Spatial Statistical Analysis of burglary Crime in Chennai City Promoters Apartments: A CASE STUDY

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ABSTRACT

With increasing availability of public interactive mapping tools comes the likelihood of knowledge to be misunderstand or misused. This study makes use of the Chennai city Promoter Apartments as a case study to evaluate various spatial statistic analysis & mapping techniques with a focus on crime. Knowledge is integrated from a few sources, including Chennai City Police Service statistical reports, community statistics and a recently developed web-based interactive crime mapping interface with a objective of demonstrating various visualization approaches to the same dataset and crime variables

Key Words:

crime analysis ,point pattern analysis ,spatial statistics, data manipulation, spatial crime distribution

1. Introduction

Continued advancement in geospatial expertise represents lots of promising possibilities in the area of crime research and analysis. Some caution must always be taken however to make definite that statistical knowledge is not misused or misinterpreted. Indeed with respect to spatial distribution of lots of social variables the chance exists of interpreting causal relationships where none may exist. Implications of such oversights are broad in scope and may weigh heavy in impact.

Analyzing crime knowledge must be completed from both a sociological point of view as well as that of the geospatial analyst. Definitely objectivity is of utmost importance when working with any spatial statistics, but with respect to criminological knowledge, there will always stay some quantitative element due to the nature of criminology & the human element in GIS. This study takes a critical approach to survey the city of Chennai promoters Apartments using a range of analysis tools. These include publicly obtainable web applications statistics as well as an collection of analysis tools in ArcGIS.

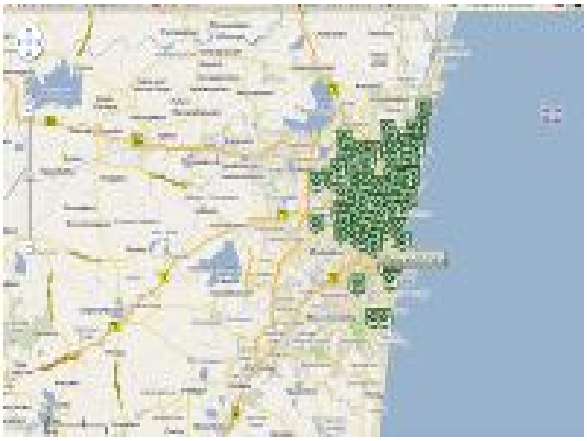

Fig 1. Screenshot of Chennai city Police Service crime mapping application

2. Overview of Data

In February 2007, the Chennai City Police Service launched an interactive web based crime map, depicting locations of crimes in the city. Users can query according to crime type and neighbourhood in time scales of week, month, months and six months. Results displayed are of crime location points, internally managed by Chennai City Police Service, using Microsoft's Visual Earth platform. Crime types include arson, assault, tried murder, commercial break-in, murder, residential break-in, robbery, sex offence, theft, theft from vehicle, vandalism & vehicle theft.

A variety of statistical knowledge is obtainable through Chennai city Police service; although in plenty of cases it is somewhat limited in scope. Crime statistics are obtainable at the community level for a period of years and categorized as either person or property crime per thousand population. These categories for the years 2006 and 2007 were used to generate the study area.

Chennai city Police service also makes obtainable their published Annual Statistical Document, for a much longer time period, with totals per crime type

for the city as a whole. This information was used for a slightly longer term analysis, but its spatial part is left at the municipal level. Additional knowledge was compiled from Chennai city Police service, Chennai Statistics housebreaking knowledge.

3. Defining the Study Area

A primary aim was to establish a study area of high crime incidence (hotspots) and low crime incidence (cold spots) based on the Chennai City Police Service neighbourhood data. The focus of this was to stay on visually displaying known data and profile the neighbourhoods in the established study are. Given the restricted temporal range of the information, no community information was used to evaluate trends.

3.1 Anomalies and Uncertainties

Limited knowledge was the driving force behind defining the exact study area. Given significant expansion by the city in recent years, lots of new communities were excluded for lack of knowledge. Lots of communities that appear on Chennai city Promoter Apartments maps do not have a long history to hold corresponding statistics in lots of fields. and thus could not be included. Furthermore, to keep away from the likelihood of misunderstanding missing knowledge to represent a zero value than a null value, any community that did not have 2006 & 2007 knowledge for both person and property crimes was excluded entirely.

