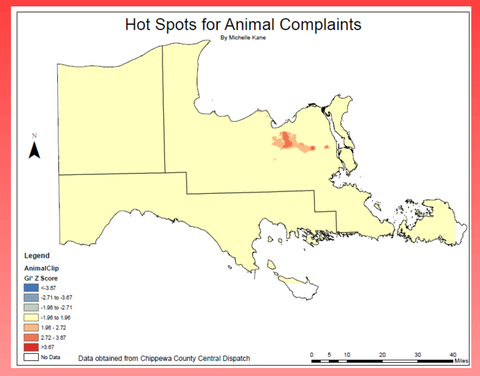
911 Hot Spot Analysis of the Eastern Upper Peninsula

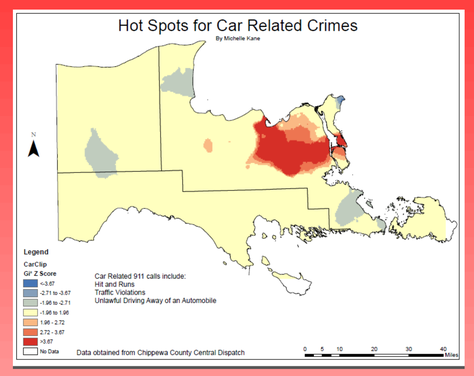
Michelle Kane
Lake Superior State University

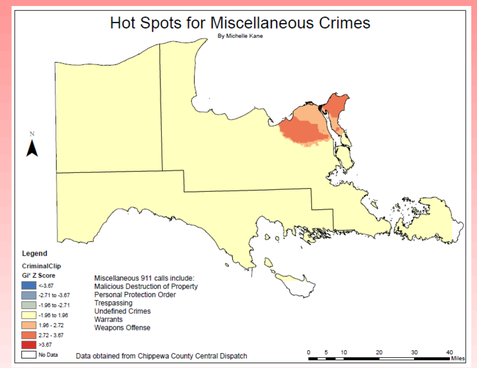
Abstract:
This project analyzed the spatial distribution of 911 calls in the Eastern Upper Peninsula. Hot spot analysis is a useful tool that can be used to understand social factors affecting crime, allocate emergency services, and more. ArcMap was used to perform a hot spot analysis on 911 call data. This pinpointed hot and cold spots of different categories of crime.

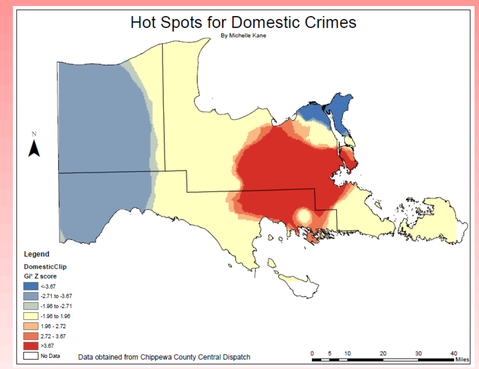
Introduction:
Spatial relations in crimes have been explored since the 1830s (Anselin et al. 2008), and advances in geospatial technology have allowed for a surge in this analysis in recent years. GIS is an extremely useful technology for performing this kind of pattern analysis, due to its ability to spatially plot points that can be associated with several attributes (Canter 2000). GIS analysis allows for hot spot analysis, a technique that pinpoints areas with abnormally high or low concentrations of crime. Hot spots show that a greater amount of crime than expected is occurring in that area (Canter 2000). Hot spots are commonly found in areas known as dangerous neighborhoods. Hot spots are now often analyzed for several purposes, including allocating police control, understanding the community context of crime, and modeling where crime may occur (Anselin et al. 2008).

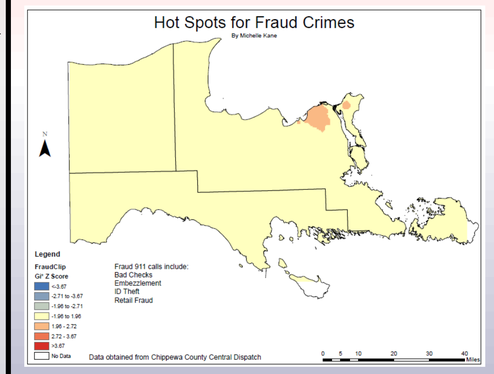
Methodology:
Data for this project was obtained from Chippewa County Central Dispatch as a shapefile and database file. 1 of 12 categories (Alcohol, Animal, Car, Children, Criminal, Domestic, Drugs, Fraud, Harassment, Peace, Sex, Theft, and Violent) was assigned to each crime. Each category was then separated into its own layer, so hot spots could be analyzed for each kind of crime separately. Each category was placed on a basemap of the 3 Michigan counties studied: Chippewa, Luce, and Mackinac. The basemap was obtained from MiGDL. Each of the following steps was done for every category of crime. First, nearby points were made coincident with the Integrate tool. Then, these coincident points were counted with the Collect Events tool.

