Using Location Quotients Technique to Analyze Residential Burglary

Abstract

Location quotients (LQ) technique is a relatively new technique for computerized crime mapping analysis. It is a measure used to compare an area's share of a particular type of activities with the reference area's share of the same type of activities. Compared to other traditional crime analysis methods, such as hot spot (kernel density) analysis, it has the advantage of being able to incorporate the discontinuous backgrounds.

This research analyzes actual police data for residential burglaries in Gainesville, Florida. Utilizing the location quotient measure, the spatial and temporal structures of residential burglary are explored. Points of entry are also analyzed to determine if some neighborhoods suffer an abnormal rate of specific kinds of break-in points. LQ is useful in quickly finding structural design faults. This paper demonstrates how different methods of analysis of the same spatial dataset from different perspectives would reveal different embedded information.

1. Introduction

Burglary, or "breaking and entering", is one of the most common crimes worldwide. Compared to violent crimes, burglary may appear to be a minor crime. However, the consequences of this crime are often serious. It can be very costly. For example, in 1996, the United States National Institute of Justice estimated that burglaries cost 9 billion every year, excluding the cost of prevention and the cost of the criminal justice system (Miller, Cohen et al. 1996). In addition to the socioeconomic cost, burglary, especially residential burglary, engenders significant psychological effects in victims. The British Crime Survey found that nearly 4 in 10 victims of "entered"

burglaries said they had been very much affected; and 68% of victims of all incidents (of burglary or attempted burglary) responded that they felt angry. Shock, fear, and difficulty in sleeping were also fairly common experiences in burglary victims (Budd 1999). Other studies also showed that the enduring psychological effects of burglary on its victims are just as severe as the effects related to violent crimes such as assault and robbery (Hough 1984).

To fight this crime, it is very important to understand burglary patterns and possible contributing factors. The spatial distribution of burglary is not random. Some communities have few burglaries, whereas others are notorious for a high concentration of burglaries. The distribution of crime over time is not random, either. For example, analysis of residential burglary in the London Borough of Croydon revealed that peaks existed in residential burglary temporal patterns (Crime Reduction Center, n.d.). Thus, if burglaries at high-density places and peak times can be prevented, then the total burglary rate can be reduced.

With knowledge of where and when burglaries occur, factors that are associated with burglary should be explored. Crime, including burglary, is related to a multitude of attributes. A large amount of studies have explored the relationship between burglary and socioeconomic variables such as poverty, ethnicity, age composition, income, education, gender, and residency expressed by percentage of foreign-born residents in a city (Byrne and Sampson 1986). However, little research has examined the relationship between structural features and burglary, especially from the view of point of entry.

To analyze spatial pattern of crime incidents, kernel density is one of the most popular technique. A lot of studies that explored burglary and possible contributing

factors use statistical methods such as correlation and regression (White 1990),(Loukaitou-Sideris, Liggett et al. 2001),(DeFrances and Titus 1993). While these established methods have many advantages, they have limitation of not having the capability of visualizing the relationships between burglaries and contributing factors such as structural design weakness. Kernel density map can visualize spatial concentration of crime incidents, but it has the shortcoming of not considering the contextual backcloth. For example, when estimating the density of robbery by incidents, the results usually show concentration in city center. However, there is also a concentration of people either living or working in these areas. Location quotient, a relative new technique for crime analysts, provides an alternative approach that can analyze and visualize crime patterns. Location quotients technique is a measure that compares an area's share of a particular type of activities with the reference area's share of the same type of activities. The methodology will be described in more detail later in this paper.

The main purpose of this paper is to demonstrate the usefulness of location quotients in understanding the spatial and temporal structures of residential burglary in comparison with the conventional density methods. The relationship between burglary and points of entry is also examined. In the following sections, we describe the concepts of location quotients, the data and methodology of this study, compare the results of kernel density and location quotients, and finally discuss the implications of the findings.

2. The Concept of Location Quotient

Location quotient is a measure developed in regional planning and economics to evaluate economic structure and specialty (Isserman 1977). The location quotient (LQ) is

an indicator that compares an area's share of a particular activity with the reference area's share of some basic or aggregate phenomenon. The formula is as follows:

$$LQi = (Eij/Ei)/(\Sigma Eij/\Sigma Ei)$$

Where:

Eij = economic activity in subarea i department j

Ei = total economic activity in subarea i

ΣEij = economic activity of department j in the whole area

ΣEi = total economic activity in the whole area

LQs are frequently calculated on the basis of employment. The interpretation of location quotients is very simple. When a region's LQ for industry j is larger than 1, it can be concluded that local employment is greater than expected. These extra jobs then must export their goods and services to non-local areas. The region then is defined as specialized in industry j.