Initial clustering analysis revealed additional limiting factor. Several areas of industrial land use showed exceedingly high crime rates, but lots of others were either inconsistent with this, or excluded for incomplete information. Due to this further limitation on the data's completeness, only residential areas were thought about for the study area.

Unsurprisingly, the downtown core of the city showed higher rates of crime, the greatest of which was the Commercial Downtown Core (although it was categorized as residential). Additionally, there was a discrepancy between differing datasets on the communities of Promoter Apartments & Valley Apartments, which in some sets were grouped together as the Beltline made to group the Beltline, because of these considerations, the decision was Commercial Downtown Core, Commercial town Promoter Apartments, Metropolitan Valley Apartments, to be separately analyzed as downtown area. These communities were not included analysis leading to generating the hot and cold spot communities.

An additional factor, the extent of which was not fully realized until further stages of project development, was the presence of a major Promoter Apartments in community The Chennai city Police service mapping application revealed the importance of this the extreme example of Chennai City community. This neighbourhood appeared to hold between 13% - 15% of reported property crime in the study area (still including downtown) (Fig two). Further exploration of this issue revealed several other neighbourhoods with Promoter Apartments as well as high and concentrated property crime occurrence, and so were also excluded from the study area.

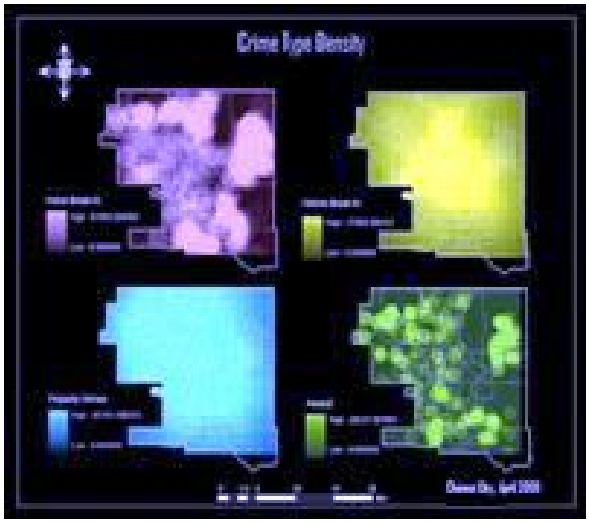

Figure 2: Queries of property crime in Chennai City Promoter Apartments . A) all four listed variables. B) Removal of 'vehicle theft'. C) Removal of 'vandalism'. D) Theft only, where symbol is not large enough to show all 280 incidents.

The investigative process of defining the study area also unveiled information that lead to further clarification of the mapping goals. As Figure 2 showed, quantitative information can easily be concealed by point data when numerous points occur in the same area. As there is no indication of point density in many web represent this concealed information graphically.

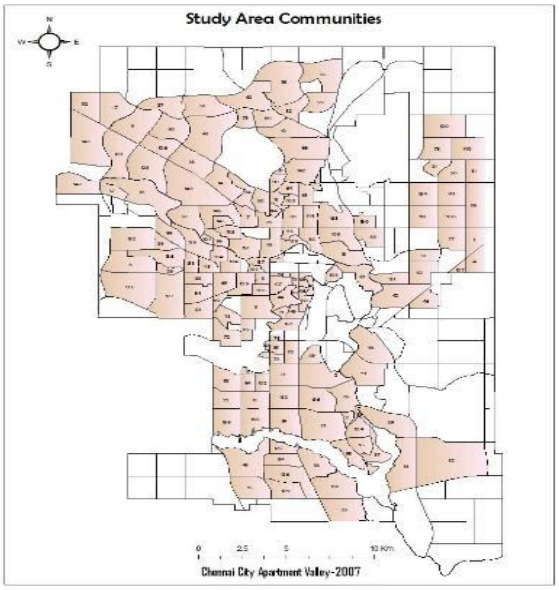

Figure 3: Study area communities shown in colors against all Promoters Apartments Valley communities. Full legend: see Appendix I.

The remaining communities, and thus the defined study area are shown on the following page, seen in relation to excluded communities. A full list of study area neighbourhoods can be found in Appendix I.

