

Using Dasymetric Mapping for Spatially Aggregated Crime Data

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With availability of crime data to the public via sources such as the Uniform Crime Reports, and increasing geographic information system (GIS) capabilities for mapping crime, macro-level studies of crime have advanced knowledge of how crime is distributed over large areas. Choropleth mapping, commonly used in macro-level studies, visually displays data by assigning the number of crimes or crime rate to the corresponding spatial unit and using different shades or textures for each value or classified values creating a thematic map. However, crime incidents or crime rates are not dispersed evenly within spatial units, and choropleth mapping masks the underlying nuances of the distribution. Artificial boundaries, along with variations in the size of the unit of analysis, can further distort the true distribution of crime. Dasymetric mapping provides a methodology for refining the distribution of crime within a spatial unit. It does so by using additional data, such as land use and census data, to provide a realistic estimate of how crime may be distributed within the units of analysis. Dasymetric mapping is also useful in creating density maps to reveal clusters of crime normally masked with choropleth maps. This paper will show how dasymetric mapping can estimate the spatial distribution of aggregate level residential burglary within political boundaries in Massachusetts based on land use and housing data.

KEY WORDS: geographic information system (GIS), dasymetric mapping; burglary; macro-Studies.

1. INTRODUCTION

Criminologists are often faced with restricted access to incident level crime data. Differences in data collection and storage formats between law enforcement agencies and different policies regarding data distribution for

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research purposes create difficulties in acquiring incident level crime counts for multi-regional studies. Crime data for such studies do exist through sources such as the Uniform Crime Reports (UCR) and the National Incident Based Reporting System (NIBRS). However, these data are aggregated to the municipal level. This means the number of crime incidents is provided for a particular location such as state, county, or municipality but not at the address level. This limits our ability to judge where crimes are occurring within the units of analysis.

Choropleth mapping is commonly used to visually display aggregate crime data by applying different shades of color or patterns for each value or classified values. However, due to the assumption of uniformity within aggregated units of analyses, this type of mapping cannot show the distribution of crime within defined spatial units.

Choropleth mapping distorts the distribution of crime under the assumption of uniformity. The size and shapes of spatial units of analysis further mask the distribution of crime (Langford and Unwin, 1994). The distortion and ecological fallacy inherent in aggregated data can be overcome to a degree by calculating crime rates based on opportunity. However, visual representations of crime and crime rate data are still distorted by the size and shape of the spatial unit of analysis. When looking at macro environments, research is more "suggestive than definitive" and often the boundaries of the units of analysis are unsuitable (Harries, 1980).

Recent criminological literature has reinforced the view that we should look at opportunity structures to understand how crime concentrates (Brantingham and Brantingham, 1982; Sacco and Kennedy, 2002). The importance of opportunity theory relates to the prescriptions it offers for situational crime prevention and target hardening. To date, opportunity theory has been tested using micro-level crime data provided primarily by large police jurisdictions that have the technical sophistication to generate computer-based calls for service and arrest data. There are many jurisdictions outside of these agencies where these micro data are simply not available to researchers and crime analysts. Suburban and rural areas have not received as much attention in the study of crime opportunity, as they are more likely to have limited access to micro-level data. Further, difficulty in obtaining micro-level crime data across jurisdictions means that we have not been able to provide comparative contextual analysis to establish how opportunity can vary across a geographic continuum.

In this paper, we explore ways in which these data limitations can be addressed using dasymetric mapping applications. Dasymetric mapping involves estimating the distribution of aggregated data within the unit of analysis, by adding additional information that provides insights on how these data are potentially distributed. We will take as our example residential

burglary data aggregated to the municipal level. Land use and housing data will be used to estimate the distribution of burglaries within municipalities. In addition, we will demonstrate how this type of mapping can assist in exploratory spatial analysis of aggregate crime data through density mapping to identify clusters of burglaries within municipalities. By incorporating incident level residential burglary data, we can visually compare density surface dasymetric maps with density maps created by the actual incidents.

2. DASYMETRIC MAPPING

Dasymetric mapping adds data to provide information on how aggregated crime may be distributed within units of analysis. When geographic information systems (GIS) were first developed, it was widely believed that dasymetric mapping would replace choropleth mapping as a form of spatial representation. However, dasymetric mapping has been slow to catch on.

“Modern GIS tools provide the capacity to use multiple layers to produce a more reasonable interpretation of a measurement contained in a choropleth census map” (Chrisman, 1997, p. 224). In 1936, John K. Wright used and coined the term dasymetric mapping to create a map for the population distribution for Cape Cod, Massachusetts, when he noticed that choropleth mapping did not reveal enough about the distribution.⁴ Dasymetric mapping provides a means to visually represent a statistical surface (DeMers, 2000) using discreet areal data. Using areal interpolation, it incorporates additional knowledge of a study area (Flowerdew and Green, 1991) to “break down” the “artificial structure” of political or arbitrary boundaries, permitting the display of data distributions that may otherwise be hidden (DeMers, 2000). This type of mapping eliminates the depiction of “spatial discontinuities in the data” created by the boundary units of the collected information to show a more realistic distribution of the data (Langford and Unwin, 1994). For example, by incorporating land use and zoning, one can isolate residential areas and classify housing by type to create a refined image of how population may be distributed throughout a municipality.

