

Analyzing crime data in DC: do crime density patterns relate to income inequality?



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Introduction to Programming for Solving Urban Challenges
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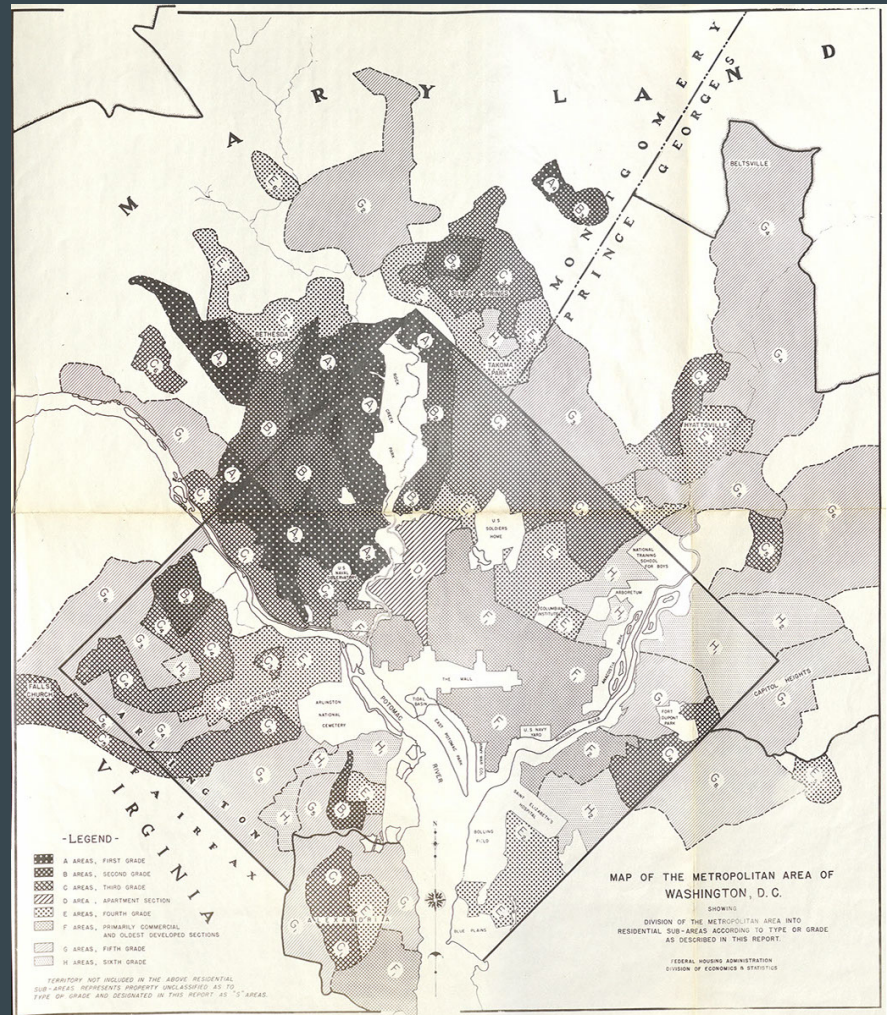
Research Question

Do crime density patterns correlate with income patterns in DC?

- Is there a temporal (time-series) correlation between crime and income patterns?
- Do some wards have similarities in temporal and spatial patterns of crime?
- Are there some similarities in crime density patterns within and across wards?
- Do crime types play a role in differentiating crime density patterns across wards?

Background

- Income inequalities were present in DC, among other inequalities such as racial and ethnic disparities.
- DC has been affected by redlining, some areas have been historically segregated. Effects of systemic inequality still partly persist (Toprak&Ekdi, 2022).
- “The disparity between white and Black households is the most disproportionate as the median household income for white residents, at \$141,650, is over three times higher than that of Black residents, which is \$45,072”(Brookings, 2022).
- Crime patterns can be related to these inequalities mainly because of residential segregation.
- In the last 30 years, DC has been widely gentrified, crime patterns have shifted.