In crime analysis, location quotients would use crime as the basic unit of count. The formula can be restated as

$$LQCi = (Cij/Ai)/(\Sigma Cij/\Sigma Ai)$$

Where:

Cij = crime frequency in subarea i

Ai = area measure like population at risk, total crime count in subarea i

ΣCij = crime frequency in the whole area

ΣAi = total area measure in the whole area

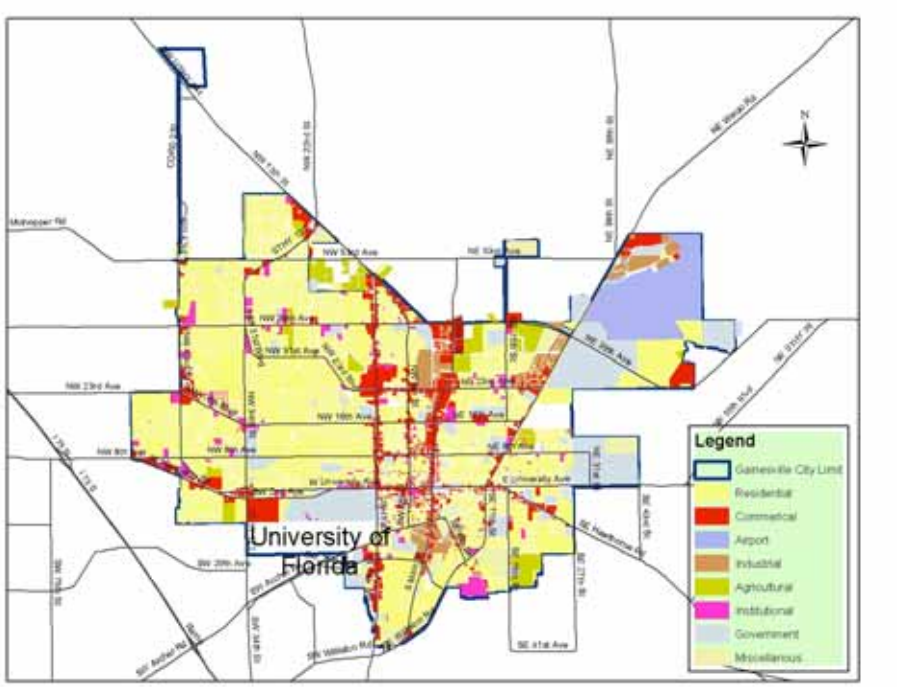
There are very few attempts to employ LQ in criminology. However, this technique can be applied in crime analysis and be a particularly useful tool with a careful and case-

based design of LQ measurement. For example, it can be used to assess changes of local crime structures over time, or to compare crime structures across localities. Although burglary cases concentrate around certain areas, even in lower risk communities, there can be certain months that the areas suffer burglary victimization disproportionally compared to the standard temporal distribution of burglary. Details are included in Section 4 where LQ is designed to inspect burglary pattern.

3. **Data and Method**

This research was conducted in Gainesville, Florida. Gainesville is located in the North Central Region of Florida. It occupies approximately 17,648 acres, has 37 thousands of households and a population of 100 thousands (US Census, 2000). University of Florida is the leading employers of Gainesville. As a college town, the median age of Gainesville's population is only 26.4, much younger than the US general population's median age, 35.3 (http://www.census.gov/population/pop-profile/2000/chap02.pdf). The percentage of people between 15-24 years of age, which has been proved to be significantly correlated with crime, is 32.59% in Gainesville, compared to 13.9% for the US general population. Gainesville is about 9 miles across north/south and 7 mile across east/west. The city has interstate highway I-75 running close its west border. University Avenue and Main Street are the east-west and north-south arteries running through the city (Figure1). Because of data availability, this research doesn't include burglaries inside the campus range.

Figure 1 Gainesville Land Use Map



Burglary incidents data was gathered from the Gainesville Police Department. The data records all the reported burglary in Gainesville, Florida from January 2000 to December 2003. Information about burglary location, type of burglary, the points and methods of entry, estimated date and time of the offenses, and item stolen are included. Within this time frame, 3100 cases of residential burglary in Gainesville were reported.

