

Wisconsin Crime and Population Analysis Summary

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1 Introduction

Crime rates and their relationship to various characteristics of the population may be critical in making informed decisions on strategies to reduce crime. This analysis begins to investigate crime patterns across Wisconsin counties, utilizing demographic data to identify clusters and potential associations with different types of crime.

2 Data Exploration

The data set encompasses 240 observations collected from 72 Wisconsin counties over a four-year period from 2020-2023. It includes 18 informational variables as displayed in table 1. Data was missing entirely for 3 northern counties which could not be included in the analysis.

Demographic data was sourced from the US Department of Health and Human Services, including information on race, age, educational background, employment, and living status for each Wisconsin county (2024). Information about crime was obtained from the FBI National Incident-Based Reporting System (2024). The crime data was originally in the format of counts of specific crime types, so the data was aggregated into three categories: crimes against people, crimes against property, and crimes against society. Using a county population census, crime count was transformed into a crime rate per 1,000 people.

Variable	Description	Median Value
Year	Year from which data was collected	-
Population	Total number of residents in each county	45,762
Race	Proportion of county population by race: Black White Hispanic Asian Native American Foreign-Born	0.008 0.915 0.034 0.007 0.003 0.025
Education	Proportion of county population (ages 25+) that have at least a Bachelor's degree	0.240
Unemployed	Proportion of county population (ages 16+) that is unemployed	0.032
Poverty	Proportion of county population that is living below the poverty line	0.101
Crowding	Proportion of county population that lives with more than 1 person per bedroom	0.140
Under 18	Proportion of county population that are age 17 and younger	0.209
Over 65	Proportion of county population that are age 65 and older	0.194
Median Income	Median yearly household income for the county	\$68,731
Crime	Crime rate per 1,000 people against: People Property Society	1.99 4.76 3.91

Table 1: Features considered in the modeling process and their descriptions.

3 Methodology

Exploratory data analysis was initially used to understand variable distributions and potential correlations. Figure 1 indicate lower rates of crime against people compared to society and property crimes yet crimes against people and property were still highly correlated. No dramatic change in crime rates was observed within the most recent years. Figure 2 looks at total crime rate across demographic data however no clear trend is visible.

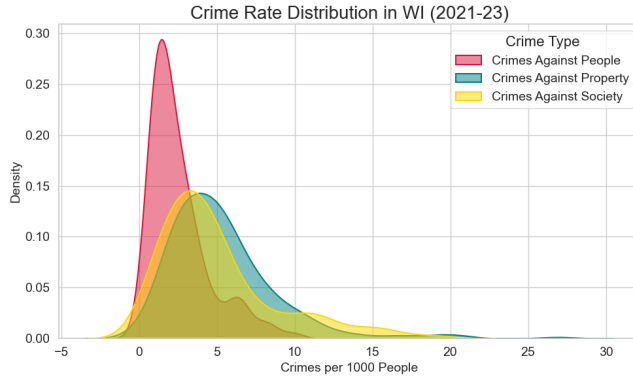


Figure 1: Distribution of crime rates

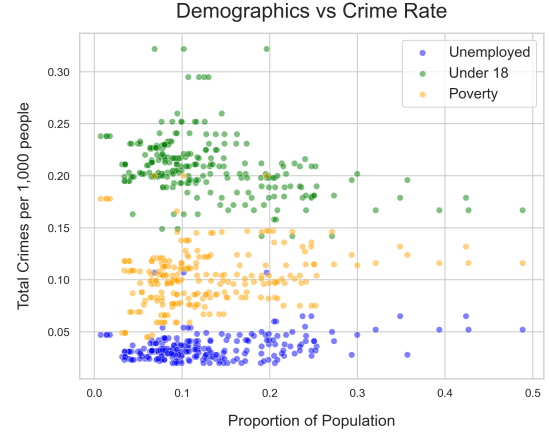


Figure 2: Proportion of people unemployed, under 18, and living in poverty against total crime rate

Principal Component Analysis (PCA) was used to evaluate the entire data set in fewer dimensions, retaining 3 components that captured 70% of variance. The counties plotted across the principal components revealed a trend in total crime rate. Additionally, clustering techniques, including K-Medoids using euclidean and mahalanobis distances, and hierarchical clustering with ward linkage, were implemented on the three crime rates, and consistently identified 2 distinct clusters. These clusters were examined to uncover relationships between demographic characteristics and crime rates. DB-SCAN clustering was also attempted but did not prove to be impactful. The k-medoids clustering technique was more robust to outliers than agglomerative, and created the most distinct clusters using a euclidean distance metric for the numerical data. Figure 3 illustrates k-medoids clusters in which each point represents a single county from a single year.