Methodology

Data processing

- Importing and concatenating the crime and the income datasets to be used
- Data cleaning for crime and income datasets
- Investigating data types and transforming data types
- Spatial join with geopandas: Merging the crime data
- Spatial join with geopandas: Merging the high/low income data
- Extras (importing and processing 'track the recovery' dataset)

Data Analysis and Findings

- Time-series analysis of daily crime numbers and employment rates between 2020-2022
- Comparison of total crime number and income distribution by Wards
- Temporal crime patterns by low vs. high income wards
 - Month, Day of Week and Hour of the Day analyses
- Crime type density in different wards
 - Theft numbers across wards
 - Other crimes across wards
- Crime vs. income mapping and correlation
 - Low vs. High Income Neighborhoods
 - Comparative heatmaps by Crime Type and Income Distribution (6 side-by-side map pairs)
 - Correlation table

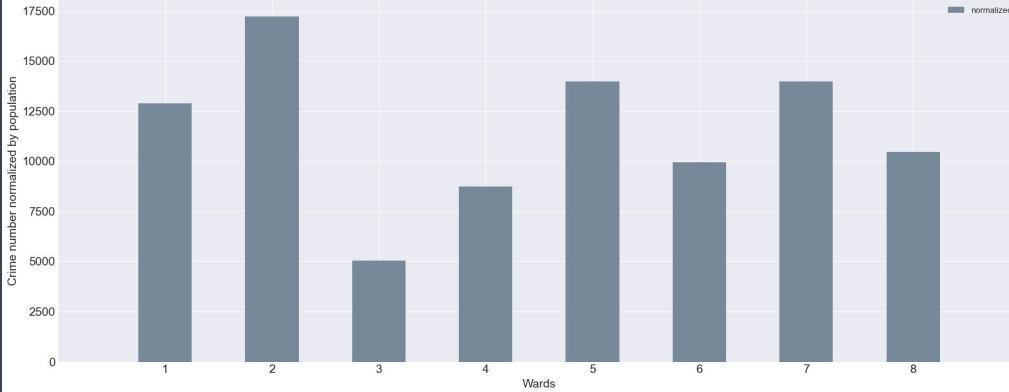
Data Analysis and Findings

Time-series analysis of crime patterns vs. employment rates

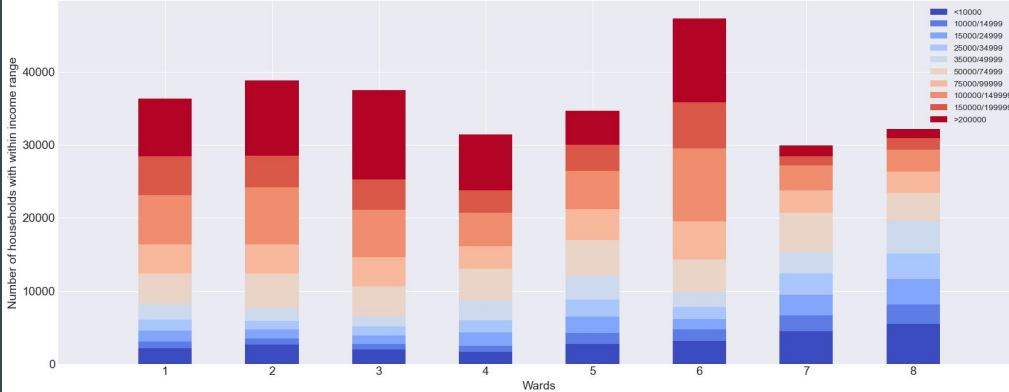


Analyses by wards part 1: Crime vs. income bar charts by 8 wards of DC

Crime Density by Wards 2020-2022



Income distribution by Wards (2022)



- Inverse correlation between high-income density vs. crime density, especially in Wards 3-6.
- Low-income dense wards such as Wards 7-8 have relatively higher crime densities.
- In neighborhoods where the wealth seems typically distributed, such as wards 1-2-5, we see a very high crime density.
- I need to provide more detail to conclude that there is a correlation between crime density and income distribution across wards.

