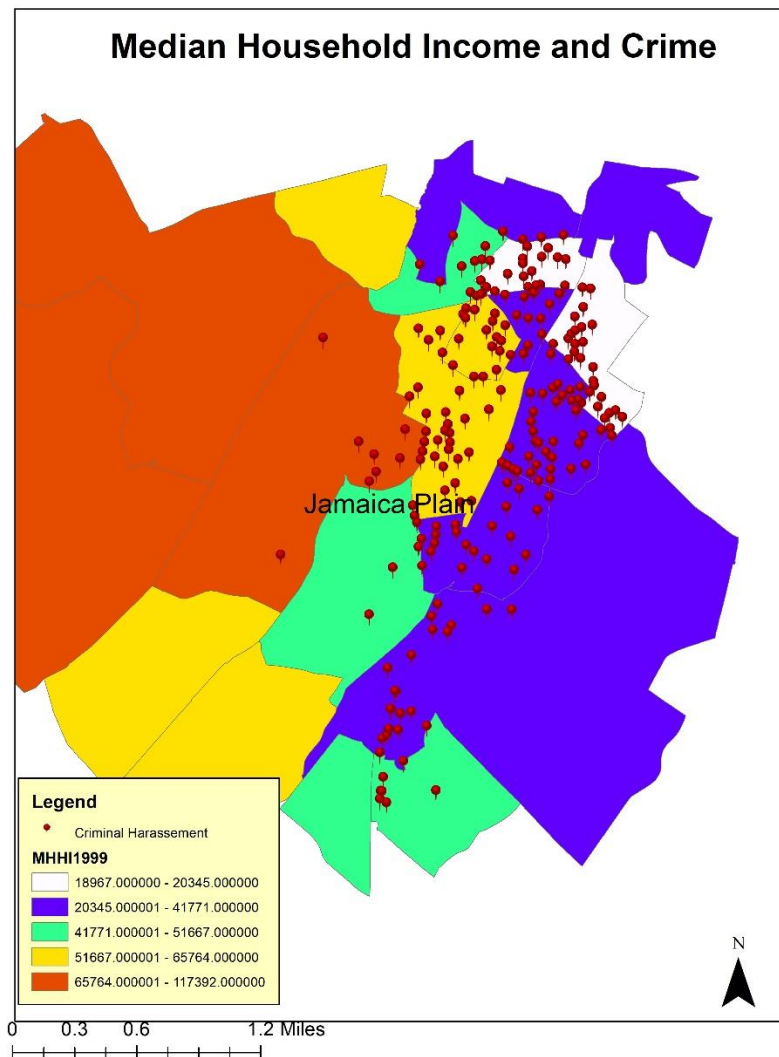
To understand crime rate in more details I have also added the median household in the following maps for Dorchester and Jamaica Plain.

Median Household Income and Crime

Legend
• Drug Addiction Report
MMHH_Dorchester
■ 12132.000000 - 25111.000000
■ 25111.000001 - 32731.000000
■ 32731.000001 - 40133.000000
■ 40133.000001 - 50039.000000
■ 50039.000001 - 90425.000000
☐ Boston_Neighborhoods