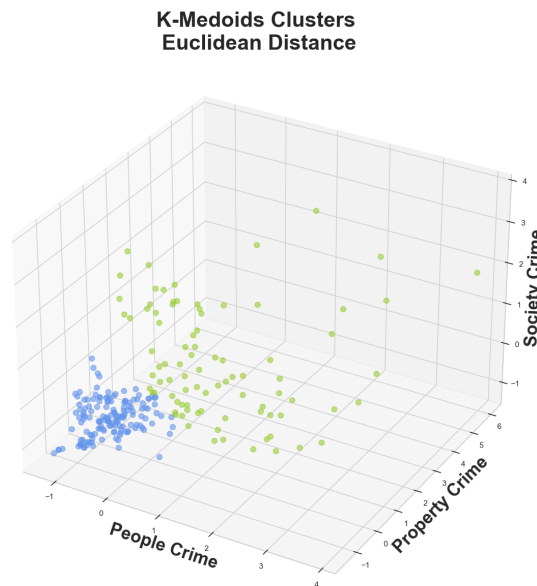


Figure 3: K-Medoids clusters using Euclidean distance plotted by types of crime

Cluster 1 was associated with higher crime rates for all 3 types of crime with a demographic profile including a greater proportion of individuals under 18, people with at least a Bachelor's degree, white population, and foreign-born residents. In contrast, cluster 0 exhibited lower crime rates and included a higher proportion of older adults (65+), as well as Asian, Black, and Native American populations. A comparison of cluster groups is shown in figure 4 for race and other population characteristics.

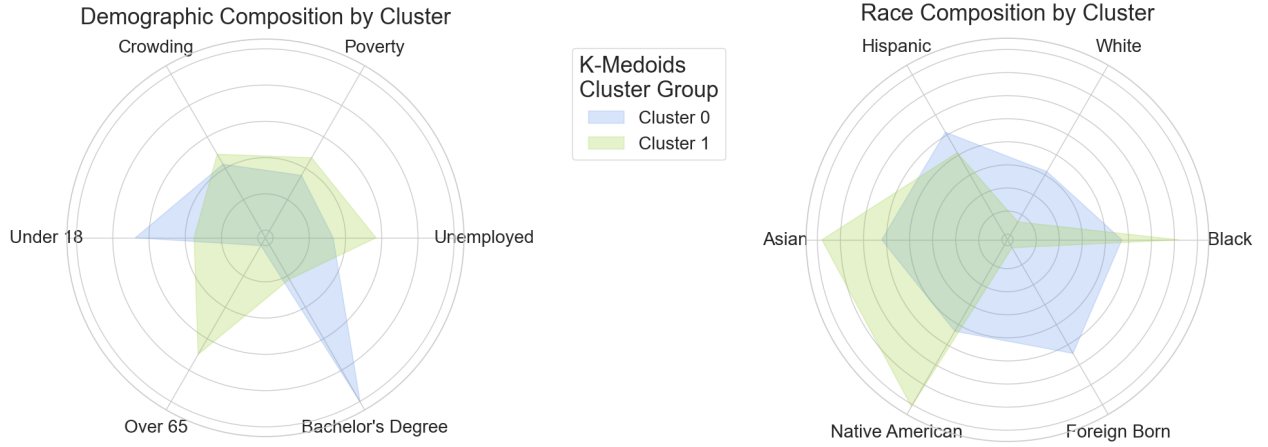


Figure 4: Comparison of cluster distributions across county demographics and racial groups.

4 Key Findings

Crime rates in Wisconsin have remained relatively stable within the last 4 years. However, clustering revealed that counties with younger populations and higher education levels tended to have higher crime rates (cluster 1), whereas counties with populations older in age and a more diverse racial composition demonstrated lower crime rates (cluster 0).

This analysis was constrained by its limited time span of data, ranging only a few years. A longer data range could have allowed for analysis of clusters overtime. Additionally, incorporating more features, such as other levels of educational background or urbanization, could have made for a more thorough investigation of crime data and potentially uncovered new cluster patterns. Further, alternative clustering methods could be considered. It's important to note that many crimes go unreported, and this analysis does not account for these missing data. The final clusters are projected on a map of Wisconsin in figure 5.

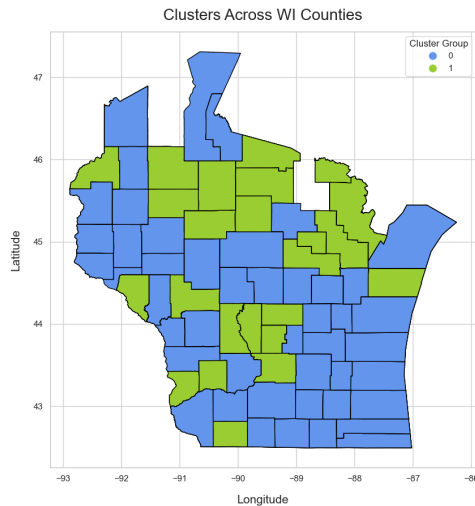


Figure 5: Wisconsin counties colored by k-medoids clusters

References

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- [2] Federal Bureau of Investigation. (2024). National Incident-Based Reporting System. How We Can Help You. <https://www.fbi.gov/how-we-can-help-you/more-fbi-services-and-information/ucr/nibrs>
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