DeMers (2000) identifies four types of dasymetric mapping. First, there is the “density zone outline” that uses additional detailed data to augment the value of the original data. Second, the map defines “other regions with the assumption of correlation.” Third, the analysis can involve limiting variables, which essentially masks out sections in the area where the variable would not exist. Finally, one can identify related variables that rely on a

⁴Wright noted that the term for this type of mapping, dasymetric, is Russian, which means density measuring.

priori relationships between the variable (crime rates) and other data that would assist in forecasting distributions of the variable.

In Wright's study of Cape Cod, Massachusetts, he identified areas within towns where people did not live, calling these "uninhabited areas." He calculated population densities for the remaining parts of the towns. In making these maps, Wright used census data from 1930 with permanent residents only, adding a temporal component by excluding areas generally inhabited by summer residents. He noted if summer residents were included, the shoreline densities would be drastically different.

Wright further divided the inhabited areas within the towns based on "controlled guesswork." He cites Joerg (1935) who stated "the premise that the distribution of population is not a phenomenon of uninterrupted, continuous gradation and hence is not properly portrayed by a system involving isopleths, as are portrayed by such gradational phenomena as slope in topography or gradient in climatology."⁵

It is also important to note that dasymetric mapping provides an estimated depiction of the distribution of data, and that "it is not a totally adequate solution" (Langford and Unwin, 1994). It cannot pinpoint exactly where the behavior under study is occurring, but it can provide a more realistic picture of where it is *most likely* occurring.

While dasymetric mapping has found use in examining population distributions (Holloway *et al.*, 1999), it has not been widely applied in the study of crime distributions. Exceptions include the recent study by Bowers and Hirschfield (1999) who used dasymetric mapping as a part of their examination of the connections between crime and disadvantage in England to create a more realistic background map for analysis of crime incidents. In another application, Craglia *et al.* (2000) employed a dasymetric mapping technique to establish expected rates of burglary in their study of Sheffield.

Dasymetric mapping can be used in conjunction with incident-based data to identify areas with higher than normal levels of crime. For example, in Craglia *et al.*'s (2000) study of crime pattern analysis techniques, they used dasymetric mapping to create a standardized burglary rate map. The standardized map was created by dividing the burglary incident totals for the city by the number of households to establish a citywide rate. The citywide rate was used to calculate the expected amounts of burglary in enumeration districts based on the number of houses. In other words, they

⁵When using dasymetric mapping it is important to be aware of the areal interpolation problem. Many times when using different data sets to estimate the distribution of a variable, the data may not have been collected in the same units of analyses. Further discussions on the areal interpolation problem and how to work with it are discussed in Lam (1983), Yuan *et al.* (1997), Fisher and Langford (1996), and Flowerdew and Green (1989).

used the aggregated distribution of targets in the enumeration districts to establish where the burglaries would most likely be taking place.

Craglia *et al.* (2000) proceeded to map burglaries in the city using the addresses where burglaries occurred. Burglaries were aggregated to the enumeration district in which they were located. From this point the known number of burglaries in the enumeration districts can be compared to the expected number of burglaries in the enumeration districts to determine which areas have a higher or lower than expected burglary count. This was used to identify enumeration districts considered to be hot spots.

The current paper will advance the techniques used by Craglia *et al.* by incorporating additional data to show where burglaries are distributed within the spatial units of analysis. In Craglia *et al.*'s research, enumeration districts use unnatural boundaries and do not show how the crime may be occurring *within* the districts. Our study uses the equivalent of the enumeration districts, census blocks, but takes the analysis further by incorporating underlying land use and residential data. We use the dasymetric mapping technique to remove areas within the units of analysis where residential burglaries could not occur. This was the technique used by Bowers and Hirschfield (1999) to create their background map by isolating residential areas within enumeration districts showing the social lifestyles of the residents.

Because enumeration districts and census blocks cover an entire city and are not normally uniform in size and shape, the distribution of the burglaries or burglary rates within the spatial units of analysis are hidden. The distribution of the targets, in this case the housing units, is assumed to be uniform within the enumeration districts and census block groups. An example is shown in Fig. 1 representing three census blocks in City X. City X, with a total of 180,000 housing units, experienced 1500 residential burglaries in a year. The burglary rate for City X would then be about 8.3 residential burglaries per 1000 housing units. Figure 1.1 displays the number of housing units in each census block. Figure 1.2 shows the estimation of the burglaries, based on the rate and the number of housing units using the shapes of the census blocks alone. Figure 1.3 reveals the underlying land use showing where the housing units could be distributed within the census blocks. Finally, Fig. 1.4 demonstrates what the estimation of the burglaries would be by incorporating the additional land use data. The comparison between Figs. 1.2 and 1.4 displays a visual difference, where 1.2 deceptively portrays a larger area of burglary and 1.4 shows a distribution closer to reality.

Dasymetric mapping will not work for all crime types. This technique is useful with crimes that have spatial patterns dictated by an underlying structure. This structure could be either a physical or a social one that is distributed spatially. It is also not useful when looking at crimes with a small number of incidents.