3.3 Generating Cold Spots

The distribution of the information was such that generating the cold spot communities was less straightforward. Again, totals were standardized to reduce the effects of the higher occurrence of property crime, but there were lots of so communities with similarly low rates that cluster analysis proved to yield more communities that could truly be thought about low-crime hotspots. This can be seen by noting the giant number of communities in the < -0.75 standard deviation section of the Hotspot Communities map (fig.4).

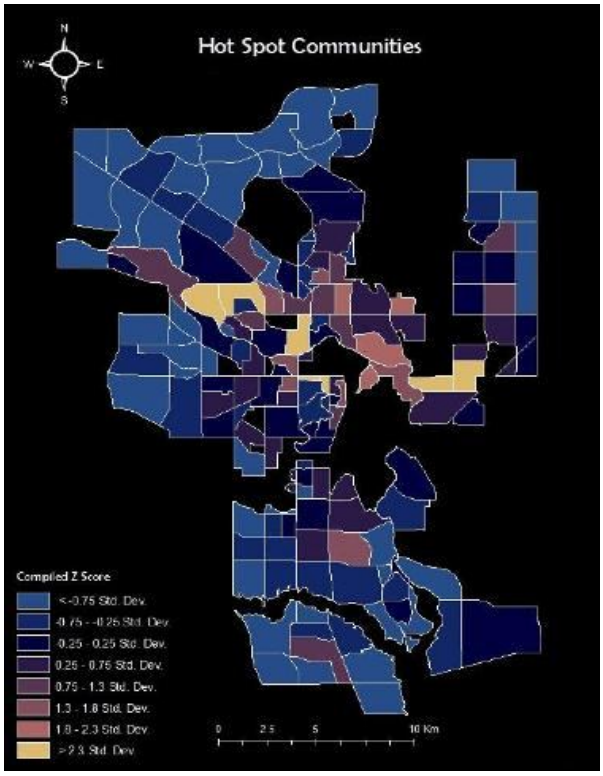

Figure 4: Hotspot community output according to compiled z-scores

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Consequently, to obtain cold spots whose values would not be underplayed by the comparatively high rates in the full dataset, the top 20% were excluded from the calculations. Cold spots were then defined with ½ Standard Deviation classification method. Cold spot communities were then considered to be those with standard deviations of less than -1.3 and can be seen on page 6. The combined effects of these techniques yielded seven hot and cold communities. (fig 5).

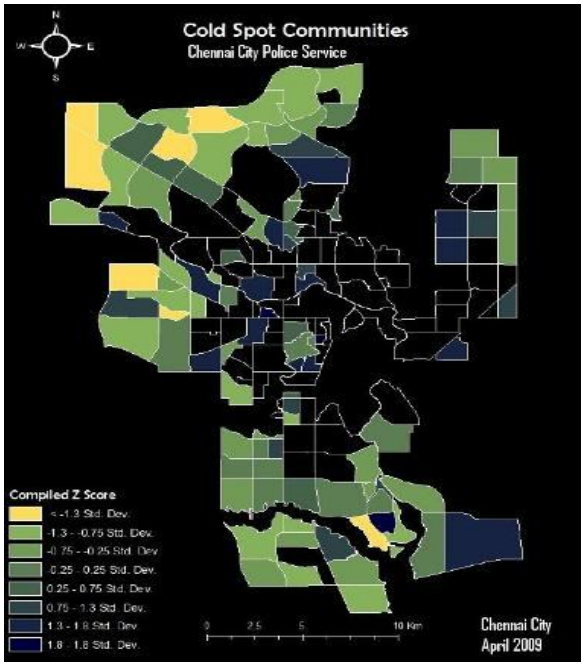

Figure 5: Cold spot classification by z-score

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Hotspot Communities	Colds pot Communities
Alwar Tirunagar	Aminjikarai
Besant Nagar	Bharathipuram
Choolai	Chromepet
Egmore	Ennur Thermal Station
Ganesh Nagar	Greams Road
Indra Nagar	Jawahar Nagar
Korattur	Kottur Madras

Figure 4: List of hot and cold spot communities

4. Mapping and Analysis

Analysis has been broken down into three different methodologies for each of the study area

