

CRIME RATES AND ENVIRONMENTAL DENOMINATORS*

KEITH D. HARRIES

*Department of Geography
Oklahoma State University*

ABSTRACT

The basic purpose of the research discussed here is to show that the expression and analysis of crime in the form of frequency counts of population-based rates may be inappropriate in various law enforcement, criminal justice planning, and research applications. It is suggested that rates incorporating environmental denominators may provide a more satisfactory expression of crime in some circumstances. Various problems associated with the use of frequencies and population-based rates are outlined. Using robbery as a sample crime, a rationale is developed for the use of specific denominators indicative of the environments with which it is typically associated. A factor analysis of robbery rates based on various denominators suggests that several can provide information about the robbery "surface" that differs significantly from the information obtained when population is the denominator.

Locational information relating to crime occurrences constitutes a set of data with important environmental implications. Crimes occur in response to the juxtaposition of opportunities and human motivation. While personal crimes demand only the propinquity of people as their host environment, property crimes call for the presence of physical opportunity (the target) in combination with human criminal intent.

Our perception of crime is very much colored by the process of the production of official statistics, and of research and planning efforts that are in turn dependent for their data base on those statistics. A crime distribution map,

*This project was supported by Grant No. 78-NI-AX-0064, awarded by the Law Enforcement Assistance Administration, U.S. Department of Justice, under the Omnibus Crime Control and Safe Streets Acts of 1968, as amended. Points of view or opinions stated in this document are those of the author and do not necessarily represent the official position or policies of the U.S. Department of Justice.

then, is a mediated reconstruction of reality – it is, in fact, much less than reality in two important respects. First, it omits incidents because crime is inevitably underreported, and second, it omits the seriousness dimension. The former problem is incurable, and researchers usually cling to the faint hope that what is reported is a reasonably good sample of what actually happens. The seriousness issue is usually accommodated indirectly simply by *classifying* crimes in any map, tabulation, or other analysis. Thus our perception is affected, and we presumably attach our own personal seriousness weights to burglary, vis-a-vis robbery, or other offenses.

It should be emphasized that any crime data, like a good deal of other social data, should be regarded circumspectly. With this caveat in mind, we can consider the implications of interpreting and manipulating crime data in order to provide useful information for purposes relating to policing and research.

FREQUENCIES VERSUS RATES

Law enforcement operations are typically organized so as to respond to high *frequencies* of occurrence in specific geographic areas. No rate calculation is involved, even on a population base, and there is no role for the concept of crime opportunity. Like most public agencies, police departments must necessarily respond to problems on a minute-by-minute basis, and it is therefore reasonable that an occurrence should be regarded as the critical unit of observation. Why, then, calculate rates? A rate is calculated on the basis of a denominator that provides an adjustment making what would otherwise be raw frequencies more intelligible; everyone is familiar with, for example, birth and death rates providing a per capita indication of events. Indeed, in some disciplines (such as demography) the rate concept has been well developed, with a variety of ratios expressing specific conditions. In crime analysis, however, the rate idea has been applied crudely (perhaps with good reason), generally relying solely on the total population denominator.

Implicit in the calculation of rates is an overview or planning posture more appropriate to the longer term, as compared to daily response to frequency of occurrence. Rate calculation, then, may be seen as a tool for monitoring in what may be termed the “macro” mode in which the overall environment of crime and law enforcement is evaluated in a general way, relatively infrequently. Typically, police departments produce an annual digest of statistics which usually includes population-based crime rates. The same is true at the state level, and in the *Uniform Crime Reports* of the F.B.I. Insofar as rates have any value, it is as a tool in the monitoring of longer term system condition and performance, whether that system is at the local, state, or national levels. (“System” is regarded here as the whole interaction process between crime and law enforcement and characteristics of society at large.)

Risk-related crime rates are seen in this context as refined tools, incorporating environmental denominators, for facilitating the kind of monitoring that is

currently done using population-based rates. It is argued that a simple count of occurrences or clearances, or even the somewhat more satisfactory (in some respects) use of a population base, is not sufficient to enable the command structure of a police department to adequately monitor the performance of that department in the context of the real environment in which it is operating. The politics of law enforcement demand that police executives show “here and now” that something is being done about each specific problem that crops up as an issue of public concern. An increased frequency of occurrences of particular types of crime will cause strong pressure on police to “do something about it.” The issue of whether the local urban environment would lead to the *expectation* that such an increase in the frequency of occurrences is likely is a point generally overlooked or ignored. The monitoring of crime on a risk-oriented basis does not remove the day-to-day pressure on police to put out the brush fires, but it does provide the capability for a broader view of the context in which crime is occurring, and may offer the command structure an opportunity to develop reasoned arguments to show that even an increasing frequency of crime may not necessarily indicate deteriorating performance by the department in question.