0   0.4   0.8   1.6 Miles
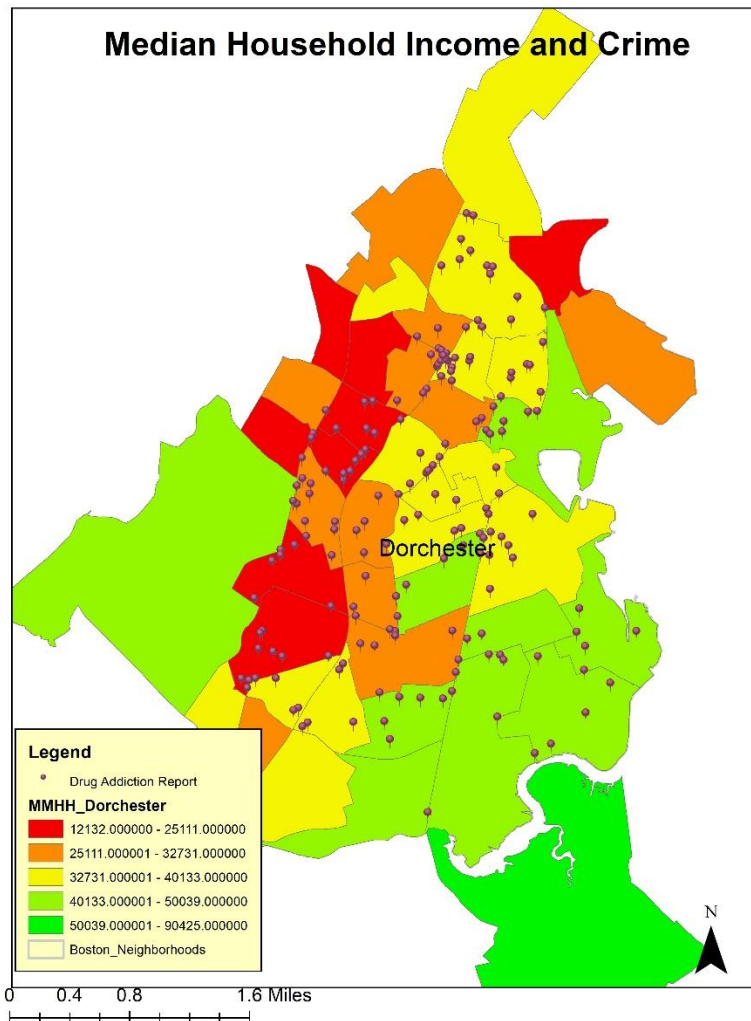
Map 5-Dorchester

The map depicts Highest median household income in Bright Green and lowest median household income in red. As we can see from the map, the drug addiction reports are generally clustered around the areas with low and medium household income. Further as previously discussed these crime spots are also near the transit stops (bus/train). Therefore, it can be said that transit line and stops largely effects the rate of crime in areas around transit stops with population mostly belonging to lower and medium socioeconomic groups. This can be due to lack of social control

in the neighborhood. Also, the area being around transit stops can be easier for commute and for escape. Further we move on to the map for Jamaica Plain.


Median Household Income and Crime

Legend
- Criminal Harassement

MHHI1999
- 18967.000000 - 20345.000000
- 20345.000001 - 41771.000000
- 41771.000001 - 51667.000000
- 51667.000001 - 65764.000000
- 65764.000001 - 117392.000000

0   0.3   0.6   1.2 Miles

Map 6- Jamaica Plain

The map of Jamaica plain shows an interesting pattern, as it can be seen though criminal harassment is high in low income areas, it is also moderately high in median and high-income areas too. Thus, we can say transit lines and stops effects the rate of crime in areas with population density mostly belonging to medium higher socioeconomic groups. This can be due to high value of living and materials. Also, the area being around transit stops can be easier for commute and for escape.

