Investigate Chicago Crime on a Spatial Aspect

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Background

It is well-known that Chicago is not a safe city. Chicago's overall crime rate, especially the violent crime rate, is higher than the US average. Chicago was responsible for nearly half of 2016's increase in homicides in the US, though the nation's crime rates remain near historic lows. We want to investigate which variables are correlated with the crime rate in Chicago. Neighborhood scholars have recently begun to note that "neighborhood effects" are in fact largely approximating the impact of spatially-bounded, local social networks (Hipp et al., 2012; Sampson, 2012). Specifically, social networks are thought to be a key intervening mechanism explaining the observed relationship between neighborhood features and local crime rates (Kubrin and Wo, 2016; Soller and Browning, 2014). Importantly, while social ties are typically construed in terms of inhibiting crime, such ties may also facilitate problematic behaviors (Browning et al., 2004). At a basic level, crime and deviance require information, skills, and logistical support, as well as deviant social norms that support such behavior. For example, social learning theory suggests that social ties—especially among peers—facilitate the acquisition of such resources. Likewise, research on street gangs suggests that internal processes directly related to social ties among members—such as cohesion or loyalty—facilitate a range of group and individual deviance and criminal behavior (Hughes, 2013).

Research Questions

We are targeting the following research questions:
Q1: Is there a statistical relationship between crime rate versus education level, unemployment rate, and income level?
Q2: Is there a spatial correlation with respect to the variables of interest?

Data Description

- Crime data from Chicago Data Portal reflecting reported incidents of crime that occurred in the City of Chicago in 2014.

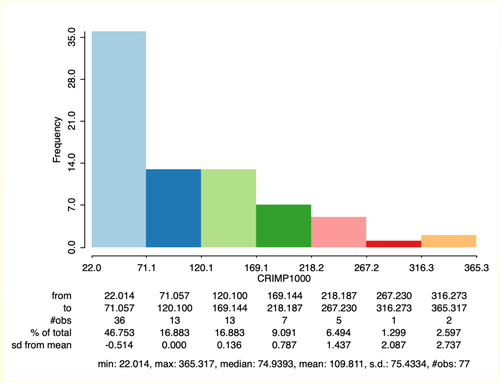
- The Public health and socio-economic indicators dataset including the Public health and socio-economic indicators for the 77 community areas of Chicago, IL, 2014.

- The Chicago community areas data set, which is a boundary file for the community areas.

- Crime rate, education level, poverty rate, unemployment rate, income level are variables of interest.

Exploratory Data Analysis

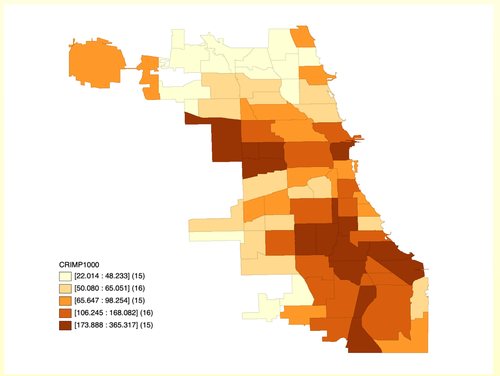
Crime Frequency Histogram



from	22.014	71.057	120.100	169.144	218.187	267.230	316.273
to	71.057	120.100	169.144	218.187	267.230	316.273	365.317
#obs	36	13	13	7	5	1	2
% of total	46.753	16.883	16.883	9.091	6.494	1.299	2.597
sd from mean	-0.514	0.000	0.136	0.787	1.437	2.087	2.737

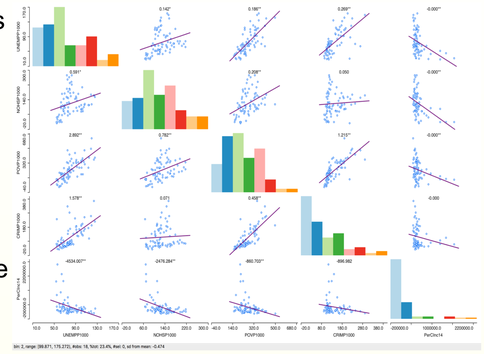
min: 22.014, max: 365.317, median: 74.9393, mean: 109.811, s.d.: 75.4334, #obs: 77

Crime Rate Quantile Map

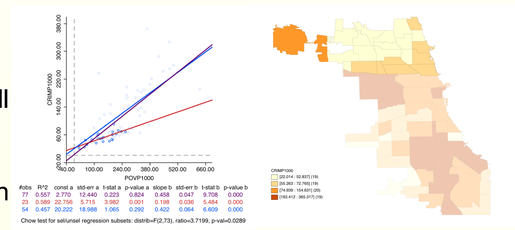


Regression Analysis and Moran's I test

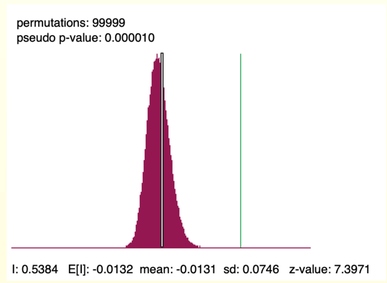
Scatterplot matrix implies unemployment rate and poverty rate are significantly related to crime rate of communities. And income level and education level are not significantly related to the crime rate of communities.



In addition, the Chow tests of North communities and the rest is significant for all the scatterplots suggesting spatial heterogeneity between North part of Chicago and the rest.



Moran's I simulation for all the variables implies spatial correlation exists among communities in Chicago. In addition, from Moran's I scatterplot, a structural difference between North communities and the rest is shown again.



Conclusion

Statistically speaking, poverty rate and unemployment rate are statistically related to crime rate, since the p-values for the slope of the scatterplot with unemployment rate versus crime rate and that of the scatterplot with poverty rate versus crime rate are both significant. In addition, they are all positively correlated, which means a higher unemployment rate and higher poverty rate will make the crime rate higher.

Spatially speaking, since as we can see from the Moran's I scatterplots, the p-values are all less than 0.05 for all the five variables, there is spatial correlation for the variables of interest. In addition, there is a structural break between north part of Chicago and the rest, which implies that North communities are generally safer and richer than the other communities. Moreover, the spatial clusters are clustered roughly by north, south, loop and west. Also, we can see that the neighbors of Chicago are influencing each other positively, which also implies similarity among neighbor communities.

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