The literature indicates that there does not seem to be any serious question that risk-related crime rates are frequently an improvement over population-based rates. Questions would appear to focus, rather, on such issues as: What denominators are most appropriate? Of the appropriate denominators, for which do we have available data? How much more difficult are risk-related rates to calculate as compared to population-based rates? To what practical uses are risk-related rates to be put once they have been computed?

The purpose of this work, then, may be summarized and restated as the presentation of an overview of the environmental denominator concept in crime rate measurement, with emphasis on dealing with methodological problems involved in the development of such rates. Some emphasis is also placed on the potential applications for environmentally-related rates in the realms of law enforcement policy and planning.

PROBLEMS ASSOCIATED WITH POPULATION-BASED RATES

The issue of crime measurement has historically been shrouded in controversy and plagued with difficulty. There has been no universal agreement on what constitutes serious crime — and hence on what offenses should be regarded as basic indicators of levels of criminal activity. The amount of crime hidden by underreporting is massive and has generally undercut the credibility of report-based indexes such as those appearing in the *Uniform Crime Reports* of the F.B.I. [1]. Victimization surveys have tended to overcome this problem, but have been limited in their usefulness by their inability to provide disaggregated data usable in local jurisdictions.

Compounding the structural problems of the various indexes constituting the public data sources on crime has been the mode of measurement or base upon which *rates* of occurrence have been calculated. By far the most frequently used and quoted crime metric is based on total population as the rate denominator. This is generally true of crime reports published by cities, of state level *Uniform Crime Reports*, and of the widely quoted federal *Uniform Crime Reports*.

The use of population-based crime rates has strong intrinsic appeal. It is obvious that crime cannot occur where there are no people. Similarly, opportunities for crime, or at least for certain types of crime, would appear to be logically associated with numbers of persons. The notion of *interaction density*, advanced by Haynes [2], involves the postulate that the occurrence of crime is essentially a function of the square of the population in a given area. The underlying concept is that it is possible for each person to commit a crime against every other person, hence the use of the square of the population.

The role of population in crime rates has also been addressed by Gibbs and Erickson [3], who suggested that the denominator in “conventional” crime rates is not necessarily representative of “the number of potential offenders or victims.” They emphasized the relevance of the “community/city population ratio” on the grounds that “as the ratio increases, the number of potential participants in a ‘city crime’ that is, a crime in the city, increases proportionately.” Their argument was summarized in the proposition that: “the crime rate of a city varies directly with the ratio of the size of the larger community to the size of the city.” [3, p. 607] Empirical investigation provided some support for the hypothesis. Yet there is substantial evidence to the effect that most criminals travel short distances (on the order of a mile or two) to commit their crimes [4, pp. 85-90], and such evidence would seem to confound the idea that the size of the larger community is critical, implying as it does criminogenic mobility over much greater average distances.

The point is that population is indeed a reasonable indicator of crime opportunity in the sense that there is a substantial amount of empirical evidence to indicate that population-specific rates do become larger when the mass of population is greater. The relationship is confounded by the fact that social pathologies tend to concentrate disproportionately in the largest communities, and that such concentration should to some extent discount the relatively high crime rates of larger cities and SMSA’s. Indeed, one might argue that there is such a large gap between potential interaction and actual patterns of occurrences that city size can be related to crime frequency only in a rather crude and indirect fashion. As Scott has pointed out, the positive relationship between city size and rates of crime is not necessarily universal. In Britain, for example, there is an inverse relationship between city size and personal crime rates, while in Denmark, the largest city, Copenhagen, has relatively low frequencies of rapes [5, p. 6].

Unfortunately, the use of a population denominator in the calculation of crime rates creates serious problems of logic and consistency with respect to

several major offenses. Population-based rates are typically produced and interpreted on the basis of aggregated and generally out-of-date population totals, but ambiguity arises from several sources, discussed below.

Social Monitoring

A fluid and complex society such as that of the United States must anticipate trends and changes in the patterns of numerous phenomena. Such monitoring is necessary in order to assist in the optimization of public expenditures with respect to all social problems including crime. Population-based crime rates do not really provide an adequate basis for the kind of monitoring that is necessary to anticipate needs or to provide a basis for attempted problem solution. Knowing only that crime per capita has increased or decreased is essentially meaningless without some knowledge of the characteristics of the population committing crime — preferably knowledge of the victims of crime and, in general, demographic data of much greater depth. No very useful purpose is served by merely reporting per capita crime occurrence.