b) Type and Intensity of crime

Next step was to differentiate among neighborhood crime reports based on the intensity and type of crime. I wanted to visualize both on the same map. Hence, I selected Brighton and Allston as the location using the query builder tool from Boston Neighborhoods. Then I used categorized symbol to show the intensity of crime for each month (2017-18) which in this case was Firearm violence and drug addiction in the two areas. As we can see from the map below the intensity of these crimes is highest in the months of January to April (315) and lowest in months of May to August (200) .
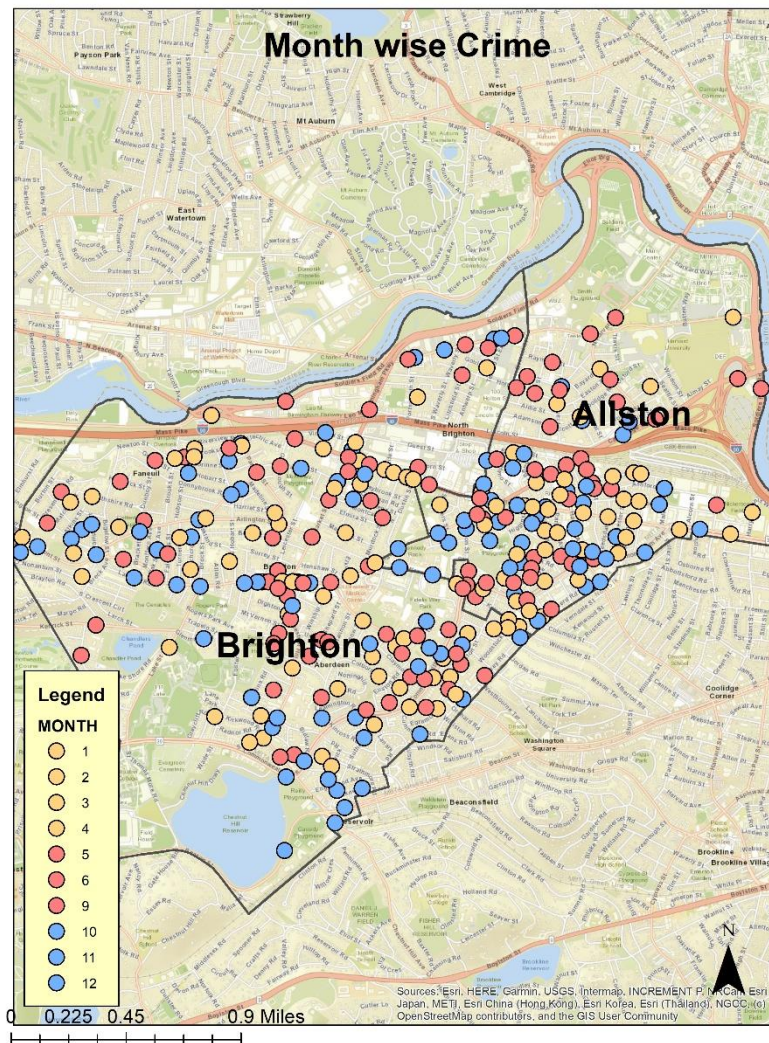
Map 7- Brighton/Allston

Similarly, I also created a map for the area of Allston and Brighton based on the type of crime. The below map depicts a segregation of 3 types of crimes. A) Auto Theft B) Firearm violations C) Fraud for the year 2018. I selected Brighton and Allston as the location using the query builder tool from Boston Neighborhoods. Then I used graduated color symbols to depict types of crimes.
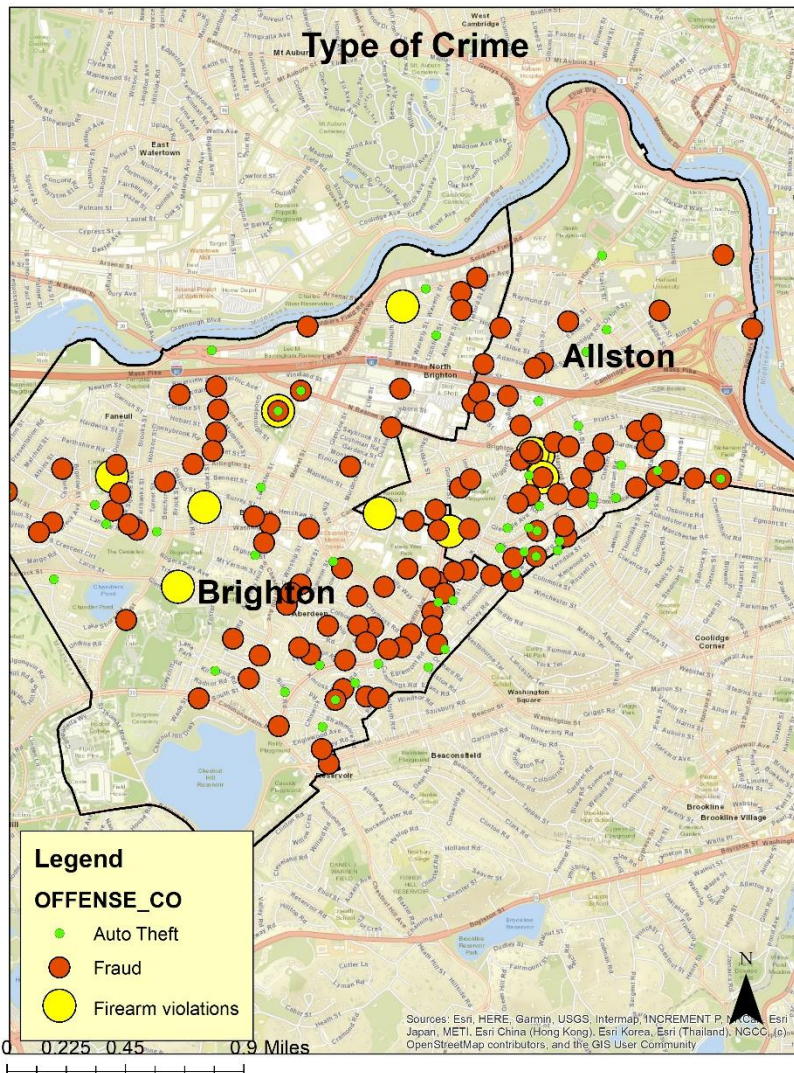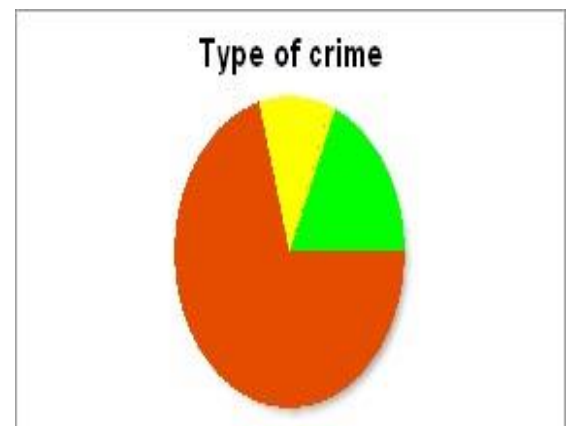