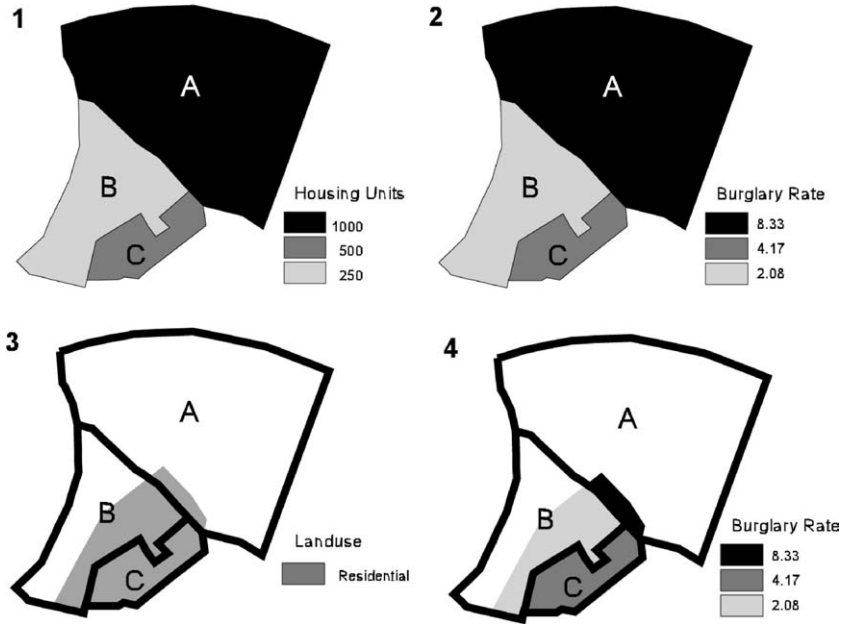


Fig. 1. Example of dasymetric mapping.

3. SPATIAL ANALYSIS OF BURGLARY

In using GIS to analyze burglary, police have been able to identify hot spots of burglary. Prevention measures have been applied, such as contacting residents in identified areas and advising them on ways they can improve their personal security. In Shreveport, Louisiana, the police department noticed one district had an abnormally high rate of burglaries (Reno, 1998). By applying GIS they looked for clustering in both space and time. It was discovered that a greater number of incidents were occurring in the daytime and appeared to be clustering around schools. The police developed a hypothesis that this may be related to a truancy problem. The police worked with the schools to fix the truancy problem and concentrated patrol efforts in the area. Subsequently, they found that burglaries in the district decreased by 67%. In Overland Park, Kansas, there was an increase of thefts from garages in residential areas (Wernicke, 1998). The police department noted that most thefts were the result of residents leaving their garage doors open. By using a GIS, the police were able to define the area in the city where most theft from garage incidents were occurring. They were able to target a preventative measure by contacting residents in the area and

reminding them to keep their garage doors closed. Thefts from garages subsequently decreased.

In addition to defining hot spots of burglary, GIS has also been useful in identifying location types that are more susceptible to burglary. In Baltimore County, Maryland, researchers found high numbers of burglaries occurred in areas with large numbers of dwellings (Canter, 1997). However, when crime rates were calculated in Baltimore County using dwelling units as the denominator, researchers found rural areas had higher levels of burglary. Wright and Decker (1994) interviewed active burglars in St. Louis, Missouri. The burglars preferred to enter a detached house through the back of the building. The burglars also indicated that they avoided well-kept areas with high proportions of elderly populations.

Rengert and Wasilchick (2000) examined the opportunity factors that attracted burglaries in both Delaware County, Pennsylvania, and in Greenwich, Connecticut. For the Delaware County study, convicted burglars were asked why they chose some houses to burgle and not others. Burglaries in urban areas were found to be more opportunistic. Suburban burglars employed more elaborate decision-making and usually required a vehicle to commit the burglary. When asked about the best parts of the county to commit burglary, the majority indicated middle class areas. However, it should be noted that the majority of burglaries were located in the southern part of the county and these were also areas generally within the burglars' "awareness space." The burglars noted they preferred to burgle premises near major routes (especially in areas not well known to them) and those that did not have houses nearby. In addition, the burglars preferred residences adjacent to open land that generated pedestrian traffic, such as, recreation or industrial property or wooded and overgrown vacant properties. In a second study, Rengert and Wasilchick (2000) sent out a survey to residents in Greenwich, Connecticut asking about personal experience with burglaries. They found many victims of burglary lived in detached single-family houses and were clustered around highways.

GIS can also be used to assist in showing movements of crime. In Edmonton, Alberta, police noticed an increase in burglaries (Warden and Shaw, 1998). They plotted the burglaries by week and noticed that the burglar(s) appeared to be moving the target selection over time. Based on the general direction of the movement, the police were able to predict the area most likely to be targeted next and were able to catch the burglar(s).

These studies indicate the importance of housing location, housing type, and transportation corridors for burglary risk. Burglary appears to be a crime defined by opportunity afforded by the clustering of targets within certain areas. We can now illustrate how dasymetric mapping can facilitate our representation of crime patterns taking these opportunities into account.

4. STUDY AREA AND DATA

There were several data sets collected and used for this study. The data were obtained in digital format and were formatted to import into a GIS software product, ArcView. The data include municipal boundaries, US Census blocks, US Census demographic data, US Census TIGER street data layer, land use, zoning, and burglary, incidents.

The municipal boundaries were obtained from MASSGIS, the office of geographic and environmental information for Massachusetts. The municipalities are stored as polygons. From these polygons, the municipalities were selected that will serve as the study area. This analysis uses data from 72 municipalities in central and western Massachusetts. The study area is shown in Fig. 2. This area contains rural, suburban, and medium sized cities. The cities selected were based on the availability of the Massachusetts NIBRS data described below. Incident-based data were not available for all municipalities. A decision was made to select the municipalities with the greatest number of adjacent boundaries to provide the best opportunity to create a continuous region. All municipalities that contain NIBRS data were plotted. The central and western regions provided the largest grouping of municipalities that were adjacent to one another. There were several cities located in the center of the groupings that did not contain NIBRS data and created gaps in the study area.