It can be persuasively argued, further, that it is not enough merely to know the basic age and sex characteristics of the population, but it is also necessary to have some information about migration patterns. American society is so dynamic, and so transient in many respects, that demographic data without migration data are significantly reduced in utility. Unfortunately, disaggregated demographic data, and particularly migration data, are not available with adequate frequency or in adequate detail. However, census data, particularly with the possible advent of the quinquennial census beginning in 1985, should go some way towards providing higher quality base-line data for the computation of what could be relatively sophisticated crime rates.

Population Estimates

The inter-censal population estimates of the Census Bureau are necessarily relatively crude. In 1981, for example, we are faced with the fact that the 1980 census will not appear in detailed form for some years and in the meantime, only 1970 data are available. Not only are the population estimates crude, but they lack the meaningful subclassifications of the cohort data that are necessary to provide any significant insights relating to the kinds of population changes that are occurring within incorporated cities or metropolitan areas. The concept of utilizing refined population data — cohort data — is appealing and important. But historically, population-based crime rates have not utilized population broken down into appropriate sub-classes. There is, in fact, great potential for the use of refined population data in the calculation of crime rates.

Law Enforcement Policy and Planning

Per capita or population-based rates are of little value in the law enforcement policy and planning process. It is probably fair to say that the average police

department mainly responds to crises, with a crisis being interpreted as a relatively high frequency of occurrences of a particular type of crime in a particular area. Other types of crises might include public emergencies or traumatic crimes such as multiple homicides, but in general it is outbreaks of neighborhood crime (attracting the attention of the population in that neighborhood) that generate the social and political pressures upon the police department compelling it to act in a timely and effective fashion. That problem is not addressed by this research and will presumably exist permanently or at least in the foreseeable future. What the current work does suggest is that the use of a variety of environmental denominators in the crime measurement process may assist in the broader interpretation of crime patterns in a city or metropolitan area, and in the longer-range monitoring and planning processes designed to allocate resources so as to optimally, or at least relatively optimally, approach the variety of serious crime problems that confront most police departments.

In the criminal justice planning process, federal guidelines have specifically suggested the use of risk-related crime rates. The M4100.1F (1-18-77) guideline stated in section 4-34-(c)2 that “comparisons should not be made between jurisdictions served by a single law enforcement agency unless population at risk rates are used. *The use of population at risk rates in this analysis is encouraged.*” (Emphasis contained in the original.) Few criminal justice planners or law enforcement officials thoroughly understand the concept of risk rates or currently have the methodology or data available to develop such rates for their own areas. It is suggested here that the inadequacy of per capita rates can be overcome with the judicious selection of some environmentally based rates in order to assist in the planning process.

Boundaries

The boundary problem in the interpretation of crime rates — however calculated — will persist. The best hope with respect to this problem is to provide information to assist in the interpretation of the impact of utilizing different geographic bases in the calculation and interpretation of rates. People are often startled to find that the New York City SMSA has a crime rate that is not particularly high. This is of course due to the dilution of the chronic inner city problems of New York City by the relatively less serious problems in the suburbs of Long Island and other outlying counties of the SMSA. On the other hand, central city or incorporated city crime rates are frequently relatively high compared to the matching SMSA, for the obvious reason that all the pathologies are concentrated in the central city and the relatively problem-free suburbs are removed by the effect of the city boundaries.

Public Information

From the point of view of the public as consumers of police services, one of the most serious drawbacks of population-based crime rates is their difficulty of

interpretation of their general ambiguity. All too often, media treatments of per capita crime rates tend to have a sensationalistic tone and it is very difficult to find any redeeming features in them either from a social or analytical point of view. The informed use of environmentally-based rates and their careful dissemination to the media in combination with their interpretation could provide a vastly improved basis for public understanding of crime problems. Furthermore, public comprehension of crime patterns and of some of the factors associated with crime would be enhanced.