Pie chart for type of crime

Map 8- Brighton/Allston

As the map and the pie chart depicts highest number is the crime of Fraud, second is number of automobile thefts and followed by firearm violence in these two areas.

c) Trend of crime

The next part of my analysis was to examine the trends of crime over the years 2016-2019. For this analysis I chose 3 neighborhoods to compare with the others and vice versa. This analysis was done to see if the rate of crime increased or decreased over the course of 3 years. The type of crime chosen for the trend analysis was auto theft. The following map depicts the crime rate of auto-theft for the years 2016-19 in the neighborhoods of Fenway, Longwood and Mission hill.
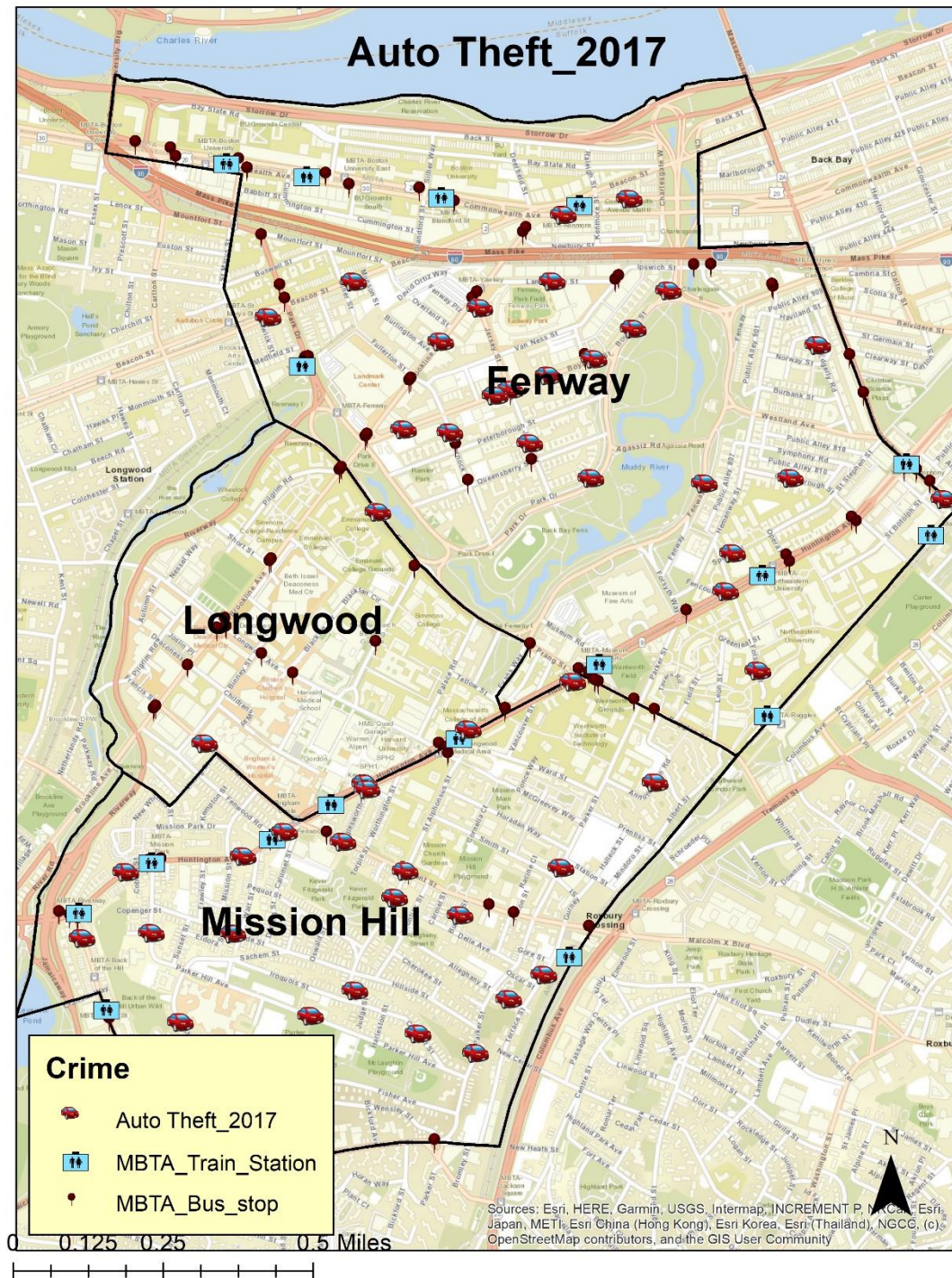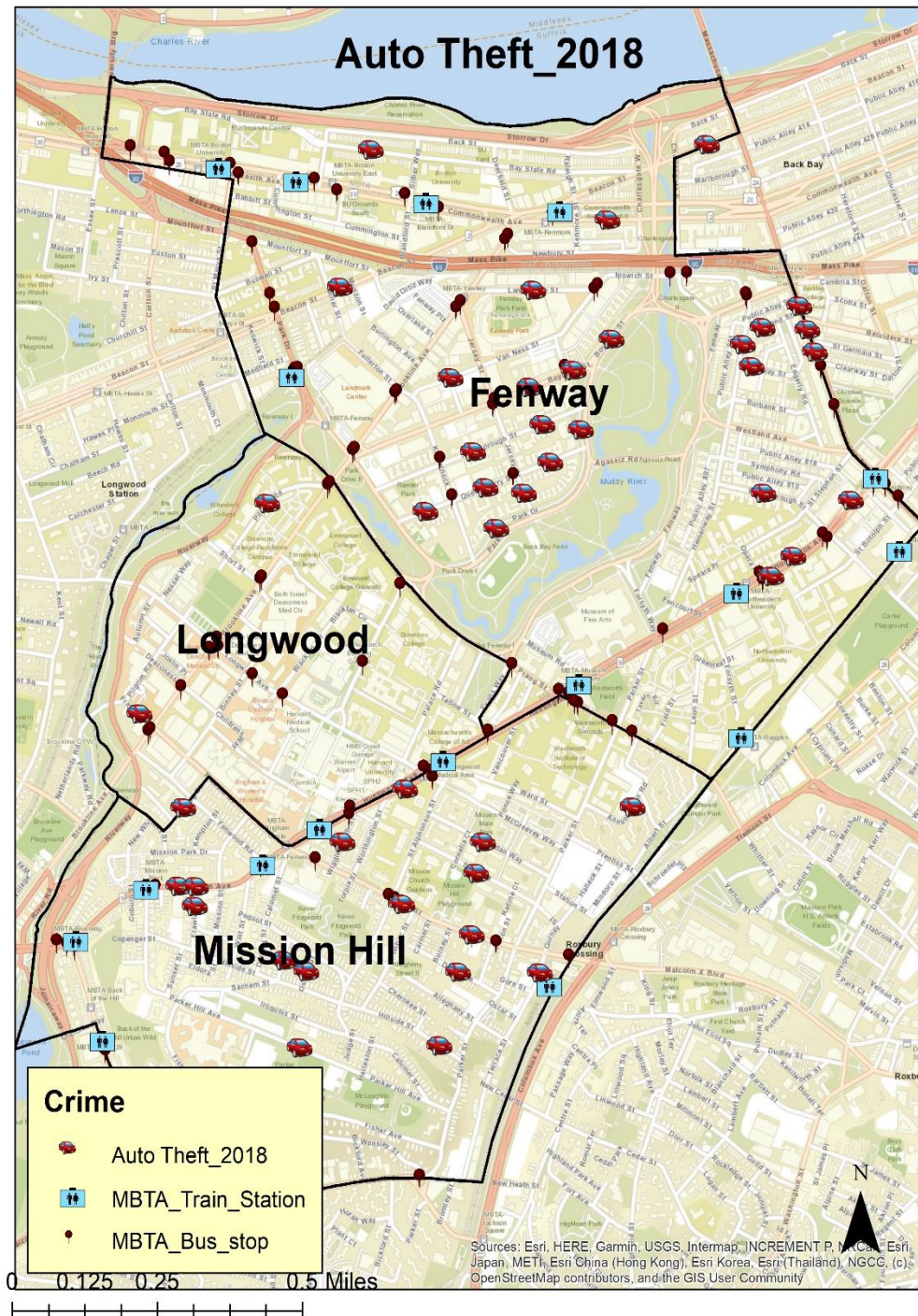
a) Year- 2016
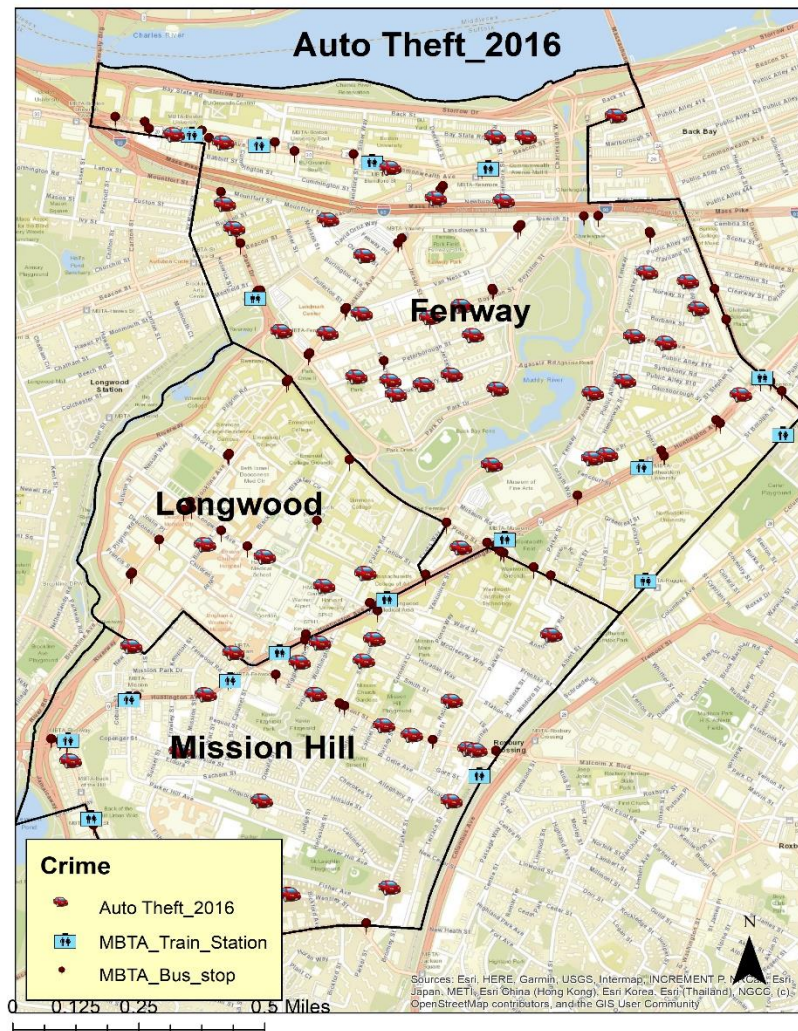
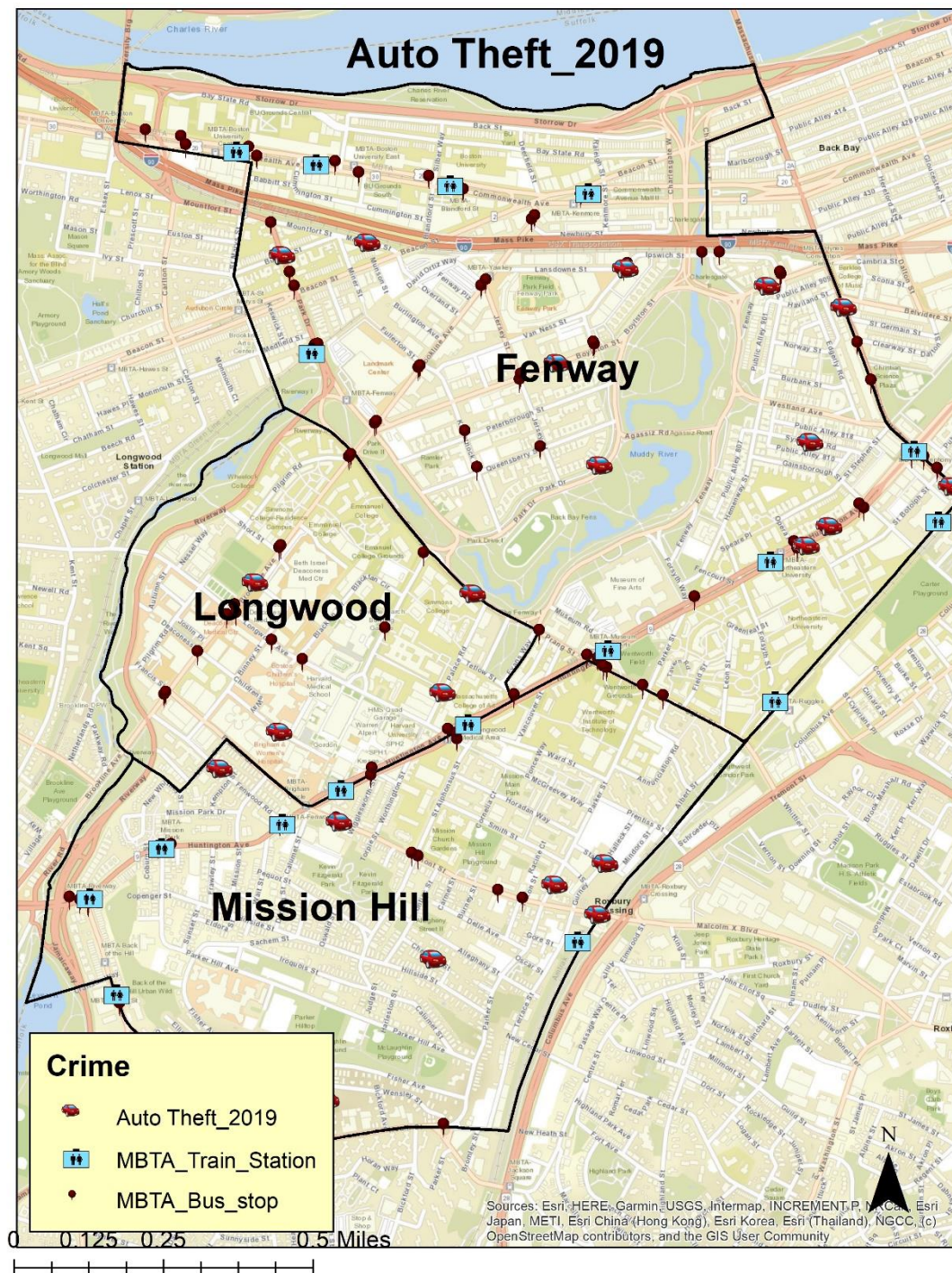Map 9_Auto Theft_2016