The NIBRS burglary data for the year 2001 were provided by the Massachusetts State Police.⁶ The burglary incidents that occurred in a residence were selected out for this study. The burglary data contained the name of the reporting agency and the incidents that occurred within the reporting agency's municipality. In addition to the municipality where the incident occurred, the address of the residence where the burglary took place was also included. The total number of residential burglaries that occurred in 2001 for the municipalities in the study area is 5,048.

To create a data layer of residential areas within the municipalities, both land use and zoning data were used. Both data sets were collected from MASSGIS. The land use data were digitized from 1:25,000 aerial photography taken between 1985 and 1997. There are 37 different land use classifications. Residential land uses were classified into multi-family, smaller than 1/4 acre lots, 1/4–1/2 acre lots, and larger than 1/2 acre lots. All these residential land uses were used for the study. In addition, municipal zoning districts were also obtained. The following zoning types were selected; multi-family, low density (3–8 dwelling units/acre), multi-family, medium density (9–20

⁶These data were put together by Dan Bibel, the Program Manager for the Crime Reporting Unit.

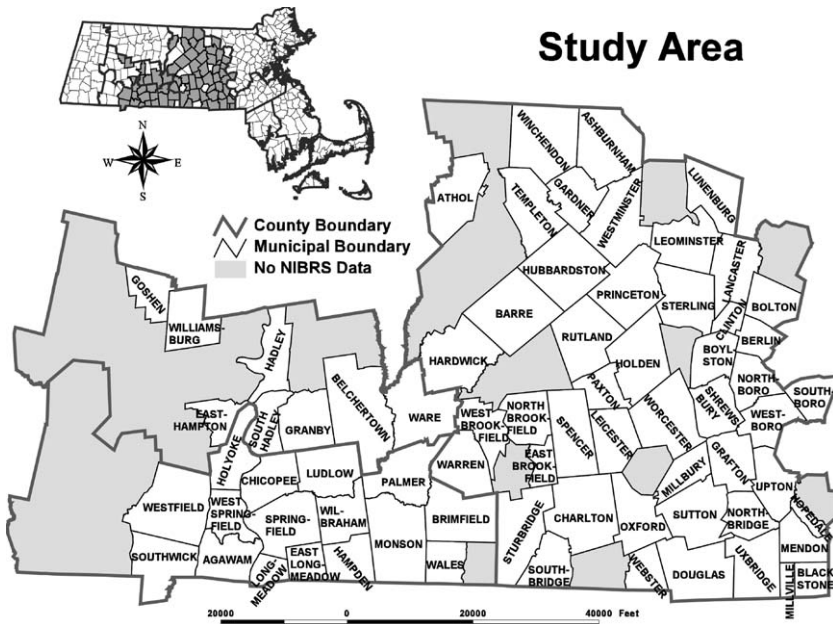


Fig. 2. Study area.

dwelling units/acre), and multi-family, high density (>20 dwelling units/acre). The land use and zoning data layers within the residential areas were merged together to create the data layer shown in Fig. 3.

The US Census provided the census blocks and demographic data. The census blocks were stored as polygons and contained the number of housing units within each census block. The census block is the smallest spatial unit used by the US Census. The census blocks for the year 2000 and the demographic data collected for the year 2000 census were used. Figure 4 shows the distribution and number of housing units by census blocks. The census blocks were used to obtain the total number of housing units for each municipality within the study area to calculate a residential burglary rate for each municipality.

Finally, the US Census TIGER street file was acquired. This digital line file was used to geocode the residential burglaries to compare the results obtained from the dasymetric mapping procedure. The TIGER file contains the street names and address ranges for each street segment.

All geographic data layers were projected to the Massachusetts State Plane coordinate system using the North American Datum 1983. The units were measured in feet.

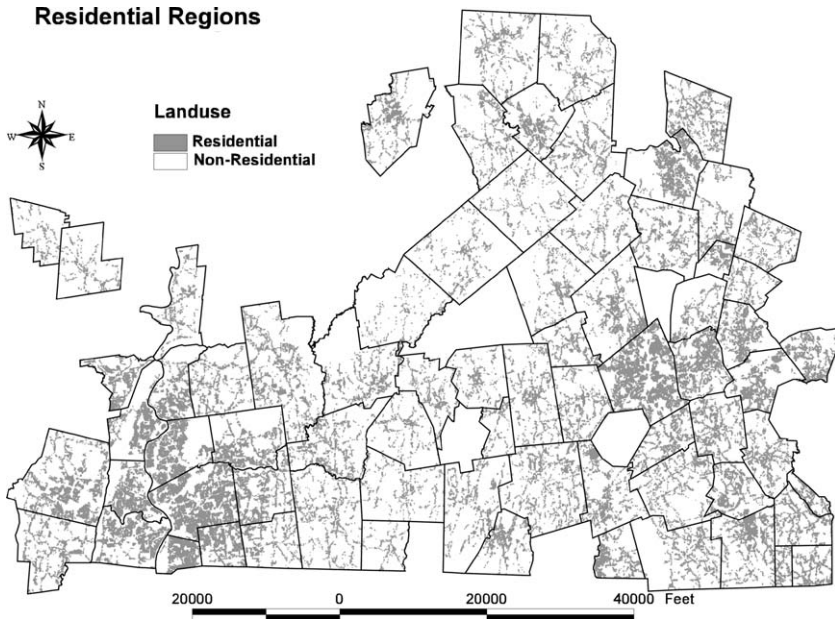


Fig. 3. 1999 Residential areas from MASSGIS.