ENVIRONMENTAL DENOMINATORS FOR ROBBERY

For any given offense, a set of denominators may be assembled, based on both criminological theory and prior empirical observation. Denominators may be classified into a dichotomy: *direct* and *indirect*. Direct denominators indicate those elements of the environment that are immediately at risk. We may consider robbery as a sample crime in this context. Robbery is defined as “the taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear.” [1, p. 15] Although the ultimate target is property, robbery is primarily a crime of violence. Two of the direct denominator variables, then, are measures of numbers of people: total population and pedestrian counts (see Table 1). Commercial establishments are included since commercial robbery is a recognized subclassification. Although people are still the victims of the violence and fear associated with commercial robbery, the presence of commercial nodes or isolated establishments will be indicative of the potential of a specific location for this type of robbery.

Indirect denominators may be regarded conceptually being secondary, in that they provide an adjustment for a specific environmental element or cluster of elements not necessarily at risk. Indirect denominators may be useful when a planner or analyst wishes to control for particular environmental elements in the course of consideration of a crime “surface.” Returning to Table 1, indirect denominators are the physical environment, neighborhood economic status, drug patterns, race, sex, and age. These environmental conditions may be subjected to varying degrees of manipulation. At the “lowest” (but perhaps most useful) level, each condition is used purely as a “visual” denominator through the process of comparing a crime frequency map with a “condition” map. A law enforcement planner, for example, suspects that a rash of robberies is related to a pattern of neighborhood drug abuse. When maps are compared, robbery clusters do indeed correspond to drug arrest clusters, tending to confirm, in an informal way, the planner’s hypothesis. This is nothing more than a crude visual correlation analysis. Indeed, rates in general may be regarded as regression residuals, in the sense that a high rate is high after adjustment for the base variable — it is, in effect, a positive residual. However,

Table 1. Denominator Variables for Robbery

<i>Direct Denominator Variables</i>	<i>Indirect Denominator Variables</i>	
	<i>Description</i>	<i>Explanation</i>
Total Population	Physical Environment	Most robberies occur on streets or in non-residential establishments, between strangers. Physical environments here may also include the alcoholic establishment variable.
Commercial Establishments		
Pedestrian Counts	Neighborhood Economic Status	Persons with incomes under \$10,000 are more likely to be robbery victims compared to those with incomes over \$10,000.
	Neighborhood Drug Abuse History	Drug addiction is a significant factor in robbery by adults.
	Race	Proportions of both inter- and intra-racial robberies are substantial.
	Sex	Most robberies are male versus male.
	Age	Most robbery offenders are youthful.

SOURCE: Compiled by author.

the methodology and nomenclature of the rate are more popular, presumably because they are more easily calculated and understood by a larger number of people.

An alternative approach might involve the use of indirect denominators in the formal calculation of rates. Thus neighborhood economic status might be expressed as an index, with high values representing low status, and vice versa. A map based on such a rate would smooth out peaks in low status areas;

Table 2. Sample Risk Rate Data for Robbery,
Based on Commercial Land Use

<i>Square Mile Number</i>	<i>Count of Robberies</i>	<i>Acres in Commercial Land Use</i>	<i>Count/(Acres/10)</i>	<i>Quintile</i>
4946	2	1	20.00	1
4345	81	198	4.09	1
4945	5	31	1.61	2
5049	1	8	1.25	3
3950	1	15	0.67	4
4845	1	129	0.08	5

NOTE: N = 116; Mean = 2.33; SD = 3.56; Range = 19.93; Skewness = 3.48.
SOURCE: Calculations by author.

remaining peaks would then (with respect to economic status) constitute anomalies possibly deserving further investigation. Direct denominators are clearly more useful than indirect, since they can result in a map that is risk-related. Indirect denominators are more helpful as controls for specific environmental conditions which are not necessarily directly at risk, but which should be considered in the course of crime analysis.

Table 2 shows sample data for Oklahoma City using commercial land use acreage as the denominator. Square mile 4946 had only two robberies, but with one acre in commercial use this led to a very high risk-related rate. Square mile 4345 had many more robberies (eighty-one), but these were spread over 198 acres of "risk" to yield a lower rate. At the other extreme, square mile 4845 had only one robbery for 129 acres, yielding a rate in the lowest quintile.

A question that naturally evolves in the course of this discussion is whether new rates actually tell us anything original about the distribution in question. In order to explore this issue more fully, rates calculated using ten available environmental denominators (both direct and indirect) were subjected to factor analysis (see Table 3). Two direct denominators (total population and commercial land use) loaded on different factors, suggesting distinctly different patterns of variation. All three of the Factor 2 rates are consistently interrelated conceptually as well as correlationally. It is reasonable to expect that commercial areas will have a high proportion of their area in streets and that what residences there are will tend to be at high density.