4. Burglary Pattern Analysis

In this analysis, we aimed to reach three products through Location Quotients. The first is spatial distribution of burglary in Gainesville. The second is the spatial-temporal pattern of burglary incidents. The third is the breaking point analysis. In this analysis, points of entry will be analyzed to find if some neighborhoods suffer an unordinary rate of some specific kinds of break points or methods. This methodology is useful in finding architecture design weaknesses quickly.

1. Spatial pattern

In addition to the conventional kernel density method, the spatial pattern of burglary is also analyzed by location quotients technique. The area denominator selected for this analysis is household unit counts. The calculation is applied on the level of census block. Figure 2 and Figure 3 show maps for both methods.

Figure 2 Kernel Density for Residential Burglaries

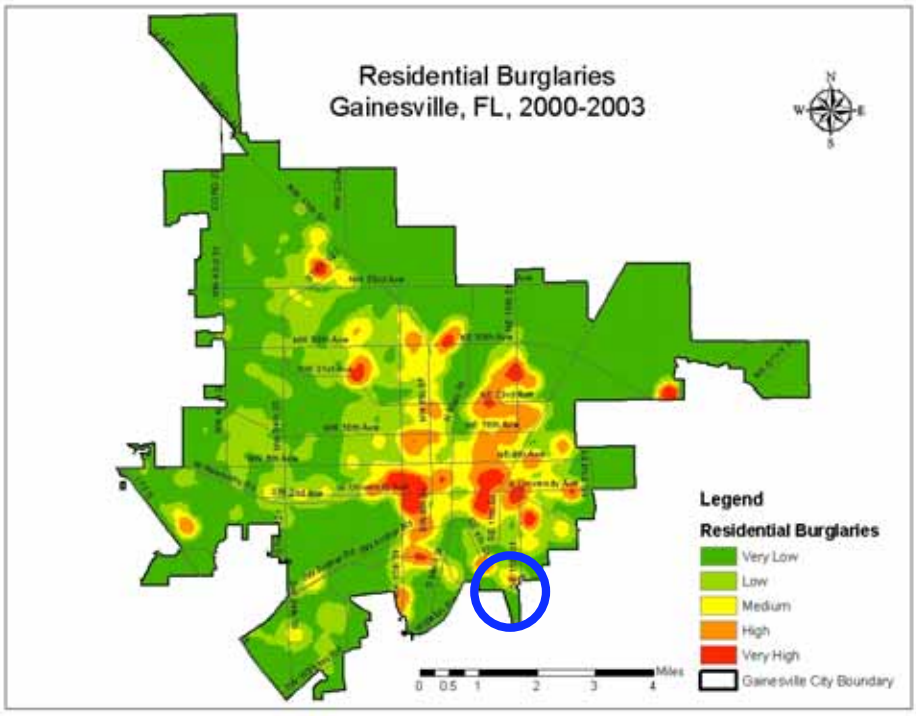
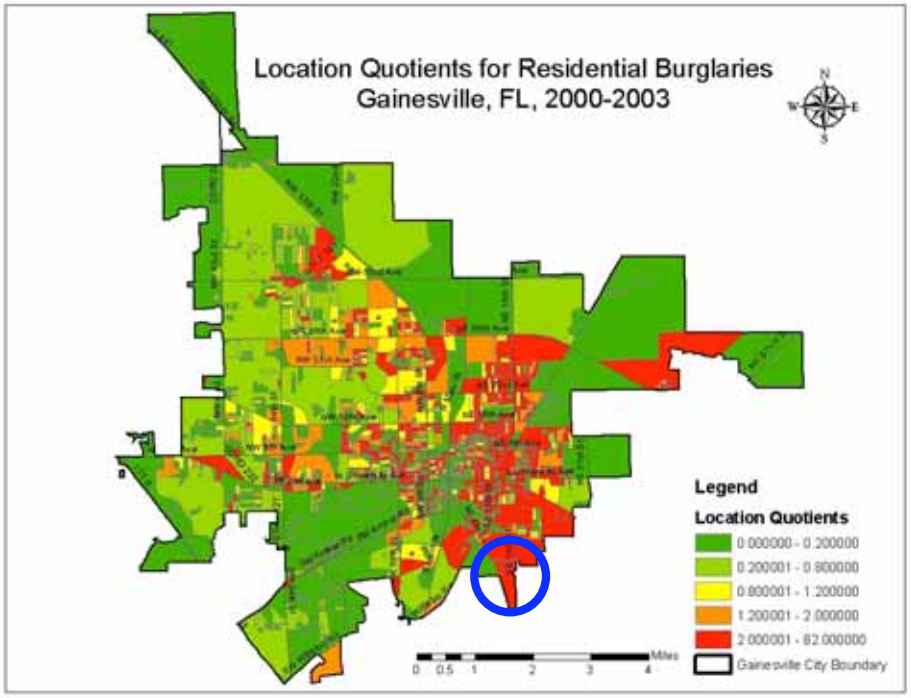
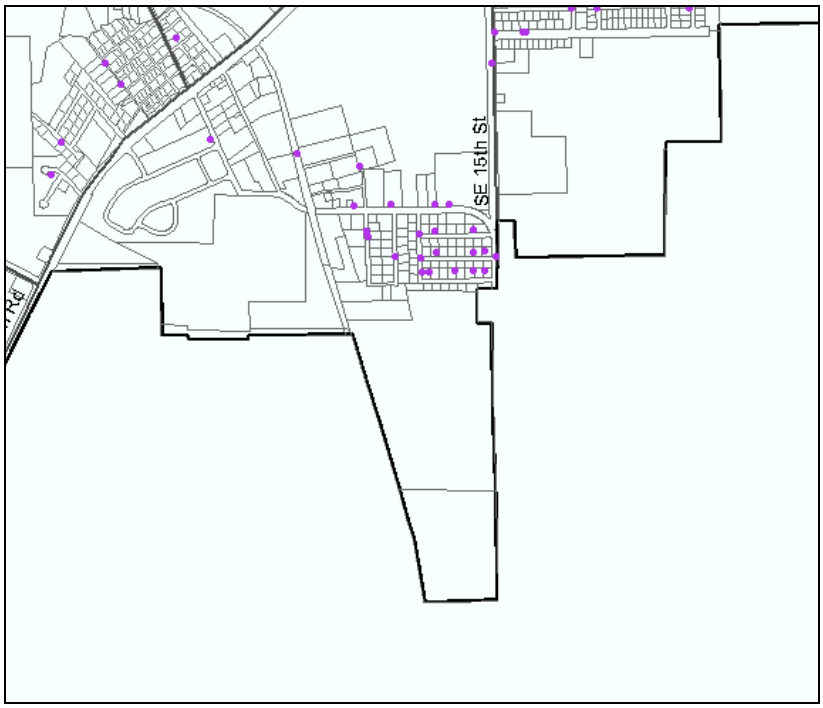