b) Year 2017

Map 10_Auto Theft_2017

c) **Year 2018**

Map 11_Auto Theft_2018

d) Year 2019

Map 12_Auto Theft_2019

There are multiple observations from the map. I have listed them as follows:

1) Auto theft are intensified around the transit stops (bus/train)

2) There has been slight decrease in auto theft from 2016 to 2019

3) In 2016 there were 71 cases followed by 64 in 2017, 54 in 2018 and 22 in 2019 till now

4) Auto thefts are lowest in Longwood area

I have also included a pie chart showing the proportion of auto theft for each year.
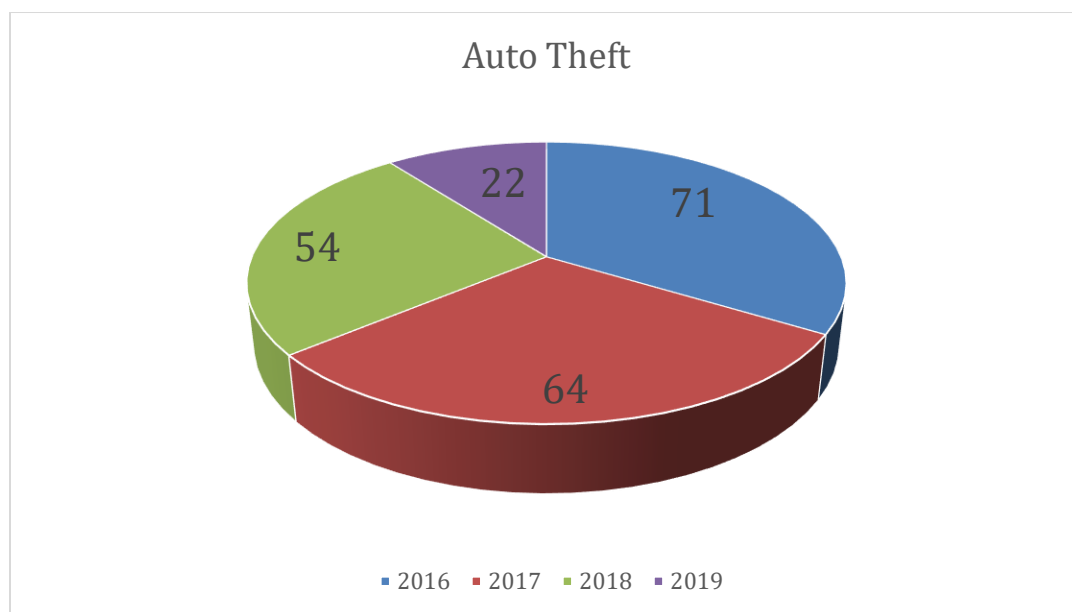
Auto theft (2016-19)

Important Key findings

- Crimes are intensified mostly around transit stops

- In terms of trends of crime, it has decreased for Auto Theft but has increased for Drug Addiction, Firearm Violation, Criminal harassment and Fraud

- Crimes which involves a commodity like car or crime involving guns like firearm violence is higher around bus stops, while crimes involving Drug Incidents, Criminal harassment are higher around train stops

- Crimes are higher in the months of June-December and comparatively lower in January-May

- It can be said that transit line and stops largely effects the rate of crime in areas around transit stops with population mostly belonging to lower and medium and also higher socioeconomic groups.

Conclusion

Crime has always been a very skeptical topic, it can have many occurrences and causes. Though this proposed study may in a way show there has been a significant effect of expansion of metro rail system on the rate of crime, it can have much more hidden factors to it. This is a very important issue for cities, if adding a new way of transport to connect cities and encourage more business and jobs for people helps enhances economy, at the same time it can also bring increasing rate of crime to it. It is always advisable to rather have safety measures like a greater number of crime helpline, more policing and safety features to be added while expanding transport to make it more effective. Also, usage of methods like Predictive Policing can help identify and Combat crime to a great extent.

Recommendations

- **Crime Mapping, Analytics and Predictive System (CMAPS)**

This is one innovative crime mapping technique which is used to gather real time data for crime. This GIS based crime mapping system gives detailed information about time, place and type of crime. This data can be used to predict the spatial and temporal patterns of crime. This data can be further used for predictive analysis of time of crime, place of crime and to predict social network of the crime gang.

- **Predictive Analysis**

  This analysis can be done to predict the location and time of crime using the data from trend analysis of crime. This real time data software can be used to predict crime and take necessary measures to prevent it.

References

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