4.1 Downtown

Using the Chennai City Police Service web application, point data of all available crime type was taken for a one month period (fig.6). To facilitate easier entry into ArcGIS, the categories were grouped as follows:

- Theft and property crime (theft, theft from vehicle, theft of vehicle, vandalism, arson)
- Assault and burglary (assault, robbery, residential break
- Sex offence
- Homicide and attempted murder

Figure 6: Kernel density analysis of Theft and Property Crime combined with Assault and Burglary

It was immediately clear that unaltered point files were not adequate to represent the 467 violations extracted from the Chennai City Police Service site. Point density analysis provided some further insight(fig 5), but still did not reveal the full extent of the dataset. Kernel density analysis served to be a more useful indicator of the underlying data. (fig. 6). For this portion of the analysis, the theft and property crime category was combined with assault and burglary, as these were the categories of high incidence responsible for causing the obstruction of underlying data. Homicide, attempted murder and sex offences were left separate as they were not found in such layers as the other categories, and furthermore not to minimize the severity of these violent crimes.

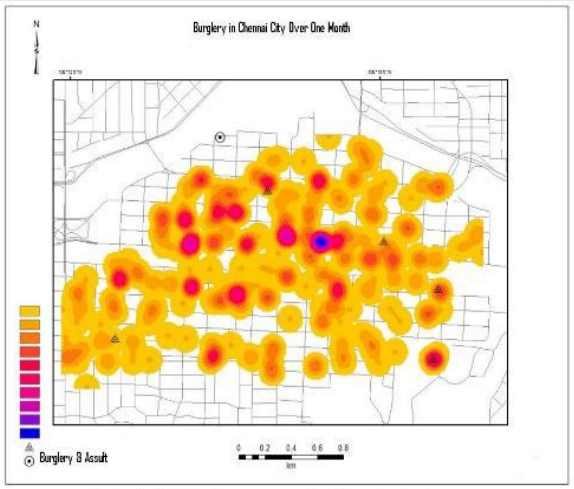

Figure 7: Point density analysis of Theft/Property Crime and Assault/Burglary categories

4.2 Hotspot Communities

The hotspot communities that were established with the 2006-2007 community data were

then queried to obtain violation points from the Chennai City Police Service mapping application, with totals listed below.

Place	Theft/Property	Burglary	Sex Offence	Homicide	Total
Alwar Tirunagar	18	3	0	0	21
Besent Nagar	14	5	0	0	19
Choolai	14	7	1	0	22
Egmore	18	5	0	0	23
Ganesh Nagar	37	10	0	0	47
Indra Nagar	46	10	0	0	56
Korattur	55	28	1	0	84

Figure 8: Hotspot community total crime for one month (from Chennai City Police Service mapping application)

It is interesting to note the totals from the mapping application relative to annual totals per thousand population from the 2006-2007 community data below. The most notable difference is perhaps the relative positions of Alwar Tirunagar and kottur. Alwar Tirunagar, the number one hotspot according to the 2006-2007 data had the lowest one month total of all the communities. kottur had the highest monthly total by far (more than twice as many violations as Alwar Tirunagar) was only the second lowest hotspot total per thousand population according to the annual totals.

	Crime per thousand population
Alwar Tirunagar	102.5
Besent Nagar	100
Choolai	105.5
Egmore	110
Ganesh Nagar	111
Indra Nagar	108.5
Korattur	114

Figure 9: Totals of property and person crime

It is important to note that a direct comparison of these datasets cannot be made, as they are both limited in several capacities. Most notably, ought to keep in mind that the violation points were only taken of the hotspot communities, not of the whole city, so it would be a misguided interpretation to assume that these areas truly reflect the neighbourhoods of highest crime incidence in the month period. With this in mind, it must be further stated that all analysis and comparisons made throughout this study have been based on limited data, and should not be interpreted to accurately reflect the spatial distribution of crime in Chennai City Promoters Apartments, but merely to serve as tools by which to explore data visualization possibilities.

4.4 Cold spot Communities

Totals were taken from the CPS map for all crimes during a one month period as was done for downtown and the hotspot communities.