5. METHODOLOGY

Figure 5 shows a choropleth map of burglaries within the study area by municipality. According to Langford and Unwin (1994), there are three problems with this type of display. First, the size of the areal units visually distorts the distribution and number of the burglaries, as a large unit may visually portray an area saturated with burglaries, when in fact burglaries may be concentrated within the areal unit. Second, this type of mapping masks any clustering of burglaries. Finally, the boundaries are, in a sense, arbitrary. If the boundaries were changed, a different distribution map would be produced. In addition, Langford and Unwin (1994) note that choropleth display is also problematic in showing the distribution of data.

The distribution of residential burglaries in these towns can be refined in the following way. The rate of burglary for each town is calculated by using the number of housing units as the denominator and the number of residential burglaries as the numerator. To establish the estimated distribution of the burglaries within the municipality, we use the housing units in the census blocks.

Housing Units by Census Blocks

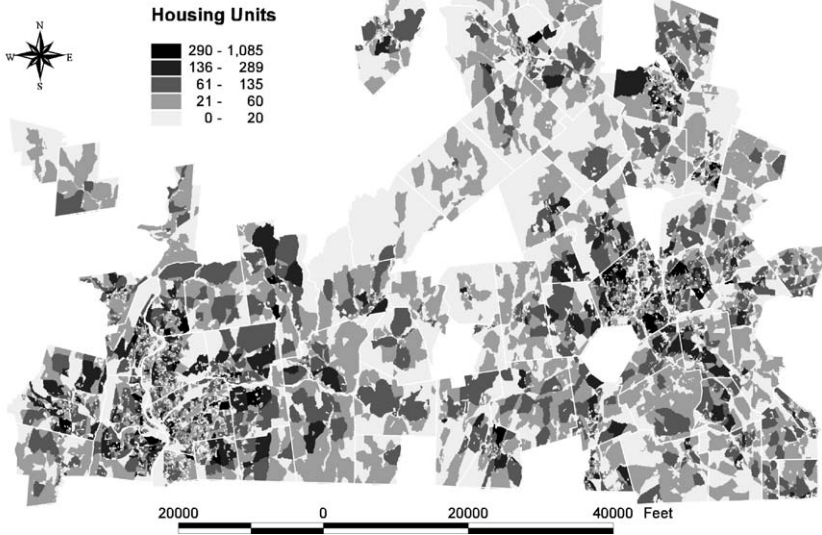


Fig. 4. 1990 housing units from the US Census.

The equation for producing the estimated number of burglaries occurring in the census blocks can be calculated as shown in the following equation

$$\begin{aligned} \epsilon_{ji} &= R_j * X_{ji} \\ R_j &= A_j / B_j \end{aligned} \quad (1)$$

Where ϵ_{ji} is the estimated burglaries for census block i , municipality j ; R_j is the burglary rate for municipality j ; X_{ji} is the number of houses in census block i , municipality j ; A_j is the number of burglaries for municipality j ; and B_j is the total number of houses for municipality j .

The residential land use and zoning data layer serves as a mask for the distribution of the estimated burglaries within residential areas. This means that for a census block, the estimated burglaries calculated for the block will be assigned to each residential polygon that falls within it. If census block A is estimated to have 10 burglaries, and within the census block there are 4 different polygons for residential land use, each of the four polygons is given the value of 10. Residential areas are used as a mask and not included for the estimation of the distribution of burglaries within census blocks because of scale. However, if we were examining the burglary distribution of one

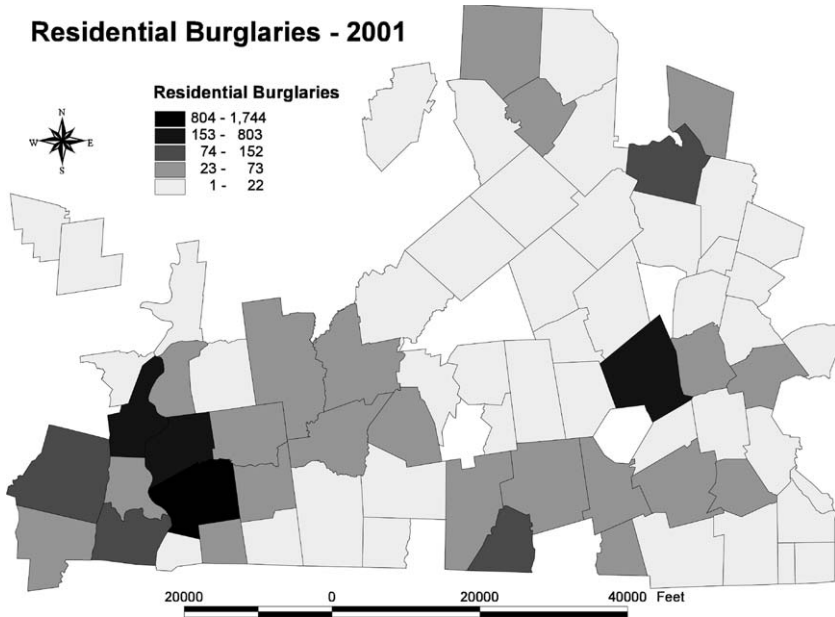


Fig. 5. Residential burglaries from Massachusetts State Police.

particular town and were interested in looking at how burglaries may also be distributed within the census blocks, there are various geographic techniques for establishing this distribution. Much of this type of distribution refinement is conducted with areal interpolation.