Analyses by wards part 2:

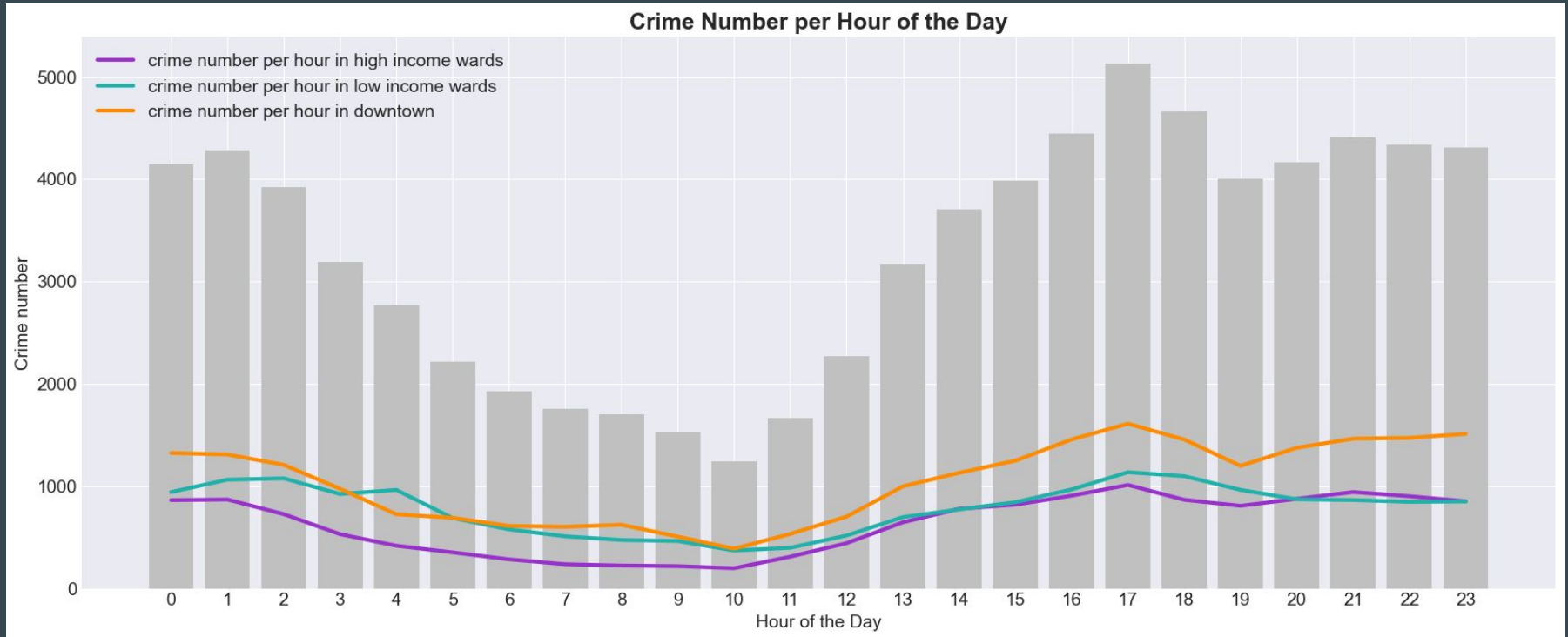
Temporal crime patterns by low vs. high income wards

- Same patterns: fewer crimes in high-income neighborhoods than in low-income wards.
- The downtown has much more crime than low/high-income neighborhoods. Residential areas vs. city center.
- Between 1 am and 5 am, low-income neighborhoods have significantly more crimes than high-income neighborhoods, meaning that low-income wards are more likely to be dangerous at night.