Place	Theft	Burglary	Sex Offence	Homicide	Total
Aminnijikari	5	0	0	0	5
Bharathipuram	4	2	0	0	6
Chromepet	6	2	0	0	8
Ennur	7	1	0	0	8
Greams Road	7	2	0	0	9
Jawahar Nagar	6	4	0	0	10
Kottur Madras	21	5	1	0	27

Figure 10: One month summary of cold spot communities.

Surveying the Chennai City Police Service map's representation of these totals showed that even in the areas of the city's lowest crime, misrepresentation of data is still possible. In both the cases of Aminnijikari and Kottur Madras, the neighbourhoods with the lowest totals of the study area according to the 2006-2007 Chennai City Police Service Community data, violation points were hidden(fig). In Kottur Madras, a query of all crime types appeared to display only five points, yet six violations were listed in the total. Further queries revealed that a residential break-in occurred at the same location as a reported theft. Only upon removal of the theft layer could the hidden data be seen. There is no way to tell what type of crime is hidden without individually checking each layer until the total violations listed matches the total visible points. Aminnijikari, the same problem occurred, with a damage point obscuring a theft from vehicle violation.

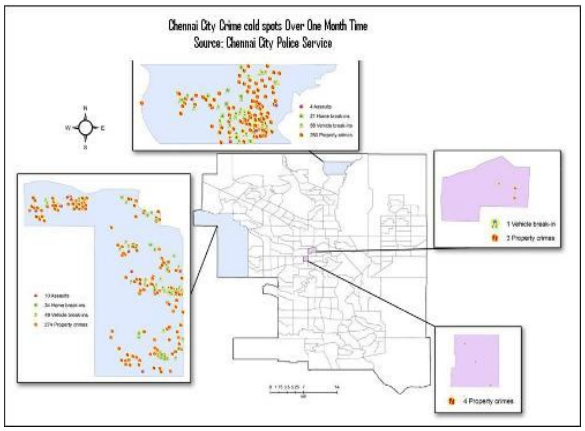

Figure 11:Highest and Lowest total crimes in the city

5. Analysis of Additional Data

A basic examination of the ten year dataset for the City of Calgary, as well as some demographic factors associated with the study area map revealed a few notable trends. Classification of the study communities by total population and population density revealed some insight into the relative location of hot and cold spot communities.

Not surprisingly, hotspot communities tended to be closer to the city centre than their outlying cold spot counterparts. Additionally, the hotspots closest to the downtown core appear to have higher population total and density. Cold spot communities are all found farther away from the city centre and appear to have lower population density than most of the hotspots.

The location of the cold spot community of Kottur Madras relative to the rest of the cold spot communities is interesting to note. It is the only cold spot community not located in the city's Aminnijikari reaches, lying rather far away in the southeast quadrant.

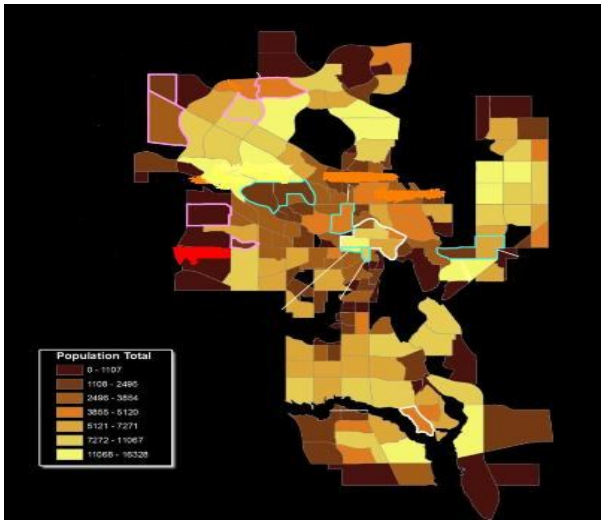

Figure 12: Classification of total population by community (Source by Chennai city police)

