# Boston Crime Mapping

## GIS: The New Batman

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## I. Introduction

The purpose of this study is to evaluate Boston crime rates during the past two decades (1990-2010) over a geographic scope. By examining the patterns of these crime rates using a convenient digital format and implementing GIS software, it is anticipated that the type and frequency of particular crimes, such as murder, rape, robbery, aggravated assault, burglary, larceny/theft and motor vehicle theft can be identified. Also, through assessing these data points and the frequency of crimes in certain areas, the various "hot spots" within Boston can be isolated, which can serve as a helpful tool for Boston residents in planning future home locations, grocery stops, and even jogging routes. Various research and studies are also incorporated to make known particular Boston policies or mitigation attempts and their effectiveness in reducing crime rates in the area.

## II. Literature Review

Crime rates have dropped dramatically in cities across the United States over the past two decades (U.S. Department of Justice, 1999). In 1998, Vice President Al Gore created the Task Force on Crime Mapping and Data-Driven Management to advance efforts to reduce and prevent crime (U.S. Department of Justice, 1999). Since that time, crime mapping has been an increasingly utilized tool by law enforcement agencies across the country, and with the use of computer software, such as ArcGIS, areas with greater concentrations of crime are able to be identified, which then allows law enforcement agencies to more effectively allocate their resources.

Crime is not spread evenly across a city. Crime actually tends to occur in concentrated areas. These areas of more frequent crimes are known as "hot spots" (U.S. Department of Justice, 2005). This term can refer to areas that have greater than average number of criminal events, or an area where people have a higher than average risk of being victimized. It has become increasingly important for law enforcement agencies and local governments to identify hot spots. Community members can also use this information to make more informed decisions about areas to avoid when selecting a home due to higher crime rates, choosing a grocery store, and even in planning jogging routes.

Boston is currently the twentieth largest city in the country with an estimated population of 645,169 people. Similar to many large cities, Boston has a relatively high crime rate. In the late 1980's and continuing through the 1990's, Boston, as well as other large cities across the country, experienced a dramatic increase in gun-related crimes (Braga et. al., 2009). Studies suggest that these gun crimes occurred in concentrated hot spots or "micro-places". One study suggests that "gun violence trends at these places follow trajectories that are consistent with a spatial diffusion process" (Braga et. al., 2009, p. 50). In other words, crime follows a very distinct pattern when occurrences begin to increase. This has many implications for law enforcement agencies. It allows police officers to monitor specific areas that are predicted to have increased criminal activity. This also suggests that crime prevention programs should focused on very specific locations rather than spread across large areas or neighborhoods (Braga et. al., 2009).

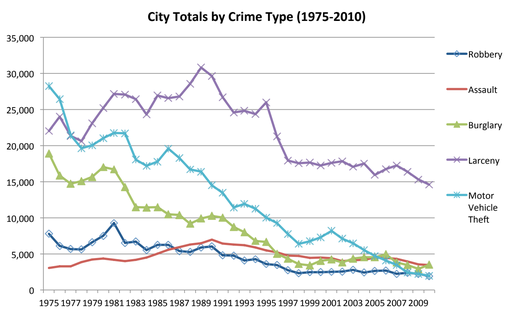


Figure 1: Line graph depicting city totals by crime type over a 35 year span (1975-2010)

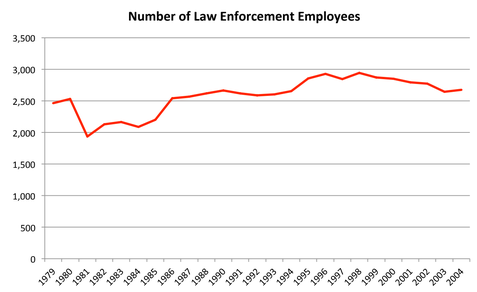


Figure 2: Line graph portraying general increase of law enforcement officers between 1979 and 2004

## III. Methodology

- Obtain city-wide statistics and employee data (law-enforcement totals) from the U.S. Department of Justice's FBI Uniform Crime Reports for the United States for years 1979-2004 and the U.S. Department of Justice's Sourcebook of Criminal Justice Statistics for years 2001, 2002, and 2003
- Acquire district data (statistics for each of the 12 Boston districts) from Shannon Fahey in the Research and Development Branch of the Boston Police Department for the 1990-2008 years
- Utilize remaining statistics needed for the 2009-2010 years from the Boston Police Department website (http://www.bpdnews.com)
- Create a Boston police district shapefile using the "Map Warper" website (http://warper.geothings.net) to georeference an image of police district boundaries using control points on the basemap in ArcMap
- Implement the crime data by joining organized tables with the Boston police district shapefile in order to effectively examine and asses crime rates on the district scale
- Normalize the 1990 and 2000 crime data to 2010 levels by using the Suffolk County population changes as a proxy for each district. Between 1990 and 2010, the population increased in Suffolk County by 8% (1990 correction factor of 1.08) and increased by 4.5% from 2000 to 2010 (2000 correction factor of 1.045)
- The classifications for the normalized 1990 and 2000 crime data were set to manual (versus the quantile classification set for 2010) in order to manually set all but the last break value to those defining the 2010 data
- Create choropleth maps that synthesize the Boston district layer and features representing the types and frequencies of violent crimes occurring over this geographic scope during different years (1990, 2000, and 2010)
- Evaluate the differences in crime trends over various periods, the possible correlation between crime totals and total law-enforcement agents, and identify districts with the highest and lowest crime rates for the different years