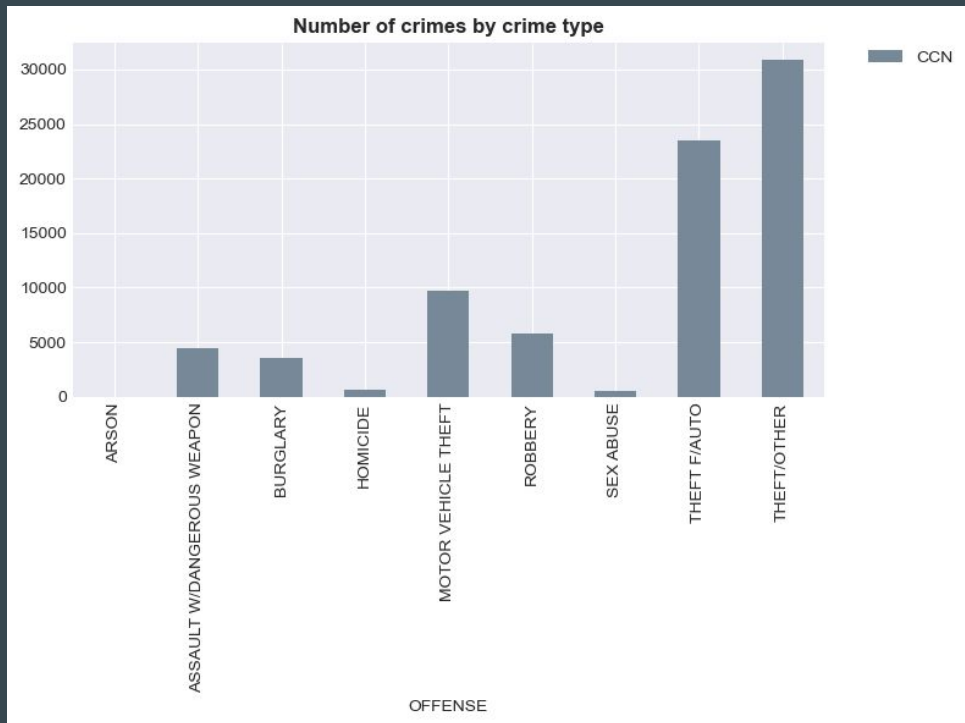


Analyses by wards part 2:

Temporal crime patterns by low vs. high income wards

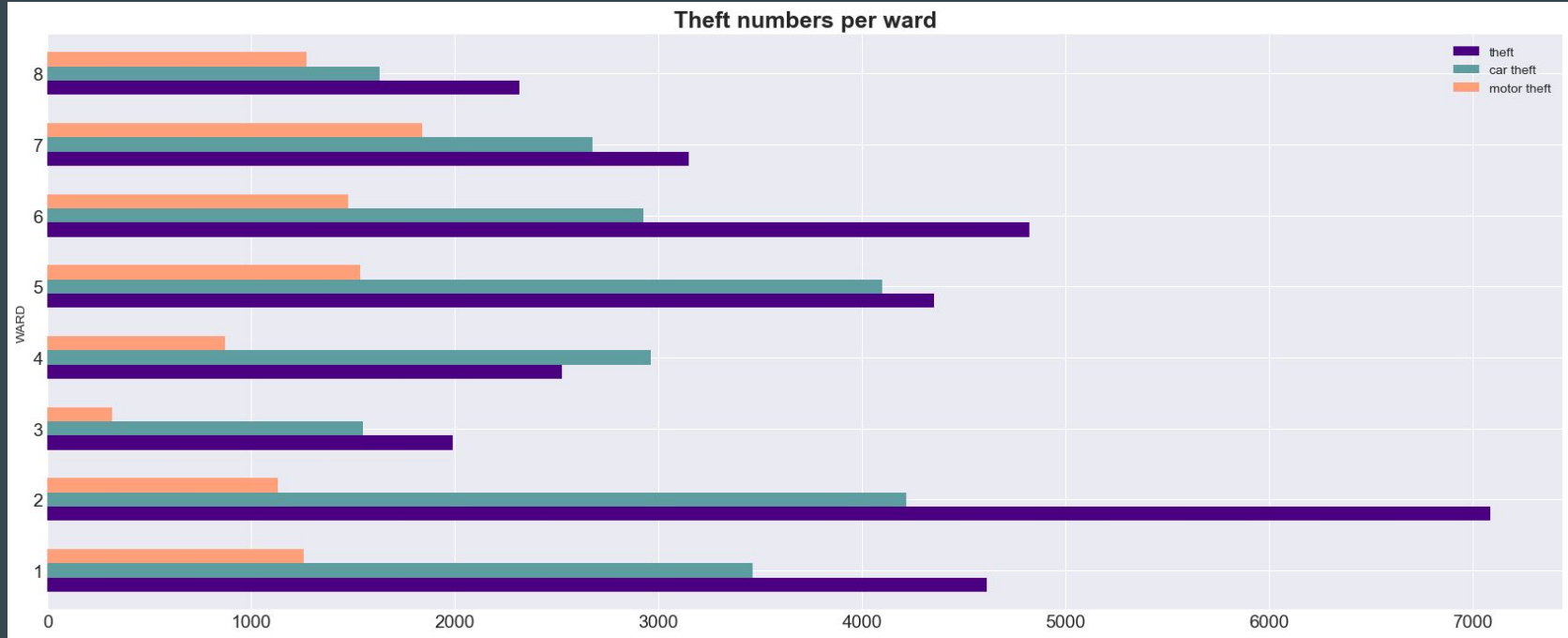


Analyses by crime types:



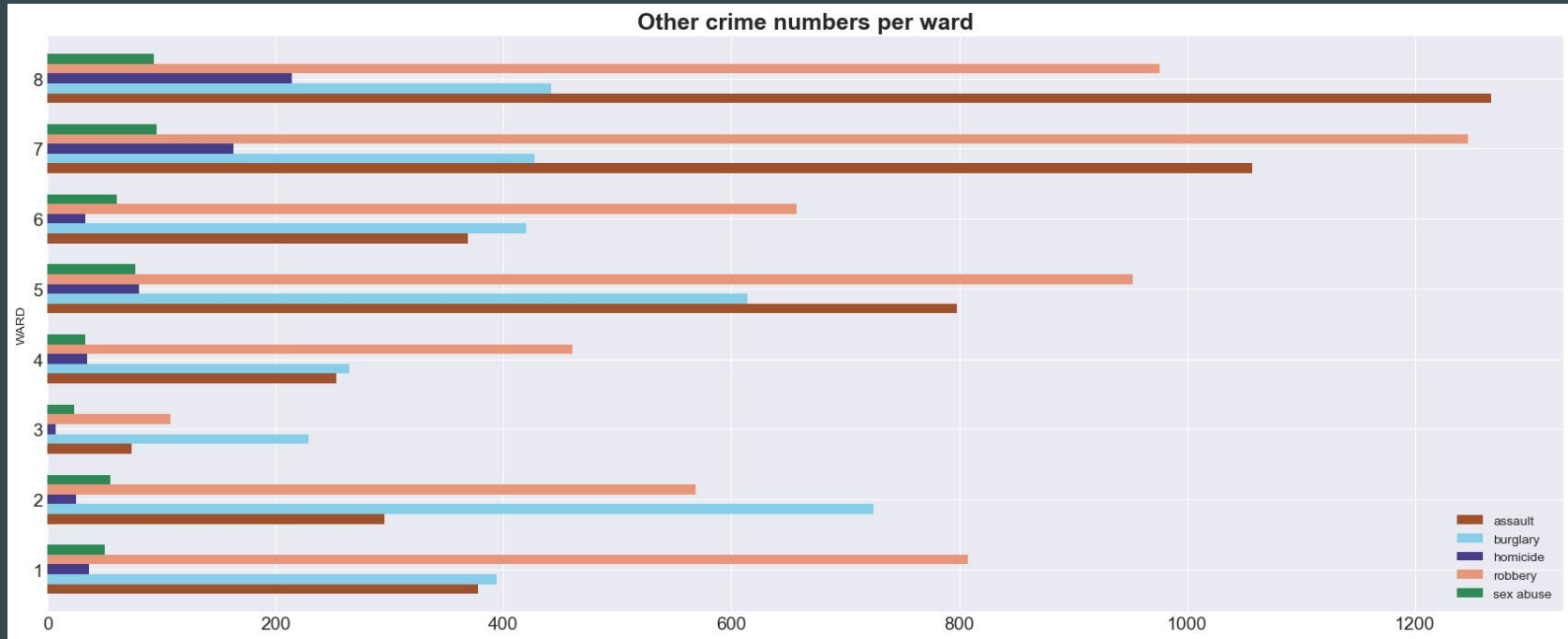
- Theft is dominating crime type.
- Arson, sex abuse and homicide is low in number.
- Next, I need to look into patterns of crime types per wards to see if there are different patterns and densities of crime, among different crime types across wards.