Figure 3 Location Quotients for Residential Burglaries



Kernel density surface map is a wonderful measurement to measure the concentration of burglary incidents over space. Two major burglary "hot spots" are identified, one beside the east side of University of Florida, along University Avenue and 13 Street, and another between Main Street and Waldo Road. The first one is where apartments and rental houses concentrated. The second is where most residential real estates' assessed values are below 50,000. The LQ map for residential burglary rate, which is burglary counts versus household counts, reveals pattern a little bit different with kernel density. The risks for apartments beside the university are not abnormally higher compared to the overall burglary rate in Gainesville. It is the dwelling units density that makes the area as hot spots. Furthermore, some districts, like the block that is highlighted by the blue circle in the map, are defined as "moderate" in kernel density map but are defined as high risk in LQ map. A thorough exploration (Figure 4) of this block finds out that this block includes an isolated community that suffered a high rate of burglary victimization. The relative risk for households in this block is much higher than the standard risk of households in Gainesville, however, as there are not many households in this area, the density of crime incidents is not high.

Figure 4. Isolated Community with High Risk

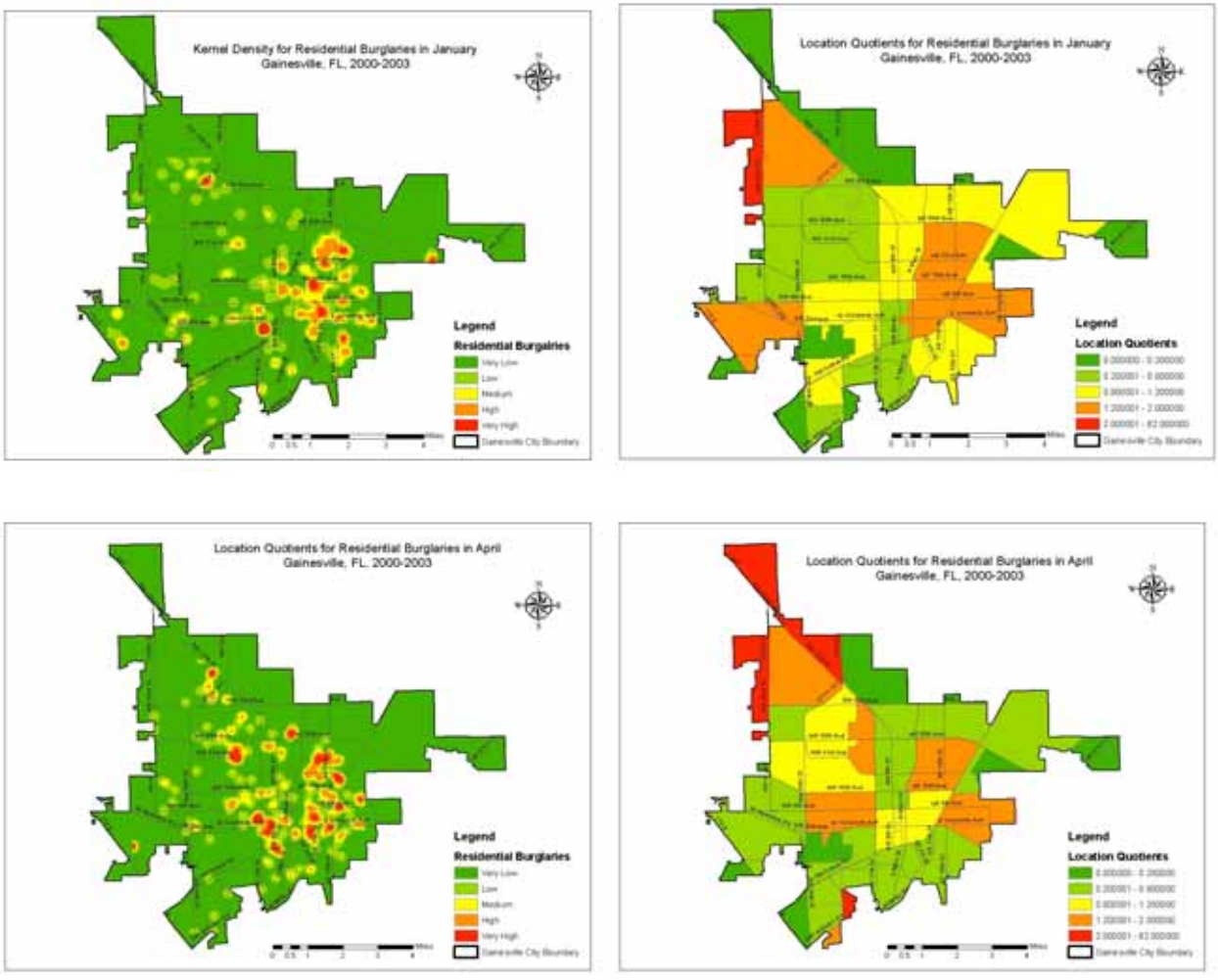