In Figures 1 and 2, variations in rate surfaces are illustrated for Tulsa Oklahoma, using as denominators population (see Figure 1) and persons per dwelling unit (see Figure 2). The differences between the surfaces are

Table 3. Rotated Factor Patterns for Robbery Denominators^a

<i>Denominator</i>	<i>Factor 1 Loadings</i>	<i>Factor 2 Loadings</i>
Persons aged 0-17	0.977	
Households with > 5 persons	0.968	
Female household heads	0.894	
Persons per household	0.856	
Total population	0.861	
Net population change	0.830	
Income index	0.817	
Land area in major streets		0.875
Net residential density		0.824
Commercial Land use		0.565

Variance contribution by factor	5.68	2.51

^a For clarity, only larger coefficients are shown.
SOURCE: Compiled by author.

substantial, and may be exemplified by reference to the inset on the left side of each map. This inset, representing the Central Business District, CBD), shows pronounced peaks when total population is the denominator, suggesting that the residential population of the CBD is, indeed, minimal. When persons per dwelling unit is used as the denominator, the CBD peaks nearly vanish (see Figure 2).

CONCLUSION

Depending on the purpose for which data are needed, neither crime frequency data nor rates based on total population may be the most appropriate metrics. The frequency count or map is the fundamental data base from which all rates are necessarily drawn. The calculation of rates does not change the underlying frequency map, but merely alters the elevation of points on its surface, if it is imagined as a three dimensional model. This research suggests that a variety of direct and indirect denominators may be used both formally and informally in order to permit the development of insights relating to crime distributions, as well as more formal hypothesis testing.