## IV. Results

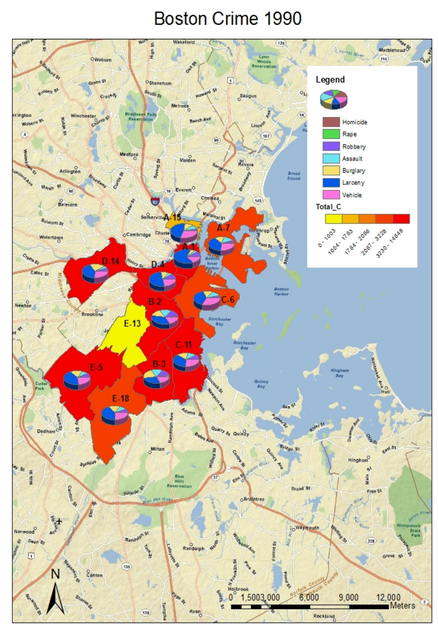


Figure 3: Choropleth map showing crimes committed by police district in 1990

Crime rates in the 12 Boston police districts decreased significantly over the past two decades, which correlates to the downward trend in rates observed since 1975 for the entire city. Districts D-4, B-2 and A-1 consistently report the highest crime rates, an districts A-15, E-5, A-7, and E-18 are historically the safest areas.

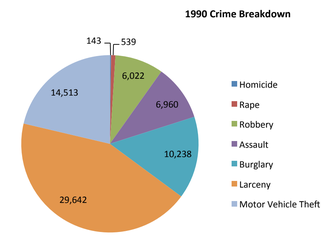


Figure 4: 1990 Percentage Breakdown of Total Crime by Type

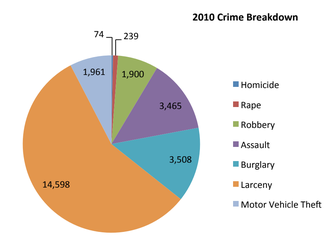


Figure 5: 2010 Percentage Breakdown of Total Crime by Type

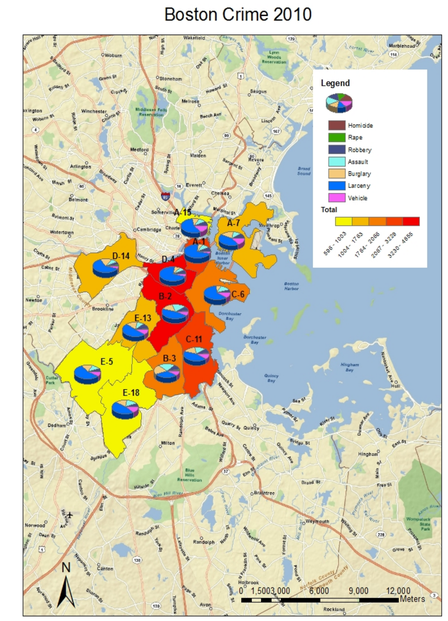


Figure 6: Choropleth map showing crimes committed by police district in 2010

## V. Discussion

Crime data was gathered from various sources to evaluate changing rates and potential patterns over time. Our research analysis concentrated primarily on changes over the past two decades (1990-2010), which allowed for a comprehensive comparison of crime types, frequencies, and in what areas crime dominated between the years of 1990 and 2010, as depicted in Figures 3 and 6. Since 1990, Boston in 2010 has experienced a 62.17% decrease in crime occurrences (calculated from non-normalized data), or a 64.98% decrease in occurrences when considering normalized data, both of which, however, signifying very significant percentage drops. This decrease can be observed in the Figure 1 line graph. Districts D-4, B-2, and A-1 consistently had the highest reported crime rates throughout all three years evaluated (1990, 2000, and 2010). District A-15 had the very lowest crime rate throughout those same years, with the next lowest rates appearing in the E-5, A-7, and E-18 districts. Larceny was the most frequently committed crime over the 1990, 2000, and 2010 years, and murder was the least frequent, as illustrated in the Figure 4 and Figure 5 pie charts. Finally, though there was an overall increase in the number of law enforcement officers over the 1990-2010 period (portrayed in Figure 2), it is difficult to attribute decreases in crime to this, as the growth was not exceedingly significant.

## VI. Conclusion

Crime mapping is limited by the scale and accuracy of the data provided by police departments around the country. The Boston Police Department is responsible for compiling crime statistics for the Boston area, but they are not responsible for ensuring that it is convenient to obtain. Civilians have the right to access crime statistics, but it is often extremely time consuming and inconvenient. Gathering historical data is also often difficult, possibly because there is less public demand for older data. Furthermore, boundary changes and missing data are common when evaluating longer time periods, as is the difficulty in acquiring sufficient shapefiles available for manipulation. While we were able to identify districts with high rates of crime, more specific data is needed to identify hotspots on a neighborhood or block scale. Also, while we were able to normalize data using population statistics for the whole of Suffolk County, one may wish to obtain population levels for each individual district and normalize the data by those standards for more accurate projections. One addition that could be made should data be available is to assess where patrols are in relation to predetermined hotspots in order to examine the possible correlation between increased police activity in certain areas and the frequency of crime. More detailed research avenues and data such as these would allow for community members to better avoid high crime areas and law enforcement officers to focus their resources in needed areas. Large companies such as CrimeReports utilize software that is able to process thousands of crimes to identify where and when they occurred., and when CrimeReports, and other like organizations, work with police departments throughout the country, GIS crime mapping becomes an even more powerful tool.

## VII. References

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## VIII. Acknowledgements

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