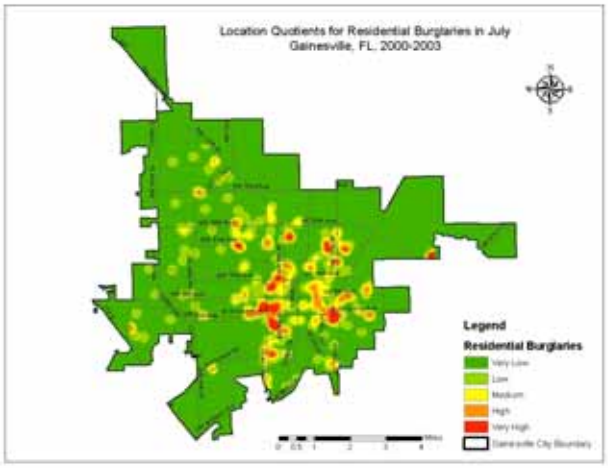
2. Spatial-temporal pattern

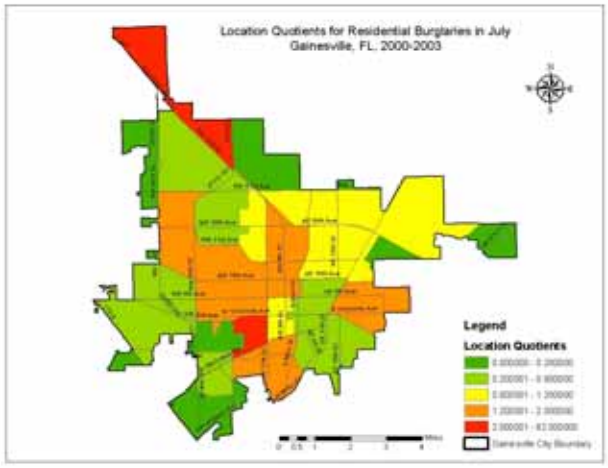
Crimes vary enormously over the year. Reliable estimates of crime seasonality are valuable for tactically deploying limited police and crime prevention resources. Crime seasonality has been explored for more than 100 years (Baumer and Wright 1996). Most of these studies are employed on large spatial units of aggregation like city, regional, and national levels (Farrell and Pease 1994). This methodology may mask variation at smaller unit. Some neighborhoods or areas may have large seasonal fluctuations and suffer victimization inappropriately in certain months. Intervening these areas at their relative peak time can be very effective in reducing crime. With the help of LQ technique, seasonality for small areas across Gainesville is mapped, the result can be very useful for policing purposes. The LQ

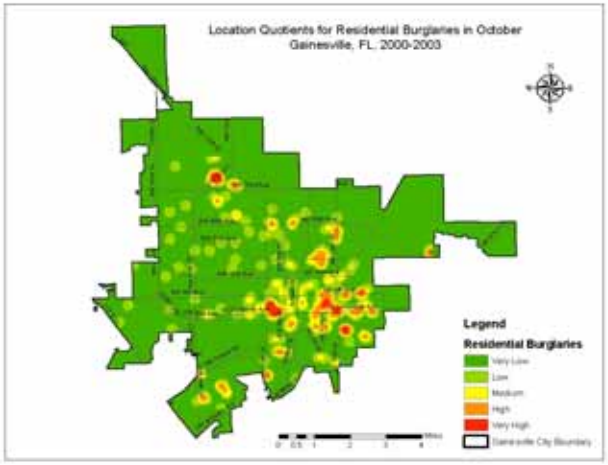
value is derived by comparing the share of burglary counts of the subarea to those within the city limit, for a specific month. As many census blocks only have one or two burglary incidents in the studies period, the analysis is applied on a larger aggregate level-census tract. Kernel density maps for every month are also provided for comparison purposes. The map below only includes the first six months' kernel density map and location quotients map.

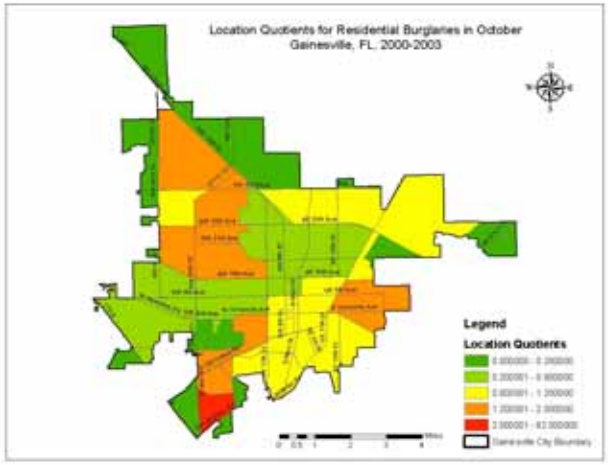
Figure 5 Monthly Kernel Density Map and Location Quotients Map