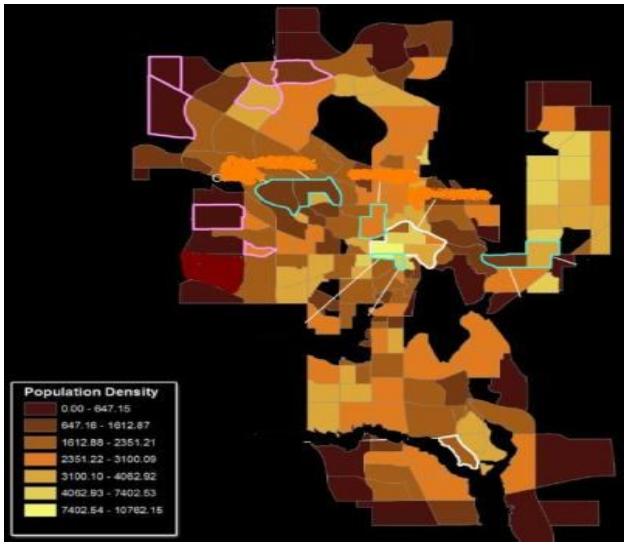

Figure 13: Classification of population density by community (Source by Chennai city police)

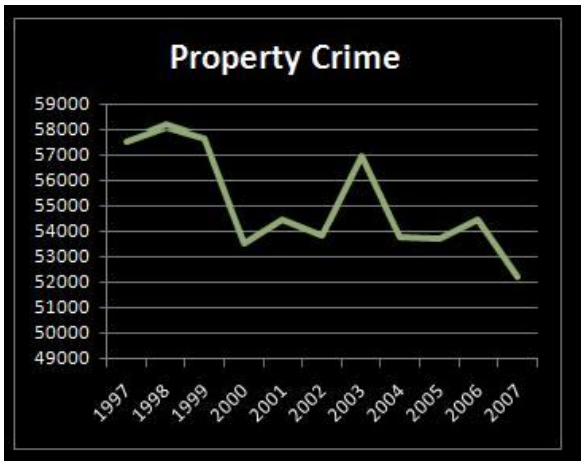

Figure 14: ten year crime trends by type of crime. Source: Annual Statistical Reports 1997-2007.

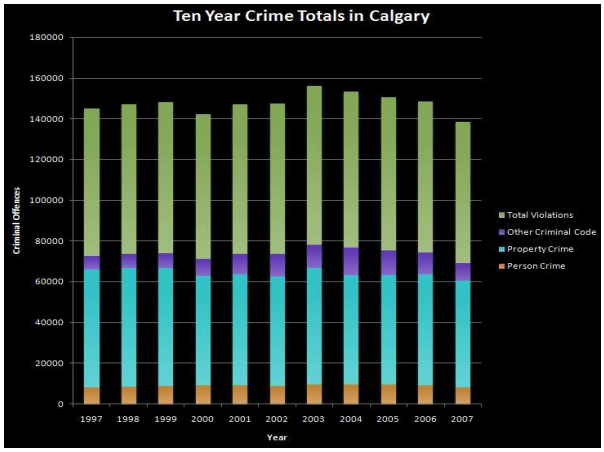

Figure 15: All crime types over ten years

The graphs above provide a good statistical representation of total number of crimes for a given time period, but it is only with the addition of relevant population data that the true rate of Chennai City crime can in fact be seen. Below, all categories of crime and total violations have been normalized by the city's total population for the given year, according to Chennai Civic Census data. It is only by doing this that the trend of dropping crime rates can be seen.

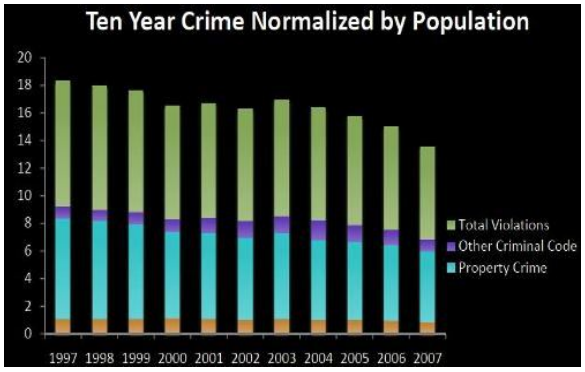

Figure 16: Total crime/ population

5. Conclusion

The investigations done throughout this study have shown the lots of possibilities that can result from spatial and statistical modification of data. In order to truly have a clear picture of any socio demographic variable must always use a variety of approaches to interpreting a dataset.