For the purpose of the analysis using GIS (see Fig. 6), the data layers are converted to a raster format with a cell size of 25 feet. A raster data layer is essentially a grid with cells that are the same size. Each cell in the grid is assigned a value based on the variable from the data layer. For example, a street line data layer converted to a raster format will have cells where the streets are located that would contain an attribute such as the type of street. Areas where the streets are not located would also have cells, however, these cells would have no value. The first step is to define the data for the *source zone* (data layer that supplies the aggregate level data) and *target zone* (data layer where the aggregate data will be transferred) (Flowerdew and Green, 1989). For this case, the source and target zones are the burglary rates by municipality and census blocks, respectively. All cells in the source zone are coded for the appropriate town and the target zone cells are coded with the appropriate census block number.

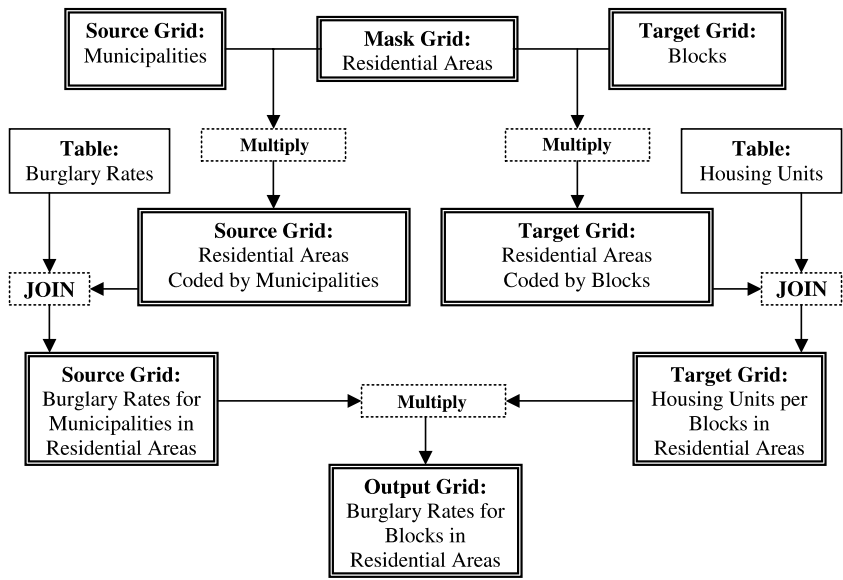


Fig. 6. Steps for creating dasymetric map with GIS for this example.

Land use data are classified by assigning a value of 1 to residential cells and 0 to all other cells to create a mask. This mask is used to isolate residential areas within the municipality (see Fig. 3). The source and target zones are multiplied by the mask to remove cells that do not fall into residential areas. Raster data sets only store one variable per cell and, in this case, the variables are identification codes for the municipalities in the source zone and the census block identification number for the target zone. The next step is to join data tables to these raster data layers. The source zones are joined to the burglary rates for the municipalities and the target zones are joined to the number of housing units for the census blocks.

Figure 7 displays residential burglary rates (per 1,000 housing units) by census block. However, this figure is misleading, as the housing units are not uniformly distributed throughout the residential areas. The final step in this process is to multiply the burglary rate by the number of housing units to calculate the estimated number of burglaries per census block (see Fig. 8). This map displays an estimate of where burglaries are occurring within the municipalities.

Previous studies on burglary provide important clues for researchers working with aggregate data as to which variables are important in estimating the distribution of crime using dasymetric mapping techniques.

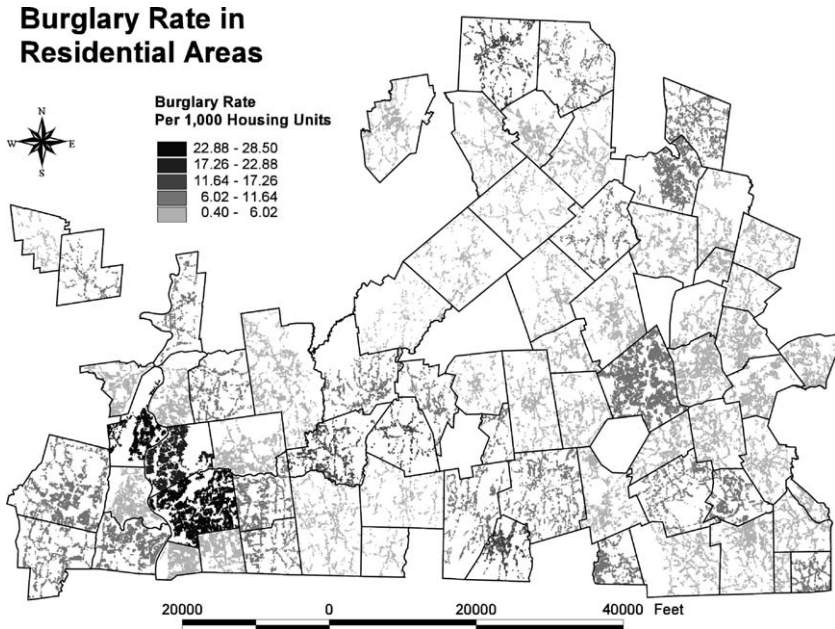


Fig. 7. Burglary rates in residential areas per 1000 housing units.