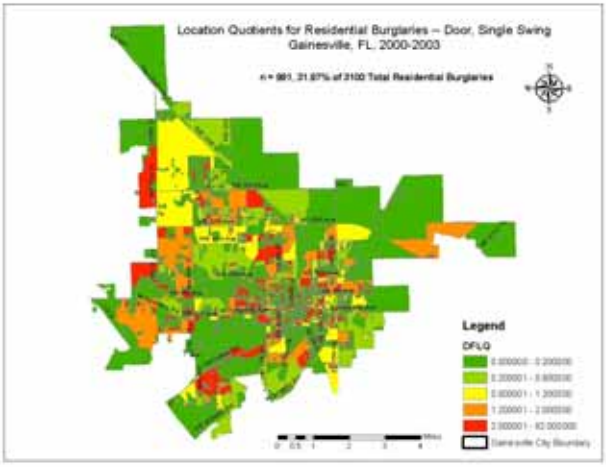
3. Point of entry analysis

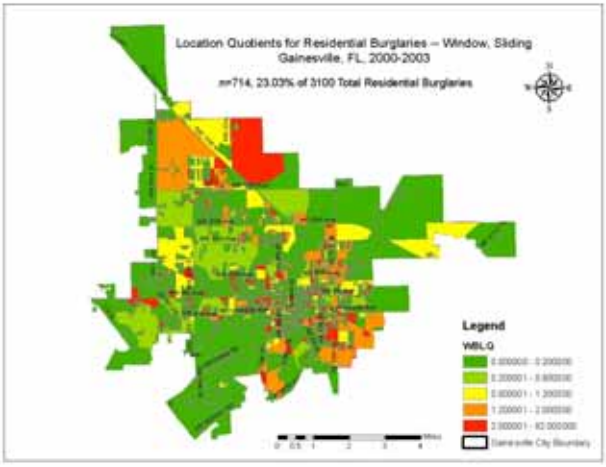
Although point of entry has been recorded in police data system, there are very few studies that explored it. This information is useful in identifying structural weaknesses; it also provides guidance on target hardening strategy.

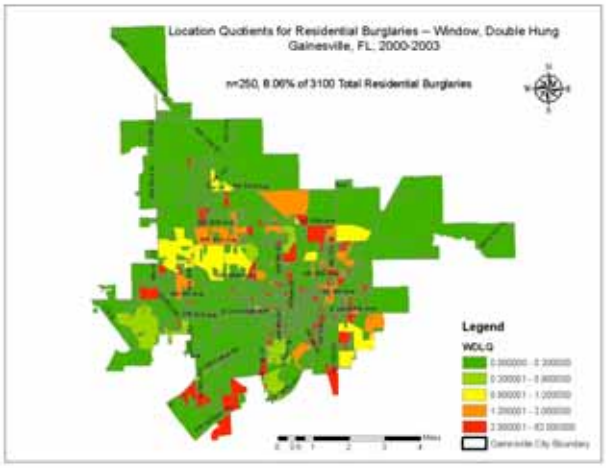
Table 1. Point of Entry

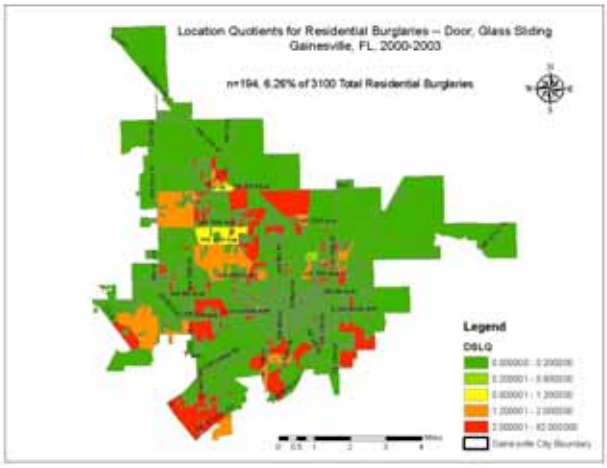
Point of Entry Code	Point of Entry Description	Percentage of Cases
DF	Door, Single Swing	31.97
WB	Window, Sliding	23.03
WD	Window, Double Hung	8.06
DS	Door, Glass Sliding	6.26

Single swing door and sliding window are the most popular choice for burglars committing offences, however, preferred points of entry differ throughout districts. Maps below demonstrate LQ value for the top four points of entry. The LQ value is derived by comparing the share of burglary counts with the specific points of entry to total burglary counts. The analysis is applied in census block level.









5. Conclusion

Utilizing kernel density and location quotient technique in the analysis of burglary patterns and contributing factors, this study demonstrates how different methods of analysis of the same spatial dataset from different perspectives would reveal different embedded information. As crimes occur on a backcloth (Brantingham and Brantingham 1993), location quotients, a relatively new technique to crime analyst, provides a relative and contextual view of crime. This method can be very helpful in understanding crime patterns and in prioritizing crime prevention resources.

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