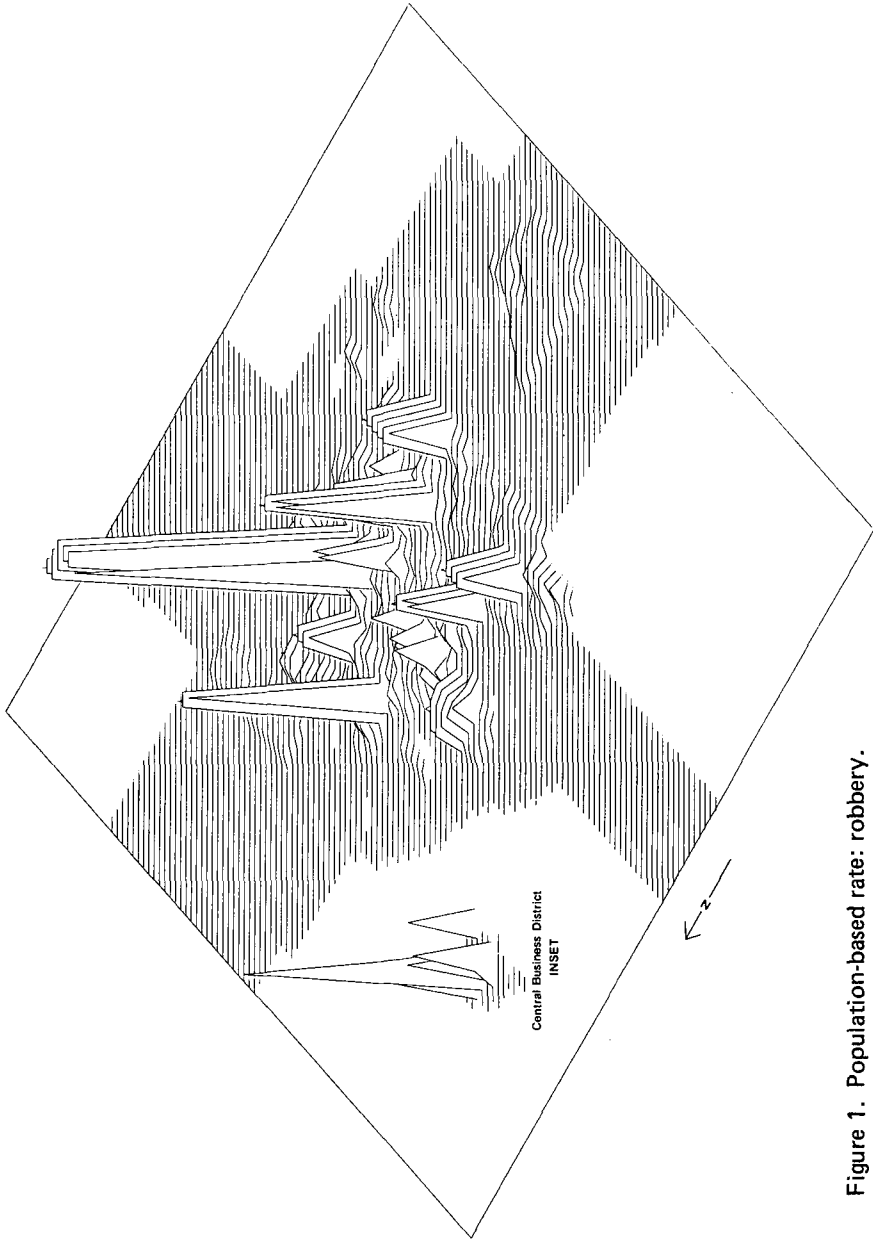


Figure 1. Population-based rate: robbery.

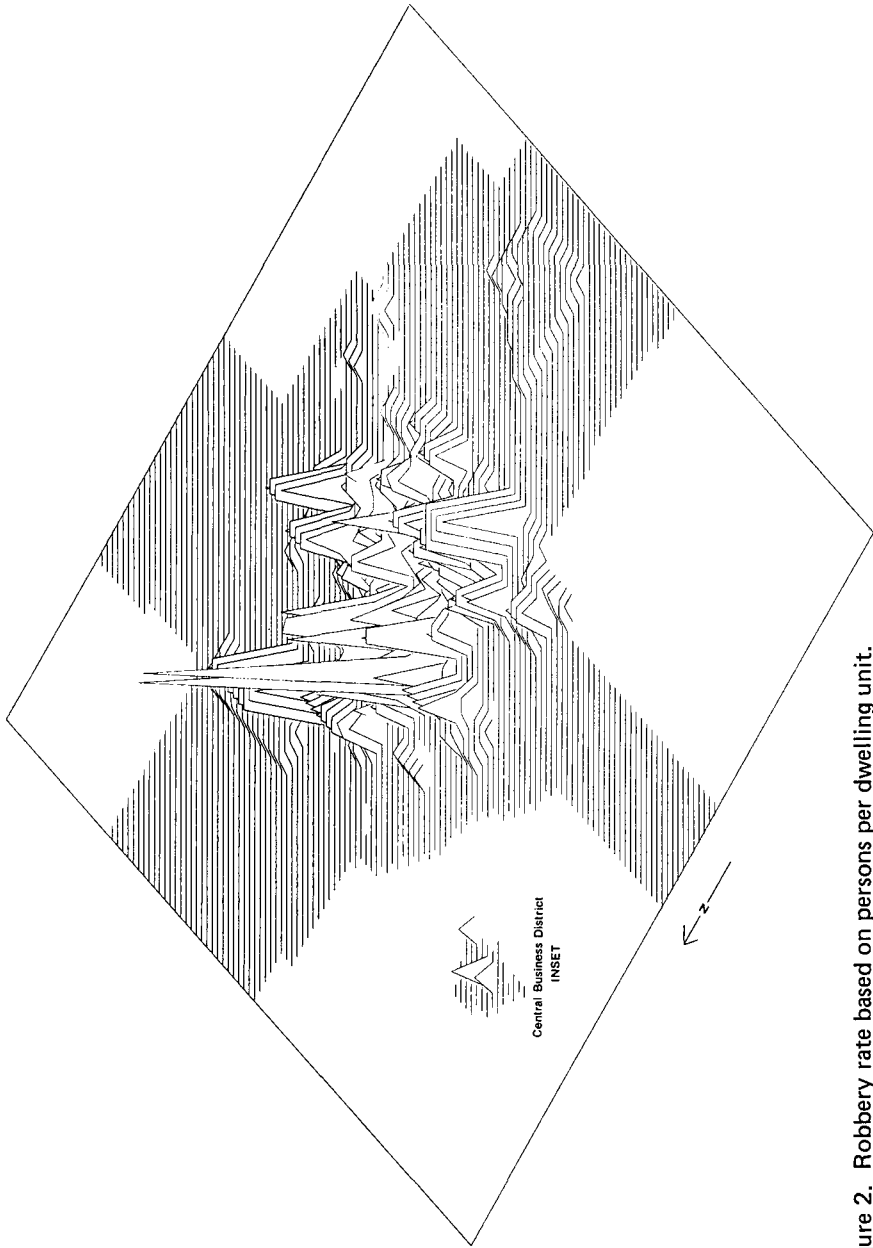


Figure 2. Robbery rate based on persons per dwelling unit.

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Direct reprint requests to:

Keith D. Harries
Department of Geography
Oklahoma State University
Stillwater, Oklahoma 74078