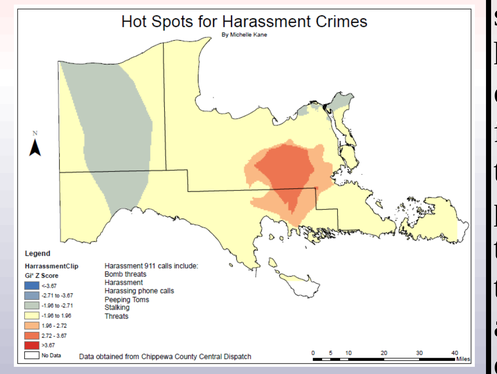


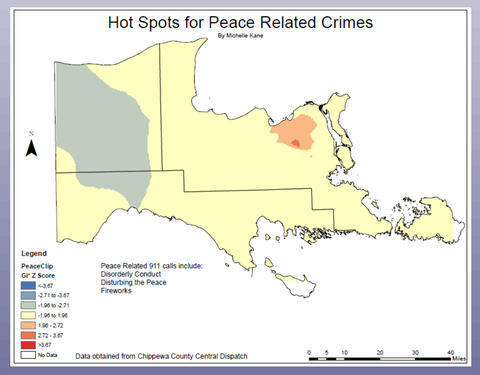


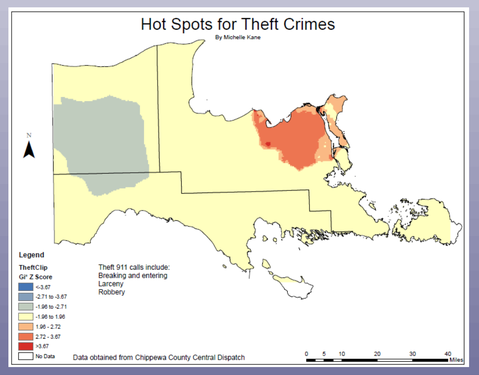


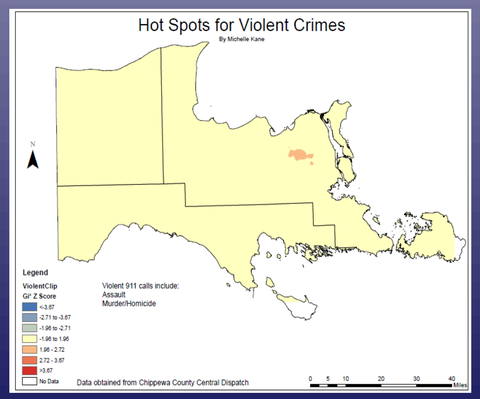




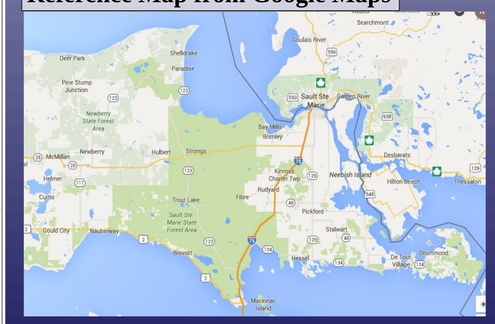








Reference Map from Google Maps



Methodology:
Then, the Incremental Spatial Autocorrelation tool was run. This showed the amount of spatial autocorrelation and identified distance bands needed for Hot Spot Analysis. When the tool didn't identify peaks, the best guess was used. The Hot Spot Analysis tool was run with these distance bands. Then, Inverse Distance Weight (IDW) was used to interpolate values and create a pleasing symbology. The Extract by Mask tool was used to limit this raster to the three counties analyzed. Symbology was appropriately updated to show hot and cold spots. Lighter colors show 90% confidence, middle colors show 95% confidence, and the darkest colors show 99% confidence. A reference map was obtained from Google Maps for comparison.

Conclusion:
No hot spots where seen for alcohol, children, drug, or sex related crimes. Each category of crime has different hot and cold spots. These differences suggest different crimes are spatially dependent based off of different factors. Almost all crimes have hot spots near Kinross, the location of the Kinross Correctional Facility. This prison houses up to 1,280 male prisoners and families of the inmates often live nearby. The most populous city in this study, Sault Ste. Marie, was a hot spot for fraud, theft, and miscellaneous crimes, and a cold spot for domestic crimes and harassment. It appears more populous areas do not necessarily have more crime, and there are more factors that play into crime. Future research could analyze specific cities like Kinross and Sault Ste. Marie for hot spots and then use additional data to model where hot spots are likely to occur.

Sources:
911 call data from Chippewa County Central Dispatch
Base map data from Michigan Geographic Data Library (MiGDL)
Anselin, L., E. Griffiths, and G. Tita. 2008. Chapter 6. Crime mapping and hot spot analysis in environmental criminology and crime analysis (pp. 97-116). Willan Publishing Cullompton, Devon.
Canter, P. 2000. Using a geographic information system for tactical crime analysis. Analyzing crime patterns: Frontiers of practice, 3-10.