Analyses by crime types per ward:



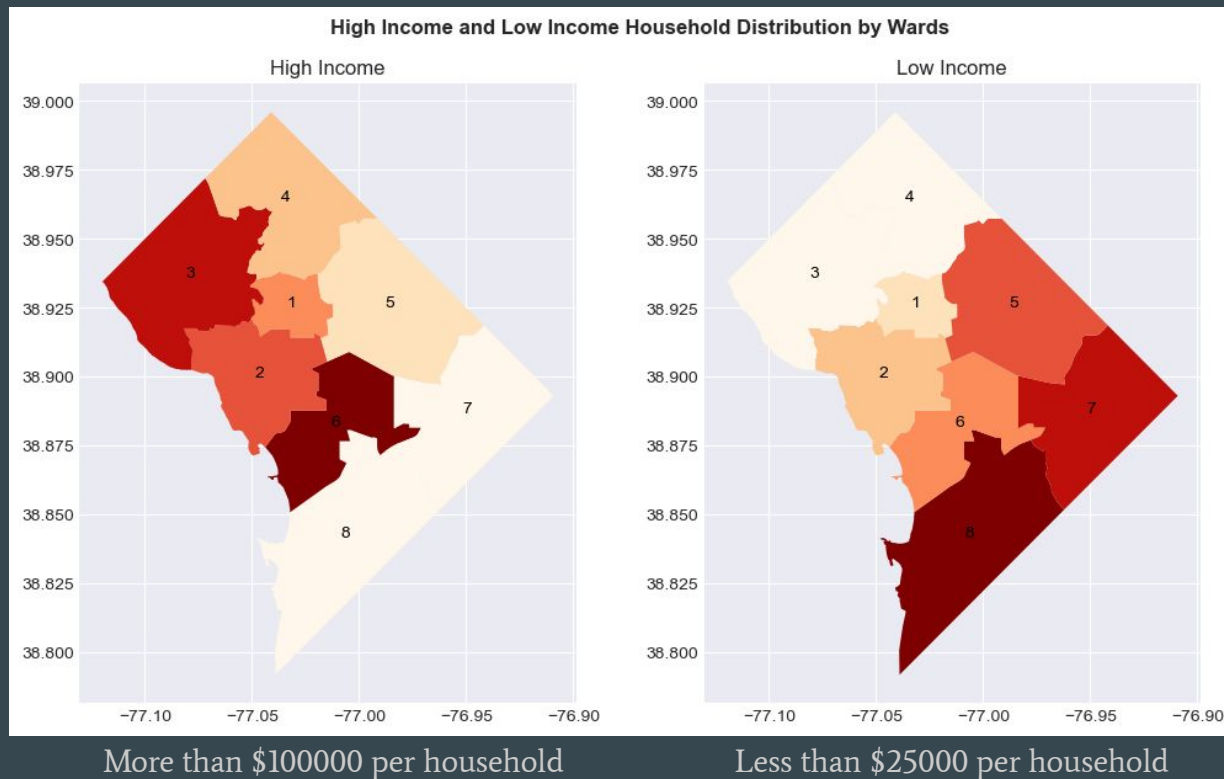
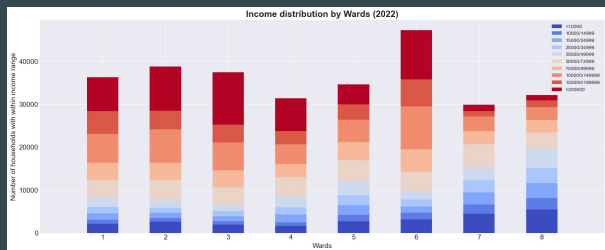
Theft crimes are very high in number and carry approximately the same trends with total crime distribution by wards.