Caution must be taken in applying this technique. In our example, if there is an area in the municipality that has a ‘hot spot’ location with more burglaries than normal, the resulting increase in the number of burglaries will then be distributed throughout the town based on the burglary rate and the number of targets. Any localized hot spot will be masked by the dasymetric mapping technique. What will be highlighted are areas with the highest potential, as can be shown with density maps.

6. EXTENDING THE ANALYSIS

The usefulness of this approach of mapping out aggregated data can only be determined by comparing the results to a map of the actual crime locations. As mentioned previously, we were able to obtain the NIBRS data with the addresses of the residential burglaries attached from the Massachusetts State Police Crime Reporting Unit. Normally, NIBRS data and crime data from the UCR provided by the Federal Bureau of Investigation available to the public do not contain the addresses of incidents, as they

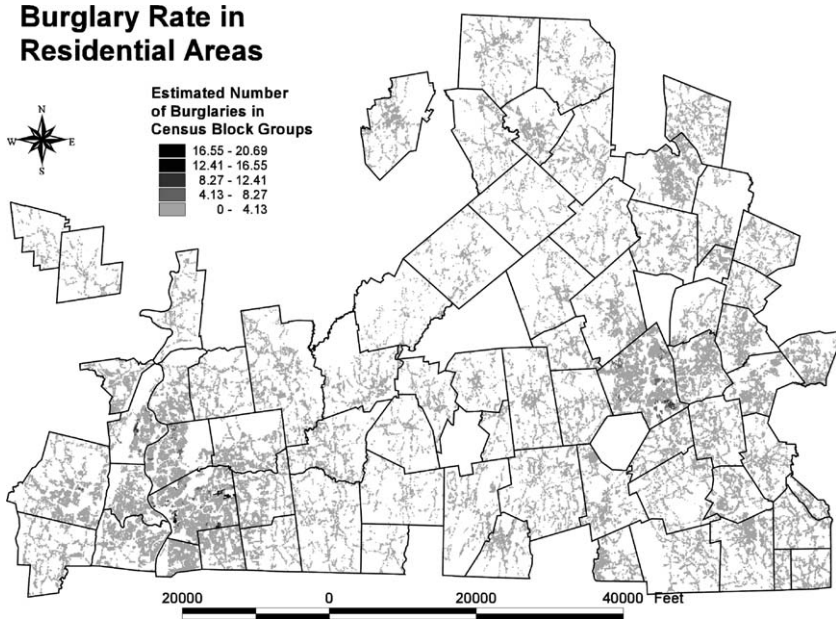


Fig. 8. The estimated distribution of residential burglaries within block Groups.

have been aggregated to the municipality. The addresses for the residential burglaries were geocoded to the TIGER street file to create a point layer for each incident.

To compare the results from the dasymetric mapping technique to the actual locations of the incidents, a surface map was created for each that showed the density of the estimated incidents and the actual incidents. To produce the surface map from the dasymetric map, a point data layer was created from the final dasymetric raster layer, where all cells became points and the cell values of the estimated number of residential burglaries (the burglary rate times the number of housing units) were attached to each point. A density map was created using the kernel method from this point layer. The kernel method produces a smoothed surface of the data by creating a grid and counting the number of incidents that fall within each grid cell and within a specified distance around the grid cell. Each grid cell is then given a value based on the number of incidents within and surrounding the grid cell. Because the point layer from the dasymetric map was created by a grid, the distribution of the points is uniform, so the kernel method allows for a smoothing of the values of the points (the

Estimated Density of Burglaries Using Aggregated Data

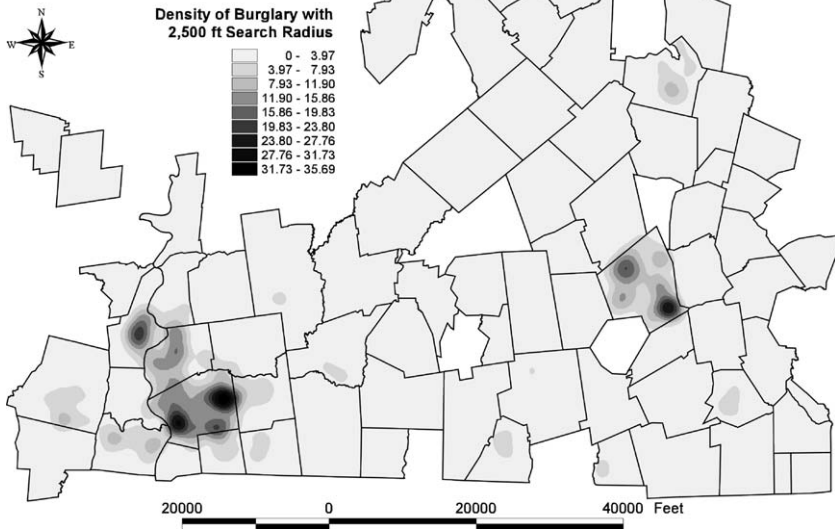


Fig. 9. Density of residential burglaries from dasymetric mapping.

estimated number of residential burglaries) rather than the points themselves. A grid cell size of 50 feet and a search radius of 2,500 feet were used for the dasymetric results shown in Fig. 9. By using the kernel method we were able to create a map showing where burglaries may be concentrated based on the underlying opportunity structure. The resulting display is a surface map that shows the densities of the distribution of incidents.