This study has shown that spatial data can easily be misunderstood or even hidden by layers of overlying data in areas of high point density. The limitations of 2-dimensional maps can be assessed by using GIS tools like kernel density which can show point data classified in raster format. They can be furthermore overcome with 3-dimenstional tools such as 3D Analyst and ArcScene.

Additionally, the effects of combining demographic variables such as population change can have a significant impact on data interpretation. In conclusion, because statistical spatial and nonspatial data alike can be manipulated in many different ways, it is imperative that a variety of tools be combined throughout the investigative process, in order to reduce the possibility of misunderstanding.

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Appendix I - Study Area Legend

Area Name	Pincode	Area Name	Pincode
Adambakkam	600 088	Nandanam	600 035
Adayar	600 020	Nanganallur	600 061
Alwarthirunagar	600 087	Nungambakkam	600 034
Ambattur	600 053	Old Pallavaram	600 117
Ambattur Ind. Estate	600 058	Padi	600 050
Aminjikarai	600 029	Pallavaram	600 043
Anakaputhur	600 070	Park Town	600 003
Anna Nagar	600 040	Parrys	600 001
Anna Nagar East	600 102	Pattabiram	600 072
Anna Nagar West Extn	600 101	Pazhavanthangal	600 114
Anna Road	600 002	Perambur	600 011
Arumbakkam	600 106	Perambur Barracks	600 012
Ashok Nagar	600 083	Perungudi	600 096
Avadi Camp H.O	600 054	Polichalur	600 074
Avadi I.A.F	600 055	Ponniamman Medu	600 110
Ayanavaram	600 023	Poonamallee	600 056
Ayyappanagar	600 111	Porur	600 116
Besant Nagar	600 090	Pozhai	600 066
Broadway	600 108	R.A. Puram	600 028
Chennai High Court Bldgs	600 104	Railway car shed complex	600 109
Chetpet	600 031	Raj Bhavan	600 022
Chitlapakkam	600 064	Red Hills	600 052
Choolai	600 112	Royapettah	600 014
Choolaimedu	600 094	Royapuram	600 013
Chrompet	600 044	Saidapet	600 015
CRP Camp Avadi	600 065	Saligramam	600 093
Egmore	600 008	Sathyamurthi Nagar	600 062
Ekkaduthangal	600 097	Selaiyur	600 073
Engineering College	600 025	Sheynoynagar	600 030
Ennore Thermal Station	600 057	Sholavaram	600 067

Appendix II: Annual Crime Totals

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Homicide	20	29	12	19	18	24	25	25	40	46	46
Sex Offences	990	1044	985	945	938	785	948	902	903	808	637
Robbery	1193	1118	1206	1172	1191	1096	1340	1076	1187	1293	1375
Assault	5624	5827	6177	6699	6659	6345	6859	6852	6775	6457	5682
Miscellaneous Person Crimes	432	402	441	490	468	442	492	539	527	498	413
Break and Enter	9858	9907	9609	7821	7986	7953	8618	8486	8092	7527	6599
Theft	27589	28146	28296	26948	26506	26503	27876	26159	26041	25279	24557
Vehicle Theft	7167	7441	6995	6307	6326	6011	6061	5347	5000	7204	7773
Fraud Related	2548	2880	3180	3034	3216	3283	4165	4301	4241	3503	2808
Other Property Crimes	10424	9823	9643	9435	10435	10114	10304	9498	10359	10965	10470
Vice	245	206	171	115	307	261	303	201	260	175	147
Gaming	7	7	18	5	10	3	6	6	4	6	9
Weapon Related	705	633	686	748	867	1009	1241	1303	1652	1611	1514
Miscellaneous	5682	6131	6698	7367	8554	9841	9866	11936	10154	8950	7220
TOTAL PERSON CRIMES	8259	8420	8821	9325	9274	8692	9664	9394	9432	9102	8153
TOTAL PROPERTY CRIMES	57586	58197	57723	53545	54469	53864	57024	53791	53733	54478	52207
TOTAL OTHER CRIMINAL CODE	6639	6977	7573	8235	9738	11114	11416	13446	12070	10742	8890
TOTAL CRIMINAL CODE VIOLATIONS	**72484**	**73594**	**74117**	**71105**	**73481**	**73670**	**78104**	**76631**	**75235**	**74322**	**69250**