Analyses by crime types per ward:



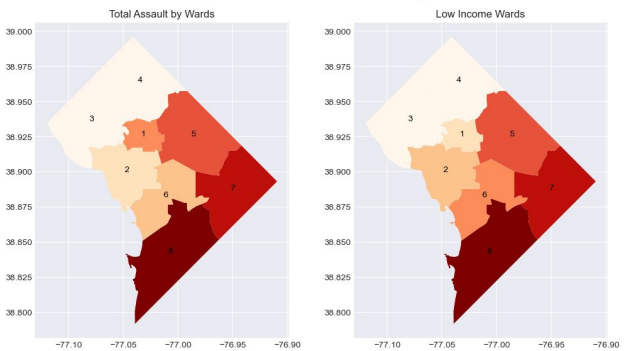
The bar plot result for other crimes per ward suggests that crimes such as assault, robbery, and homicide are more likely to happen in low-income neighborhoods than anywhere else, including downtown.

High Income Wards vs. Low Income Wards: Household Income Distribution

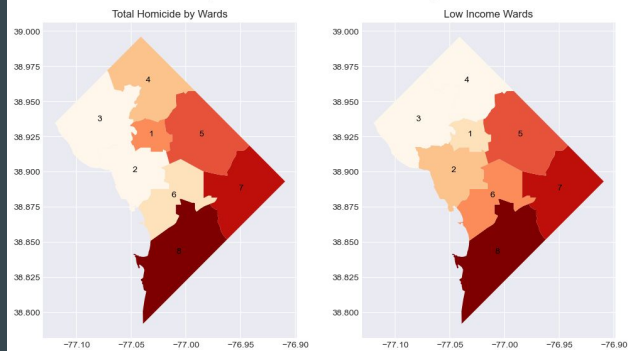


Crime types vs. Low Income

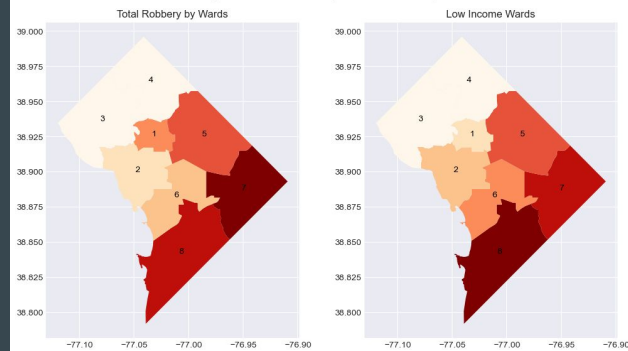
Comparison of Total Assault and Low Income by Wards



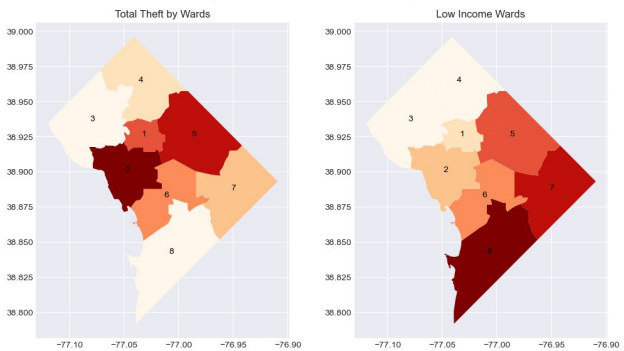
Comparison of Total Homicide and Low Income by Wards