The second density map created for the actual residential burglary incidents also used the kernel method, however, this second density map is based on the number and location of incidents. This difference in the grid surfaces using the burglary value for the potential surface and the number of incidents for the actual burglary surface will result in different values for the density surfaces. Again, a grid cell size of 50 feet and a search radius of 2,500 feet were used to create a density map of the actual residential burglary locations, shown in Fig. 10.

Dasymetric density maps do not depict *actual* clusters of burglaries, however, these maps do depict where the burglaries may be clustered based on the distribution of potential targets (housing units) and the number of

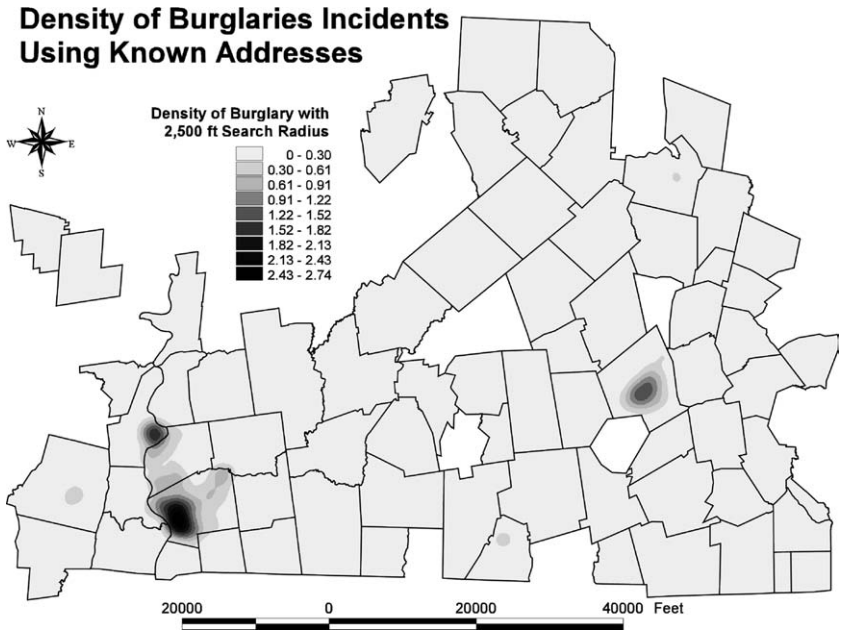


Fig. 10. Density of residential burglaries using geocoded incidents.

burglaries in the municipality. It should also be noted that using density mapping on the estimated distribution of burglary would not display hot spots of burglary. Hot spots are locations with a higher than normal rate of crime and the dasymetric mapping technique alone does not allow for such calculations. Visually comparing the results of both maps (Figs. 9 and 10), we can see that the dasymetric mapping matches the actual incidents. The dasymetric map does, however, have a greater number of areas where the density is higher. This difference can be explained where the dasymetric map evenly disperses the burglary rate based on the underlying opportunity structure, and there is no means to predict higher than normal rates. The fewer high density areas for the actual incidents may show areas that are higher than normal and these potential hot spots are hiding the distribution of the remaining burglaries.

Taking what is known about residential burglary to further assist in estimating where residential burglary occurs could refine this estimation. This further analysis would include incorporating a weighted system based on what is known about residential burglary. As discussed in the literature, detached single-family homes and houses located on or near major routes

appear to have a greater risk of residential burglary. By using additional variables from census data that describe housing units and using transportation network data, weights could be assigned to further estimate the distribution of residential burglary.

7. CONCLUSIONS

This type of mapping technique is tailored for researchers working with aggregated data such as the UCR. Where address level crime data are available, this technique is not needed. However, for regional crime analysts, aggregated data from the UCR and NIBRS may be the only source of data for a macro-level analysis. The dasymetric mapping technique assists with identifying those locations within the units of analysis where the crime can potentially occur.

Macro-level studies of crime using choropleth mapping techniques of aggregated data can mask underlying distributions of crime. This can visually distort the reality of where crime occurs through the assumption that crime is uniform throughout the unit area and the size and boundaries of the units are fixed. Dasymetric mapping offers a means to create a more realistic picture of where crime is occurring through the use of additional data. As shown by Langford and Unwin (1994), this approach can provide us with a means to create density maps, which choropleth mapping alone is ill-equipped to do.

The type of crime will determine the “collective guesswork” that will be used to divide the crime incidents in the area. For example, burglary occurs in places where buildings are, and the type of burglary, either residential or commercial, can assist in the controlled guesswork. Census and land use data can show the densities of the buildings, the number of units in each building and whether they are located in a residential or commercial area or mixed. At this point, we can determine the rates based on the number of buildings and the number of burglaries. Although we can now show the rate of burglary based on the distribution of the buildings, this may not be the way burglary works. Some areas may need to be assigned different weights based on density. Burglary may be more likely to occur in one type of building distribution. Single-family houses spaced far apart near a wooded area may offer more protection for the burglar to work in secret than a series of townhouses in a denser area. In this case, using additional research on burglary would allow us to apply weights from data such as census, land use, and zoning to provide a more realistic distribution of burglary potential than that from choropleth mapping.

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