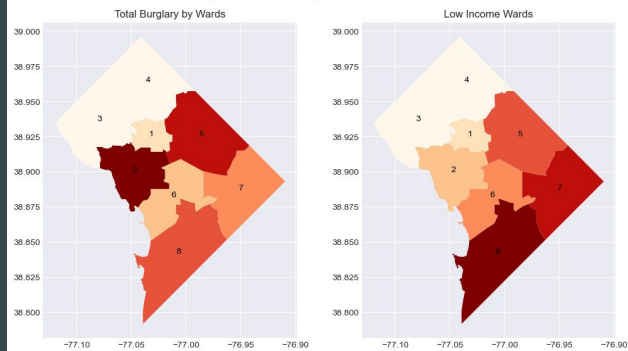
Comparison of Total Robbery and Low Income by Wards



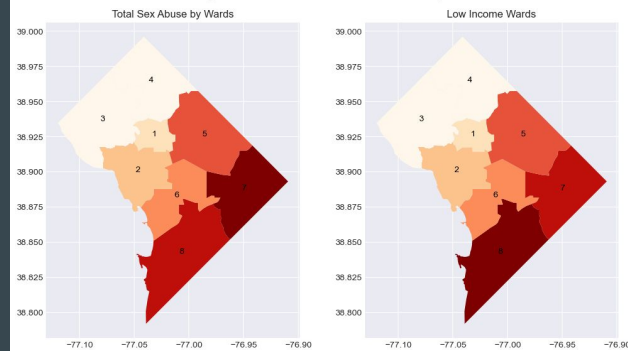
Comparison of Total Theft and Low Income by Wards



Comparison of Total Burglary and Low Income by Wards

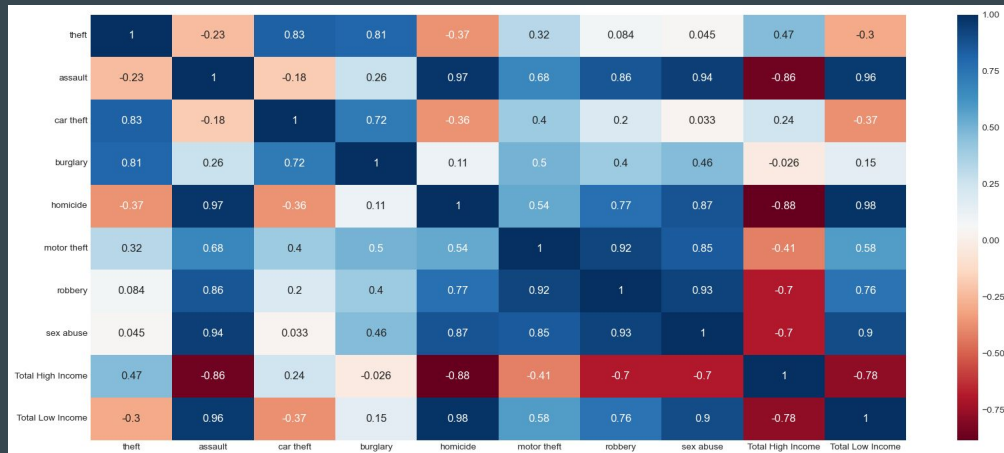


Comparison of Total Sex Abuse and Low Income by Wards



Correlation table:

- strong correlations in this table (0.98 between homicide and low income, 0.96 between assault and low income) like I predicted the patterns on the heatmaps.
- strong inverse correlations, such as -0.86 and -0.88, between high-income groups and homicide/assault.
- substantial consequence of exclusion and segregation by income, and most probably other factors that I did not specifically look into for this study, such as ethnic and racial differences



Results:

- Specific crime types' distribution across wards correlates with wealth distribution across the same neighborhoods.
- There are only certain types of crimes that connect with low-income neighborhoods, and these crimes are assault, homicide, and robbery: more dangerous for citizens because guns or other weapons are more likely to be involved.
- Results bring equity questions: Do crime patterns (especially more dangerous crimes) contribute to inequality spatially? Or are they one of the results of segregation?
- 'Unequal crime patterns carry substantial correlations with exclusion and segregation by income, and most probably other factors such as ethnic and racial differences'.